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The Impact of Higher Oil Prices on Low Income Countries and on the Poor

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Executive Summary

1 The rapid and large oil price rise experienced during 2004 has created widespread concern about its impact on low income countries and on poor households in many countries. To appreciate the magnitude of this impact and to formulate policies to ameliorate these effects, a number of questions need to be answered.

- What are the routes by which countries are impacted?
- Which countries are most vulnerable to oil shocks?
- What determines the degree of vulnerability to such shocks?
- How much are the poor in various countries impacted by the effects of higher oil prices?
- What policies can reduce the vulnerability of countries to oil shocks, both immediately and in the medium to long run?

2 Three levels of analysis are used to discuss these issues: the macroeconomic, that looks at the direct impact of the balance of payments and the necessary adjustment of GDP to restore equilibrium; the mesoeconomic, that looks at factors which determine a country's propensity to be a net oil importers, including oil self-sufficiency, oil dependence and energy intensity; and the microeconomic that looks at the direct impact and indirect impacts on households of an increase in oil prices.

The Impacts of Higher Oil Prices

3 The report shows that there are a number of routes by which oil prices impact the poor.

The net oil import bill

4 The net oil import bill, relative to GDP, determines, for countries without substantial foreign reserves, the size of the domestic adjustment in absorption needed to restore balance of payments equilibrium. Analysis of data for a large number of countries shows that a sustained US$10 a barrel price increase would deliver a shock equivalent to a loss of GDP of 1.47 percent for the poorest countries (those with GDP per capita of less than US$300). Even the highest income group (over US$9000 per capita GDP) would suffer a loss of GDP of 0.44 percent. Some of the lowest income countries suffer a shock of up to 4 percent of GDP, and were oil prices to stay US$20 a barrel higher, then the effect on GDP would be doubled.

5 Statistical evidence shows that there is a small but significant negative association between the level of per capita GDP and the ratio of net oil imports to GDP, so that systematically the lowest income oil importers suffer the most from the direct impact of higher oil prices on the balance of payments. Growth and development therefore tend to reduce the vulnerability to such shocks but this effect is small.

Impacts on Net Oil Exporters

6 The group of countries that are net exporters will experience a substantial improvement in the balance of payments as a result of higher oil prices - the lowest income group (less than US$900 per capita income) would enjoy a 5.21 percent improvement in GDP. For countries such as Angola a US$10 a barrel oil price increase is equivalent to a gain of 30 percent in GDP. Several other developing countries also experience very large gains. The challenge for these countries is to use the extra resources well. Incremental fiscal revenues arising from the higher oil prices need to be spent wisely or sterilized in an oil fund, held for future generations. Transparency over receipts and expenditure becomes more important at times of such large increments in revenue.

Reduction in World GDP and Trade

7 Following a global oil price rise, world GDP falls below where it would otherwise have been, so that there is an additional impact on oil importers as they see their exports of other goods fall. The reduction in world GDP is estimated at around 0.5 percent, that translates into a further 0.5 percent reduction in the GDP of the oil importing countries.

Direct and Indirect Effects of Oil Price Increases on Households

8 Households, which are consumers of certain petroleum products (kerosene, LGP and gasoline) and who also purchase other goods whose costs are impacted by oil product prices (diesel for transportation) will feel the effect of higher oil prices in their household expenditure, unless the government controls product prices and does not let them rise (thus increasing any subsidy element). Calculations show that low-income deciles are more severely affected than higher income groups. For example, a study of Yemen of a possible price increase of petroleum products, equivalent to US$15 a barrel, raised the cost of acquiring the same bundle of goods as before by 14.4 percent, while for the top decile the increase was only 7.1 percent. An important component of this total cost of living increase came from impacts on non-fuel expenditures, especially those on transport and food, which are impacted by higher diesel prices. Other detailed studies, for Iran and Pakistan, confirmed the picture that the rural poor suffer the most, primarily because of the importance of kerosene for these households.

9 Small and medium size enterprises are also likely to suffer from higher fuel costs, and the size of the price rise, coupled with the volatility of oil prices in general points to a possible barrier to the sustainable development of these sources of growth.

10 In countries where petroleum products are subsidized, the impact of higher oil prices will not be directly felt by households, but the worsening of the government's fiscal position will result in less government spending than would otherwise have been possible. Since much of this spending might have benefited the poor, the attempt to

protect them by across the board subsidies on petroleum products may be less than successful, and will be unsustainable.

Vulnerability of Oil Importing Countries to Oil Price Shocks

11 To understand where policies to reduce the impact of current or future oil shocks should be directed, attention should be focused on their vulnerability, as measured by the ratio of net oil imports to GDP. This ratio can be understood in terms of three component parts:

Oil imports / GDP = (oil imports / total oil use)? (total oil use / total energy use) ´ (total energy use / GDP)

Oil imports / total oil use = **1 - self sufficiency in oil production**

Total oil use / total energy use = **dependence on oil as energy source**

Total energy use / GDP = **energy intensity**

12 The challenges for policy are to understand what factors determine oil sufficiency, oil dependence and energy intensity.

13 Data analysis reveals that dependence on oil as a source of energy, and the general level of energy efficiency are weakly negatively related to the level of per capita GDP, but that certain countries over time have been able to make substantial reductions in these factors. A better understanding of the dynamics of fuel choice and energy efficiency will be a key component to identifying the processes and policies by which the vulnerability to oil shocks can be reduced.

Policies to Dddress the Impacts of Higher Oil Prices

14 In the short term the number of policies to address the impacts of higher oil prices are severely limited. At a macroeconomic level, focusing on the balance of payments, governments have little alternative but to deflate the economy in order to adjust the balance of payments. Short term borrowing or reserve reduction may be an option for some countries, but for many this is not possible, and in any case it is not a sustainable response to a permanent shift in oil prices. Financial instruments, such as hedging against oil prices, are as yet untested and might prove expensive and ineffective for many poorer countries.

15 At the level of protection for households, where oil price rises will be felt most directly, governments have to balance short term support in terms of subsidies, whether targeted or across the board, and the longer term need to let the market work in order to force the discipline of higher prices on the choice of fuels and energy practices. Determination of the actual severity of the impact of higher prices on the poorest groups in society will reveal whether the problem in terms of equity is so severe that a trade off against efficiency needs to be made, if only in the short run.

Agenda for further work

16 The paper identifies a number of issues where further knowledge of past experience will be valuable for understanding the possibilities for reducing vulnerability to oil shocks, and the policies for encouraging this. These include:

- Obtaining a better understanding of the nature of the volatility of the oil price, and the decomposition of price changes into "permanent" and "transitory" components. Both households and small and medium sized enterprises are likely to be affected by the volatility of oil prices, as well as by their trend. Having a better analysis of the volatility of oil prices will allow a more nuanced set of policy responses, and will permit a better informed debate of the role of volatility on decision making on fuel choice and energy intensity related policies. Importantly, the design of and emphasis on different policies to handle short run shocks, and long run permanent changes depends on an understanding of the likely degree of permanence of oil price changes.
- The ratio of net oil imports to GDP is a key variable for indexing the likely vulnerability of an economy to oil price shocks. Better understanding of changes in the ratio over time, and explanations of differences between countries can form the basis for design of policies to reduce vulnerability over time. Other factors influencing vulnerability, such as the size of foreign reserves, and ability to access capital markets should also be identified.
- In the immediate aftermath of a large oil price rise, many governments may feel that they have little choice but to provide some subsidies to protect poorer households from the potentially large impacts on their welfare. The mechanisms of subsidy provision, whether targeted, based on particular goods (especially kerosene) or income related, need to be carefully considered in terms of costs and benefits. Schemes for providing temporary relief need to be investigated, given the propensity of subsidy schemes to become permanent. Over the longer run governments need to consider letting oil product prices reflect market values (whether import or export parity) in order to allow the discipline of the market to achieve efficient use of resources, and to encourage substitution. Removing subsidies on oil products has proved politically difficult in a number of countries, so that there is urgent need to see whether there are any good practice lessons that can be shared between governments considering this strategy.
- An important policy response is to improve diversification of fuel use. One way in which this can be improved is by increasing the self-sufficiency of the economy with respect to oil production. The identification of countries with prospects of increasing oil production, and

hence reducing import dependence, will permit better targeting of technical assistance to develop the oil sector in a beneficial fashion. Revenue management strategies, combined with improved transparency, are seen as a key to enhancing the likelihood of successful development of oil reserves. For oil exporters the management of large and unexpected increments in revenues places increasing burdens on the system of fiscal management. Investigation of the operation and performance of existing oil funds is needed to learn whether these were adequate to accommodate the large revenue inflows recently experienced.

- Oil price elasticities of demand indicate the extent to which market forces produce reactions to higher oil prices, both in terms of fuel switching and improved energy efficiency. The limited information available on these elasticities for lower income countries needs to be supplemented in order to provide more information on the extent to which the effects of a sustained price rise will be mitigated by substitution away from oil. Successful fuel switching is likely to occur in economies with more diversified fuel use, and where the prices of competing fuels (gas, coal, hydro and biomass) do not increase in line with oil prices. More systematic information on trends in fuel portfolios and movements in local fuel prices are needed in order to validate policies designed to encourage fuel switching.
- The role of biomass as an alternative fuel, under conditions of market pricing without sustained government subsidies, needs further investigation. In particular, allowance for the predictability of oil prices will need to be factored into policies to achieve sustainable commercial development of biomass.
- Trends in energy efficiency over time suggest that countries have been able to make progress in this, but cross section evidence reveals that there is surprisingly little difference between many developing and developed countries. Better understanding of trends and potential for gains is urgently required before policies are advocated on a wide scale to achieve gains that may prove difficult to realize. The relationship between oil dependence and energy intensity also needs to be understood, since countries with higher energy efficiency will probably be able to do less to reduce oil dependence than those with lower energy efficiency.

1

Introduction

1.1 The recent sharp rise in oil prices has created concerns about their impact on all countries, high and low income, both net oil importers and oil exporters. Estimates of the likely effects on world Gross Domestic Product (GDP) and on the GDP of specific groups of countries have been made by several organizations, including the World Bank, as well as the International Energy Agency. Of particular concern for agencies concerned with development and the Millennium Development Goals is the impact on the poor.

1.2 Similar concerns were voiced after the oil price shocks of the period 1973 to 1983[1], and there has been considerable analysis of the impact of oil prices on developed countries' economies. As regards lower income countries there has been less study, partly because of data limitations, and so this paper has a threefold goal:

(i) To describe the various links by which oil price rises are likely to impact low income countries and poorer households and, where possible, to provide evidence on the magnitude of these links;

(ii) To highlight areas where there are substantial gaps in knowledge about the routes by which the poor may be impacted and the magnitudes of such effects, so as to indicate possible tasks for future study;

(iii) To relate the various impacts on the poor to policies that may be able to mitigate some of the effects of these oil price rises.

1.3 The report discusses the impacts of oil price shocks at three levels of economic aggregation:

(i) The **macroeconomic** level, where the link is from oil prices to the balance of payments, to gross domestic product, and from there to per capita incomes;

(ii) The **mesoeconomic** level of factors which determine the vulnerability of an economy to an oil price shock via its impact on the balance of payments – these factors, which reflect certain aspects of the internal

[1] *Socio-Economic and Policy Implications of Energy Price Increases*. Armand Pereira, Alistair Ulph and Wouter Tims, Gower Press, 1987.

structure of the economies, include the degree of self sufficiency in oil production, the oil dependence of energy use, and the energy intensity of production;

(iii) The **microeconomic** level, where the impacts of higher oil prices, other prices impacted by the oil prices, and lower GDP, all combine to bwer household real income, and where detailed expenditure surveys can throw some light whether the poor are proportionately affected the most by oil price rises.

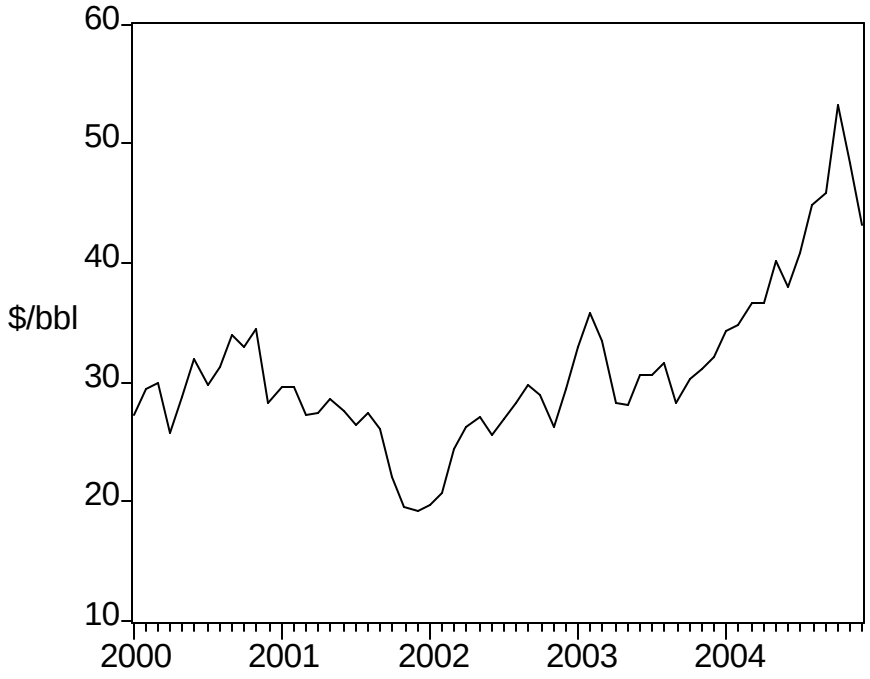
1.4 Similarly, policies can be grouped around these three levels of aggregation, and a section of the paper is devoted to discussing where better understanding of the various factors involved and their historical experience may highlight possible policies, and their likely efficacy with respect to mitigating the impacts of higher oil prices.

