



## Oil price scenarios and the global economy

Oil prices have risen above the US\$50 a barrel level despite a lift in output by OPEC producers. Turmoil in Iraq, unrest in Nigeria, uncertainty of supply by Yukos — the Russian oil giant — and high demand from a booming China have all played their part. Even Hurricane Ivan that hit the Caribbean and South-eastern USA played a role in disrupting oil supplies. Yet, while crude oil prices have risen dramatically, crude oil inventory levels have been increasing. And recently the OPEC President predicted US\$30 a barrel shortly on the fundamental supply and demand situation.<sup>1</sup> In this report, two scenarios are evaluated: a sustained lift in prices to levels recently experienced and a temporary rise with levels returning to a 'normal' US\$25 a barrel. Conventional wisdom about who gains and loses under such scenarios — at least for non-oil developing countries — is challenged by the analysis here.

The conventional wisdom, most recently espoused by the International Energy Agency (IEA)<sup>2</sup> is that a sustained US\$10 a barrel increase in oil prices lowers OECD real GDP by 0.4 per cent below baseline in 2004 and 2005, lifts inflation by 0.5 and 0.6 percentage points above base, worsens unemployment and causes a deterioration of the combined current accounts of OECD economies.

The IEA also finds that the economies of oil-importing developing countries in Asia and Africa would suffer most from higher oil prices because their economies are more dependent on imported oil and energy is used less efficiently in these countries (see chart 1). These differences in oil intensity are probably overstated since it is not apparent that GDP figures have been corrected for purchasing power parity (PPP) differences. But the point remains: developing countries typically use oil less efficiently than developed countries.

China's GDP, the IEA found, would drop by 0.8 per cent below baseline one year out following a permanent US\$10 a barrel price hike. Their current account would deteriorate and their exchange rate depreciate. But oil dependency and the oil intensity of use are just two of the important variables affecting the impact on economies.

<sup>1</sup> New Zealand Herald 2004, 'Oil: Price slops as Opec sees over-supply and hurricane looms', <http://www.nzherald.co.nz/business/businessstorydisplay.cfm?storyID=3590213>, Accessed 27 September 2004.

<sup>2</sup> International Energy Agency, *Analysis of the Impact of High Oil Prices on the Global Economy*, May, 2004.

### Key points

- Relative to base, in 2005 a permanent doubling of oil prices causes:
  - OECD real GDP to fall 1.6 per cent;
  - OECD inflation to be 0.4 percentage points higher in 2004, and 0.1 percentage points higher in 2005;
  - US exports to fall 1.2 per cent, but Japanese exports to rise by 1.1 per cent.
- A permanent rise in oil prices hits Japan hardest, not China as suggested by the IEA since there is offsetting stimulus from investment in China due to the monetary relaxation under a fixed exchange rate.
- The results suggest a bigger impact on OECD real output, but a smaller impact on inflation than IEA analysis. Non-oil developing countries are not as hard hit as found by the IEA.

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### Using these scenarios

Nobody can foretell the future. If they could, they wouldn't tell you about it. These scenarios are not predictions or forecasts. To make profitable investments from this information you also need to decide how likely the events portrayed here are, and what is already priced in the markets. The value of this material is in the insights it offers into the economic effects of various possible events.

Also important is the investment response to higher oil prices, the financial and economic effects as a result of the investment response and the stance of monetary policy in those countries maintaining fixed exchange rates with the US dollar. And the income effect will be different across countries depending on their overall energy situation and how prices of coal and gas change. We find that also taking these effects into account *reverses* the findings by the IEA for non-oil developing countries. It is worth reviewing the economics of an oil price hike before looking at the quantitative effects.

