Typology of oil shocks: why 2004 is different

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Abstract

A sudden increase in the price of oil is unavoidably associated with the word "shock". Considerable research has shown that an increase in the price of oil reduces output and boosts inflation. This is evidently true for the previous oil crises, but when it comes to the recent upturn in the price of oil, inflation remains under control in developed countries and the world surprisingly continues to grow at a highly respectable pace. The same cause no longer leads to the same consequences. Since very few papers have defined what the main characteristics of a true shock are, it has therefore become of key importance to step back and analyse previous oil crises to better understand the current situation and evaluate what is likely to happen in the coming years.

The first section of this paper reviews previous oil crises to establish a grid of characteristics and determine whether the recent upturn in oil markets can be viewed as a genuine oil shock. We will observe that 2004 is evidently different from previous oil shocks.

In the second section we will try to understand why today the world does not behave as economics tell us. We will evidence the decreased level of dependency of major economies to oil and show using a VAR model that a redistribution of wealth is in fact offsetting the classic shortfalls of past oil shocks.
Keywords: oil shock, economics of exhaustible resource, oil proceeds redistribution

1 Introduction

Oil has increasingly been a focus of attention since 2004. The price of the West Texas Intermediate (WTI) which is a type of crude oil commonly used as

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benchmark in oil pricing more than doubled in the last two years. In February 2004, the price of a WTI barrel cost US$32.50. On the 30th of August 2005, the same barrel closed at US$69.81. As we write this paper, the barrel costs over US$70. Because oil affects the consumer on a daily basis, most magazines and newspapers have given front page to oil and attempted to predict the consequences of what appears to be a new crisis. Experts too have developed a lot of theories and forecasts on the impact of oil price movements on consumer spending, interest rates, growth and equities. In a recent paper published in February 2005, the OECD estimated that a sustained move from US$25 to US$40 a barrel would subtract at least 0.2% from OECDwide real growth and fuel consumer price inflation [2]. The macroeconomic effects of an oil shock are easy to understand. The initial impetus lies in some sort of crisis, be it economic or political which pushes the price of crude oil. The first-round effect is easily described: crude oil price increases together with gasoline, heating oil and other closely associated prices. As a result, import prices in industrialised countries go up. The move filters through the price of intermediary goods and consumer prices. The impact of the first round effect is usually limited and contained: unit costs and production prices go up, consumption decreases, leading eventually to an increase in unemployment. Often, productivity improvements, substitution products or more energy-efficient production techniques are enough to re-balance the whole system. What differentiates an oil move from an oil shock is whether a "consumer price/wages" loop is initiated. When it happens, inflationary pressures and recession effects are boosted. In practice, the loop starts with the desire of employees to maintain a legitimate purchasing power. Union protests and salary claims usually do the rest. Besides, up until early 1990s, in many industrialised countries wages were directly linked to some sort of inflation index and would automatically fuel the consumer price/wages loop. Yet, since 2004, the world real growth has not dramatically slowed down nor has inflation taken off. In fact many economists continue to forecast a very strong global performance in 2006 and 2007. Major economies continue to enjoy healthy economic indicators. This article will review and analyse reasons which may explain why the recent oil movement is different.

2 Stylized facts of oil shocks

In this paper, we will not focus on key determinants of the price of oil such as supply, demand, inventories, GDP analysed in one of our previous paper [3] or speculation factors reviewed for instance by Weiner [4]. We will instead study facts that characterize oil crises and oil shocks.

2.1 Review of previous oil crises

Post World War II, the world experienced 4 major oil crises as indicated in Figure 1: 1973, 1979, 1990 and 2004. The 1973 crisis began on the 17th of October when Arab members of the Organization of Petroleum Exporting Countries (OPEC) announced that they would no longer provide petroleum to