2

The Recent Oil Shock

2.1 The recent rise in the oil price (of both crude oil and products) is one of a series of large shifts in price which have occurred during the last 30 years. From a relative "low" price, in December 2001, of US$19.7 per barrel for the monthly average price of WTI crude, the average for October 2004 reached US$53.2 (with daily prices showing even more volatility). Recent downward movements led to the December average of US$43.2 being some US$10 below its October peak, but it does seem clear that in the medium term oil prices are very likely to remain well above the levels seen until 2004.

Figure 1: The Course of World Oil Prices 2000–2004
West Texas Intermediate US$/bbl Monthly Averages



2.2 The graph shows not only that there was an almost steady climb between the end of 2001 and the present (and a virtually uninterrupted rise from September 2003), but also that from late 2003 prices were above levels they had been for several years, and that by the autumn of 2004 they had reached the highest levels ever in current price terms, and almost the highest in constant price terms. With such a rapid and sustained change (88 percent increase from September 2003 to October 2004) the impacts steadily increased in severity, and occurred so fast that there was too little time for policy measures to ameliorate their impacts. These very large movements make forecasting difficult, but it seems clear that for the near future prices will be certainly US$10 a barrel higher, and perhaps even US$20 a barrel higher, than was expected even one year earlier. Taking the longer view, an important issue is the extent to which oil price changes tend to be permanent or transitory. If most increases are followed by some reversion towards a trend level, then the policy implications revolve largely around accommodating short-term shocks, while if price changes tend to be largely permanent then policies need to focus on encouraging structural changes in affected economies. Preliminary estimates[2] suggest that about half of any oil price change is permanent and half is transitory, which implies that the medium term price is around US$37, as opposed to the current actual price of around US$45. This estimate certainly suggests that medium term forecast need to be adjusted sharply from where they were a year ago, and that the impact of a sustained oil shock might be evaluated at around an extra US$15 a barrel.

2.3 Although in some countries part of the effect of this huge oil price increase may have been offset by exchange rate movements (especially given the weakening of the US$ versus the Euro) it is evident that this increase must have major impacts on some countries, and on certain groups within those countries.

[2] *Understanding Oil Prices*. Christopher Gilbert, presentation at the World Bank, February 2005.

3

The Macroeconomic Effects of Higher Oil Prices

3.1 The impacts of higher oil prices are of course different for net oil importers and for net oil exporters (combining both crude and products). Oil importers immediately face a larger import bill and, unless the country is already running a surplus, or has extremely large foreign exchange reserves, this must be met by a reduction in total demand for all imported goods, so as to restore balance of payments equilibrium. The usual mechanism for this is a reduction in domestic demand (both consumption and investment) which leads to reduced imports and reduced domestic production. If real wages are sticky downwards this also will translate into increased unemployment. This short-term reduction in the rate of growth is the mechanism by which resources are effectively transferred from oil importing countries to oil exporting countries. The fall in final expenditure indicates that the shocks to households and firms in terms of welfare may be large since the price they pay for imports is much higher and has to be balanced by lower quantities.

3.2 In addition, the net effect of the oil shock is expected to lower world GDP because the reduced spending on all items by oil importers to balance higher oil import costs will not be fully offset by increased demand for imports from oil exporters. Thus, most oil importing countries experience a further fall in GDP as their exports of other goods fall. Several estimates of the elasticity of GDP with respect to higher oil prices have been made. The IEA estimated that, for the OECD as a whole, a sustained US$10 a barrel price increase would result in a loss of GDP of 0.5 percent during 2004 and 2005, which corresponds to an elasticity of around 1.25 percent. A similar figure has been quoted by a recent World Bank study [3]. For the USA, estimates of the elasticity are much higher, and an average elasticity of 6 percent has been cited.[4]

3.3 Oil exporters experience the reverse conditions – with the large improvement in the Balance of Payments, domestic spending can be relaxed and nominal GDP can rise, unless the government is able to completely absorb the increase in some

[3] *Preliminary Estimates of the Financing, Growth and Poverty Implications of the Oil shock on Developing Nations.* Santiago Herrera, Tala Khartabil, Gaobo Pand and Stefano Paternostro. The World Bank. 2004.
[4] *Impacts of Oil Supply Disruption in the United States*. Paul Leiby. Presentation at the IEA/ASEAN workshop: "Oil Supply Disruption Management Issues", April 2004.

form of savings scheme. Since much of the net increase in revenue will accrue directly to the treasury through royalty and other payments, the fiscal management of the extra revenues will determine the impact on the economy, and will present formidable challenges to these governments to spend in a sustainable and efficient fashion. Poorly targeted additional spending programs may merely increase the rate of domestic inflation, especially where the local absorption capacity is low. This is in effect one aspect of the so called "Dutch Disease" where the extra oil revenues can lead to worsening export performance in the non-oil sectors as well as increased spending on non-tradeables which add little to domestic welfare.

3.4 One policy tool seeks to avoid the problem of oil shocks altogether by hedging, or using other similar financial instruments, to offset the risks of higher (for consumer countries) or lower (for producer countries) than expected oil prices. These instruments can offer financial returns that would offset the higher or lower prices, respectively, but this is achieved at a cost to the country taking out the hedge. Hedging against a sustained price rise would be difficult because of the thinness of markets that stretch out for several years. Few countries appear to have carried out such operations on a large scale or for lengthy periods [5]. Large producers would find it difficult to hedge their production, while many smaller economies probably do not have the institutional capacity to undertake hedging. In addition, hedging could lead to misuse of oil revenues in countries with weak governance and poor transparency of government actions.

3.5 Finally, exchange rate policies can have major implications for the impact on the Balance of Payments and the subsequent adjustment of the economies. Where an economy has been dollarized, the whole of the oil price rise (since oil prices are quoted in dollars) will be felt on the Balance of Payments. Currencies tied to other economies (e.g. West African Francophone countries tied to the EURO) or freely floating may find that part of the immediate impact is offset by an exchange rate adjustment.

[5] *Hedging Government Oil Price Risk*. James A. Daniel, in: *Fiscal Policy Formulation and Implementation in Oil-Producing Countries* , eds. J. Davis, R. Ossowski and A. Fedelino: International Monetary Fund. 2003.

4

The Direct Impact of Higher Oil Prices on Countries' GDP

4.1 The simplest calculation to provide an estimate of the direct impact of higher oil prices on GDP is based on the ratio of the net imports (exports) of oil and oil products to GDP . If there is a zero price elasticity of demand for oil and oil products then, following a rise in the oil price, GDP will have to change by as much as the change in the value of net imports:

$$\Delta \text{GDP} = \Delta \text{NI} \quad (1A)$$

$$\therefore \ \% \text{GDP} = \Delta (\text{NI/GDP}) \quad (1B)$$

where NI is the net import of oil and oil products (negative for net imports) and ? is the percentage rise in the oil price.

4.2 This formulation gives a simple linear relation between the percentage change in GDP experienced and the ratio of net imports oil to GDP,[6] but is open to certain qualifications. Firstly, the calculation assumes that the higher price lasts a full year, but there are no microeconomic adjustments to the oil shocks, and that the response is entirely by a reduction in absorption, rather than a reduction in reserves or increase in borrowing. As such, the calculations act as an index of the severity of the shock on different economies, rather than as a forecast as to how the economies will react. Secondly, economies gradually adjust to large changes and this can offset some of the severity of the initial shock. In particular, if the own price elasticity of demand for oil and oil products is greater than zero, the demand for oil will reduce and so the strain on the balance of payments will be less and a smaller adjustment in GDP will be required. If this effect were strong then countries might well adopt a temporary policy of reducing the level of foreign exchange reserves if any were available, to give time for the internal adjustment to take place. However, many poorer countries do not even have this option

[6] Methodology and calculations based on a World Bank study carried out by DEC prospects group.

and the short run price elasticities of demand tend to be very low, so that the only solution is for the economy to contract.

4.3 Calculations of the size of the initial shock, as measured by the implied percentage change in GDP required by the individual countries' ratio of net oil imports to GDP, based on a very wide range of countries, except for the very smallest, and grouped separately by net oil exporters (34 countries) and net oil importers (97 countries) aggregated by per capita income ranges, give results as shown in table 1. The data on which these calculations are based is given in Appendix 1, table 2. The GDP and trade data, based on the average values for the period 1999 to 2001, correspond to a base oil price of US$23.55, so that the US$10 price increase is equivalent to a 42.5 percent increase.

Table 1: Percentage Change in GDP Required by a US$10 a Barrel Rise in Oil Prices

Per capita income (1999-2001 US$)	*% change in GDP*
Net Oil importers	
< 300 *[18]*	-1.47
> 300 and < 900 *[22]*	-0.76
>900 and < 9000 *[36]*	-0.56
> 9000 *[21]*	-0.44
Net oil exporters	
< 900 *[10]*	+5.21
> 900 and < 9000 *[17]*	+4.16
> 9000 *[7]*	+1.50

4.4 This table shows some strong features. For net oil importers, the group of countries with the lowest incomes suffers the largest proportional loss in GDP, being the most dependent on oil imports. On average the impact of a US$10 a barrel price increase is equivalent to a shock lowering GDP by 1.5 percent, so that a US$20 a barrel shock would be equivalent for the poorest group of countries to 3 percent of GDP. For country groups with higher average per capita incomes the effects are smaller, being 0.44 percent of GDP for countries with per capita incomes above US$9000. Within these groups there are also very substantial inter country variations – for example, in the lowest income group of countries, Togo suffers an impact equivalent to 4.6 percent of GDP for a US$10 oil price increase. This poorest group of oil importers is not dominated by single country – all have a small GDP as well as very low GDP per capita, so that the result is truly reflective of the general experience of the poorest countries.

4.5 Conversely, oil exporters enjoy substantially larger positive impacts per group (and individually) than the negative impacts on oil importers. Interestingly, for the period 1999-2001, only one oil exporter had a per capita income of less than US$300 so that there were very few of the poorest countries in the world in this group. For the 10 "poor" oil exporting countries with per capita incomes less than US$900, an increase of

US$10 a barrel is equivalent to 5.2 percent increase in GDP, and a US$20 a barrel increase is equivalent to a more than 10 percent increase in GDP. This group is dominated by the large but poor economy of Indonesia that is only just a net exporter, so that the group average is very much affected by the small size of the shock (0.3 percent) for this one large country. For middle-income countries with incomes under US$9000 the impact is also substantial at over 4 percent. The highest income net exporting countries include highly diversified economies for which the share of oil exports in GDP is low and the impact of the price change is small, e.g. U.K (0.2 percent) and Canada (0.3 percent) so that the overall gain is only 1.5 percent of GDP.

4.6 Again, within the income groupings there is variation between the oil exporters, but this is even more substantial than for importing countries – for example, Angola, with net exports of oil at 70 percent of GDP, receives a positive shock of about 30 percent of GDP from a US$10 a barrel increase in oil prices. Other countries with very large impacts include Nigeria (18 percent), Republic of Congo (26 percent), Equatorial Guinea (36 percent), Gabon (21 percent) and Oman (17 percent).

4.7 These broad trends raise the issue of whether there is a negative correlation between the ratio of net oil imports to GDP and the level of GDP per capita. If there is such a correlation then it appears that the process of development itself could reduce vulnerability as incomes rise. A cross section regression between the size of the impact as calculated above and the level of per capita GDP yields a squared correlation of 11 percent, which is significant, but the coefficient of per capita GDP is very small at 0.000042. This implies that for every US$1000 increase in per capita GDP the impact of a US$10 a barrel oil price rise offsets the negative impact on the percentage change in GDP by 0.04 percentage points. The vulnerability to oil shocks therefore is only slightly less for higher income countries taken as a whole. Moreover, this suggests that, over a lengthy period following earlier large oil price shocks, the higher income countries, which certainly have access to finance and technology to reduce the ratio of oil imports to GDP, have either not wished or not been able to do so to any very substantial extent.

