INTERNATIONAL MONETARY FUND

Fuel and Food Price Subsidies: Issues and Reform Options

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September 8, 2008

Contents

EXECUTIVE SUMMARY

Government price subsidies are pervasive in developed, emerging, and low-income countries. A subsidy is a form of government intervention resulting in a deviation of an actual price facing consumers and producers from a specified benchmark price. Subsidies affect consumption and production patterns as well as the distribution of resources, with important implications for the budget, expenditure composition, and long-term growth. They can and often do involve fiscal costs, but not all affect government fiscal accounts in the same way. Price subsidies have spillover effects onto prices and quantities in domestic, regional, or global markets. This paper discusses the key issues and policy options in the reform of subsidies for fossil fuels and selected food commodities, and their implications for the work of the Fund.

Concern over fossil fuel subsidies has risen because of the importance of fossil fuels as sources of both energy and pollutants, and because insufficient pass-through of international prices to domestic prices can affect world prices. Countries largely passed through price increases through end-2006, but the substantial rise in international prices since then has curtailed this trend. As of end-2007, roughly one-fifth of the countries for which data are available were subsidizing gasoline, and slightly more than one-third were subsidizing diesel. Nineteen of the 25 countries that subsidized aggregate consumption of gasoline and diesel are oil exporters. However, these percentages would be significantly larger—and the country sample of subsidizing countries much broader—if countries with comparatively low taxation of such products (tax subsidies) were reclassified as subsidizing countries. Country studies show that fuel subsidies are almost invariably badly targeted. Almost one-third of the countries either had increased or were planning to increase fuel subsidies during 2008, with substantial fiscal costs.

Many countries have reduced taxes or increased subsidies in response to food price increases in the past two years. For example, food taxes were reduced between 2006 and 2008 in more than one-half of the countries for which data are available. Most of these tax decreases involved reducing import duties, rather than VAT or consumption taxes. More than two-thirds of tax cuts in low and middle-income countries occurred in the last five months, with 45 countries decreasing taxes in 2008. Twenty-two countries increased food subsidies. The fiscal cost of these policy measures is substantial and is likely to increase.

Key policy recommendations include: (1) passing through international prices to domestic prices to promote efficiency and to mitigate the impact on the balance of payments of net importers, as well as negative externalities, although the adjustment may have to be gradual; (2) reining in the fiscal costs of subsidies, especially when required by macro-fiscal considerations; and (3) protecting the poor and other vulnerable groups from the impact of rising prices.

However, subsidy reform has often been difficult to implement. The absence of safety net programs to shield the poor from subsidy cuts and weak capacity to target are important obstacles to subsidy reform. In many countries, it is not feasible to quickly put in place sophisticated safety net measures, such as targeted cash transfers, to minimize the impact of subsidy reform. In such cases, governments can (1) raise prices of goods primarily consumed by the poor (for instance, cereals and kerosene) more gradually than other prices; (2) identify a package of short-term measures to mitigate the adverse impact of price increases on the poor; (3) use some of the savings from subsidy reform to increase public spending that especially benefits poor households; and (4) use a range of methods to improve targeting of needy households, such as categorical or geographical targeting or linking benefits to a self-targeting work program or schooling requirement. Although such measures are imperfect, they are more cost-effective than universal subsidies in protecting poor households.

Successful subsidy reforms should include steps toward building political support. Measures to overcome vested interests include promoting transparency and educating the public. One major advantage of transparent reporting of subsidies is that it helps clarify the cost of subsidies and assess trade-offs through public debate. Assuring the public that the savings from targeting will be used well can also promote subsidy reform.

Cross-border spillovers of subsidies are transmitted through different channels. Lack of pass-through of international prices to domestic prices and export restrictions have effects on global demand—a key spillover effect. Subsidies can also exacerbate global or regional externalities such as climate change and other environmental risks that can spill over into other countries. Smuggling of subsidized items, pass-through of subsidies into export prices, and agricultural subsidies can also have spillover effects. For global and regional spillovers, international coordination of subsidy policies will be needed.

Reforming pricing mechanisms is an essential element of successful subsidy reform. Liberalized and automatic pricing regimes facilitate full pass-through of changes in world prices. However, many countries have abandoned automatic pricing regimes when faced with increasing world prices. The challenge, therefore, absent a liberalized market, is to develop pricing mechanisms that are resilient to such increases.

I. INTRODUCTION

1.   **Government price subsidies (defined here as policy interventions engendering a deviation of consumer or producer prices from appropriate benchmark levels) are pervasive in developed, emerging, and low-income countries.** They reflect public choices in favor of certain economic outcomes and/or efforts to overcome market failures. For example, virtually all governments subsidize the costs of education and health services for the bulk of their populations. Food and energy subsidies are relatively large in many emerging and low-income countries. Many governments subsidize the cost of transport. Agricultural subsidies are relatively large in a number of developed countries. Other common subsidies include those for utilities, public services, and pharmaceutical products.

2.   **Price subsidies are primarily used to:**

➢   **alter consumption and production patterns** by changing the relative prices faced by consumers and producers—to achieve policy objectives such as addressing externalities; or

➢   **affect the distribution of resources** since subsidies typically benefit some social groups (including income groups) more than others—to attain policy objectives such as achieving a fairer society.

3.   **However, in doing so, price subsidies can also have other consequences, such as:**

➢   **fiscal costs that must be financed**, for a given fiscal stance, either through tax increases (with their own concomitant deadweight losses), or through cuts in other public expenditure. These distortions can have serious consequences for long-term growth. Moreover, it can be difficult to predict and budget for the cost of open-ended subsidies.

➢   **spillover effects onto prices and quantities in other markets**. Spillovers can occur at domestic, regional or global levels—for instance, influencing world prices (including from policies favoring biofuels); environmental spillovers; and cross-border smuggling.

Thus, when evaluating subsidies it is important to assess their impact on the efficiency of resource allocation, the distribution of resources, the fiscal burden, and their spillover effects.

4.   **Subsidies are coming under renewed scrutiny.** The recent sharp increases in food and fuel prices have brought subsidy issues to the fore. More broadly, many countries are striving to create fiscal space for various needs—for example to finance additional spending to achieve the Millennium Development Goals (MDGs)—and subsidy reforms can contribute

5.   **However, reforming subsidies can be difficult.** First, the cost and social impact of subsidies are often poorly understood, which hampers their assessment and the design of reform. Second, subsidies can create vested interests that may be difficult to overcome politically. Third, reducing subsidies that primarily benefit the rich may also adversely affect the poor and hence mitigation mechanisms must be established. But, some countries find it difficult to design and administer effective mitigation systems due to weak institutions and administrative capacity. Finally, even when governments reduce subsidies, they can reemerge over time if governments are reluctant to adjust prices on a regular basis.