countries that had demonstrated support to Israel in their conflict with Egypt and Syria (Yom Kippur War). OPEC members also decided to use their predominant position to control the oil price-setting mechanism to drive the price higher. In 1973, oil price quadrupled in a year, moving from US$3.29 a barrel to US$11.58 [5]. The 1979 oil crisis was caused by the Iranian revolution. Ayatollah Khomeini took control of the country after the Shah of Iran Mohammad Reza Palhavi fled the country. The political change only caused a small disruption in oil supply, as OPEC members and Saudi Arabia in particular stepped in to offset the shortage in oil supply by increasing production. The net supply fell by less than 5%, yet the damage was done and a worldwide panic drove oil prices higher. The 1979 crisis caused oil price to rise from approximately US$15 a barrel to US$34 shortly before the war between Iran and Iraq. The third oil crisis in 1990 was also a consequence of political disruption and was a result of the Gulf War. It was shorter than the previous crisis and last a mere six months. The oil production suffered as Saddam Hussein retreated from Kuwait setting oil fields on fire. Oil price moved from US$15 a barrel to a then-record US$40.42. In 2004, it is more difficult to pinpoint at a single event to explain the increase in petroleum products. Amongst other factors, some of the usual suspects are the situation in Irak, terror, but also a fast growing economy which leads countries like China to consume more and more energy. The fact is that the WTI price moved from approximately US$30 a barrel to hit a high of 70.50 on the 30th of August 2005. One simple way to classify the 4 crises is to look at the magnitude of each move and compare them. This is what Table 1 does by summarising oil price moves for each period.

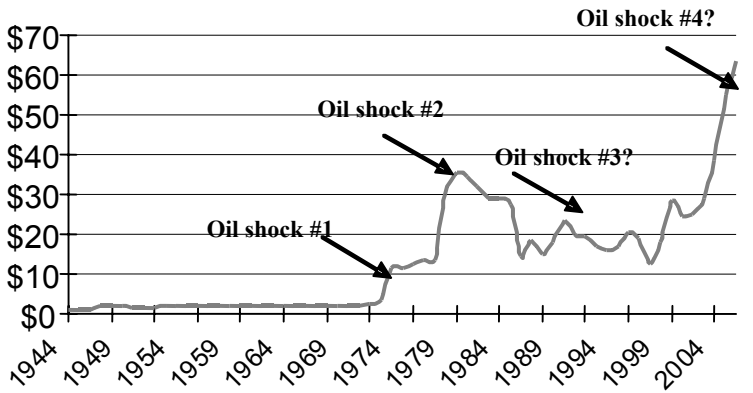

Figure 1: Oil price nominal.

2.2 Oil shock definition

A shock is a price increase that has to have a significant impact on the world economy. Figure 2 plots real growth in percentage points through the last four oil

crises. In the next paragraph, we will measure both price and economic impact for the last four crises, and will attempt to provide a grid to differentiate an oil crisis from an oil shock.

Table 1: Oil price in nominal dollars.

	Nominal Dollars		% change	factor
	From	To		
1973-1974	3,29	11,58	252%	**3,5**
1979-1981	14,55	37,96	161%	**2,6**
1990-1991	15,86	40,42	155%	**2,5**
2004-2006	32,05	70,5	120%	**2,2**

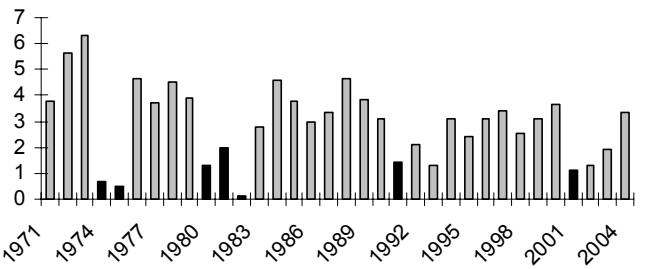

Figure 2: OECD real growth 1971-2004.

2.3 Characteristics of an oil shock

2.3.1 Price assessment

2.3.1.1 Magnitude and speed The magnitude of the price move is a first indication as illustrated in Table 1. For all the considered periods the price more than doubled. This information is important, but not sufficient if oil was in a trending environment in which the price doubles every two years. A shock means a large deviation from an established trend. Trends are mathematically materialised by moving averages. Figure 3 displays oil price versus it 5 year and 10 year moving average and Figure 4 plots positive deviations of the spot price versus the 5 year moving average.