4.8 The very similar oil import dependence of higher income and lower income countries might be explained by the rather temporary nature of the earlier price shocks. Following the increase from US$2 a barrel in the early 1970s to US$34 a barrel in the early 1980s (a much larger proportional increase than seen at present) the price then fell back to US$16 a barrel by 1987, making the point that the peak prices did not persist for very long and were indeed followed by lengthy periods of substantially lower prices. Adjusting for inflation and exchange rates it is possible to view the price rise of the period 1974-1982 as atypical, and the relatively constant price experience of the next twenty years as giving grounds for producer and consumer complacency against large and permanent oil price changes.

4.9 Detailed country-by-country studies over a lengthy period of time may be able to reveal whether some countries have been able to make substantial changes in their dependence on imported oil, and to identify policies that were used to achieve this.

4.10 The simplest macroeconomic adjustment to the impact of the price shock is through the price elasticity of demand for oil products and for oil. To the extent that consumers and producers reduce their demands for oil (either by fuel switching) or by switching to other goods or other products the import bill will be reduced from the immediate level initially impacted by the shock. There have been many estimates made since the first oil shocks, primarily for O.E.C.D. countries, and these give a fairly uniform picture. During the first year of the price rise (the "short run") the price elasticity is extremely low with a value for most countries around 0.05 [7]. This implies that about 5 percent of the impact calculated above might be offset during the first full year by adjustment in domestic demand. Over the longer run, when more complete adjustments can take place, the price elasticities for O.E.C.D. countries appear to be in the range of 0.3 to 0.5, which suggests that a substantial offset to the impact of the price rise can be expected by the normal operations of the market as firms and consumers react to the higher prices. However for non-O.E.C.D. countries the long run elasticity may be substantially lower at below 0.2 [8]. Importantly, if oil prices fall back substantially to their earlier levels following the sustained price rise, there is evidence of irreversibility in demand in that demand does not appear to rise all the way back to its former level. These aggregate prices elasticities incorporate both the effects of switching to alternative fuels and of reducing the amount of fuel consumed (including oil) through efficiency and changes in industrial structure and household consumption patterns.

4.11 Policies to ameliorate the effects of the present oil price rise, or to guard against future further price increases, must focus either on the vulnerability of the economy to the oil shock (that is on the ratio of net oil imports to GDP) or on its ability to react dynamically to the shock in terms of the adjustment process, which in turn reduces the vulnerability of the economy.

4.12 One important aspect of the macroeconomic adjustment is that once the economy has reduced to a level where the balance of payments is again sustainable it can continue to grow at its former underlying rate, albeit at a lower level of income. After a few years, for even for the worst hit economies, the level of GDP will have returned to where it was before the oil shock, but the loss in output is a permanent loss of welfare.

[7] For recent estimates see, for example: *Price Elasticity of Demand for Crude Oil: Estimates for 23 countries*. John C.B. Cooper. OPEC review. 2003.

[8] *The Asymmetric Effects of Changes in Price and Income on Energy and Oil Demand*. Dermot Gately and Hillard G. Huntington. Economic Research Report, Department of Economics, New York University, 2001.

5

The Vulnerability of Countries to an Oil Price Shock

5.1 The central variable for quantifying the vulnerability of an economy to a change in the oil price is the ratio of net oil imports to GDP. This ratio effectively compares the exposure of the economy to the shock to the relative importance of the exposure. High import bills relative to GDP will require a larger adjustment in the face of a given change in the international oil price. This ratio can be understood as the product of three terms, each of which has an important interpretation:

Oil imports / GDP = (oil imports / total oil use)? (total oil use / total energy use) ´ (total energy use / GDP)

Oil imports / total oil use	=	**1 - self sufficiency in oil production**
Total oil use / total energy use	=	**dependence on oil as energy source**
Total energy use / GDP	=	**energy intensity**

5.2 The first ratio can be altered by discovery and production of domestic supplies of oil. To the extent that oil is imported as products, rather than in its unrefined state, as is often the case for low-income countries without refineries, the discovery of oil may result in exports of crude to offset the imports of products. Self-sufficiency is then taken to represent the balance of these flows, rather than a simple quantification of the import of crude oil.

5.3 The second ratio can be affected by policies to encourage inter fuel substitution or diversification of the energy portfolio.

5.4 The third can be affected by increasing energy efficiency and by switching output to less energy intensive sectors.

5.5 Each of these components suggests where policies can be focused in order to ameliorate the overall vulnerability to higher oil prices.

Oil Self Sufficiency

5.6 The increase in oil prices and reliance on a small number of large producers at the time of the first oil shocks led to a worldwide increase in exploration, development and production. Some of this has been in countries where there was formerly no oil production, many of which are developing countries, while the rest has been in existing oil provinces.

Table 3 presents the size distribution and numbers of oil producers in 1965 and 2003.

Table 3: The Number and Size of Oil Producing Countries by 000b/d

Year	*< 200*	*200 - 1000*	*> 1000*	*Mean (000 b/d)*
1965	27	11	8	649
2003	11	24	19	1421

Source: BP Statistical Review of World Energy.

5.7 The table shows that eight new countries entered production during the period, and that many of the smaller producers in 1965 had became much more important by the end of the period. For example, countries producing less than 20,000 b/d in 1965 included Norway, U.K., Ecuador, Oman, Syria, Yemen, Angola, Chad, Republic of Congo, Equatorial Guinea, Sudan, Malaysia, Thailand, Vietnam and Australia. By the end of the period eleven more countries were in the category of producing more than one million barrels a day (Canada, Mexico, Brazil, Kazakhstan, Norway, U.K, U.A.E., Algeria, Nigeria, China and Indonesia) of which most were in lower income group. Not only has the number of sizable producers increased, but also the mean size of the average producer has more than doubled. Although this has been a slow process, it has been steady and indicates that, where the geology is favorable, countries embarking on well designed oil development programs can be highly successful. For these countries the establishment of the oil sector has certainly been effective in reducing vulnerability to large oil price rises. This success has also brought concerns about the ability of countries with weak governance to control the oil tax revenue flows in such a way as to benefit the country and not to suffer from mal-effects of Dutch Disease and the Resource Curse.

5.8 Several oil-producing countries have established oil revenue funds, which may have as one of their objectives the stabilization of the macro economy against large oil price shocks. Essentially, a large fraction of revenues are paid into an earmarked fund, which may be separate from the main budget, or merely a "virtual" fund used as an accounting device within the budget process. The fund is invested according to good management strategies and the returns also added to the fund. Withdrawals from the fund into the budget for spending purposes are made at a steady and sustainable level (providing revenue to the budget even after the oil production has ceased). In principle, when oil prices are higher than the long term expected value, and tax revenues are also higher, the fund accumulates more than usual, and when the oil price is lower than the

long term projected value, the fund receives less than usual, and may even decline in value. The purpose of this type of "stabilization" fund is to ensure a fairly steady stream of government spending, avoiding a type of "stop-go" policy" that can be damaging to the economy. Experience with such funds is rather mixed [9] with two substantial difficulties to overcome. Firstly, although the government can be disciplined about its use of the fund to finance the budget, it can be undisciplined outside the fund (borrowing against oil receipts etc.) which negates the stabilization objective, and secondly, the erratic behavior of oil prices makes it difficult to determine what is the expected price against which the flows in and out of the fund are to be determined. Operating such funds, or indeed managing large oil revenues without a fund, is very challenging for developing economies with weak capacity to manage the sector and the budgetary process.

5.9 The information on oil production is usefully supplemented by an analysis of the degree to which countries are self sufficient in the consumption of oil. Some countries produce oil, but not in sufficient quantities to cover their own consumption needs. A measure of self-sufficiency is given by the ratio of consumption less production to consumption. In this measure consumption is defined in terms of refined products (both imported and domestically produced) while production refers to domestic crude output. Table 4 is based on the set of 131 countries used for the calculation of the impact of oil shocks.

Table 4: Oil Self Sufficiency in 2001: (Consumption-Production)/Consumption. Number of Countries in each Range

Self sufficiency index	*< -2*	*-2 to 0*	*0 to 0.8*	*0.8 to 1.0*	*1.0*
Number of countries	17	17	20	32	45

Source. EIA World Petroleum Supply and Disposition.

Note. Negative values indicates more than self sufficient, 0 indicates just self sufficient, 1 indicates complete import dependency.

5.10 The countries with values less than –2 are mainly Gulf countries, some African producers and Norway, while other net exporters include U.K, Denmark, Malaysia, Argentina, Russia and Azerbaijan. Producers who are overall net importers include a wide range of economies including China, India, U.S.A., Australia, and several post soviet countries. Countries with small production relative to consumption are mainly European and middle-income countries, while countries that are entirely dependent on imported oil and products are largely developing countries. Of the group of 47 countries whose per capita income is less than US$2 a day, 9 were self sufficient (Democratic

[9] *Stabilization and Savings Funds for Nonrenewable Resources: Experience and Fiscal Policy Implications* Jeffrey Davis, Roland Ossowski, James A. Daniel and Steven Barnett, in: *Fiscal Policy Formulation and Implementation in Oil-Producing Countries*, eds. J. Davis, R. Ossowski and A. Fedelino. International Monetary Fund. 2003.

Republic of Congo, Nigeria, Sudan, Vietnam, Yemen, Cameroon, Azerbaijan, Angola and Indonesia) and 25 were entirely import dependent.

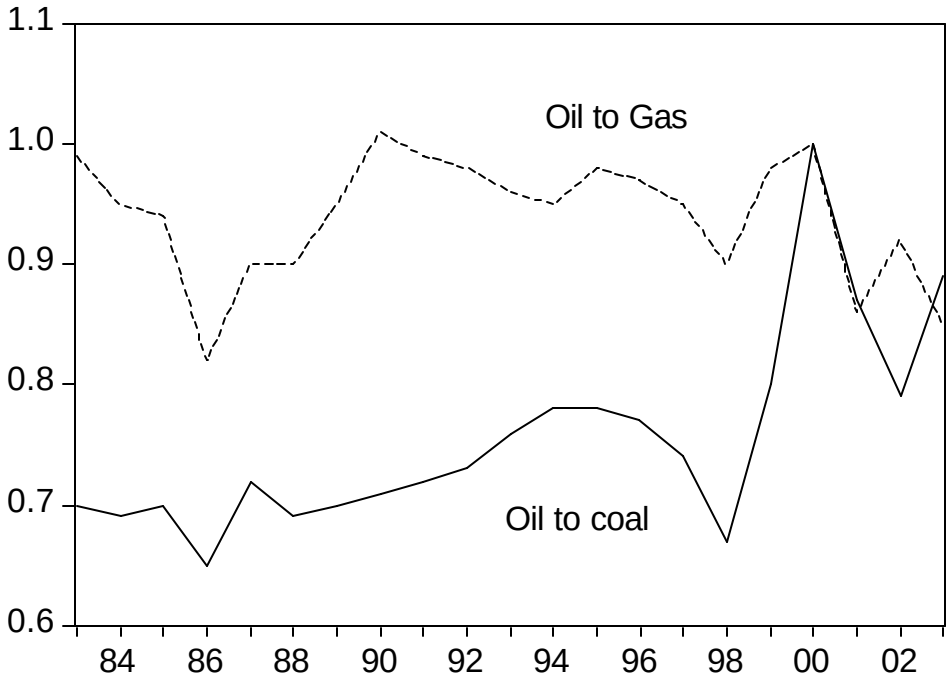
5.11 Policies to encourage production revolve round making the sector and country attractive to foreign investors, since the oil sector requires capital expenditure on a scale that is outside the reach of most low-income countries.

Oil Dependence of Energy Use

5.12 The reliance on oil as a source of primary energy (as opposed to gas, coal, hydro or renewables) in any economy is determined by a number of factors. Resource endowment is among the most important of these, since the availability of domestic supply can give a competitive advantage even if only through reduced transport costs. For oil, which must be refined before using it (for virtually all applications) the presence or absence of domestic refining capacity is important. If oil production has to be exported then there is no necessary reason to rely on imports of oil products, if other fuels are more attractive. Hence issues of relative fuel prices must also be seen as an important factor in determining fuel choice.

5.13 This immediately raises a very important issue in respect to the analysis of an oil price rise, in terms of the short and longer-term behavior of other fuel prices. If other fuels also are able to raise their prices to match those of oil, then little fuel switching can be expected, but if the other fuel markets are more competitive than oil, so that prices stay linked to costs, then other fuels will indeed gain a competitive advantage. Gas contract prices are often tied to oil market prices, so that internationally traded gas prices will often closely follow oil prices, allowing relatively little gain from fuel substitution in those markets where this is technically easy. Little systematic evidence over time of relative fuel prices is available, especially for developing countries, but the International Energy Agency does give, for the O.E.C.D. as a whole, indices of real energy prices for end users which can be used to check relative price movements, and for the period 1983 to 2003 the ratios of oil to coal and oil to gas prices are shown in figure 2.

Figure 2: Ratio of Oil to Coal and Oil to Gas Prices to End Users in the O.E.C.D.