## Economics of an oil price hike

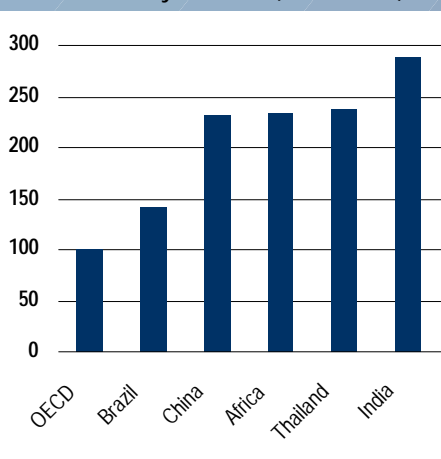
When oil prices rise — and it matters whether the rise is permanent or temporary — several things happen. Higher oil prices transfers income from oil importing to oil exporting countries. The adverse change in the terms of trade for oil importers reduces incomes, lowers real consumption, causes a deterioration in the balance of trade and puts downward pressure on exchange rates. Economic growth slows, higher costs causes inflation to rise.

There are also substantial effects at the microeconomic level. Higher oil prices create an incentive by consumers — both final and intermediate producers — to reduce consumption and use alternatives where possible such as gas which also experiences a price rise. Large coal and gas exporters like Australia receive a compensating benefit. Whether this price gain offsets the loss in the quantity of coal and gas exported due to the downturn in the global economy for a country like Australia is an empirical question to be settled by quantitative analysis.

The relative price hike for oil, if permanent, also creates an incentive by producers to substitute away from oil and into other inputs such as capital. There will be a switch within an economy to industries that are less oil intensive. This switching leads to investment in new capital and that has a stimulating effect on the economy. That is, there are both income and substitution effects with flow-on effects around the economy.

Another effect to consider is the impact of oil price rises on monetary policy. For those countries pegging their currency to the US dollar, to maintain their peg, countries end up expanding monetary policy and that effect turns out to be important for a country like China. All of these income, substitution and monetary policy effects are captured in the model used here.<sup>3</sup>

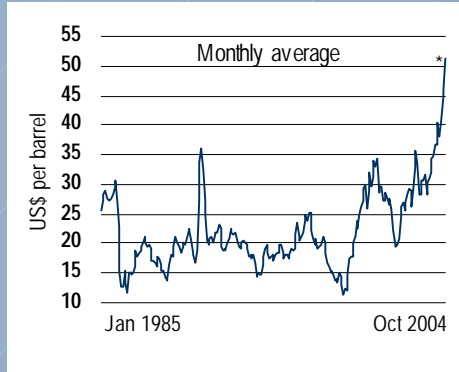
1 Oil intensity<sup>a</sup> in 2002 (OECD = 100)



<sup>a</sup> Primary oil consumption per unit of GDP.  
 Source: IEA, Analysis of the Impact of High Oil Prices on the Global Economy, May 2004.

<sup>3</sup> The version of the model used here is G-Cubed Version 59E, which has twelve sectors in each of twelve countries- five sectors deal with energy with details for oil, coal, gas and electricity. To see a full description of the model, either follow the links on this website or directly access [www.msgpl.com.au](http://www.msgpl.com.au).

## 2 Price of West Texas Intermediate crude



\* As at 11 October 2004.

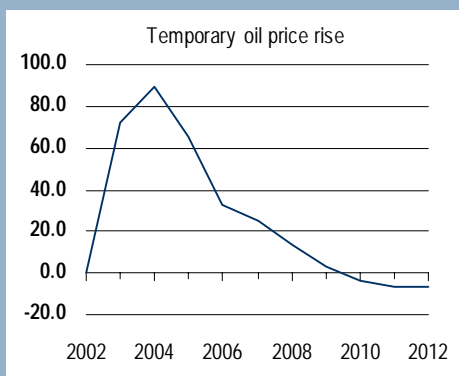
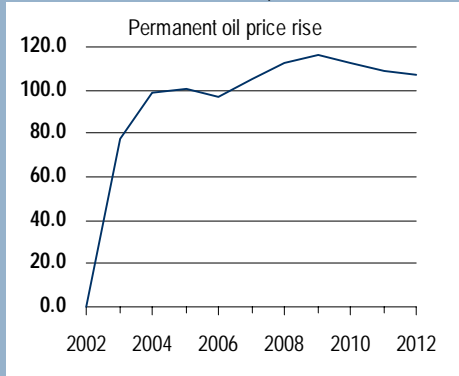
Source: Reserve Bank of Dallas  
<http://www.dallasfed.org/html/data/data/oilp.tab.htm>. Accessed 11 October 2004.