6.   **The Fund has long been concerned with the macroeconomic and fiscal implications of subsidies.** Domestic subsidy issues have been prominent in the Fund's bilateral surveillance, program design, technical assistance, and operational research. Previous work has included Board and working papers, a manual to guide the design and implementation of subsidy reforms, and, more recently, a Board paper on food and fuel prices that included a discussion of subsidies.[1] This said, the analysis of international spillover effects has been more limited, and has been carried out mainly in the context of regional and multilateral surveillance.

7.   **This paper discusses policy issues related to subsidies and subsidy reform and their implications for the Fund's work, with a specific focus on subsidies for fossil fuels and selected food commodities.** This focus stems from three considerations:

➤   The substantial recent increases in international fuel and food prices have posed difficult challenges for policymakers and highlighted the importance of subsidies and spillover effects.

➤   The analysis, results, and policy recommendations in the paper broadly apply to other price subsidies, such as housing and transportation subsidies.

➤   The focus on fuel subsidies allows the use of a uniform methodology to estimate fuel subsidies across countries, based on data not previously available. The application of a common methodology to a consistent set of cross-country data addresses the measurement problem arising from the fact that in many countries fuel subsidies are not fully reflected in the fiscal accounts.

8.   **The paper's central policy messages focus on three major themes:**

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[1] See, for example, Baig and others (2007), Coady and others (2006), Coady, Dorosh, and Minten (2008), Gillingham (2008), Gupta and others (2000, 2003), and IMF (2008a). Analyses produced by the World Bank include Bacon and Kojima (2006 and 2008), and World Bank (2008a and 2008b).

➢   the importance of passing through international prices to domestic prices to promote efficiency, mitigate the impact on the balance of payments of net importers of the subsidized goods, and reduce negative externalities—though in some cases the price adjustments may have to be gradual;

➢   the need to rein in the fiscal costs of subsidies, especially when required by macro-fiscal considerations; and

➢   the need to protect the poor and other vulnerable groups from the impact of rising prices.

9.   **The rest of the paper is organized as follows.** Section II sets out a conceptual framework for defining, measuring, and reporting subsidies. Sections III and IV provide information on the production, consumption, and trade flows for fossil fuels and food, and discuss the level of subsidies for these goods, presenting estimates of how they have increased in response to recent price changes. Finally, Section V discusses issues that must be addressed in reforming subsidies.

II.   DEFINITION AND EVALUATION OF PRICE SUBSIDIES

Measuring subsidies

10.   **A subsidy is a form of government intervention resulting in a deviation of an actual price facing consumers and producers from a specified "optimal" benchmark price.** In an economy characterized by complete and perfectly competitive markets in which resources can be costlessly redistributed using lump-sum taxes and transfers, the marginal supply cost is taken as the benchmark price. In the real world where consumption taxes are needed because of deviations from these theoretical features, benchmark prices should also include "optimal taxes" in addition to marginal supply cost (see Appendix I). A tax that is below its optimal level generates a "tax subsidy."

11.   **Unfortunately, the concept of "optimal" taxes is too elusive to apply unambiguously in the measurement of subsidies.** Countries can set consumption tax rates for a variety of legitimate reasons. Even in the absence of distributional concerns, measuring optimal taxes is problematic, as the exercise by Parry and Small (2005) estimating optimal gasoline taxes for the United States and the United Kingdom demonstrates. *Consequently, consumer and producer price subsidies are measured in this paper as deviations of actual prices from appropriately defined marginal supply costs.*[2]

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[2] See Gupta and others (2003) for an attempt to construct tax-inclusive benchmark prices from which to measure subsidies.

> For internationally traded goods, the marginal supply cost should be based on international prices, adjusted for transportation, distribution, and marketing costs. [3, 4]

> For non-traded goods, it should be based on marginal production cost.[5]

Consumption subsidies measured relative to marginal cost will underestimate *full* subsidies—that is, subsidies measured relative to a benchmark that includes optimal taxes—whenever optimal taxes are positive. This underestimation could be serious for fuel subsidies, for which optimal taxes may be high, given the local pollution they engender, their contribution to global warming, and the possible use of fuel taxes to address issues such as highway congestion and safety. Therefore, the paper also provides a sensitivity analysis to evaluate the effect of measuring subsidies after including an assumed level of optimal taxation.[6] Moreover, much of the paper focuses on whether countries passed through increases in international prices to consumers, that is, on whether subsidies increased or whether taxes were reduced, possibly below their optimal level.

Accounting for the cost of subsidies

12. **Subsidies can and often do involve fiscal costs.** However, not all subsidies need affect the fiscal accounts in the same fashion:

> **Certainly, any subsidy that creates a direct budgetary outlay or reduces revenue will be reflected in the budget, even if not explicitly identified as such.** This would include, for instance, a reduction in a tax rate, or reimbursement of producers for selling goods and services at below cost.

> **Government fiscal accounts may also reflect the cost of subsidies incurred when state-owned enterprises sell goods and services at below cost.** For example, a state-owned refinery might sell fossil fuels at below production cost. In any case, the resulting losses will be shared between the refinery and the budget through the tax

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[3] For example, the benchmark price for petroleum product importers used below is estimated as the price at the nearest international hub *plus* trade and transport costs to the country's border *plus* domestic distribution and retailing costs. For exporters, the benchmark price is estimated as the price at the nearest hub *minus* the trade and transport costs to ship the product to the international hub *plus* domestic distribution and retailing costs.

[4] It is sometimes argued that actual production cost, rather than opportunity cost, is appropriate for oil exporters, as the resulting subsidy is the best measure of the oil rents that could be shared with consumers. As is argued here and elsewhere, such subsidies are very poorly targeted, and it would be relatively simple to better target benefits. *Better* targeting, rather than *perfect* targeting, should be the counterfactual.

[5] There is an ongoing debate, centered around utility pricing, on whether long-run or short-run marginal cost is appropriate. As the subsidy estimates presented below are for traded goods, the paper abstracts from this debate.

[6] When estimating the magnitude of producer subsidies, on the other hand, a marginal-cost benchmark price is likely to provide a good estimate of the true subsidy. Except in the presence of production externalities, taxes on production are not efficient, so the assumption that optimal taxes are zero is appropriate.

and dividend regime (Espinasa, 2003). Moreover, since the losses borne by the refinery will eventually revert to the budget when the refinery exhausts its financial resources, fiscal transparency would be enhanced by including the costs as a budget transfer to the refinery.

➢ **Some subsidies need not show up in government finances.** For instance, a state-owned refinery may be required to sell domestically at a price that is above production cost but below the price at which it could export. Similarly, a ban on exports of a particular good will reduce the domestic price. Both of these examples lead to a price subsidy for domestic consumers financed by producers. By contrast, an import tariff raises the price received by domestic producers, resulting in a producer subsidy financed by consumers. In none of these cases need the subsidy be reflected in the budget. Rather, they are regulatory *cross subsidies*. However, even subsidies that have no fiscal costs should be measured and analyzed and, where appropriate, reported in budget documents.