5.14 The graph shows that, following the very sharp drop in oil prices in 1986, the oil to gas price ratio tended back to rough equality until the fall in 2003, which was reversed during 2004. Oil to coal prices showed an increasing trend over the period, apart from the periods of temporary falls in the oil price in 1986 and 1998. These graphs, that are for end user prices, and therefore also incorporate taxes which are substantial in certain O.E.C.D. countries, do suggest that gas prices are likely to move with oil prices, so that the scope for oil to gas substitution may be limited. Oil to coal substitution has been encouraged by the relative price movement, but environmental concerns and the limitation of coal to use for power stations and heat processes also restrict the degree of substitution possible.

5.15 The different sub-markets within an economy have different potentialities for interfuel switching. For example, the power sector market can switch from oil to gas or even coal with some incremental expenditure, but a switch to hydro would be considerably more expensive because of the large capital cost. Switching to renewables as a main source of power generation might also be costly, but smaller scale generation is clearly a potential market. In all cases the easiest form of substitution is in new plant, required to meet incremental demand, where the choice of the most economic fuel can be made without having to allow for the advantages of sunk costs of installed plant. This

suggests that more rapidly growing economies will find it easier to gradually shift the fuel mix than will rather static economies.

5.16 The transport sector accounts for a very large part of oil product demand, and in this sector there is little prospect for large-scale fuel substitution in developing countries without some financial support. Technologies that reduce the use of petroleum products over the full life cycle of vehicle use, such as ethanol-based engines, have hitherto required subsidies to farmers or to vehicles to make them financially viable. The rise in the oil price will clearly move the balance towards the point where such fuels may become viable without wide scale subsidies, but the volatility of oil prices will be a factor inhibiting free markets from adapting such solutions until they are more certain that the oil price will not fall back substantially.

5.17 However, as well as domestic resource availability, domestic pricing policies are also crucial in determining which fuels are preferred. The domestic demand for oil products depends to a substantial degree on domestic pricing issues – countries with controlled prices have often set these well below international prices (resulting in an explicit subsidy in oil importers and an implicit subsidy in oil exporters). Such a subsidy limits the government's ability to spend on other desirable and important developmental goals. At a time of rapidly increasing international oil product prices, governments are faced with a dilemma. Either they continue to control prices below import parity, in order to support consumers, thus increasing the drain on the treasury, or else they take the politically unpopular decision to let prices rise to reflect in part the increase in world prices. Since oil product prices are highly visible and affect large number of the population directly, many governments have been unwilling to let product prices increase sufficiently to keep the subsidy constant, let alone to increase enough to remove the subsidy. In effect, a short-term trade-off in favor of political expediency rather than economic development is being made. This feature makes it particularly difficult for policy responses at a time of rapidly rising prices. This results in a further distortion of the economy, with too little pressure for energy efficiency and oil substitution at a time when a medium term price rise requires such actions to be taken.

5.18 For oil exporters, who set domestic product prices below the import parity (even if they are actually importing products) the amount of the subsidy is less apparent, being balanced by the higher export prices. However this effectively is transferring the extra rent from the natural resource to a subset of consumers and industries, without an explicit income redistribution policy. For certain fuels, as explained below, this subsidy policy can be pro-poor (kerosene in particular is utilized by lower income households in many developing countries), but for other fuels (e.g. gasoline) the policy is pro-rich.

5.19 Data on gasoline and diesel prices are available on a country-by-country basis [10] for November 2004 based on a survey of 171 countries. This study calculates that at that time the cost of products, allowing for international crude prices, refinery costs,

[10] *International Fuel Prices 2005*, 4th Edition Data Preview: G. Metschies. Deutsche Gesellschaft für Zusammenarbeit GmbH. 2005.

local industry margins, oil company service fees, the local dealer margin and an average sales/VAT of 10-20 percent, should have produced an unsubsidized product price, excluding any excise tax component, of US 42 - 46¢ a liter for diesel and for gasoline. Variations in local transport costs and margins were not found to be large with respect to the oil price component. Countries can be ranked relative to these "breakeven" prices as in tables 5A and 5B, where those pricing at less than 37¢ a liter are shown, this being clearly in the range where government subsidies, either explicit or implicit, were required.

Table 5A: Countries Pricing Super Gasoline Below 37¢ a Liter at November 2004

Country	*Price per Liter*
Algeria	32
Egypt	28
Libya	9
Trinidad and Tobago	35
Venezuela	4
Bahrain	27
Brunei	32
Saudi Arabia	24
Yemen	21
Kuwait	24
Iran	9
Myanmar	12
Oman	31
Qatar	21
Yemen	19
Uzbekistan	35
U.A.E.	28
Turkmenistan	2
Iraq	3

5.20 Table 5A reveals that relatively few countries gave large subsidies for super gasoline, and almost all that did so were major oil producers, probably supplying crude to domestic refineries below world market prices with an implicit subsidy. The number giving really large subsidies, pricing below 20¢, was extremely small.

Table 5B: Countries Pricing Diesel Below 37¢ a Liter at November 2004

Country	*Price per Liter*	*Country*	*Price per Liter*
Egypt	10	Syrian Arab Rep.	13
Sudan	29	Jordan	19
Algeria	15	Kyrgyz Rep.	25
Angola	29	Azerbaijan	18
Libya	8	Tajikistan	24
Ecuador	27	Malaysia	22
Colombia	36	U.A.E.	28
Trinidad & Tobago	24	Qatar	16
Venezuela	2	Bahrain	19
Bangladesh	34	Saudi Arabia	10
Brunei	19	Yemen	9
Indonesia	18	Kuwait	24
Myanmar	10	Iran	2
Oman	26	Turkmenistan	1
Uzbekistan	35	Vietnam	32
Philippines	34	Iraq	1

5.21 Table 5B shows that a considerable number of countries were giving a substantial subsidy to diesel fuel at the end of 2004. The great majority of these were oil producers, but a few were entirely dependent on imports, and thus were faced with explicit subsidies. A larger number of countries may have been giving small subsidies. It is clear from these tables that governments did regard diesel as more important for social reasons and were prepared to sell it below world market price equivalent. Unfortunately, information of the same type does not exist for kerosene or LPG, both of which are important fuels for households.

5.22 A policy of absorbing the price increases to firms and households by increasing the level of fuel subsidies does not avoid the macroeconomic effects of the oil shock. The economy still needs to contract in order to offset the effect on the balance of payments, and indeed the failure to let domestic prices rise blocks off the adjustment that would gradually come from the short and medium term impacts of the price elasticity of demand for oil. The increasing government deficit itself is likely to be unsustainable and will eventually require some offsetting fiscal action.

5.23 Governments which have been trapped into controlling prices below world market prices do have an opportunity, if oil prices start to fall back, to adjust towards

import parity by not letting the domestic price fall by the same amount as the international price, while still being able to show consumers some price reduction.

5.24 Countries that have abolished subsidies, and use excise taxes on petroleum products as an important source of revenue, may be tempted to cut the tax rates as import product prices rise in order to soften the increase in final prices. However, this also reduces total tax take with its inevitable impact on other items of government spending. In effect, the government is partially substituting a reduction in government spending for a reduction in consumer spending as the method of bringing the economy into equilibrium.

5.25 For many countries that have very low incomes, especially those in Africa, the majority of non-oil energy supply comes from biomass (much of which is non-marketed). Pressures of higher oil prices inevitably will lead to substitution back towards this source of energy, which contributes to indoor air pollution, with its adverse health effects, and eventual deforestation. At the same time, the increasing deforestation is increasing the costs in time and or money of collecting firewood, so that this alternative fuel may be no more than a short-term solution. However, a long term and substantial rise in the price of petroleum products may give increased opportunities for new forms of commercial biomass based fuels to compete in a fully effective fashion, without themselves requiring subsidies to do so. The size of the long term price rise, versus the present competitive disadvantage of commercial biofuels, will determine the extent and speed with which this could happen.

5.26 The evolution of economic policy, both with respect to pricing and production (as in post soviet economies) as well as domestic resource endowment, determines the oil intensity of energy use. Variations between countries are likely to reflect these factors. Some countries are completely dependent on oil as a primary commercial fuel, while others (often major gas producers) may depend on oil for less than 20 percent of primary energy needs. A regression of oil dependence on GDP per capita was carried out in order to check whether there is any systematic variation observable that is related to the general income level of a country. Omitting both net oil exporters and post-soviet economies, leaving a sample of 68 countries, yielded a very small and barely significant squared correlation of 5 percent. The coefficient on GDP per capita was also very small indicating that each one thousand dollar increase in per capita income was associated with a decrease in the ratio of oil use to energy use (both measured in BTU) of only 0.005. This suggests that there is no strong tendency to decrease the level of oil dependence as energy use increases with the level of development, as revealed by a comparison between countries. However, detailed country studies may reveal different patterns, where those that have followed active policies to encourage oil switching may have been successful. The substantial variation in oil dependence between countries does give some reason to believe that active policies may be able to change the fuel mix although, as pointed out above, this may not reduce fuel costs greatly due to the tendency of parallel pricing between fuels.

5.27 A number of studies have analyzed the interfuel price elasticities, which measure the propensity to change fuel use as the price of one or other fuel changes.[11] Virtually all of these studies related to O.E.C.D. economies, and show that for the power and industrial sectors the long run cross price elasticities between oil and other fuels are only modest in scale [12]. A study for Asian developing countries [13] produced larger long run own price elasticities for petroleum products, but relatively small cross price elasticities between petroleum products and electricity. On balance the evidence suggests that at an economy wide level, a sustained rise in oil prices can be expected to lead to some fuel switching where other fuel prices remain constant, but this effect is again likely to be modest in scale and slow to occur.

Energy Efficiency

5.28 The most promising route for reducing vulnerability to oil shocks would appear to be to reducing aggregate energy intensity. This can happen by a number of routes, including shifting the output mix away from energy intensive industries in response to their increase in costs relative to other sectors, changing household consumption patterns away from activities which require large amounts of energy (e.g. using less transportation), and by various production activities becoming more energy efficient in response to the rise in input costs.

5.29 Table 2 illustrates that there are enormous difference in energy efficiency as measured by the ratio of energy use (in BTU) to GDP measured in US$US. Some of this is due to the historical paths of development where government policies have imposed non-market decisions on the production or consumption structure. Countries from the post-soviet bloc, even when not large primary energy producers, have enormously high energy intensity. For example, whereas O.E.C.D. countries are largely below 10,000 BTU per US$ of GDP, Ukraine is at 171,000 BTU per US$ of GDP, Armenia is at 79,000, Belarus is at 73,000, while China is at 35,000 and India is at 26,000. A regression of energy intensity for net oil importers on GDP per capita, excluding post soviet economies, yields a very small, but significant, squared correlation of 7 percent, where the negative regression coefficient indicates that for every dollar increase in per capita GDP, there is an average reduction of 0.28 BTU used per US$ of output between different countries. Again, growth alone does not appear to be enough to offer substantial reductions in the vulnerability to oil price rises.

5.30 Policies to encourage energy efficiency beyond that which currently exists mainly revolve round some form of financial incentive. This can take the form of the

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[11] A survey of this material is given in: *Measuring the Possibilities of Interfuel Substitution*. Robert Bacon. Policy Research Working Papers, WPS 1031, The World Bank. 1992.

[12] A very interesting recent study for China by Baiding Hu, (www.iemss.org/iemss2004/pdf/kyoto/huanan.pdf) estimates that the cross price elasticities between coal and other fuels in the industrial sectors were significant but relatively small.

[13] *Energy Demand in Asian Developing Countries*. M. Hashem Pesaran, Ron P. Smith and Takamasa Akiyama. Oxford Institute of Energy Studies. 1998.

market based disincentives to use so much energy caused by higher prices, or some financial reward from the government to avoid using so much energy, either by giving incentives to low energy intensity industries or subsidizing low energy using processes in existing industries. Evidence on the effectiveness of these types of policies is difficult to obtain, especially in developing countries because it requires information on firm behavior gathered over a number of years before and after the oil shock or incentive was imposed.

5.31 A general approach of using the market as the primary incentive avoids the problem of "picking the winners" – that is, of the government trying to identify which industries and processes merit support. In particular, sustainability is crucial in this context or else the government will find that it has embarked on a permanent program of subsidies that will exact costs to the economy similar to those that it is trying to avoid by encouraging the reduction in the use of oil.

5.32 The most attractive policies could be those which can be used to "kick start" some new industry or process that, once established, would be able to be self sustaining at the new energy prices and would not require permanent subsidy. This could be the case where there is an immediate economy of scale that requires a modest injection of capital to achieve a much lower cost per unit of production, or some barrier to adoption of the technology or process due to legal restrictions or information gaps. More detailed studies of successful policies to encourage increases in energy efficiency are needed to identify both the strategy utilized, as well as the sectors and processes to be encouraged.

6

Pathways by Which Higher Oil Prices Impact Households and the Poor

6.1 So far the discussion has focused on macro economic impacts, treating them as if they impacted all people within the economy equally. This is certainly not likely to be true. In order to make a detailed analysis of the impacts on households, three different effects need to be quantified:

(i) The impact of a lowering in the level of GDP and the rate of growth on different groups within the income distribution;

(ii) The direct effect of oil and oil product price increases on the cost of living of the different groups;

(iii) The indirect effect of oil prices on the prices of other goods, and their impact on the cost of living of the various groups.