## The scenarios

Oil prices are volatile. There was a spike at the time of the first Gulf war and then prices slumped to just above US\$10 per barrel in 1998 (chart 2). On 28 September this year oil prices broke the US\$50 a barrel figure — a record high in nominal terms. The long run average price used as a baseline in this model is US\$25 per barrel. Global oil demand for 2004 is projected by the IEA to be 82.16 million barrels per day — up 3.2 per cent from 2003 levels.<sup>4</sup> World supply reached 83.6 million barrels per day in August causing crude inventory levels to rise. This phenomenon of crude oil prices rising whilst crude inventory levels have increased has caused the IEA to hypothesise that something ‘appears to have empirically changed over recent months’.<sup>5</sup>

The IEA does not know whether ‘the disconnect represents speculative froth, an underlying structural shift or some other factors in the market’.<sup>6</sup> They argue that ‘more analysis needs to be done in this area’. What is apparent is that there is uncertainty of supply, especially out of Iraq, which has the world’s second-largest oil reserves. Spare production capacity is down. The ‘expected supply’ of oil has fallen relative to demand. Because we cannot know the future course of oil prices, we evaluate two scenarios here to see how different outcomes matter for the level of risk faced by investors.

## 3. Price of OPEC crude oil exports (per cent deviation from baseline)



### 1. A permanent rise in the price of oil to US\$50 a barrel

As the IEA notes above, it is difficult to explain just why the price of oil has risen so much based on previous known relationships between the fundamentals of supply and demand. But the purpose of the exercise here is not to replicate the oil market and project future oil prices but rather trace out all of the consequences for world output, trade and financial variables if the doubling of the price of oil over the last two years turns out to be permanent. The temporary price shock is set out below.

To represent an approximate doubling of oil prices over the last two years we have used a combination of export taxes by OPEC to lift prices plus a reduction in available supplies represented by a negative productivity shift for the supply of oil. But shifting these variables has feedback effects on financial and output markets so it is not easy, without a lot of work, to replicate the movements in OPEC’s price of oil. The path of oil prices underlying this scenario is therefore represented in the top panel of chart 3. From a base of US\$25 a barrel there is an 80 per cent rise in crude oil prices in 2003 and a further rise in 2004 to give a doubling of oil prices to US\$50 a barrel above the baseline rate of US\$25 a barrel. This rise is permanent and subsequent fluctuations are due to dynamics and feedback effects mentioned earlier. The key point is a doubling of the price of oil over the two years from 2002 to 2004.

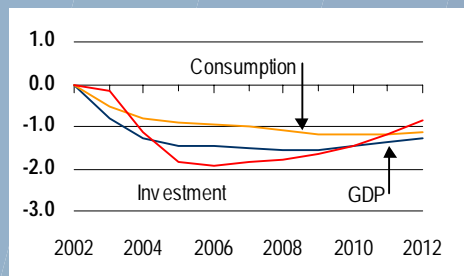
<sup>4</sup> International Energy Agency 2004, *Monthly Oil Market Report*, 9 September, p. 5.

<sup>5</sup> International Energy Agency 2004, *Monthly Oil Market Report*, 9 September, p. 26.

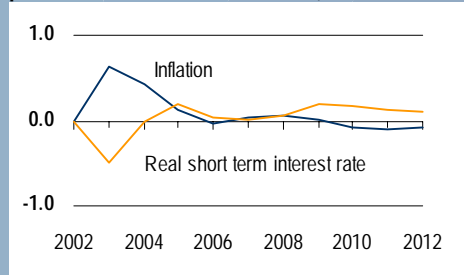
<sup>6</sup> International Energy Agency 2004, *Monthly Oil Market Report*, 9 September, p. 26.