The standard deviation of the spot price from the 5 year moving average over the last 50 years was 24.9%. The graph shows that the spot price jumped over one standard deviation for three of the considered crises: 1974, 1979, and 2005. In 1974, the initial deviation from the 5yr average was + 60%, continued in 1974 with +41% and again in 1975, with +27%. In 1979, the move was + 38%, followed by +31% in 1980. Spot price crossed the one standard deviation again in 2005 (+36%). It is interesting to note in 2000, spot did cross the line (+27.3%) whereas in 1990 it did not happen.

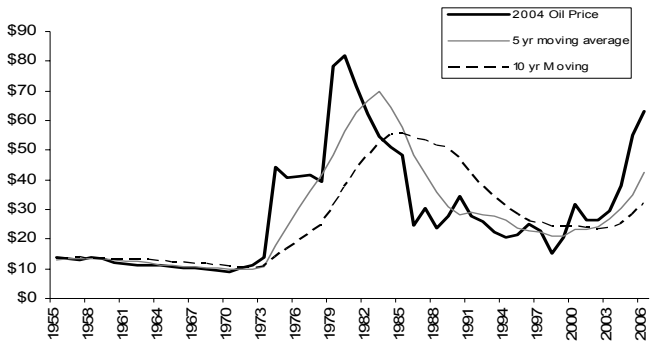

Figure 3: Oil Price Nominal versus 5 yr and 10 yr moving average.

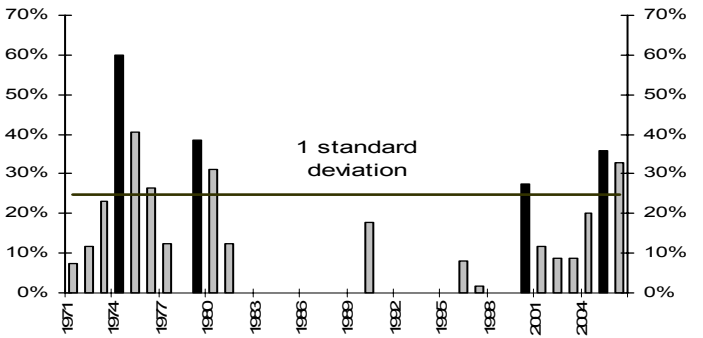

Figure 4: Positive deviation between Oil price and 5 year average.

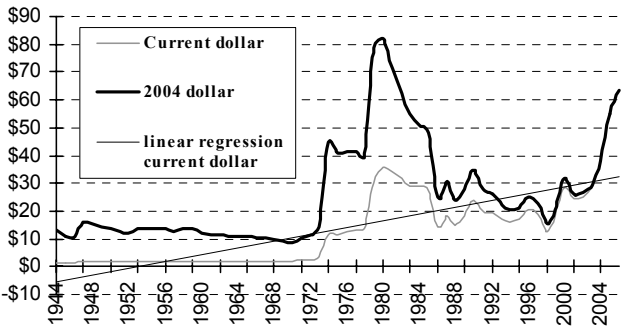

Figure 5: Oil price nominal versus oil price 2004 adjusted for inflation.

2.3.1.2 Real price To compare oil price taken at different times, the nominal price has to be converted into today's price. This is done in Figure 5. Today oil is

more expensive than it was after the 1973 crisis and is slowly reaching levels not seen since 1980. If we consider a linear regression to materialise the post world war trend, we observe that in both 1973 and 2003, the price of oil was bounced off the 50 year average. The graph also confirms that three major moves stand out: 1973, 1979 and 2004.