6.2 The first effect is related to the debate on whether growth rates tend to be pro poor or not. To the extent that higher growth benefits the poorest households, then lower growth will certainly impact them negatively. In the longer term, oil importing countries are likely to reduce government spending and this route of improving the physical and social infrastructure for all households may be weakened. Conversely, oil-exporting countries will be more able to sustain higher social spending, which should affect all members of the society positively.

6.3 The second effect, that of the direct impact of oil product prices on households, depends on whether governments control such prices, and if they do, whether they decide to pass on all or only some of the rise in imported product prices (or set domestic refined prices at import parity). Where the government passes on less than the full price increase it has to bear the financial burden, and this will have macroeconomic consequences in terms of reduced expenditure on other items, which in itself may be anti-poor. Spending on the weakest groups in society is often the most easily reduced. Where prices are liberalized, or fully passed on, then some petroleum products (notably gasoline, LPG and kerosene) are purchased directly by households so that product price rises will be felt very soon after a rise in the world crude price. The extent to which such effects affect different income groups depends on their relative importance in household budgets.

Evidence on this can be found from those countries that have sufficiently detailed household expenditure surveys to give not only total spending on energy, but also total spending by fuel.

6.4 The third effect, that of induced (indirect) effects of oil product price increases, is the most difficult to calculate. It requires the availability of both an input output table and a household expenditure survey, and some method of linking the categories in these two sources of information. For example, in many developing countries, much of the purchase of diesel is by firms (including taxis, buses etc.) rather than households. These then sell their services or products to households. Transport services also illustrate effects at two or more steps removed. Transport costs are themselves an important item in total food costs, and so the rise in the diesel price also makes itself felt in the food price index, and hence is felt by households at two steps removed from the original impact. By knowing the contribution of diesel costs to transport costs, of transport costs to food costs, and then of the share of food costs in the total household budget, a total picture for the impact of oil product price increases via this chain can be quantified. Where the original shock is small these indirect effects may be negligible, but certainly for large changes, such as those now occurring, they should also be taken into account. This type of effect needs to be calculated for each fuel and each final product in order to calculate the aggregate impact of the price shock on household expenditure. Evidence on the shares of inputs into outputs requires an input output table, which is available for only a few developing countries, while expenditure surveys detailed by fuel use also are available for only a few countries. Not surprisingly, little detailed work on this type of price shock on household welfare has been quantified.

The Effect of Reduced GDP on the Poor

6.5 Substantial work has taken place on the impacts of changes in the growth rate of economies on the number of poor households. Empirical work [14] has established a negative relationship between the growth elasticity of poverty and a country's Gini coefficient. To apply this on a country-by-country basis requires individual measures of the inequality of income distribution, which are in many cases not available. A cautious estimate suggests that the average elasticity of the 'dollar a day" poverty rate to the growth rate is around -1.5. This suggests that the impact on poverty will be around 50 percent higher than the growth rate alone effect indicates. However, the "growth shock" of an oil price rise does not create a permanent lowering of the growth rate, but rather a temporary large negative (for oil importers) shock which is then gradually succeeded by growth rates tending back towards the underlying long run rate of growth (leaving the economy at a lower level of output than would have been the case without the shock). The impact of such temporary growth shocks (as opposed to income shocks) on the different groups within society is less clear, and needs separate analysis.

[14] *Pro-poor Growth*. M. Ravallion. World Bank Policy Research Working Paper, 3242. 2004.

6.6 This loss of welfare comes primarily from the loss of output and employment in the economy caused by the reduction in aggregate demand made necessary by the oil price rise. In addition, households feel the effects of changes in consumer prices, which further contributes to their loss of welfare.

Direct and Indirect Impacts of Oil Price Increases on Low-Income Households: Survey Evidence

6.7 To estimate the full impacts on household expenditure for various income groups of a large change in oil prices, a number of pieces of information are needed. Firstly, calculations of the price rise for all final goods purchased by households need to be calculated, based on the oil price rise. Secondly, the shares of household expenditures on each of these final goods need to be established for several different income classes. Combining these two pieces of information gives a first estimate of the increased cost of purchasing the identical bundles of goods before and after the oil price rise. Thirdly, if own and cross price elasticities are available from a complete system of demand equations, some adjustment to household purchases for the different prices can be made and a revised estimate of the increment in the cost of living obtained.

6.8 A number of studies have traced the effects of a set of large energy price rises through an input output table to final consumer prices and hence on to changes in household expenditure. Because for the countries involved there were no systems of demand equations and price elasticities available, the approach assumes that there is no quantity response to higher final prices. The calculated increase total household expenditure, which is equivalent to a fall in consumer welfare proportionate to the percentage rise in the cost of living (effectively assuming zero own price elasticity), is an overstatement of the actual welfare loss to households.

6.9 The report reviews three fairly recent studies which have made estimates of both the direct effect of price increases (through the share of petroleum product prices in the budget) and indirect price increases of goods whose cost of production and hence whose final price have been affected by petroleum product price increases.

Pakistan

6.10 A study for Pakistan [15] investigated a scenario in which the average price of gasoline and diesel was increased by 33 percent, while the prices of other petroleum products remained constant. The impacts came through changes in the cost of transportation, both direct and indirect, and are shown in table 6.

[15] *Pakistan: Clean Fuels*. ESMAP report 246/01.

Table 6: Estimated Percentage Changes in Household Expenditure for Quartile Groups in Pakistan as a Result of an Average Transport Fuel Cost Increase of 33%

	Urban	*Rural*
Quartile 1	1.9	1.9
Quartile 2	1.8	1.7
Quartile 3	1.7	1.5
Quartile 4	1.2	1.0

6.11 This table shows that even for transport fuels, where the poorest households certainly do not own their own vehicle, the impact of the fuel price increase is, in percentage terms, most burdensome for the poorest quartiles. This is most marked for the rural households, whose total household expenditure for each quartile is around 25 percent lower than for the corresponding urban quartile. These results are for cash expenditures, so although non market activities may add to the welfare of rural households, and so reduce the proportionate welfare loss to some extent, the relative impact on cash expenditures will remain unchanged, with the poorest group of household being proportionately affected almost twice as much as the highest quartile group. Given that the actual price increase analyzed was 33 percent, and it excluded changes in prices for both kerosene and LPG, it is clear that the total effects of current product price increases would be several times greater.

Iran

6.12 A study for Iran [16] analyzed the impact of bringing all energy prices to import parity. Since different domestically produced oil products received implicit subsidies of different amounts, this meant that the price increases were of different percentages for the various products. In addition, electricity prices were also adjusted to import parity (reflecting the increase in input costs that would be felt). This set of price increases was equivalent to a 308 percent rise in the average energy price (electricity needed a 200 percent increase, kerosene and diesel 606 percent, and gasoline 183 percent). The individual effects were fed through an input output table and then into household expenditure data to give estimates of the increase in the total cost of living, excluding any inter commodity substitution, as shown in table 7.

[16] *Iran: Medium Term Framework for Transition. Converting Oil Wealth to Development*. World Bank Report 25848-IRN, 2003.

Table 7: Estimated Percentage Changes in Household Expenditure for Quintile Groups in Iran as a Result of an Average Energy Price Increase of 308%

	Urban	*Rural*
Quintile 1	33.0	47.6
Quintile 2	33.8	45.2
Quintile 3	31.2	42.8
Quintile 4	30.6	40.6
Quintile 5	25.2	29.6

6.13 The impact of the enormous price rises contemplated is in line with those calculated for Pakistan. Firstly, the size of the increase is about 10 times larger and secondly, the coverage is across all fuels including electricity, which could well double the importance of the effect. The lessons are again clear – in overall terms poorer households would be much harder hit than better off households, especially in rural areas. Iran is a country where the deep subsidies on fuels have encouraged high use, and the availability of biomass is limited, so that the amount of non-cash use of biomass is rather small.

Yemen

6.14 A recent study for Yemen,[17] although not based on an input output table (since none was available) was able to calculate direct and some indirect impacts of potential fuel price increases on household expenditures. The study considered the impact of increasing petroleum product (diesel, kerosene and LPG) prices, designed to bring domestic prices to import parity. Data was not separated into urban and rural households. The suggested price increases are shown in table 8, and the impacts on total household expenditure (allowing for no inter commodity substitution) for the decile groups are shown in table 9. Indirect impacts of the diesel price increase on food and water prices and expenditures were calculated using some simplifying assumptions.

Table 8: Petroleum Product Prices in Yemen (2003 prices)

	LPG	*Gasoline*	*Kerosene*	*Diesel*	*Fuel Oil*
Economic Price (YR/liter)	31.8	41.6	40.3	39.8	32.8
Actual Price	10.2	35.0	16.0	17.0	31.0
% increase	211	19	152	134	6

[17] *Household Energy Supply and Use in Yemen*. ESMAP report, December 2004.

6.15 Table 7 shows that the price increases required in 2003 to bring actual prices to border prices would be very large for kerosene, LPG and diesel. The price distortions for gasoline and fuel oil are small and hence were ignored in the evaluation of the price increases on household welfare.

Table 9: Estimated Percentage Changes in Household Expenditure for Decile Groups in Yemen as a Result of an Average Fuel Cost Increase of 62%

	Kerosene	*LPG*	*Direct Diesel*	*Indirect Diesel*	*Total*
Decile 1	2.4	6.5	0.4	5.1	14.4
Decile 2	1.3	4.8	0.1	4.9	11.1
Decile 3	1.0	5.1	0.8	4.6	11.5
Decile 4	0.9	4.3	0.8	4.4	10.4
Decile 5	0.6	4.8	1.0	4.7	11.1
Decile 6	0.5	4.2	0.4	4.7	9.8
Decile 7	0.5	4.1	1.3	4.3	10.2
Decile 8	0.5	3.5	1.4	4.3	9.7
Decile 9	0.2	3.1	1.3	3.9	8.5
Decile 10	0.1	2.0	1.6	3.4	7.1

6.16 The basic household survey showed that for the poorest decile LPG accounted for 3.8 percent, kerosene for 4.4 percent, and diesel for 0.2 percent of total expenditure, while for the highest decile LPG accounted for 1.2 percent, kerosene for 0.3 percent, and diesel for 1.9 percent. This pattern of fuel expenditures ensures that the impact of the fuel price rises would again strongly be regressive, with the lowest decile being impacted by a factor twice that of the highest expenditure decile. Expenditures on kerosene and LPG are strongly regressive, while the direct impacts of the diesel price increase are progressive (the high income households use diesel for agriculture and self generation). The indirect effects, which exclude any allowance for costs of transportation itself, are shown also to be regressive because of the assumed impact on food prices, linked to the transportation of food, which is a dominant expenditure for the lowest income group. Importantly, the indirect effects of the diesel price increases, because they affect so many other commodities purchased by households, are large than the direct effects. The overall proportional impact appears to be commensurate with that calculated for Iran, where the energy price increases were double those of Yemen, and spread over a wider base, including power. The effects are roughly equal to a US$15 a barrel oil price increase overall, but are probably more weighted against poorer households because of the large increases for kerosene and diesel.

6.17 For other countries such detailed calculations are not available. However, evidence on expenditure shares on different fuels by income group is available for a number of countries, and this is useful when considering an across the board rise in oil product prices.[18] The most detailed study gives quintile data for six countries with rural and urban split, and these are shown in tables 10A and 10B.

Table 10A: Shares of Kerosene Expenditure in Total Household Expenditure for Quintile Groups in Several Countries

	South Africa	*Vietnam*	*Guatemala*	*Ghana*	*Nepal*	*India*
Urban						
Q1	4.17	0.54	0.31	1.62	2.36	1.90
Q2	2.12	0.73	0.03	1.15	1.80	1.98
Q3	1.29	0.81	0.04	0.77	2.12	1.75
Q4	0.64	0.72	0.00	0.62	1.78	1.43
Q5	0.11	0.35	0.00	0.42	0.76	0.75
Rural						
Q1	3.58	0.70	0.78	3.23	1.07	1.23
Q2	2.90	0.50	0.57	2.38	1.06	1.16
Q3	2.56	0.49	0.40	1.90	1.06	1.12
Q4	2.51	0.35	0.32	1.70	0.96	1.10
Q5	1.38	0.35	0.20	1.28	0.97	0.99

6.18 The data in table 10A shows that kerosene is used most intensively by lower income households – the share of expenditure consistently declines as income rises. This is true for both rural and urban households. The intensity of use as between rural and urban households differs by country – in some it is more important for rural households, while for others it is more important for urban households. The lowest quintiles show shares of expenditure that can be as high as 3 or 4 percent of total household expenditure. A 50 percent rise in kerosene prices alone is then equivalent to a loss of welfare of up to 2 percent of household expenditure for the poorest households, while for the highest expenditure groups the loss of welfare is of the order of magnitude of 0.5 percent.

[18] *Household Energy Use in Developing Countries: A Multicountry Study*. ESMAP Technical Paper 042, 2003.