**CHART 4: PERMANENT OIL PRICE SHOCK EFFECTS ON THE UNITED STATES**

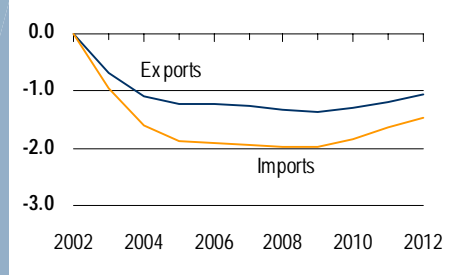
Real GDP, consumption and investment (per cent deviation from baseline)



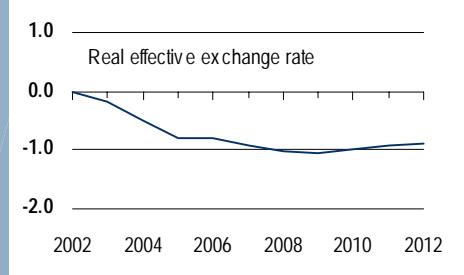
Interest rates and inflation (percentage point deviation from baseline)



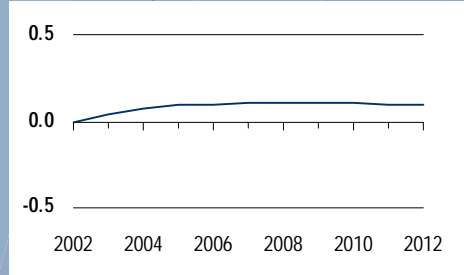
Exports and imports (per cent deviation from baseline)



Exchange rates (percentage point change from baseline)



Current account (per cent of GDP change from baseline)



## 2. A temporary rise in the price of oil

The temporary price rise in OPEC’s crude prices is scaled to give a similar two-year effect on oil prices as above but the rise in prices does not last. The supply tightening represented by the negative productivity shock and the price lifting effect of the export tax on OPEC oil represented in the permanent shock declines by half in the third year and is fully eliminated in the fourth year. So the timing of the temporary shock is the initial shock in 2003, the extra price hike in 2004, but this falls by half in 2005 with no effect in 2006. The price path in terms of deviation from baseline is shown in the bottom panel of chart 3. Again, with dynamics and other feedback effects there is a small residual effect in 2006 and beyond.

## Results – permanent rise in oil prices

The effects of a permanent US\$25 a barrel price hike in the price of oil on the United States — the world’s largest economy — are shown on chart set 4. Panel 1 shows that the adverse movement in the terms of trade reduces real incomes and lowers real consumption. Also, the permanent shift in relative prices causes a restructuring of the economy. The adjustment costs are also reflected in the loss of real GDP which falls by 1.3 per cent below baseline in 2004 and 1.5 per cent in 2007, four years after the initial start of the doubling of the price of crude oil.

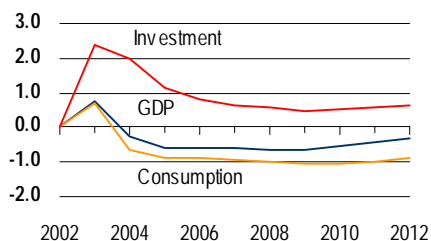
The higher price of oil feeds through the economy and inflation is 0.4 percentage points above baseline in 2004 before returning to baseline two years later. The inflation effect is much less than suggested by the IEA earlier. Remember the IEA analysis was for a permanent US\$10 a barrel lift in oil prices whereas the shock here is US\$25 a barrel over two years. Our effect is only half that suggested by the IEA. This most likely reflects the assumption about monetary policy responses in the United States. In this model the Fed responds to both inflation and output deviations from target. The higher inflation and drop in investment means there is a dip in the real short term rate of interest (panel 2 of chart set 4).

On the trade front both price and income effects are working and it is an empirical question on which effect dominates. Higher oil prices raises the United States’ import bill, but the slowdown in the economy reduces import demand. The effect of the slowdown dominates and imports fall by nearly 2 per cent below baseline from 2006 to 2009 (panel 3 of chart set 4). The global slowdown also reduces demand for US exports, which fall by over 1 per cent from baseline in 2004. The small 1 percentage point depreciation of the real effective exchange rate (panel 4) by 2007 from baseline is not sufficient to offset the slump in world demand for US exports. Because imports slump by more than exports and the base level of imports is higher than exports in the United States there is a slight improvement in the trade balance and therefore the current account (panel 5) of the United States — again a different story than described by the IEA analysis.