13.   **The economic impact of subsidies can be achieved in many ways.** While consumer subsidies are the most direct subsidization tools available, a whole array of other indirect forms of subsidization exist—such as, for example, subsidizing capital or labor for producers. In the same way, reduced tax rates and lowered bases for capital and labor can have an equivalent effect on the price of the same product. While dealing with all these forms of subsidies goes beyond the scope of this paper, the impact of all subsidies should be transparently analyzed.

14.   **The incidence of subsidies need not be entirely domestic.** First, global or regional externalities such as climate change or environmental risks are leading causes of spillovers among countries (see Appendix II). Second, if subsidized consumption is sufficiently large, it will also reduce supply to other countries and increase world prices. Third, smuggling implies that the residents of one country may pay for the subsidies that accrue to residents of another country. Fourth, domestic subsidies on intermediate inputs can be passed through to the prices of exports. Finally, producer subsidies for agriculture, including biofuels subsidies, will have adverse spillover effects on the supply and price of staple food items.

15.   **In sum, measuring the full economic costs of subsidies is a complex task.** Costs accrue at the level of consumers, producers, and the public sector. At each level, subsidies have implications for efficiency and equity. Thus, evaluating the costs of subsidies requires a comprehensive social cost-benefit analysis to compare the outcome of the economy in the presence and the absence of subsidies. As noted above, the rest of this paper will focus only on the deviations of prices from their benchmark levels and abstract from efficiency costs.

III. FOSSIL FUEL SUBSIDIES

Petroleum product subsidies have increased recently, as a number of countries have been unwilling to fully pass through increases in world prices. Prices substantially below marginal supply cost are prevalent in oil-exporting countries. The rate of taxation varies dramatically among countries, with taxes in at least some of these countries arguably falling below optimal levels. Relevant spillover effects arise from below-cost prices, as well as insufficient taxation. The fiscal cost of subsidies has placed a strain on the budgets of many countries.

16. **Concern over fossil fuel subsidies has risen because of the importance of fossil fuels as sources of both energy and pollutants, and the rapid increase in their prices over the last five years.** Fossil fuels accounted for almost 90 percent of the world's primary fuel consumption in 2007. Oil and oil derivatives accounted for about one-third, coal for about one-quarter, and natural gas for about one-quarter. The prices of all these fuels have increased rapidly in recent years (Figure 1). Many countries have not passed through these increases to consumers, resulting in new or increasing subsidies.

Figure 1. Average Annual Rate of Nominal US$ Price Change, December 2003 to July 2008
(In percent)
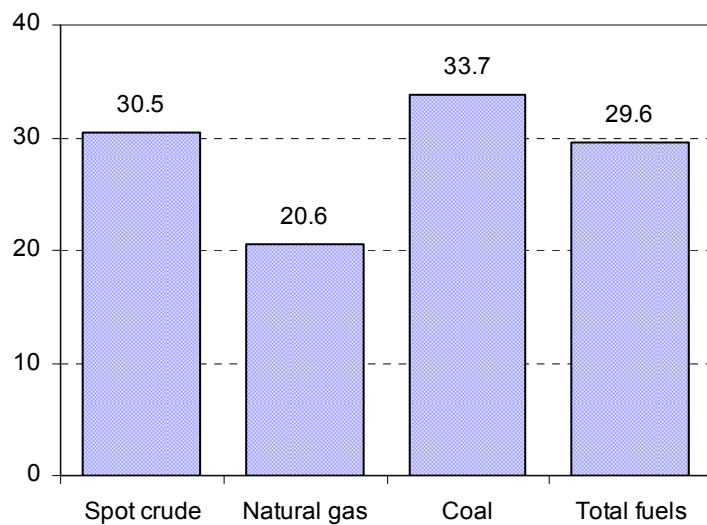
Source: IMF commodity database.

17. **This section describes the distribution of production, consumption, trade, and subsidies separately for oil and oil derivatives, coal, and natural gas.** A comprehensive database on benchmark and country-specific retail prices for petroleum products was constructed using various sources, including country authorities, the International Energy Agency, and the OECD. Consequently, it is possible to produce detailed estimates of price subsidies based on the deviation of domestic prices from world benchmark prices for these products. At a country or regional level, the resulting estimates of total price subsidies could be compared to budgetary subsidies to identify (after adjusting for the appropriate level of taxation) which subsidies are truly off budget and which are not explicitly classified as subsidies. The data necessary to apply this approach fully to coal and natural gas are not readily available, however, as there is relatively limited international trade and price information for these commodities.

A. Oil and Oil Derivatives

18.   **The international distribution of the benefits and costs of higher fuel prices will reflect the distribution of trade in crude oil and oil derivatives.** Rapid price increases (Figure 2) have resulted in very large resource transfers among countries. Both imports and exports of oil and oil derivatives are geographically concentrated (Table 1). In 2005, the five largest exporters and importers accounted for over 50 percent of the total corresponding trade flows, and the largest ten accounted for over 75 percent of trade flows. Out of the 190 countries for which information is available, 46 countries were net exporters, while 133 were net importers (11 had no net trade during the year).

Figure 2. Average Annual Rate of Price Change, end-2003 to June 2008
(In percent)
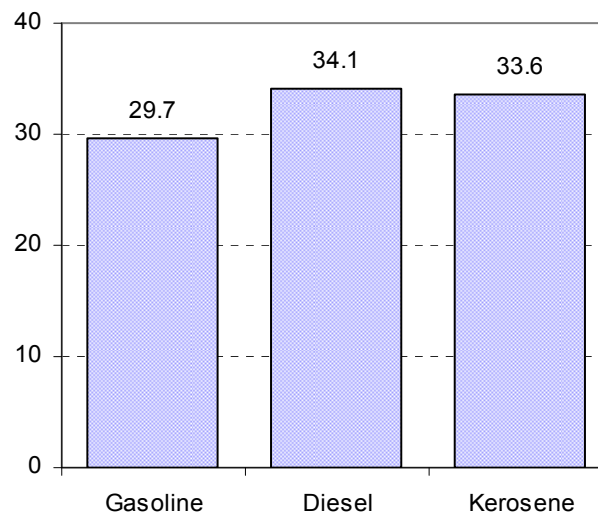
Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

19.   **The increase in oil prices provides a substantial windfall for exporting countries that needs to be carefully managed**. The ratio of net oil and oil derivative exports to GDP determines the cost for a country, as a ratio to GDP, of a doubling of the price of these commodities, absent policy or behavioral responses. The median impact of a doubling of prices for oil and oil derivatives is 13.8 percent of GDP for exporters; one-quarter have an impact greater than 42 percent, and five have an impact greater than 50 percent. The median adverse impact for importers is 3.2 percent of GDP; one-quarter have an impact greater than 5.2 percent and six have an impact greater than 10 percent. The large impacts are felt primarily by European countries and small island economies.