2.3.1.3 Price relative to other commodity prices Oil is a commodity and we wanted to assess its behaviour versus other commodities at times of crises. We used the CRB index as reference, known as the commodity index, which was launched in 1957. Like most indices it has evolved over time to include the most influential components. Initially, it was made of 28 commodities but did not include crude oil, which was added only in 1983 together with Gold. In 1987, the composition of the index was reduced to 21 commodities and in 1995, the index was cut to 17 commodities. The final revision was made last year. The CRB index now has 19 components. Crude oil accounts for 23% of the index and total petroleum for a third of the index. The ten revisions to the CRB index diminish the validity of such a benchmark. An alternative is to compare crude oil to components of the CRB index. We computed this oil index and divided it by a simple non-weighted average of all non-petroleum sub commodity indices. Broadly speaking commodities and oil have a tendency to trend together with 4 noticeable exceptions: 1973, 1979, 2000 and 2004. We proceeded as we did when measuring magnitude and speed of the price and observed that the standard deviation of positive and negative moves over the period was 35%. It was exceeded in particular in 1974, 1979, and in 2005. Again, it is interesting to note that it was also exceeded in 1999 and 2000.

2.3.1.4 Price relative to demand and supply In this section, we will look at supply and demand characteristics at times of crises. Table 2 shows reserves, consumption and production for each of the considered crises:

Table 2: Proved reserves, consumption and production during crises.

	Proved reserves Thousand million barrels	Consumption Thousands barrels daily	Proved Reserves/ Consumption *10000	Production Thousands barrels daily
1973	628,5	56381	**111**	58463
1979	642,2	64307	**100**	66049
1990	999,1	66272	**151**	65470
2004	1188,6	80757	**147**	80260

To assess the strength of the crises, let us first consider the price of oil relative to proved reserves (literally oil price in US dollars times 100 divided by proved reserves in billion of barrels) and see how 2004 compares to previous recognised shocks (Table 3).

It is interesting to note that 2004 price relative to reserves is relatively small when compared to what it was in 1973 and 1979, and even when compared to the first Gulf war in 1990. Figure 6 which displays positive year on year variances shows that at times of crisis this indicator exceeds the standard deviation (30.8%).

Table 3: Oil Price relative to reserves during crises.

	Oil Price		Reserves Thousand Mio Barrels	Oil Price/ Reserves * 100	
	Prior Shock	After Shock		Prior Shock	After Shock
1973	14,1	44,55	628	2,2	**7,1**
1979	39,6	82,15	642	6,2	**12,8**
1990	27,8	34,44	999	2,8	**3,4**
2004	38,3	63,28	1189	3,2	**5,3**

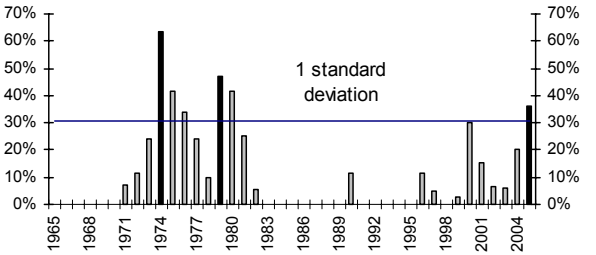

Figure 6: Positive deviation year on year: oil/proved reserves.

Table 4: Oil price relative to consumption during crises.

	Oil Price			Oil Price/ Reserves * 10000	
	Prior Shock	After Shock	Consumption	Prior Shock	After Shock
1973	14,1	44,55	56381	2,5	7,9
1979	39,6	82,15	64307	6,2	12,8
1990	27,8	34,44	66272	4,2	5,2
2004	38,3	63,28	80757	4,7	7,8

Proved reserves (supply) are only one side of the equation when looking at a non-renewable commodity. Consumption (demand) is the other driver. Again, a simple exercise consists in calculating the price of oil relative to consumption (Table 4). This indicator shows that 2004 oil price relative to consumption is comparable to the 1973 situation.

The year on year variance exceeded the standard deviation during three crises: 1973, 1979 and 2004 (Figure 7).

The same study is done with respect to proved reserves over consumption. The year on year variance exceeded the standard deviation during each crisis but 1990.