Table 10B: Shares of LPG Expenditure in Total Household Expenditure for Quintile Groups in Several Countries

	Brazil	*South Africa*	*Vietnam*	*Guatemala*	*Ghana*	*Nepal*	*India*
Urban							
Q1	2.85	0.50	0.06	1.27	0.00	0.00	0.50
Q2	1.20	0.44	0.16	2.32	0.02	0.00	1.22
Q3	0.80	0.29	0.30	2.31	0.13	0.07	1.89
Q4	0.51	0.14	0.76	2.12	0.17	0.23	2.20
Q5	0.25	0.04	1.06	1.45	0.15	0.72	1.90
Rural							
Q1	1.96	0.05	0.04	0.05	0.00	0.01	0.01
Q2	1.07	0.14	0.03	0.12	0.00	0.00	0.04
Q3	1.21	0.22	0.04	0.41	0.01	0.00	0.09
Q4	1.06	0.33	0.04	0.62	0.01	0.00	0.21
Q5	0.79	0.35	0.12	1.33	0.03	0.04	0.67

6.19 The pattern of expenditure on LPG is somewhat different from that on kerosene. In some countries it is of very little importance except for the highest expenditure groups, but for certain countries such as Brazil it is used by all expenditure groups. In Brazil the welfare loss of a 50 percent rise could range between 1 percent for the poorest groups, and under 0.5 percent for the highest income groups. In some countries LPG is clearly a progressive expenditure, where the share rises with income group.

6.20 Drawing the evidence together of the impact effect of a decline in GDP, and the increase in the cost of living with a differential impact for poorer households, it is clear that an increase of about US$10 dollar a barrel (40 percent) would have a substantial but not overwhelming negative impact on poor households in most poor countries. In a few countries where there is unusually high oil import dependence, the effects could be serious. If the price increase remains of the order of US$20 a barrel (80 percent) then in many countries the impacts will be serious and the impacts on the poor, where the fraction of household expenditure on petroleum products is relatively high (primarily kerosene) could be severe.

7

Issues of Knowledge and Policy Responses to Higher Oil Prices

7.1 Although the duration and magnitude of the increase in world oil prices is not yet clear, there is certainly enough evidence to raise concerns about their impact on the poor throughout the developing world. Even if the extremes of this recent episode turn out to be short lived, and long term oil prices settle in the mid US$30 a barrel range, there will be substantial impacts immediately, and the episode will also illustrate the vulnerability of certain economies and groups within societies to possible future price shocks. A more permanent shock of US$20 a barrel, with oil prices settling in the mid US$40 range will have more severe effects and will demand a greater policy response, both for economies overall and also to support the groups most impacted by the change.

7.2 A series of broad policy questions arise from this brief overview, which suggest areas that need investigation and possible support for policy intervention:

- Which countries are most at risk from an oil price shock, and what are the indicators of this vulnerability?
- What macro economic policies can be adopted to offset or mitigate the impacts of higher oil prices on output and the balance of payments?
- How can countries reduce their energy intensity, without lowering their growth potential or damaging infrastructure needed to support development goals?
- How can countries reduce their oil dependence relative to their use of energy, and is this likely to be cost effective?
- How can countries utilizing price subsidies for oil products handle the fiscal implications of the higher oil prices? For countries that rely heavily on excise taxes on oil products, should the tax regime be adjusted to smooth out the effect on consumers of higher world oil prices?
- For countries where there is potential for domestic oil production, what can be done to speed up its development while not opening the economy

to the "resource curse" syndrome that has been observed in certain oil producing states?

7.3 Around these major questions a number of issues have been raised in the paper, which point to the need for more systematic analysis and information collection.

a) Forecasting the oil price level and its volatility

Because the implications of a short run "spike" in oil prices (such as occurred in the early 1990s) are very different from a sustained oil price rise, more attention needs to be paid to quantifying the "permanent" and "transitory" components of oil prices. This would require forecasts to be prepared, not only for long term prices as happens at present, but also more attention to be given to the likely range of prices to be experienced. Although Bank projects focus on long run prices, macroeconomic policies need to be linked to assessments of the vulnerability of economies to oil price changes (perhaps in a high, medium, low categorization) as well as the chances of experiencing substantial increases or decreases over the short to medium term. Most of this work is done by commercially based specialists in the international oil markets, but internal emphasis could be placed on the risk elements of price forecasts.

b) Quantifying the link between international oil prices and exchange rates

Changes in the dollar/euro and dollar/Yen rates over the recent past have been well documented, but the extent to which exchange rates in developing countries have changed versus the dollar is less well publicized. Some developing countries may have experienced much smaller impacts of the recent oil price rise than appears apparent, because of the movement of their own exchange rate against the dollar. Some evaluation of the importance of this effect at times of large oil price rises should be available on a systematic basis, in order to highlight a second dimension of vulnerability to oil price shocks.

c) The size and use of foreign exchange reserves

It was noted that countries with substantial foreign exchange reserves would be in a better position to withstand the first impacts of sharp increases in international oil prices. To the extent that the price increase is subsequently moderated, and that the economy itself can start to adjust structurally to the price increase, the first few months following the price rise may be the most difficult to weather for the government. The size of reserves relative to the net imports of oil is an index of the ability to finance the increased costs without domestic deflation. Foreign aid grants to offset the oil price shocks can act as a temporary increase in reserves. This variable also needs to be quantified in a systematic fashion, and added to the list of indicators for the vulnerability of different economies to oil price shocks.

d) Hedging against future oil price increases

Oil producing countries, often through the agency of the national oil company, have considered or even used hedging price techniques to offset the impacts of sharp changes in the international oil price. Such techniques are less well known in net importing

countries, especially where there is no institution that has expertise in understanding the operations of the international oil market. Furthermore, the possibilities of hedging against more than the initial onset of a price rise may be limited. More detailed analysis is needed before hedging techniques can be recommended to developing countries, and the possible costs and benefits need to be quantified.

e) Management of incremental government oil revenues

For net oil exporters a large increase in oil prices may be associated with large increases in government revenue, some of which may turn out to be short lived, depending on the permanence of the oil shock. Fiscal systems, including oil funds, have been designed to deal with variations in revenue, but the funds are largely of very recent implementation, and there is very little evidence on how governments have recently coped with the large and unexpected oil flows. The design and experience of savings and stabilization funds, including those being currently proposed, should be reviewed in the light of the possibility of continuing large shocks in the oil market.

f) Prediction of oil related fiscal flows

For oil producing countries the prediction of fiscal flows from oil revenues can be extremely important, as well as difficult. Integrating the complexities of the contract, oil production, oil quality and oil prices, to give a reasonable tool for forecasting oil revenues is important. Models to do this are commercially available, but the Bank needs to be able to keep a constant surveillance of this issue in order to be able to provide timely advice when the situation undergoes some unexpected change. Integrating the various ad hoc approaches to this found around the Bank within its various units is important, as would be working to support governments that presently have no capacity for oil revenue forecasting.

g) The relation between the ratio of net oil imports to GDP and the level of GDP per capita

The key variable for assessing the extent of a country's vulnerability to oil price shocks is the ratio of net oil imports to GDP. There is cross section evidence that this tends to decline slightly with the level of economic development. However, there appears to be no country specific evidence which traces out how this has changed over time and, for countries where changes did occur, what the driving forces were. A study to investigate these factors could form a valuable basis for determining what sort of long run policies may be effective in reducing vulnerability to oil price shocks.

h) Economywide price elasticities of oil demand

In assessing the vulnerability of developing countries to oil price shocks one important, but largely unknown, factor is the price elasticity of oil demand. If the medium term elasticities are substantial, then policies need to focus on short run management of the impacts of the shock, since the market will make much of the medium term adjustment through the operation of the price elasticity. If price elasticities are low then more reliance will have to be placed on policies explicitly designed to alter the vulnerability.

Gathering information of this topic for developing countries should be a simple task, and undertaken before any more substantive study is launched.

i) Prospects for changes in oil self sufficiency

The most dramatic change in country's vulnerability to oil shocks comes from developing new oil production. Prospects for future developments should feature in a list of indicators of vulnerability. Information on supply developments, especially in lower income countries, could be assembled on a more routine basis as an aid to work in that group of countries that have prospects of changing production levels. This would also serve to indicate whether this is a very small group or whether the recent trends in the oil market will continue to expand the range of countries where oil production is expected to commence.

j) Policies to encourage incremental oil production

For some countries, where geology is favorable, there will be opportunities to increase or commence oil production following further exploration and development. Policies to ensure transparent, fair and sustainable development of the sector are required in order to avoid unsatisfactory outcomes that are likely to occur without adequate safeguards. The Extractive Industries Review proposes actions to support these sorts of developments, including Technical Assistance for drafting laws and regulations, creating or restructuring a hydrocarbons ministry, advice on the desirability and natural of any national oil company, and actions to ensure revenue transparency through adherence to the principles of the Extractive Industries Transparency Initiative.

k) The behavior of relative fuel prices in developing countries

Analysis of oil sector specific policies to combat the impact of higher oil prices largely supposes that substitution to alternative fuels can be stimulated by well designed policies. However, if other fuel prices also increase pari passu with oil prices, these policies may be ineffective. There is very little evidence available on competing fuel price movements for economies where there is substantial use of more than one primary fuel and where substantial substitution may be an option. Evidence should be sought on developing economies where a mixture of primary fuels is utilized to see how prices have evolved over time and, in particular, whether large oil price changes have been rapidly matched by changes in the prices of competing fuels.

l) Opportunities for fuel switching

One of the most promising areas for reducing the vulnerability of economies to oil price shocks is that of encouraging fuel switching. Although the market may encourage this, there may be non-market barriers that governments could remove or reduce. Statistical evidence suggests that there is no association between oil dependence and GDP per capita, but more detailed country-by-country analysis may indicate that some countries have systematically been able to shift the fuel mix over time. The identification of such economies, the extent to which they have been able to shift the fuel mix, especially following earlier oil shocks, and the drivers which led to this, could form a valuable

starting point for identifying policies and industrial/household uses that are amenable to fuel switching. The existing fuel mix is in itself an indicator of vulnerability because the economies that are most diversified in fuel choice are likely to be those where some fuel substitution is possible.

m) The relation between the use of biomass and oil prices

In many of the poorest developing countries biomass is a fuel widely used by low-income households, and kerosene is the commercial fuel most likely to be in competition with non-marketed biomass. One area of considerable interest is the extent to which switching from biomass to kerosene, which has been observed recently, is being reversed under the pressure of higher oil prices. If there is substantial reversibility in this market, governments may wish to consider how to counter it through targeted subsidies or other means, and whether these policies can be made cost effective. Experience in a number of countries has suggested that subsidizing kerosene, or LPG, is rather ineffective as a method of encouraging fuel switching, or protecting poor households against the impacts of higher fuel prices. A wider range of experience could be sought following the recent experience with substantially higher prices in those countries that have not fixed the price.

n) Opportunities for commercial uses of biomass

There are a number of applications of commercial biomass that have been advocated as being alternatives to oil and hence more sustainable. Most applications so far have required some form of direct or indirect subsidy to become viable, but the sharp rise in oil prices may change the relative attractiveness of certain applications. It is very important that thorough and detailed studies of such possibilities are carried out, in order to be able to advise governments of possible new applications that would be viable without long term subsidy and, if there are such projects, to formulate a program for introducing them in an effective manner. The breakeven point for oil prices is extremely important in this area, both in terms of knowing what the potential for substitution may be, and for relating forecasts of the oil price to possible new developments.

o) Opportunities for changing energy efficiency

The second main area where there would seem to be substantial long term potential for decreasing vulnerability to oil price shocks is that of increased energy efficiency. Although the market might be expected to be the major driver behind the movement towards greater energy efficiency, it is striking that there is little correlation between energy efficiency and the level of GDP per capita. More work needs to be done in order to establish whether individual countries experience cycles of energy efficiency – first falling as demand shifts to basic but energy intensive necessities, and then rising as the pattern of demand shifts to other goods, and cost saving becomes important. Changes in energy efficiency following earlier oil shocks in developed countries suggest that there are large possibilities to be exploited, so that policies to encourage this, beyond the market itself, are needed.

p) The political economy of removing petroleum product subsidies

One of the most important policies for allowing the market to act to reduce the vulnerability of the economy to oil price shocks is to allow internal prices to fully reflect world market prices. The political economy of increasing product prices requires study, since the involvement of various interest groups, often not the poorest members of society, is a major barrier to implementing this more rational policy. Case studies of different attempts to adjust prices may be able to shed light on which approach may be successful in this regard.

q) Evidence on household choice of fuels and susceptibility to oil price increases

At present there is rather little evidence on the actual impact of oil price rises on the cost of living for the different income groups within countries. Ex post household surveys may soon be available in some countries to provide a before and after picture which would be a valuable complement to the theoretical simulations so far carried out. In addition, studies have not coupled a fully integrated set of demand equations, including own and cross price elasticities, with information from input output tables that allows an oil price increase to be translated into a set of commodity price increases. Although such an exercise might at present be able to be carried out for only one or two economies where there is a particularly rich set of data, this is an area where even one complete study would be valuable, both from the factual and methodological point of view.