Table 1. Oil and Oil Derivatives Exporters and Importers by Income Class, 2005

Region	Number of countries	Number of importers	Imports/ GDP (median)	Number of exporters	Exports/ GDP (median)
High income OECD	25	21	1.4	4	1.0
High income non-OECD	17	10	3.2	7	34.9
Upper middle income	36	24	3.8	12	5.7
Lower middle income	50	36	4.1	14	9.0
Low income	51	42	3.0	9	19.1
All	179	133	3.2	46	13.8
Memorandum items:					
Trade share of top 5		57		52	
Trade share of top 10		76		76	

Source: IMF commodity database.

20.   **Many low- and middle-income countries have not fully passed through higher world prices for fuel products to domestic consumers.** Pass-through is defined as the ratio of the absolute change in the domestic retail (tax-inclusive) price to the absolute change in the benchmark price (Appendix III). Table 2 presents the median level of pass-through for each product for a sample of 90 low- and middle-income countries for gasoline, 88 countries for diesel, and 64 countries for kerosene.[7] Although the dataset does not include high-income countries, OECD countries in this category have liberalized price regimes. This is reflected in the price levels in these countries reported below. Several non-OECD high-income countries, however, are oil exporters with ad hoc pricing regimes, which explains the low average prices in these countries.

Table 2. Median Pass-through of International Prices to Domestic Consumers

(End-2003 to End-2007, in percent)

	Gasoline	Diesel	Kerosene
Pricing Regime			
Ad hoc	68	51	39
Formula	124	114	114
Liberalized	120	105	98
Oil Trade			
Importer	117	106	90
Exporter	36	19	12
All	103	86	68
Number of countries			
Total	90	88	44
Pass-through less than 1.0	44	56	44
Pass-through less than 0.75	32	36	35
Pass-through less than 0.5	22	23	26

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

21.   **Between end-2003 and end-2007, the median cumulative pass-through was highest for gasoline (103 percent) compared to diesel (86 percent) and kerosene (68 percent).** Although the median country had largely passed through price increases through end-2006 (see Appendix III), the substantial rise in international prices since then appears to have adversely affected this trend. As Table 2 demonstrates, roughly one-quarter of the countries failed to pass through even one-half of the price increase in gasoline and diesel. Pass-through was especially low in oil-exporting countries and in countries where domestic prices were changed on an ad hoc basis. This pattern of pass-through contributed to the variation of retail prices of these products (Table 3). At end-2007, retail prices were particularly low in oil-exporting countries and for kerosene.

22.   **Reflecting the limited pass-through, by end-2007, subsidies had increased significantly.** To assess these subsidies, retail prices for gasoline and diesel in 93 countries and kerosene prices in 39 countries were compared to benchmark prices based on prices prevailing at the major international trading hubs, adjusted for transactions costs (see Appendix III). In what follows, the focus is on the difference between retail prices and

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[7] These products represent roughly 75 percent of total refined petroleum products.

adjusted benchmark prices. A positive difference implies a "net tax." A negative difference implies a subsidy, at least in a narrow sense, that is not accounting for optimal taxation.

Table 3. Weighted Average Domestic Retail Prices, End-2007

(US$ per liter)

Country group	Gasoline	Diesel	Kerosene
High income OECD	1.10	1.37	0.70
High income non-OECD	0.59	0.82	0.15
Upper middle income	0.98	0.95	0.69
Lower middle income	0.68	0.59	0.21
Low income	0.71	0.23	0.55
All Countries	1.00	1.08	0.57
Importers	1.05	1.15	0.61
Exporters	0.75	0.73	0.25
Memorandum items:			
Number of countries	93	93	39
Average world hub price	0.61	0.69	0.69

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

➤ At end-2007, roughly one-fifth of the sample countries were subsidizing gasoline, and slightly more than one-third were subsidizing diesel (Table 4). More than two-thirds of the (primarily low and lower middle income countries for which data were available) were subsidizing kerosene. However, under the assumption that the uniform optimal tax is US$0.30 per liter for gasoline and US$0.28 for diesel— the average tax levels reported in Table 4—the number of subsidizing countries is much larger (almost 45 percent for gasoline and almost 60 percent for diesel), the larger share reflecting the countries with tax subsidies (that is low taxation of these products relative to the assumed optimum).

➤ The subsidizing countries in a narrow sense—that is, relative to marginal supply cost— accounted for only 12 percent of total gasoline consumption and for one-third of diesel consumption. Virtually all of the kerosene was subsidized. However, again assuming that uniform optimal tax equal to current average taxes, 56 percent of gasoline consumption and 45 percent of diesel consumption would be classified as subsidized.

➤ Nineteen of the 25 countries that have combined subsidies on gasoline and diesel (in a narrow sense) are oil exporters. Conversely, only 11 oil-exporting countries accrue positive tax revenue from gasoline and diesel, including three high-income OECD countries.

➤ For gasoline, the weighted average net tax for all countries is US$0.30 per liter (43 percent of the weighted average before-tax price). For diesel, the corresponding average tax is US$0.28 per liter (36 percent of the weighted average before-tax price).

23. **The average tax rates of gasoline and diesel mask extreme variation across countries that has important implications for international spillovers.**

Table 4. Taxes and Subsidies for Gasoline, Diesel, and Kerosene, End-2007

	Gasoline			Diesel			Kerosene		
	Countries w/taxes	Countries w/subsidies	All countries	Countries w/taxes	Countries w/subsidies	All countries	Countries w/taxes	Countries w/subsidies	All countries
Number	74	19	93	61	32	93	12	27	39
Average price (US$)	1.06	0.32	1.00	1.32	0.55	1.08	0.84	0.56	0.57
Average net tax (US$)	0.36	-0.34	0.30	0.52	-0.23	0.28	0.09	-0.22	-0.21
Aggregate net tax rate (percent)	51	-52	43	65	-30	36	12	-28	-27
Percent of consumption	88	12	100	69	31	100	4	96	100
Percent of total tax	110	-10	100	125	-25	100	-2	102	100

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

Note: Average price and net tax w eighted by quantities consumed. Aggregate net tax rate is the mean tax as a percent of mean before-tax price.