2.3.2 Economic indicators and oil shocks

We explained earlier that in a shock, oil price affects the worldwide economy in general and world growth in particular. Figure 8 illustrates oil price versus OECD real growth. In 1973, 1979 and 1990 real growth reacted negatively and violently to sudden price increases. This is not the case in 2004: real growth continues to increase. Each crisis took place at a time of sustained profitable

growth. In 1973, the OECD real growth scored a high 6.3% [6]. Real growth was hit hard by the disruption in oil output and decreased to 0.71% in 1974 and 0.35% in 1975. What about other economic indicators? The impact on the stock market was also noticeable. The Dow Jones index which started 1973 above1000 points dropped to a low of 577.60. At the same time, the 10 year treasury yield moved from 6.4% to over 8% towards the end of 1974. In France for instance, inflation jumped from 6% in 1972 to 9% in 1973 and close to 14% in 1974. It took the world over two years to recover.

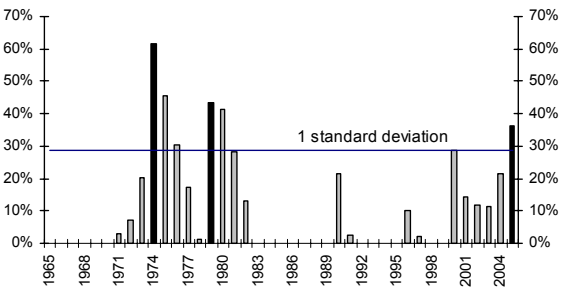

Figure 7: Positive deviation year on year: oil/consumption.

Table 5: Price relative to proved reserves over consumption during crises.

	Oil Price		Oil Price * 10/ Proved Reserves/Comsumption	
	Prior Shock	After Shock	Prior Shock	After Shock
1973	14,1	44,55	1,3	4,0
1979	39,6	82,15	4,0	8,2
1990	27,8	34,44	1,8	2,3
2004	38,3	63,28	2,6	4,3

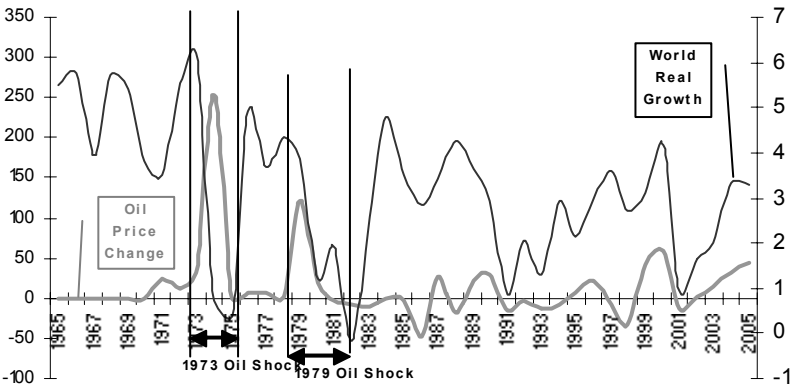

Figure 8: Real growth versus oil price change year on year.

In 1979, real growth was at 3.9% and dropped to 1.2% in 1980. The trend continued to the extent that the world economy even shrank in 1981. The 10 year rate which was trading around 9% in 1979 moved close to 16% at the end of September 1981. Again in France, between 1978 and 1980, inflation moved from 9 to over 13%.

In 1990, OECD real growth dropped from 3.1% to 1.4 but recovered faster than the two previous crises. The Dow index scored a high of 3010.60 in July 1990, dropped to 2353.71 in October 1990, but was back above 3000 in February 1991. The 10 year rate had a blip from 8.25% to 9% yield in August but was sub 8% in December. In 2004, there are no signs impact on real growth, the pressure on long rates is contained around 4.25%, and the stock market is performing very nicely.

Figure 9 illustrates over a longer period the impact of oil price on US inflation (here CPI quarterly). We notice the two jumps during the 1973 and 1979 episodes. We can also notice that despite a jump in oil price between 2000 and 2006, inflation remains very contained. In addition, we observed that in the US the surge in inflation during oil crises always precedes a fall in GDP. In 1979, the same scenario occurred. Directionally, the situation is the same in 1990, even though the shock is less noticeable. In fact between 1970 and 2000, broadly speaking US CPI and US real growth have moved in opposite directions. This is however no longer the case: since 2000, the US CPI and US real GDP have trended up together.