7.4 The set of issues and suggestions raised above are built around two big themes. Firstly, there is a need to assess the vulnerability of different economies to large oil shocks by using a series of indicators. Once the degree of vulnerability is assessed, it then follows that for highly vulnerable economies priority should be given to the various policies that can reduce this vulnerability. Investigation of a number of the issues raised above will indicate where policies have been used and that have been successful.

7.5 This listing of areas of knowledge and information required in order to make more detailed assessments of where action may be most needed and what sort of actions should be pursued, also indicates that there is no single set of policies which can be put forward in a "cookie cutter" approach. The specifics of any single economy will be crucial for determining where to focus policy and indeed for which information needs to be collected before designing a specific policy package. Nevertheless, policies can be grouped around the main headings already identified.

A. Policies to mitigate the initial impact of an oil shock

These policies can be grouped into external responses and internal responses.

- External responses include aid from donors and development agencies, and are likely to take the form of short term concessionary or grant financing to support the balance of payments. The agencies are likely to rank countries according to the severity of the shock on the various countries and their needs. These policies can deal with the impacts of the current shock if there is sufficient agreement by the external bodies. The

various indices of vulnerability outlined in the paper indicate the various criteria that might be relevant in this context. Policies in this context are already mainstreamed by the various international agencies, but a more systematic categorization of vulnerability and how it is evolving could be developed.

- Internal responses to lessen the impact of oil price rises are more likely to be suitable to be aimed at future oil shocks. Any policy that reduces the relative size of the net oil import bill relative to GDP will lessen the impact of any future shock, and supplementary policies, such as hedging against future oil price increases, may be able to offer some short-term relief. Policies to increase currency reserves relative to GDP will also provide more flexibility to meet the immediate impacts of any future oil shock.

B. Policies to encourage self-sufficiency in oil production

At times of high oil prices and perceived limitations on oil supply outside of certain OPEC countries, the market will be the driving force for new exploration and development. Nevertheless there is still competition between the various new suppliers of oil for international finance, especially from the most respected oil companies, and policies to increase the attractiveness of development are important. Advice and Technical Assistance on laws, regulations, and contract negotiations have regularly been provided by international development agencies, but recently the emphasis on increased transparency in all aspects of the oil sector, and better management of oil revenues has given a new agenda to the policy dialogue.

- Transparency of oil revenues and the oil sector has been widely identified as a necessary (but not sufficient) condition for creating a better business climate, for allowing better planning of the use of a country's oil wealth, and for increasing the knowledge and participation of civil society (including parliament) in the development of the economy that in turn can help to promote better use of the resource revenues. The Extractive Industries Transparency Initiative has launched a global campaign to provide guidance and assistance to countries willing to adopt transparent procedures in the oil sector. Mainstreaming this into the World Bank's agenda has already started (as it has also with the International Monetary Fund) and further support for this over the next two years, which is the period planned to generate pilot country experience that will serve as a template and encouragement to other countries, could be extremely effective. Moreover, although there are only a small number of new producing countries at any one time, a substantial number of existing oil/gas producers are situated in the developing world so that the EITI is expected eventually to benefit a wide range of countries.

- Oil funds and oil revenue management schemes are becoming a regular feature of the international agencies' work with oil producing economies (also for economies highly dependent on other non-renewable resources). Further support for this agenda, through comparative studies of experience, documentation, and advice on drafting the appropriate laws and regulations, will be required.

C. Policies to reduce oil dependence

Reducing oil dependence is likely to be simplest where the country already is using a substantial amount of other fuels so that switching supply sources would avoid some of the set up costs. The strongest force encouraging sustainable fuel switching is likely to be the market itself, where larger price differentials between fuels are established. However, there may be barriers to switching in terms of large initial costs, or lack of information. Both of these areas are suitable for policy intervention, but require detailed country specific information on the sectors (outside of transport) where oil is being currently used. Renewables are an important subset of such substitution possibilities, particularly for power generation at various scales.

D. Policies to reduce energy intensity

In order to add to what market incentives would bring towards reducing energy intensity, sectoral uses of energy need to be identified, in order to highlight those where the greatest opportunities for increasing efficiency can be found. Comparative data and practices in more efficient countries could provide benchmarks against which targets could be set, and policies derived. In addition, sectoral shifts are also likely to come about as economies gradually move away from highly energy and oil intensive sectors, under the pressure of raised costs. Policies to reinforce the market signals are again likely to include help for set-up costs and information provision.

E. Policies to protect the poor from the impact of higher oil prices

Many governments already have policies in place to protect households against high oil prices. These policies are usually in the form of explicit or implicit subsidies through setting product prices below import price parity. Evidence suggests that gasoline is the least often heavily subsidized, which can be justified on the grounds that gasoline is rarely consumed directly by lower income households. By contrast, diesel is often subsidized, even through it is not purchased directly by lower income households, because of its importance as an input into goods and services (especially transport) which are purchased by the poor. Subsidies to diesel and kerosene are subject to large leakages, since much is also consumed by less poor households, which adds enormously to the budget costs to the government. Various schemes for targeting the subsidies have been tried (including vouchers and coupons) but there is little evidence to show that these have worked well. The alternative to direct subsidies on fuels, where the impacts of higher oil prices on the poor are really substantial, is to consider general income subsidies that may be able to be targeted more effectively in certain circumstances. Since subsidy policies can be very costly, and difficult to reverse once started, attention should be given to

making a full evaluation of the impact of the higher product prices and the possibilities of all alternatives before embarking on an economy wide scheme of support.

Annex 1

Table 2. Data on Energy, Oil and GDP

	Impact on GDP of a 10 increase in oil prices - % change	*Population: millions*	*GDP US$: 1999-2001*	*GDP per capita*	*Oil consumption 000b/d 2001*	*Oil production 000b/d 2001*	*Oil vulnerability*	*Petroleum consumption in BTU quadrillion 2002*	*Energy consumption in BTU quadrillion 2002*	*Oil dependency*	*Energy intensity BTU per 1995 US$US of GDP*	*Net oil exports as % of GDP*
Congo, Dem. Rep.	0.2	51.03	4632.0	91	9.5	24	-1.53	0.021	0.082	0.256	17142	0.5
Nigeria	17.8	126.8	41618.0	328	305.7	2261.4	-6.40	0.632	0.939	0.673	8517	41.9
Sudan	3.6	31.44	12185.5	388	56	210.8	-2.76	0.136	0.149	0.913	11524	8.6
Vietnam	3.2	78.41	30847.1	393	178.6	356.8	-1.00	0.384	0.87	0.441	26215	7.5
Yemen	13.9	17.48	8808.3	504	75.5	437.6	-4.80	0.15	0.15	1.000	41961	32.8
Cameroon	3.5	15.11	8885.7	588	22.5	76.9	-2.42	0.047	0.082	0.573	6771	8.1
Azerbaijan	11.6	8.03	5187.2	646	119.9	308.9	-1.58	0.245	0.605	0.405	145871	27.4
Angola	29.5	12.42	8139.8	655	43	741.9	-16.25	0.093	0.127	0.732	15911	69.5
Indonesia	0.3	206.21	143817.2	697	1077	1434	-0.33	2.252	4.452	0.506	20331	0.6
Congo, Rep.	26.0	3.01	2787.1	926	5.6	254.7	-44.48	0.013	0.017	0.765	6830	61.1
Syrian Arab Republic	9.5	16.17	17653.2	1092	253.7	518.1	-1.04	0.553	0.857	0.645	20965	22.4
Kazakhstan	7.1	15.04	19105.2	1270	224.6	816.1	-2.63	0.351	2.087	0.168	87158	16.7
Ecuador	5.9	12.41	17882.5	1441	142	418.7	-1.95	0.287	0.365	0.786	18566	13.9
Egypt, Arab Rep.	0.7	63.95	95664.0	1496	564.7	806.5	-0.43	1.177	2.349	0.501	27441	1.7
Iran, Islamic Rep.	8.0	63.45	106069.9	1672	1330.3	3800	-1.86	2.791	5.862	0.476	41123	18.8
Algeria	8.0	30.38	51967.2	1711	217.9	1559	-6.15	0.452	1.285	0.352	23290	18.9
Russian Federation	5.3	145.27	254072.3	1749	2737	7160	-1.62	5.306	27.536	0.193	72162	12.5
Colombia	2.1	42.29	83927.1	1985	283.2	647.2	-1.29	0.532	1.213	0.439	12178	5
Equatorial Guinea	36.1	0.46	1305.2	2837	1.1	181.4	-163.91	0.003	0.05	0.060	41417	85
Gabon	20.6	1.26	4539.2	3603	12.5	269.8	-20.58	0.026	0.038	0.684	8237	48.5
Malaysia	1.0	23.24	85761.8	3690	490.1	751.1	-0.53	1.035	2.328	0.445	20897	2.4
Venezuela	7.8	24.17	116922.1	4837	564.5	3334	-4.91	1.03	2.905	0.355	38876	18.3
Mexico	0.8	97.95	561582.6	5733	1990	3600	-0.81	4.341	6.625	0.655	17646	1.8
Trinidad and Tobago	5.0	1.29	8062.6	6250	29	124.2	-3.28	0.059	0.502	0.118	70173	11.8
Argentina	0.5	36.71	278807.8	7595	474.4	876.1	-0.85	0.864	2.464	0.351	9875	1.2
Oman	17.0	2.41	18507.2	7679	56.7	915.5	-15.15	0.119	0.36	0.331	20233	40
Saudi Arabia	14.1	20.63	177707.3	8614	1442	8906	-5.18	3.048	5.144	0.593	35346	33.3
Bahrain	12.1	0.66	7509.0	11377	35.7	49.3	-0.38	0.075	0.417	0.180	54788	28.5

	Impact on GDP of a 10 increase in oil prices - % change	Population: millions	GDP US$: 1999-2001	GDP per capita	Oil consumption 000b/d 2001	Oil production 000b/d 2001	Oil vulnerability	Petroleum consumption in BTU quadrillion 2002	Energy consumption in BTU quadrillion 2002	Oil dependency	Energy intensity BTU per 1995 US$US of GDP	Net oil exports as % of GDP
Kuwait	17.0	2.17	33476.8	15427	293.2	2126	-6.25	0.646	0.953	0.678	34406	40.1
Canada	0.3	30.77	683643.1	22218	2043	2813	-0.38	4.376	13.065	0.335	17341	0.8
United Arab Emirates	21.7	2.91	64806.0	22270	346.6	2500	-6.21	0.77	2.118	0.364	41961	51.1
United Kingdom	0.2	58.8	1442605.1	24534	1724	2595	-0.51	3.411	9.581	0.356	7039	0.6
Denmark	0.4	5.33	163603.4	30695	213.4	348.5	-0.63	0.411	0.832	0.494	3920	0.9
Norway	7.4	4.49	164928.0	36732	220.5	3417	-14.50	0.447	1.993	0.224	10968	17.5
Ethiopia(excludes Eritrea)	-1.6	64.21	*6511.7*	101	23.3	0	1.00	0.049	0.071	0.690	9176	-3.8
Burundi	-1.0	6.81	*694.0*	102	2.8	0	1.00	0.006	0.008	0.750	7555	-2.3
Sierra Leone	0.0	5.02	684.8	136	6.3	0	1.00	0.014	0.014	1.000	17184	0
Malawi	-2.2	10.36	1734.9	167	5.3	0	1.00	0.011	0.022	0.500	12514	-5.2
Niger	-1.3	10.91	1920.6	176	5.1	0	1.00	0.012	0.017	0.706	8232	-2.9
Guinea-Bissau	8.8	1.2	213.4	178	2.3	0	1.00	0.005	0.005	1.000	10350	20.8
Chad	-0.1	7.69	1531.4	199	1.4	0	1.00	0.003	0.003	1.000	1475	-0.3
Mozambique	-2.2	17.67	3701.7	209	9.4	0	1.00	0.021	0.1	0.210	24809	-5.2
Rwanda	-1.0	8.49	1814.9	214	5.2	0	1.00	0.012	0.014	0.857	5653	-2.3
Nepal	-1.9	23.02	5360.1	233	15.3	0	1.00	0.032	0.06	0.533	10831	-4.4
Mali	-2.3	10.87	2540.9	234	3.9	0	1.00	0.008	0.013	0.615	3789	-5.4
Burkina Faso	-1.7	11.31	2742.0	242	7.6	0	1.00	0.017	0.017	1.000	5271	-4
Uganda	-1.0	23.27	5832.7	251	9.5	0	1.00	0.019	0.036	0.528	4028	-2.4
Madagascar	-1.8	15.51	4041.5	261	13.3	0.1	0.99	0.023	0.028	0.821	8065	-4.3
Central African Republic	-0.4	3.71	990.5	267	2.2	0	1.00	0.005	0.006	0.833	4598	-0.8
Tanzania	-0.9	33.67	9019.2	268	18.9	0	1.00	0.042	0.07	0.600	9683	-2.1
Kyrgy z Republic	-1.8	4.91	1381.3	281	18.1	2	0.89	0.04	0.23	0.174	111973	-4.2
Togo	-4.6	4.53	1300.2	287	6.8	0	1.00	0.016	0.018	0.889	13431	-10.9
Moldova	-3.2	4.3	1313.1	305	34.2	0	1.00	0.071	0.164	0.433	115391	-7.5
Ghana	-3.7	19.37	5998.8	310	36.3	7.2	0.80	0.075	0.14	0.536	16231	-8.7
Gambia, The	-1.9	1.3	423.6	326	1.9	0	1.00	0.004	0.004	1.000	7697	-4.6
Zambia	-1.4	9.87	3335.3	338	11.8	0.1	0.99	0.026	0.105	0.248	24463	-3.3