Table 5. Net Taxes by Income Level and Net Export Status, End-2007

	Gasoline			Diesel			Kerosene			Total gasoline & diesel	
	Aggregate net tax rate (in percent)	Net tax as a percent of GDP	Total net tax share	Aggregate net tax rate (in percent)	Net tax as a percent of GDP	Total net tax share	Aggregate net tax rate (in percent)	Net tax as a percent of GDP	Total net tax share	Net tax as a percent of GDP	Total net tax share
High income OECD	57.4	0.73	88.2	71.7	1.03	111.4	-9.5	-0.02	23.6	1.76	100.5
High income non-OECD	-8.6	-0.12	-0.3	9.6	0.18	0.4	-78.7	-0.01	0.2	0.07	0.1
Upper middle income	47.2	0.79	14.6	24.7	0.54	9.0	-4.4	0.00	0.5	1.33	11.6
Low er middle income	-6.8	-0.14	-2.8	-25.8	-1.11	-20.0	-73.9	-0.33	72.3	-1.24	-11.9
Low income	8.1	0.20	0.3	-13.5	-0.51	-0.8	-27.1	-0.19	3.4	-0.31	-0.3
Importer	47.0	0.67	92.4	41.4	0.79	97.7	-22.2	0.0	73.3	1.45	95.2
Exporter	21.0	0.31	7.6	5.5	0.11	2.3	-64.4	-0.1	26.7	0.41	4.8
Total	42.9	0.61	100.0	35.9	0.68	100.0	-26.9	-0.1	100.0	1.29	100.0
Memorandum item:											
Number of countries		93			93			39			

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

➢ Unless the optimal tax rates on gasoline and diesel are greater than 43 and 36 percent, respectively, the issue is not the aggregate level of taxation, but rather its distribution across countries.

➢ For gasoline, the aggregate net tax rates for countries with taxes and countries with subsidies are 51 and -52 percent, respectively (Table 4). For diesel, the corresponding rates are 65 and -30 percent.

➢ For countries with taxes, the key question is whether the country-specific tax rates that yield the above averages are higher or lower than what might be considered the optimal tax rates for these countries. They are higher than broad-based consumption tax rates, but are the differences sufficient to address the efficiency, equity, and externality components of an optimal tax on these commodities in these countries?[8] An answer to this question is beyond the scope of this paper, but the reported tax rates provide the information for observers to draw their own conclusions.

➢ The countries with subsidies, particularly those with subsidies in a narrow sense, impose significant costs on themselves, as discussed in Section V below. The net tax rates range as low as -91 percent for gasoline and -97 percent for diesel. Fourteen and 21 countries have net tax rates lower than -25 percent for gasoline and diesel, respectively, and almost all are oil exporters.

➢ Aside from their effect on domestic demand and prices, these subsidies increase incentives for smuggling—exporting the subsidies—and corruption—diversion of the subsidies away from consumers.

➢ To the extent that any decrease in domestic consumption would be exported, reduction of subsidies in oil-exporting countries could also reduce world prices. This effect is limited, however, by the small share of consumption in these countries and the fact that a reduction in domestic consumption need not be redirected to exports.[9] Rather, an increase in taxes in several countries with low tax rates—for instance, China, Mexico, and perhaps the United States—would likely have a larger spillover effect.

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[8] It is problematic to quantify a "typical" broad-based consumption tax rate. Standard rates vary from 5 to 25 percent, and other positive rates range from 1 to 40 percent.

[9] If a single oil exporter or group of oil exporters accounts for a sufficiently large share of world production, it could have monopoly power in setting the world price. If its total production were fixed, a reduction in domestic subsidies would decrease domestic demand and increase export supply, leading to a reduction in the world price. In this case, it would be optimal for the country or group of countries to set domestic prices below marginal cost (see Gupta and others, 2003). However, this concern would not obtain if the country or group of countries can adjust production to reflect reduced domestic demand; in this case, it can reduce domestic subsidies without engendering a reduction in world price.

➢   On the other hand, countries with high tax rates create positive spillovers, reducing aggregate demand. The tax rates range up to over 400 percent for gasoline and 300 percent for diesel.

24.   **High-income OECD countries account for 76 percent of total consumption of gasoline and diesel, but more than 100 percent of the estimated net aggregate taxes paid on these products in the sample countries** (Table 5):

➢   The United States (31 percent of total consumption) is the only high-income OECD country in the dataset that has a tax rate below 40 percent.

➢   Oil-exporting countries account for only 5 percent of the total tax collected on gasoline and diesel, compared to 12 percent of consumption.

➢   Figure 3 shows the distribution of countries according to their average rate of tax or subsidy (in a narrow sense) on these two products. Most European Union countries, Australia, and Brazil pay both a high tax rate and a significant share of aggregate taxes.

➢   Figure 4 shows the distribution of countries according to their share of aggregate net tax revenue on gasoline and diesel.

➢   The average net tax rate for kerosene is -27 percent for the (unrepresentative) sample of countries for which data are available, -64 percent for oil-exporting countries, and -22 percent for importing countries.

25.   **This exercise highlights the difficulty in measuring subsidies precisely, and especially the importance of knowing the optimal tax rate.** If the optimal tax on gasoline and diesel were assumed to be US$0.50 per liter in all countries, rather than the US$0.30 and US$0.28 assumed above, the current pricing scheme would imply average tax subsidies of US$0.20 per liter for gasoline and US$0.22 for diesel. Table 6 presents estimates of net *subsidies* relative to benchmark prices that include this "optimal" tax. Only the average price on diesel in high-income OECD countries exceeds the average benchmark price. Seventy percent of the total net subsidy accrues to lower middle-income countries, and total subsidies are almost 1 percent of total GDP.

26.   **Fuel subsidies are almost invariably poorly targeted.** Subsidy amounts increase with income because higher-income households consume larger quantities of fuel products. For example, the IMF review of country studies (Arze del Granado and others, forthcoming) found that, on average, over 80 percent of the benefits of fuel subsidies, assuming a uniform subsidy across different products, went to the top three income quintiles. The World Bank estimated that in Venezuela in the early 1990s the richest fifth of the population received