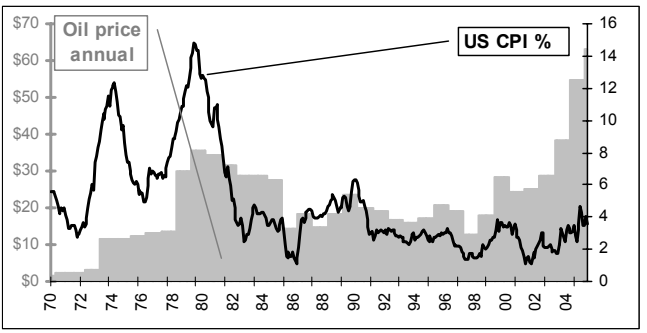

Figure 9: US CPI versus oil price nominal.

2.4 Conclusion: oil shocks or oil crises?

We studied 4 periods and tried to establish factual evidence to classify them into either oil crisis or oil shock. To meet the definition of an oil shock, price surge and adverse economic impact have to coexist. Table 6 shows that 1973 and 1979 meet both conditions. 2004 meets all price action criteria but fails to meet any of the expected economic impacts. In the following chapter we will review reasons why 2004 is different.

Table 6: Summary table.

OIL SHOCK ASSESSMENT	1973	1979	1990	2004
Price Assessment				
Magnitude > 2	Yes	Yes	Yes	Yes
Move > 1 STD				
- Speed of the move	Yes	Yes	No	Yes
- Oil relative to commodities	Yes	Yes	No	Yes
- Oil relative to consumption	Yes	Yes	No	Yes
- Oil relative to reserves	Yes	Yes	No	Yes
- Oil relative to reserves/consumption	Yes	Yes	No	Yes
Price behaviour in line with oil Shock	YES	YES	NO	YES
Economic assessment				
GDP drops by 2 percentage points	Yes	Yes	No	No
Stock exchange Fall	Yes	Yes	Yes	No
Inflation Rise	Yes	Yes	No	No
Economic behaviour in line with oil Shock	YES	YES	NO	NO
OIL SHOCK	**YES**	**YES**	**NO**	**??**

3 Why is 2004 different?

3.1 Oil dependency from Major economies

The current assessment is that industrialised countries are less vulnerable to oil movements today than they were during the first 2 shocks [7]. To prove this point, we reviewed energy consumption for OECD countries. The United States still absorbs over a quarter of the oil consumed in the world but its consumption over the last five years has only gone up by 5.1%. Over the same period, Japan, France and Sweden experienced a drop in oil consumption. China and South Korea, on the other hand, experienced significant increases (respectively +51% and +5%) but together only account for 10% of total oil consumption. This is further evidenced when looking at the situation since the first oil shock: China increased its consumption of oil by 473% and South Korea by 760%, but more importantly in the case of China its dependence on oil grew faster than the overall energy consumption. In most industrialised countries, the importance of oil has significantly diminished. The change in Real GDP highlights another fundamental change: in industrialised countries, less energy is required to create wealth. This is particularly true for the US which required 30% more energy to grow its GDP by 60%. With the same energy requirement, the UK grew its GDP by 45% [8]! China however required 370% more energy in 2004 versus 1973 but "only" improved its GDP by 270%.

In addition to developing energy-saving programs rich countries have also progressively moved from industry to service sectors which consume far less primary energy. As an example, today, the industry output only represents 26% of the French GDP, 18% of the US GDP, 31% of the German GDP and 24% for the UK GDP. In China, industry output now represents 51.7% of GDP. In Brazil it is still as high as 40%. In addition, because industrialised countries faced a number of crises they engaged into a rationalisation of their energy supply mix

and developed alternative sources of energy. In France for instance, nuclear programs and energy saving campaigns have dramatically decreased the country dependence on oil. It is estimated that today France is twice as less exposed to oil as it was in 1979. In other words, the price of oil would need to move up to double what it was in 1981 to have the same impact, i.e. about US$150 a barrel! At the moment, some countries are too busy growing to worry about energy savings.