	Impact on GDP of a 10 increase in oil prices - % change	*Population: millions*	*GDP US$: 1999-2001*	*GDP per capita*	*Oil consumption 000b/d 2001*	*Oil production 000b/d 2001*	*Oil vulnerability*	*Petroleum consumption in BTU quadrillion 2002*	*Energy consumption in BTU quadrillion 2002*	*Oil dependency*	*Energy intensity BTU per 1995 US$US of GDP*	*Net oil exports as % of GDP*
Bangladesh	-0.4	130.96	46713.2	357	81.3	4.1	0.95	0.175	0.568	0.308	10554	-0.8
Kenya	-1.3	30.07	10744.2	357	51.9	0	1.00	0.111	0.155	0.716	15360	-3
Mauritania	-0.7	2.67	959.8	359	23.7	0	1.00	0.05	0.05	1.000	35412	-1.7
Benin	-1.2	6.28	2338.0	372	11.4	0.7	0.94	0.023	0.026	0.885	9042	-2.9
Lesotho	-4.9	2.04	846.0	415	1.4	0	1.00	0.003	0.006	0.500	5469	-11.6
Pakistan	-1.9	138.06	59434.3	430	367.1	61.6	0.83	0.777	1.828	0.425	24748	-4.4
Guinea	-1.4	7.41	3205.2	433	8.3	0	1.00	0.018	0.023	0.783	4742	-3.3
India	-1.4	1015.58	460956.2	454	2184	782	0.64	4.486	13.981	0.321	26198	-3.3
Senegal	-0.1	9.52	4578.3	481	29.4	0	1.00	0.062	0.064	0.969	10579	-0.2
Uzbekistan	0.1	24.61	14080.1	572	157.2	156	0.01	0.341	2.121	0.161	158975	0.3
Zimbabwe	-1.3	12.6	7251.6	576	23.5	0	1.00	0.043	0.211	0.204	37383	-3
Georgia	-1.2	5.24	3015.8	576	34.6	2.1	0.94	0.078	0.19	0.411	42940	-2.8
Armenia	-1.7	3.11	1958.5	630	37.1	0	1.00	0.08	0.161	0.497	78720	-4.1
Nicaragua	-3.0	5.07	3392.7	669	25.6	0.5	0.98	0.054	0.062	0.871	25480	-7.1
Ukraine	-2.5	49.46	33617.2	680	402.8	88.3	0.78	0.856	6.548	0.131	171027	-5.9
Cote d'Ivoire	-0.2	15.8	11289.8	715	21.7	11.5	0.47	0.042	0.105	0.400	7864	-0.4
China	-0.4	1261.15	1082604.3	858	4918	3435	0.30	10.592	43.177	0.245	35764	-0.8
Sri Lanka	-1.2	18.45	15911.7	862	73.4	0	1.00	0.157	0.191	0.822	11307	-2.9
Honduras	-3.4	6.46	5924.6	917	33	0	1.00	0.073	0.1	0.730	20756	-8
Philippines	-1.6	76.55	74704.4	976	346.9	7.8	0.98	0.701	1.176	0.596	12560	-3.8
Bolivia	-0.2	8.42	8233.1	978	46.7	45.3	0.03	0.092	0.153	0.601	18482	-0.5
Morocco	-1.2	28.7	34161.3	1190	161.2	4	0.98	0.333	0.46	0.724	10564	-2.8
Albania	-0.6	3.12	3797.8	1217	22.7	6	0.74	0.08	0.096	0.833	27842	-1.3
Belarus	-0.9	10	12416.0	1242	237.6	35.4	0.85	0.503	1.153	0.436	73451	-2.1
Swaziland	-4.4	1.04	1349.0	1297	3.5	0	1.00	0.007	0.015	0.467	9882	-10.3
Paraguay	-2.4	5.27	7437.0	1411	21.9	0	1.00	0.049	0.393	0.125	41941	-5.8
Bulgaria	-0.5	8.16	13052.2	1600	99.3	1.2	0.99	0.19	0.852	0.223	64533	-1.3
Romania	-0.5	22.41	37603.5	1678	254.9	140.4	0.45	0.549	1.713	0.320	46766	-1.1

	Impact on GDP of a 10 increase in oil prices - % change	*Population: millions*	*GDP US$: 1999-2001*	*GDP per capita*	*Oil consumption 000b/d 2001*	*Oil production 000b/d 2001*	*Oil vulnerability*	*Petroleum consumption in BTU quadrillion 2002*	*Energy consumption in BTU quadrillion 2002*	*Oil dependency*	*Energy intensity BTU per 1995 US$US of GDP*	*Net oil exports as % of GDP*
Guatemala	-0.8	11.38	19522.9	1716	65.9	20.9	0.68	0.137	0.17	0.806	9115	-1.8
Jordan	-2.3	4.88	8476.5	1737	98.8	0	1.00	0.212	0.225	0.942	27154	-5.3
Namibia	-1.0	1.76	3335.2	1895	15.1	0	1.00	0.034	0.049	0.694	11214	-2.3
Thailand	-1.6	60.64	120206.7	1982	801.6	191.8	0.76	1.726	3.076	0.561	16701	-3.8
Peru	-0.3	25.93	52685.3	2032	163.5	98	0.40	0.342	0.57	0.600	8862	-0.7
Tunisia	0.0	9.55	20081.5	2103	87.2	72.5	0.17	0.179	0.338	0.530	13408	0
El Salvador	-1.1	6.21	13134.2	2115	39.4	0	1.00	0.08	0.118	0.678	10298	-2.6
Dominican Republic	-1.6	8.35	19377.0	2321	118	0	1.00	0.254	0.265	0.958	14311	-3.9
Turkey	-1.0	67.36	176111.5	2614	618.6	46.8	0.92	1.287	3.096	0.416	15188	-2.4
South Africa	-0.8	43.76	124441.7	2844	458.2	209.3	0.54	0.949	4.544	0.209	24928	-1.9
Jamaica	-2.8	2.58	7400.2	2868	66.2	0	1.00	0.145	0.15	0.967	26381	-6.5
Latvia	-1.1	2.38	7162.6	3010	43	0	1.00	0.093	0.191	0.487	29260	-2.6
Botswana	-0.7	1.66	5156.2	3106	11.5	0	1.00	0.024	0.052	0.462	7812	-1.8
Brazil	-0.4	170.05	548932.5	3228	2206	1601	0.27	4.387	8.591	0.511	10579	-0.9
Lithuania	-0.3	3.5	11438.7	3268	103.3	12.9	0.88	0.207	0.449	0.461	55949	-0.8
Mauritius	-1.9	1.18	4374.9	3708	21.7	0	1.00	0.048	0.057	0.842	9940	-4.4
Slovak Republic	-0.7	5.39	20495.4	3802	77.6	3.5	0.95	0.161	0.84	0.192	33809	-1.7
Estonia	-1.0	1.37	5313.5	3878	54.4	5.1	0.91	0.119	0.173	0.688	33920	-2.4
Panama	-0.8	2.85	11796.1	4139	80.3	0	1.00	0.18	0.206	0.874	18238	-1.9
Costa Rica	-1.0	3.8	16045.1	4222	37.6	0.1	1.00	0.078	0.154	0.506	9974	-2.3
Croatia	-0.9	4.45	19398.7	4359	85.5	32.8	0.62	0.184	0.376	0.489	15673	-2.1
Poland	-0.6	38.61	172267.2	4462	412.5	25.4	0.94	0.77	3.347	0.230	20004	-1.5
Chile	-1.1	15.2	71670.5	4715	232.5	19.1	0.92	0.469	1.055	0.445	11498	-2.5
Hungary	-0.1	10.14	48853.5	4818	139.6	48.7	0.65	0.296	1.052	0.281	18019	-0.3
Czech Republic	-1.0	10.26	54533.1	5315	177.4	9.5	0.95	0.36	1.578	0.228	27162	-2.3
Uruguay	-0.9	3.32	19853.2	5980	34.1	0.5	0.99	0.063	0.151	0.417	8188	-2.1
Slovenia	-1.2	1.98	19520.0	9859	52	0	1.00	0.101	0.302	0.334	12290	-2.9
Korea, Rep.	-1.5	46.95	479688.3	10217	2132	2.8	1.00	4.542	7.847	0.579	12340	-3.5

	Impact on GDP of a 10 increase in oil prices - % change	Population: millions	GDP US$: 1999-2001	GDP per capita	Oil consumption 000b/d 2001	Oil production 000b/d 2001	Oil vulnerability	Petroleum consumption in BTU quadrillion 2002	Energy consumption in BTU quadrillion 2002	Oil dependency	Energy intensity BTU per 1995 US$US of GDP	Net oil exports as % of GDP
Greece	-0.7	10.81	116493.2	10776	405.7	8.2	0.98	0.859	1.38	0.622	9159	-1.6
New Zealand	-0.6	3.86	53246.8	13795	135.9	44.9	0.67	0.281	0.878	0.320	11871	-1.4
Spain	-0.6	40.47	582216.8	14386	1492	26.1	0.98	3.156	5.868	0.538	7945	-1.4
Israel	-0.8	6.27	110423.7	17611	273.4	3.9	0.99	0.57	0.794	0.718	7400	-1.9
Italy	-0.5	57.63	1115682.6	19359	1839	119	0.94	3.846	7.636	0.504	6186	-1.2
Australia	0.0	19.17	387459.9	20212	882.5	768.3	0.13	1.843	5.594	0.329	11936	0.1
Singapore	-1.3	4.01	85909.3	21424	726	15	0.98	1.602	1.645	0.974	14370	-3.1
France	-0.4	58.88	1357508.9	23056	2053	85	0.96	4.103	10.986	0.373	5998	-1.1
Germany	-0.6	82.19	1943884.9	23651	2815	149	0.95	5.68	14.269	0.398	5269	-1.3
Finland	-0.5	5.17	123101.3	23811	207	7.8	0.96	0.441	1.229	0.359	7322	-1.1
Netherlands	-0.1	15.92	384497.9	24152	894.5	81.5	0.91	1.883	3.917	0.481	7755	-0.4
Hong Kong, China	-0.7	6.65	162942.7	24503	245.4	0	1.00	0.576	0.852	0.676	4972	-1.7
Austria	-0.5	8.01	196790.5	24568	262.7	24.9	0.91	0.551	1.394	0.395	5088	-1.3
Ireland	-0.6	3.81	97631.2	25625	197.6	0	1.00	0.377	0.628	0.600	5273	-1.5
Sweden	-0.6	8.88	236922.8	26680	330.1	1.6	1.00	0.703	2.225	0.316	7405	-1.3
Iceland	-0.6	0.29	8120.5	28002	17.4	0	1.00	0.037	0.139	0.266	15511	-1.5
United States	-0.4	281.84	9664866.9	34292	19649	8957	0.54	38.401	97.649	0.393	10575	-0.9
Switzerland	-0.5	7.19	248200.7	34520	275.9	1.8	0.99	0.537	1.271	0.423	3746	-1.2
Japan	-0.4	126.73	4469670.4	35269	5389	121	0.98	10.932	21.965	0.498	3876	-0.9

The first block of countries are net oil exporters arranged in increasing per capita GDP, followed by net oil importers also ranked by increasing per capita GDP.
Percentage change of GDP on 1999-2001 base as a result of a $10/bbl oil price rise: World Bank calculations.
Population in millions: World Bank database.
GDP in US$ 1999-2001 average: World Bank database.
GDP per capita: derived from World Bank data.
Oil consumption in 2001, in 000 barrels a day: Energy Information Agency, World Petroleum Supply and Disposition table.
Oil production in 2001, in 000 barrels a day: Energy Information Agency, World Petroleum Supply and Disposition table.
Oil vulnerability: (Oil consumption – oil production) / oil consumption, derived from EIA data above.
Petroleum consumption in quadrillion BTU for 2002: Energy Information Agency, World Petroleum Consumption table.
Energy consumption in quadrillion BTU for 2002: Energy Information Agency, World Total Primary Energy Consumption table.
Oil dependency: ratio of petroleum consumption to total primary energy consumption, derived from EIA data above.
Energy intensity in BTU per 1995 $US of GDP: Energy Information Agency, World Energy Intensity table.
Net oil exports as a percentage of GDP: World Bank calculations