Figure 3. Distribution of Countries by Net Tax Rate
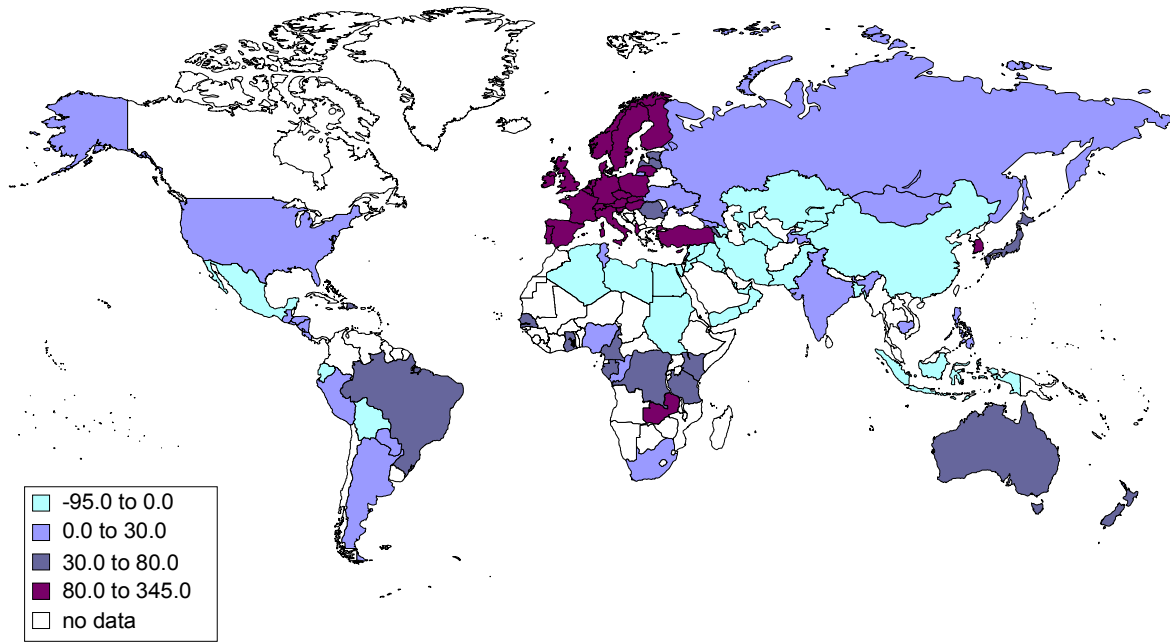
- ☐ -95.0 to 0.0
- ☐ 0.0 to 30.0
- ☐ 30.0 to 80.0
- ☐ 80.0 to 345.0
- ☐ no data

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

Figure 4. Distribution of Countries by Share of Net Revenue
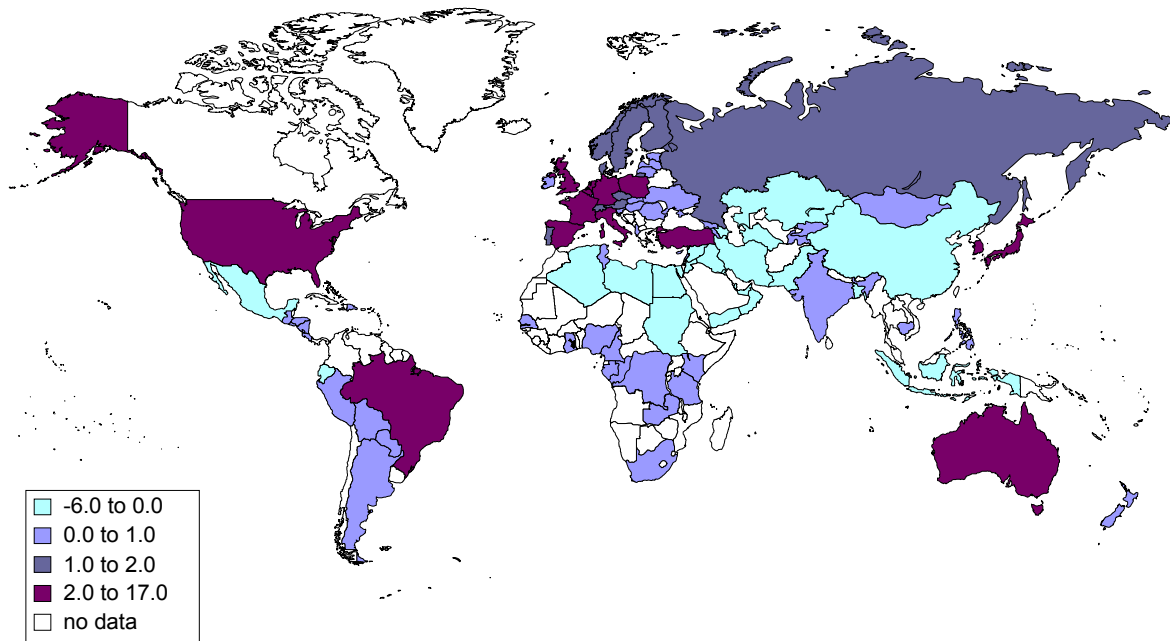
- ☐ -6.0 to 0.0
- ☐ 0.0 to 1.0
- ☐ 1.0 to 2.0
- ☐ 2.0 to 17.0
- ☐ no data

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

Table 6. Net Subsidies by Income Level and Net Export Status, End-2007
(Benchmark prices inclusive of US$0.50 per liter tax)

	Gasoline			Diesel			Total	
	Weighted aver. net *subsidy* rate	Net *subsidy* as percent of GDP	Total net *subsidy* share	Weighted aver. net *subsidy* rate	Net *subsidy* as percent of GDP	Total net *subsidy* share	Net *subsidy* as percent of GDP	Total net *subsidy* share
High income OECD	8.3	0.18	32.6	-5.3	-0.13	-18.5	0.05	4.0
High income non-OECD	48.4	1.16	4.0	36.1	1.10	3.0	2.27	3.4
Upper middle income	15.8	0.46	12.7	25.7	0.89	19.5	1.35	16.5
Low er middle income	44.7	1.53	46.5	55.1	3.77	90.2	5.30	71.0
Low income	38.7	1.67	4.2	23.2	2.90	5.8	4.57	5.1
Importer	13.5	0.32	67.4	12.6	0.38	62.4	0.70	64.6
Exporter	33.2	0.88	32.6	38.5	1.28	37.6	2.16	35.4
Total	16.7	0.41	100.0	17.2	0.52	100.0	0.93	100.0

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

6½ times more in fuel subsidies per person than the poorest third (World Bank, 1995). Coady and others (2006) provide similar evidence for several countries.[10]

Policy responses to increases in world prices in 2008

27.   **Countries have taken additional steps in recent months to respond to the further surge in prices that took place in the first half of 2008.** While data to apply the more precise methodology used above are unavailable, in the recent IMF survey of policy responses (planned and implemented as of June) for 2008 (IMF, 2008a), 25 of the 159 countries surveyed report having reduced or planning to reduce revenue from fuel taxes in 2008 (Table 7; note these are fiscal cost estimates, estimated using different methods and data than used to estimate the more comprehensive subsidies above). The projected cost of these measures is reported in Table 8.

➢   Some of these countries, however, reduced only import tariffs. To the extent that tariffs distort trade patterns, eliminating them can have a positive impact. Also, the lost revenue can be recouped over time by using more efficient taxes as part of a broader tax reform. However, if tariffs function as broad-based consumption taxes (as can happen, for instance, when all domestic consumption is met through imports), they should be included in the benchmark prices used to quantify optimal taxes, and their reduction should be viewed as a tax subsidy increase.

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[10] Clements, Jung, and Gupta (2007) assess the impact of higher petroleum prices on the price level, growth, and income distribution in Indonesia within a computable general equilibrium model.