In China industrialisation is affecting a growing number of people day by day. This means more and more people can afford to buy new products such as cars for instance: the number of cars increased by 50% in the last 3 years. China however provides mitigating factors to the world economy:

- The fantastic Chinese growth is associated to an investment cycle which reached 53% annualised growth in February this year – to be compared to the US investment cycle which peaked at 22% in the last 4 years. Consequently, the Chinese economy buys massively outside of its own country. Chinese imports increased 423% since 1990.
- China is becoming a large oil consumer. Its oil consumption is up 51.3% since 1999.
- China holds a large amount of US dollar denominated assets and as such, plays a key role in the evolution of the green back.

So if industrialised countries are less exposed, through China, they are clearly not immune to increases in oil price. So long as China maintains low manufacturing costs, in other words low wages, it will continue to attract investments and will continue to mitigate the impact of oil on the rest of the world. If however China was to suffer whatever the reason, the perspective of a third oil shock could become very real.

3.2 Redistribution

This time an increase in oil price does not negatively impact the world economy. As an illustration, on April 13th 2006, as oil was trading around 70 dollars a barrel, the IMF revised global growth forecast for 2006 from 4.3 to 4.9%. Another mechanism is taking place: redistribution. An increase in the price of oil generates a transfer of wealth to oil exporting countries, which we will limit to OPEC Countries for the purpose of this paper. Then, this extra money is either used locally, or invested back outside of OPEC countries in the form of goods and services, imports or even as foreign direct investments. For the purpose of this study, we will limit the beneficiary countries to G7. On a “business as usual” basis, since countries which provide these goods and services also turn out to be large oil importers, the impact, or in other words the wealth going back to G7 countries, is limited and probably not sufficient to compensate for extra costs generated by an increased oil spending. If the increase in the price of oil is however sudden and violent, it shifts a large amount of wealth to OPEC countries to a point that it probably covers more than usual domestic needs. There is then a chance that the windfall profit going back to G7 countries exceeds the negative effects of the oil price increase. Let us see if this redistribution is actually taking place.

To address this question, we selected an autoregressive vector model. This type of models is particularly appropriate as it assumes that all variables are considered endogenous. Additionally, vector autoregressive models enable the analysis of lagged variables and thus enable dynamic analysis. These models can therefore not only explain the impact of a shock created by one variable, but also the speed at which the shock spreads, and the number of periods during which the given variable affects other variables of the model. An extra benefit of these models is that they offer the opportunity to analyse how one variable affects another one (using for instance the Granger causality test)

In this case, we propose to model the impact of a shock on the price of oil. We assumed that the shock would be US$30 which corresponds to the recent increase to US$65 versus the latest long term stable price of US$35. For the purpose of this article, we will not detail the result of the estimation of the various parameters and will instead focus on the graphs which feature the response to impulses in the model.

We used homogenous quarterly data versus annual data because they give a better picture of the dynamics of economies. Quarterly data we used are as follows: OPEC real growth, OPEC consumption, OPEC investments, OPEC imports, OPEC savings, G7 real growth and WTI price. The estimation period covers the first quarter 1990 through the last quarter of 2004. The time series are stationary. For each of them, the unit root hypothesis was rejected at the 5% significant level by the augmented Dickey-Fuller unit root tests. The VAR model is as follows (eqn (1)):

$$\Pi_t = \sum_i^p \Phi_i \Pi_{t-i} + \varepsilon_t \tag{1}$$

where:

$$\Pi_t = \begin{pmatrix} \ln GDPopep_t \\ \ln CONSOopep_t \\ \ln INVopep_t \\ \ln IMPORTSopep_t \\ \ln SAVINGSopep_t \\ \ln GDPG7_t \\ \ln OILPRICE_t \end{pmatrix}$$

matrixes Φ_i , for i =1,……, p, contain the coefficient factors of the model.

Vector ε_t represents non-systematic influences, also called impulses or innovations.