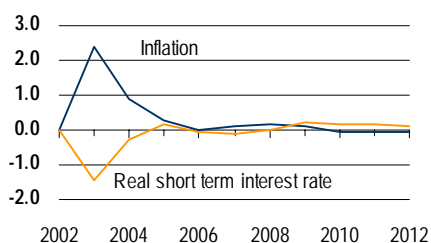


**CHART 5: PERMANENT OIL PRICE SHOCK EFFECTS ON CHINA**

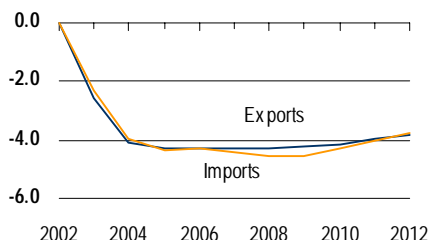
Real GDP, consumption and investment (per cent deviation from baseline)



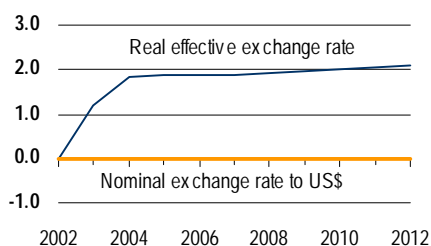
Interest rates and inflation (percentage point deviation from baseline)



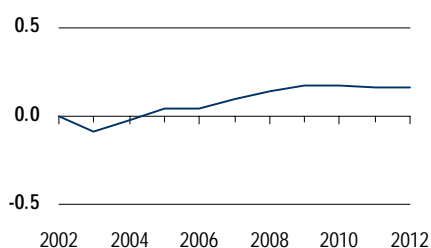
Exports and imports (per cent deviation from baseline)



Exchange rates (percentage point change from baseline)



Current account (per cent of GDP change from baseline)



## Effects on other countries

The permanent oil price rise has differing effects across countries/regions as seen in table 1. Japan, being heavily dependent on oil imports experiences the largest drop in real GDP from baseline by 2007. The drop in the level of real GDP in Japan is 2.6 per cent below baseline in 2007, but that does not imply recession in Japan. Japan's baseline growth of real GDP is just under 2 per cent per year so the level of GDP is 5.7 per cent higher in 2007 over 2004. Roughly a third of this growth would be lost through a permanent US\$25 a barrel oil price hike. Japan experiences an increase in real exports because the Japanese real exchange rate depreciates relative to the US and more so relative to Europe, the rest of the OECD and the rest of Asia. Thus exports especially of manufactures and services become more competitive.

**1 Effects of permanent oil price rise (Per cent deviation from baseline)**

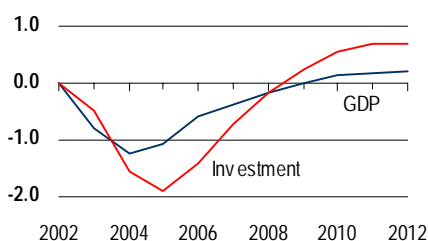
Country/region	Real GDP		Real consumption		Real investment		Real exports	
	2004	2007	2004	2007	2004	2007	2004	2007
United States	-1.9	-1.5	-0.81	-1.0	-1.1	-1.9	-1.1	-1.3
Japan	-2.2	-2.6	-1.741	-2.4	-1.9	-3.0	1.2	1.0
Australia	-1.2	-1.7	-1.11	-1.6	-0.5	-1.6	-3.0	-3.1
Europe	-1.4	-1.6	-1.1	-1.4	-0.8	-1.4	-3.0	-3.1
Rest of OECD	-0.2	0.4	0.2	0.7	7.1	9.4	-4.9	-5.1
China	-0.2	-0.6	-0.6	-1.0	2.0	0.7	-4.1	-4.3
Non-oil developing countries	-0.6	-1.0	-0.5	-1.1	3.4	2.6	-6.2	-6.5

Of interest is the difference in effect for China and non-oil developing countries. They experience an initial boost in real GDP, consumption and investment in 2003 before turning negative in 2004, with the effect more pronounced for China. That effect appears at odds with the analysis of the IEA cited earlier so it warrants explaining since it demonstrates another mechanism that comes into play with countries that peg their exchange rate to the US economy.