Table 7. Pattern of Fuel Tax Decreases by Tax and Country Characteristics, 2008

	Number of countries	Tax reduction				Countries w/changes	Percent of countries
		Import	VAT	Sales	Excise		
Income group							
High-income OECD	18	2	0	0	1	2	11
High-income non-OECD	15	0	0	0	0	0	0
Upper-middle income	34	1	2	0	4	5	15
Low er-middle income	43	4	3	0	1	7	16
Low-income	49	7	3	0	4	11	22
Net oil trade balance							
Importer	90	14	7	0	10	24	27
Exporter	69	0	1	0	0	1	1
All Countries	159	14	8	0	10	25	16

Source: IMF (2008a).

Note: The count for total changes may differ from the sum across tax categories because a country may have tax changes in more than one category.

➢ Reductions in consumption taxes can be considered as increases in tax subsidies, unless they are corrections to the tax system that should have taken place even in the absence of the increase in petroleum product prices. Almost all of the tax reductions occurred in importing countries and represent measures to limit pass-through.

28. **Almost one-third of the countries report either having increased or planning to increase fuel price subsidies during 2008.** The fiscal cost of these measures has been substantial. Table 8 displays the countries that incurred new fiscal costs in excess of 0.5 percent of GDP. For these countries, the cost of subsidy increases far outweighs the cost of tax reductions. For the 26 countries that report subsidy increases for 2008, the median fiscal cost is 0.6 percent of GDP.

B. Coal

29. **The production and consumption of coal are both highly concentrated** (Table 9). In 2007, China and the United States accounted for 59.9 percent of production and 59.3 percent of consumption. The top five (ten) countries accounted for 77.3 (90.7) percent of production and 72.9 (83.9) percent of consumption. Moreover, only a small percentage of coal is traded internationally. Consequently, neither benchmark prices nor domestic prices are easily available to make the same kind of detailed estimates for coal as for petroleum products. Available evidence suggests, however, that coal price subsidies per se are not pervasive, except for a few, possibly important cases. Rather, there are questions about whether coal price increases have been passed on to consumers in the prices of products for which coal is an important intermediate input.

30. **Over 80 percent of coal is used either in industry or for the generation of electricity and heat.** Electricity generation accounted for one-third of coal usage; 7 percent was used in combined electricity and central heating; and central heating plants use slightly over 2 percent. Industrial uses accounted for more than 38 percent, and less than 3 percent was sold to final users. Consequently, to assess subsidies for coal, it is necessary to obtain the prices paid by large users. In some cases, such as for the United States, this is straightforward. In other cases, where the coal producers, electricity generators, and large industrial firms may be state-owned enterprises, it is more difficult (for instance, as in Mongolia). This problem can apply also when other fuels are used to generate electricity and heat.

Evidence on coal subsidies

31. **Consumer subsidies.** In the mid-1990s, consumer subsidies for coal were prevalent in the transition economies of Eastern Europe as well as in the large Asian consumers of coal (Anderson and McKibben, 1997). Substantial—though yet incomplete—progress has been made in subsidy reform. Evidence for two of the largest consumers identifies ongoing market imperfections:

> - **China** has eliminated price subsidies on coal. However, electricity prices continued to be regulated and apparently have not increased commensurately with the price increases in coal.
>
> - **India** still has significant coal subsidies, where quality-adjusted prices are low relative to international prices. However, such subsidies are not in the budget, which makes it difficult to determine their size and incidence.

Table 8. Countries with Large Fiscal Responses in 2008

Country	Tax reduction	Subsidy increase	Total cost
Increase in fiscal cost > 0.5 pct of GDP			
Ecuador	0.0	2.3	2.3
Yemen, Republic of	0.0	2.2	2.2
Morocco	0.0	2.1	2.1
Venezuela, Rep. Bol.	0.0	2.0	2.0
Pakistan	0.0	2.0	2.0
Malaysia	0.0	1.3	1.3
Ukraine	0.0	1.2	1.2
Peru	0.4	0.8	1.2
India	0.0	1.2	1.2
Egypt	0.0	1.1	1.1
Seychelles	1.0	0.0	1.0
Cameroon	0.0	1.0	1.0
Turkmenistan	0.0	0.8	0.8
Nigeria	0.0	0.6	0.6
Sudan	0.0	0.6	0.6
Mexico	0.0	0.6	0.6
Korea, Republic of	0.5	0.0	0.5
Guyana	0.5	0.0	0.5
Decrease in fiscal cost > 0.5 pct of GDP			
Barbados	0.0	-0.7	-0.7
Angola	0.0	-1.1	-1.1
Jordan	0.0	-1.9	-1.9

Source: IMF (2008a).

Table 9. Largest Coal Producers and Consumers
(In percent)

Largest producers		Largest consumers	
China	41.1	China	41.3
United States	18.7	United States	18.1
Australia	6.9	India	6.5
India	5.8	Japan	3.9
South Africa	4.8	South Africa	3.1
Total	77.3	Total	72.9

Source: British Petroleum (2008).

32.   **Producer subsidies.** According to Anderson and McKibben (1997), as of the mid-1990s, in Western Europe costs of coal production per ton were two to three times import prices. These differences were maintained partly by restricting imports to raise the domestic coal price, partly through direct budget subsidies, and partly by imposing minimum purchase obligations on electricity generating utilities, requiring them to buy certain volumes of coal from local mines at above international prices. As discussed in Appendix IV, producer subsidies persist, especially in Germany, Spain, and Poland, although the levels have been reduced. Similar producer subsidies still exist in Japan.

C. Natural Gas

33.   **The consumption and production of natural gas are far less concentrated than for coal.** The top five countries in each category account for about 50 percent of total production and consumption (Table 10). However, as with coal, available price data are sparse. Likewise, it is difficult in many cases to identify the prices charged by natural gas distributors to electricity power plants and large industrial users. Consequently, the information on subsidies for natural gas is less complete:

Table 10. Largest Natural Gas Producers and Consumers
(In percent)

Largest producers		Largest consumers	
Russia	20.6	United States	22.6
United States	18.8	Russia	15.0
Canada	6.2	Iran	3.8
Iran	3.8	Canada	3.2
Norway	3.0	United Kingdom	3.1
Total	52.5	Total	47.7

Source: British Petroleum (2008).

➢   **The natural gas markets in the OECD and the EU appear to be relatively free of distortion.** The market for the United States, Canada, and Mexico, which accounts for more than one-quarter of both production and consumption, appears to be self-contained, with trade flows only within the group.

➢   **The EU is in the process of creating a single, free natural gas market.** The new-member states of the EU have also made significant progress in reducing energy subsidies generally and natural gas subsidies in particular. The purpose of existing subsidies appears to be to expand the existing natural gas grid to reach more customers.

➢   **Subsidies persist in some of the countries of the former Soviet Union.** These countries account for more than one-quarter of world production. The International Energy Agency identified significant energy subsidies in these countries, including natural gas.