Schwarz, Akaike and Hannan-Quinn tests were used to determine the optimal number of lags in this model. For each of these three tests, a lag of 2 quarters offered the best result. The objective was to evaluate the impact of an oil shock on other variables of the model. Results of an oil shock of US$30 are displayed in the following response curves (Figure 10). The first observation is that a sudden increase of US$30 in the price of oil has a limited medium term impact

(10 quarters) on OPEC savings and domestic consumption. In the first quarter an oil price shock generates a negative move on savings. Thereafter, it remains positive. The effect on consumption however is immediately positive but not significant. It is interesting to note that OPEC imports and investments are the ones which react most to an oil shock. Very clearly, the redistribution effect mentioned earlier in our hypothesis is taking place. In other words, an increase in the price of oil generates a transfer of wealth from oil exporting countries to industrialised countries, here G7 countries. We observed that real GDP for G7 countries although initially negatively impacted by an oil shock turns positive after the first quarter, even if the up move remains moderate.

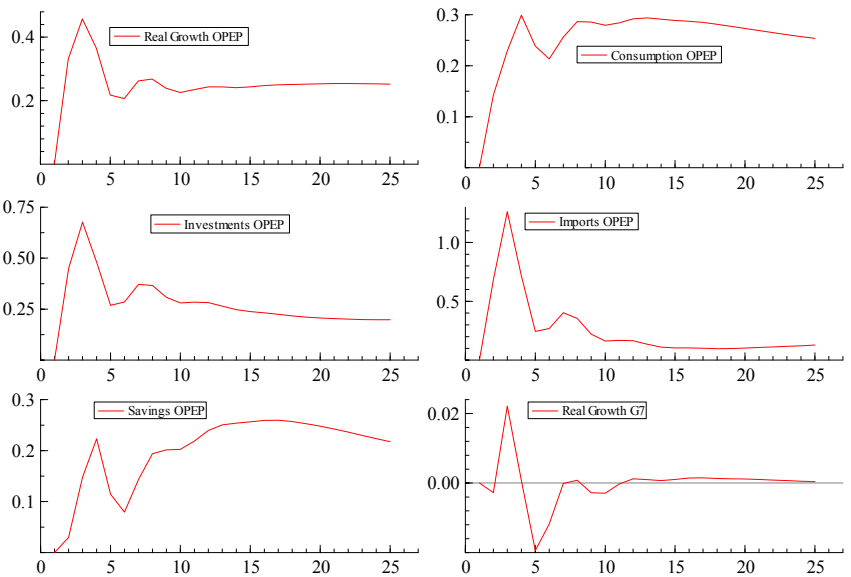

Figure 10: Impulse response to an oil shock.

If the stocks keep on going, and if the world keeps on growing, it's only because the extra spending in oil consumption comes back in the economies and redistributes growth around. The world is a global exchange place. Trade exchanges have increased, particularly between OPEC countries and industrialised countries. OPEC imports have more than doubled between 1990 and 2003 as oil price went up. An oil price shock today does not have the negative effect on real global growth that is used to have. Economic models we used in the 1970s are no longer valid. History is history and the consumer should no longer be frightened when oil price shoots up. This win/win situation only works so long as OPEC countries keep on reinvesting. Else, we know what happens as history has had a tendency to repeat itself.

4 Conclusion

In this paper, we have seen that the price of oil was amongst other factors significantly linked to the economic environment. In addition, speculation plays a significant role in price determination, particularly when the market is stretched, although it remains difficult to evidence through statistical models.

If an increase in oil price is an issue and has been for the last 35 years, it does not necessarily lead to what we defined as a shock. Thus, of the last 4 periods of tension (1973, 1979, 1990 and 2004), only 2 can be considered as genuine oil shocks (1973 and 1979). As strange as it seems, 2004 is not. The world has changed since the seventies. Most trade barriers have disappeared, international exchanges have increased and so has the redistribution of "petrodollars". In addition, industrialised countries are progressively reducing their dependency on oil.

Finally, the empirical evidence that we described with respect to the 2004 price increase may no longer be valid should the price jump rapidly over 100 dollars a barrel. In the meantime, the International Monetary Fund is revising global growth up as the price of oil is precisely moving towards US$100.

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