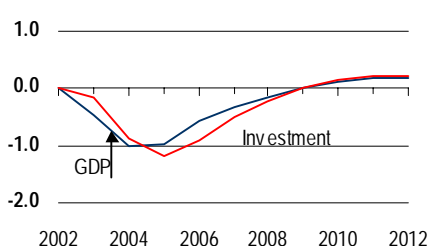
The effects of a permanent rise in the price of oil on China are shown in chart set 5. The most obvious difference between the effects on China and the United States is what happens to real investment (panel 1 of chart set 5). Since China maintains a fixed nominal exchange rate to the US dollar (as do some other non-oil developing countries) and the US dollar tends to depreciate, to prevent their currency appreciating Chinese authorities have to buy United States dollars and sell yuan. The increase in foreign reserves gives a monetary stimulus. This stimulus lowers the real short term interest rate. That effect combined with the incentive to substitute away from oil to other inputs such as capital causes investment to rise by 2.4 per cent above baseline in 2003 (panel 1 of chart set 5) and nearly 2 per cent in 2004. The higher investment is sufficient to cause a spike in real GDP, which rises 0.7 per cent above baseline in 2003 before turning small negative in 2004 and falling by 0.6 per cent below baseline by 2007. The ultimate fall in output is delayed by the monetary implications of the fixed exchange rate regime.

**CHART 6: TEMPORARY OIL PRICE SHOCK**

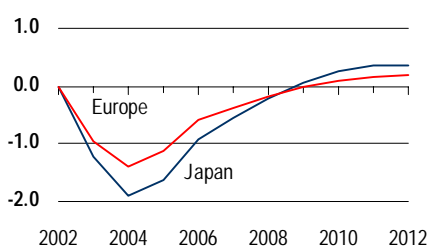
**USA: real GDP and investment (per cent deviation from baseline)**



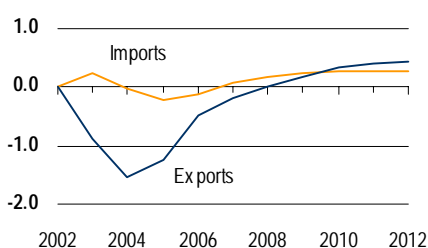
**China: real GDP and investment (per cent deviation from baseline)**



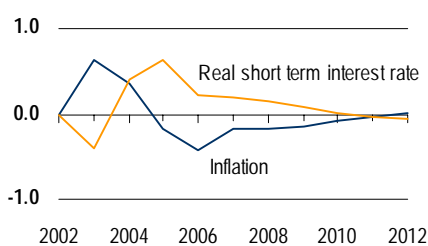
**Europe and Japan: real GDP and investment (per cent deviation from baseline)**



**Japan: exports and imports (per cent deviation from baseline)**



**USA: interest rates and inflation (percentage point deviation from baseline)**



With the extra investment in China there is some extra capital inflow so there is an initial drop in the current account (expressed as a per cent of GDP from baseline), but the effect is small (panel 5 of chart set 5). The combination of oil price rises, monetary stimulus and price inflation leads to an appreciation of real effective exchange rate of 2 percentage points above baseline since the nominal rate is fixed to the US dollar (panel 4).

## Results: temporary oil price rise

The main difference with the temporary oil price shock from the permanent scenario is that the same incentive to substitute away from higher prices of oil to other inputs does not occur. This effect is particularly seen by comparing the investment and real GDP response for China under the temporary shock (panel 2 of chart set 6) with the permanent oil shock (panel 1 of chart set 5). Under the temporary shock, investment in China falls by around 1 per cent below baseline in 2004 and 2005 whereas under the permanent shock investment *rose* by 2 per cent above baseline in 2004 and over 1 per cent in 2005.

Because the investment experience and monetary stimulus from the pegged currency policy in China are different, the impact on China's real output is also different. Now, under the temporary shock there is no short-term lift in real GDP, which falls by 1 per cent below baseline in 2004 and 2005. China's pattern of GDP change under the temporary oil price shock is now similar to that of the United States (panel 1 of chart set 6). Again, it is Japan that is most adversely affected by the temporary oil price shock. Real GDP in Japan could be 2 per cent below baseline in 2004 (panel 3 of chart set 6). The different effects on the world economy means that the impact on Japan's exports is now different. Whereas there was a lift in exports from Japan under the permanent oil price rise scenario, now exports fall by 1.5 per cent below baseline 2004. The reason is that the real exchange rate hardly changes given the temporary nature of the shock.

The temporary oil shock only has a short-term impact on inflation — typified by the response in the United States (panel 5 of chart set 6). Inflation falls below baseline by 2005 as oil prices come down again and real short-term interest rates mirror the movements in inflation.

For comparison with the permanent shock, the effects of the temporary oil price rise as set out in table 2.

**2 Effects of temporary oil price rise (Per cent deviation from baseline)**

Country/region	Real GDP		Real consumption		Real investment		Real exports	
	2004	2007	2004	2007	2004	2007	2004	2007
United States	-1.2	-0.4	-0.6	-0.2	-1.5	-0.7	-2.0	-0.4
Japan	-1.9	-0.6	-1.2	-0.4	-1.3	-0.5	-1.5	-0.2
Australia	-1.2	-0.6	-1.0	-0.4	-1.2	-1.1	-3.0	-0.3
Europe	-1.4	-0.4	-0.8	-0.3	-1.7	-0.6	-3.4	-0.6
Rest of OECD	-1.0	-0.3	-0.1	0.1	-2.6	-2.1	-1.8	-0.7
China	-1.0	-0.3	-0.9	-0.3	-0.9	-0.5	-2.0	-0.4
Non-oil developing countries	-1.6	-0.7	-0.8	-0.5	-1.8	-1.5	-3.3	-0.8

## Implications

Higher OPEC oil prices adversely affect the world economy, but there are some big differences between countries. Whereas conventional wisdom, as typically expressed by the IEA, argues that non-oil exporting countries such as China are hardest hit by a permanent oil price rise — we find the opposite. The investment response as a result of substitution away from the relatively more expensive oil input in combination with a monetary stimulus that flows from their fixed exchange rate policy to the US dollar can actually make China better off in the first year of the oil shock. There are many offsetting effects at work when a major variable such as oil prices change in such a big way and a comprehensive framework has to be used that allows for all real and monetary effects to capture what might be happening for countries. A temporary oil price shock, however, gives a similar investment response as between China and other OECD economies. Longer term, China and other non-oil developing countries are the least hardest hit compared to major OECD economies when oil prices double permanently.

The results of these scenarios also suggest some other differences with conventional wisdom. Whereas the IEA finds a 0.4 per cent decline in real GDP for every US\$10 a barrel price hike, these results suggest an impact that is 50 per cent greater on OECD real output. However, these results also suggest a much smaller impact on inflation. The inflationary impact on OECD economies in 2004 could be roughly a third suggested by the IEA and much smaller than suggested by the IEA in 2005. This reflects assumptions about monetary policy in affected countries which is not taken into account in conventional energy models.

Yet another difference between these results and those of the IEA is the impact on current accounts of OECD economies. There is very little change in any of the current accounts of the OECD economies from the permanent US\$25 a barrel price rise. Higher oil import bills are offset by lower imports as economies slow. Both exports and imports decline and there is little change in trade balances and therefore current account balances. To the extent there is a change, it is for a slight improvement in current account balances, not a deterioration as suggested by the IEA.

Of the OECD economies, Japan is hardest hit and the oil shock, if permanent, could wipe off roughly a third of Japan's growth by 2007 if their baseline growth up until then is just under 2 per cent per year.

Japan is not hit as hard if the shock turns out to be a temporary one, but the decline in output in Japan is still the greatest of the OECD economies.

The results are sensitive to the various assumptions underlying the model. For example if China chose to sterilize the monetary implications of the exchange rate peg then real output in China would fall by more in the initial year with more negative impacts on the rest of Asia. Similarly the monetary policy reactions across the globe are important for the results in the first years of the shock but the underlying real consequences of an oil price shock cannot forever be changed with monetary policy.

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