IV. FOOD SUBSIDIES

Many countries have reduced taxes or increased explicit subsidies in response to the recent surge in the prices of internationally traded food commodities. The fiscal costs of these policy measures has reached more than 0.5 percent of GDP in eleven of the countries for which data are available.

34.   **After a long period of declining real prices, internationally traded food commodity prices have recently increased sharply.** In particular, the prices of cereals and vegetable oils increased at an annual rate of about 50 percent between end-2006 and May 2008, with much of the increase occurring since the beginning of 2008. At least three factors mitigate the gravity of this price surge at the country level:

➢   First, these two food categories account for less than half of food exports. The price of overall food exports increased at roughly half the rate of cereals and oils, as the prices of the remaining food commodities were roughly unchanged.

➢   Second, the price increase for food exports measured in euros is slightly more than half the increase measured in U.S. dollars.

➢   Third, although cereals and oils are roughly half of food *exports*, they are a much smaller share of food *consumption*.

35.   **Mitigating factors notwithstanding, the surge in the prices of cereals and oils is a cause for serious concern.** The countries that have been hardest hit are those for whom these commodities are a relatively high share of consumption. For instance, rice—the price of which has increased at almost twice the rate of other grains—comprises almost one-tenth of total consumption for households in Senegal, and an even larger share for relatively poor households. Going forward, the potential competition from biofuels production (Appendix V) adds to uncertainty about future trends. Moreover, production in high-income countries is heavily subsidized, and the overall pattern of production and trade is distorted away from developing countries.

36.   **The distribution of the benefits and costs of higher food prices across countries will reflect the distribution of trade.** Exports of food are much more concentrated across countries than imports. As reported in Table 11 for the four main traded cereals (corn, wheat, rice, and soy) and total food, the number of net exporters is small (ranging from 18 to 36 countries across the four cereal groups) compared to the number of net importers (ranging from 154 to 172 countries). Exports are also more heavily concentrated than imports; the largest five exporters account for 80–100 percent of exports over the four cereal groups compared to a range of 22–51 percent for imports. Africa and the Middle East are the most vulnerable regions, with very few exporters relative to importers.

37. **The short-term impact of price increases on individual countries reflects the extent of its international trade in the relevant commodity**. The median impact of a doubling of four *cereal prices* is estimated at -0.9 percent of GDP for net importers and 0.5 percent for net exporters. One-quarter of cereal importers have a loss exceeding 1.4 percent of GDP and five have an loss greater than 5 percent. One-quarter of exporters have a gain exceeding 1.3 percent and three have a gain greater than 3 percent. Out of the 25 such importers, 15 are in Africa, while all such exporters are in Latin America.

Table 11. Exporters and Importers by Income Class and Product, 2002-04

Region	Corn	Wheat	Rice	Soy	Food
	Number of Exporters				
High income OECD	6	12	5	1	11
High income non-OECD	4	2	3	3	3
Upper middle income	9	11	7	6	18
Lower middle income	11	5	9	4	20
Low income	6	0	5	4	6
All	36	30	29	18	58
Trade share of top 5	93	79	82	100	60
	Number of Importers				
High income OECD	21	15	22	26	16
High income non-OECD	19	21	20	20	20
Upper middle income	29	27	31	32	20
Lower middle income	42	48	44	49	33
Low income	43	49	44	45	43
All	154	160	161	172	132
Trade share of top 5	51	28	22	42	49

Source: IMF commodity database.

38. **Although the data necessary to make direct estimates of either pass-through or the level of taxes and subsidies are not available, the recent IMF survey (IMF, 2008a) does provide indirect evidence:**

➢ **Food taxes were reduced in 84 countries between 2006 and 2008** (Table 12; information is only available on revenue, not on rates or per unit specific taxes). Most of these tax decreases involved reducing import duties rather than VAT or other consumption taxes. Food import taxes were cut in 76 countries and VAT rates in 22 countries—reductions in import duties are much easier to administer than preferential VAT rates. More than two-thirds of tax cuts in low and middle-income countries occurred in the last five months, with 45 countries decreasing taxes in 2008. Therefore, the prevalence of tax cuts is likely still increasing.

➢ **Responses have also been influenced by country membership in economic and monetary unions**. For instance, the West African Economic and Monetary Union allows every member state to exempt from VAT seven basic food items that comprise a relatively large share of consumption by poorer segments of society. This policy limited the use of VAT reductions to offset price increases in these countries. The Caribbean Community and Common Market decided earlier this year to reduce or suspend the common external tariff on several products, including cereals, baby formula, milk, and beef.

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Table 12. Pattern of Food Tax Decreases by Tax and Country Characteristics

	Number of Countries	Tax reductions				Year of reduction		Countries w/changes	Percent of countries
		Import	VAT	Sales	Excise	2007	2008		
Income group									
High-income OECD	18	17	0	0	0	16	1	17	94
High-income non-OECD	15	5	1	0	0	4	1	5	33
Upper-middle income	49	20	10	2	0	7	19	23	47
Lower-middle income	43	19	4	1	1	10	14	19	44
Low-income	34	15	7	0	0	12	10	20	59
Net total food trade balance									
Large importer	19	10	5	1	1	4	9	12	63
Small importer	99	47	12	1	0	32	24	28	28
Small exporter	28	15	4	0	0	11	7	9	32
Large exporter	13	4	1	1	0	2	5	6	46
Net cereal trade balance									
Large importer	104	46	16	3	1	21	37	51	49
Small importer	38	20	3	0	0	21	2	22	58
Exporter	17	10	3	0	0	7	6	11	65
All Countries	159	76	22	3	1	49	45	84	53

Sources: IMF (2008a).

Note: Large food importer: net imports greater than 3 percent of GDP; large food exporter: net exports greater than 4 percent of GDP; large cereal importer: net imports greater than 0.2 percnt of GDP.
The count for total changes may differ from the sum of 2007 and 2008 because the same country may have tax changes in both years.

➤ **Twenty-two countries increased food subsidies, including both targeted and universal subsidies.** In contrast, six countries reduced subsidies in the face of increasing world prices and associated fiscal costs.

➤ **Exporting countries have used both tax and regulatory measures to contain increases in domestic prices.** These measures have included increases in export taxes, the introduction of export quotas, and even the imposition of outright bans on certain exports. At least 30 countries have imposed export restrictions or bans on agricultural commodities, especially on rice.

Fiscal cost of policy responses

39.   **The fiscal cost of these policy measures is substantial and is likely to increase.** The cost of tax and tariff reductions ranged up to 1.1 percent of GDP in the 31 countries reducing taxes. The fiscal cost was over 0.5 percent of GDP in eight countries. Most of this revenue loss was due to tariff reductions. Coady, Dorosh, and Minten (2008) found that reductions in rice tariffs in Madagascar generated substantial efficiency gains reflecting the narrow import base (imports are only a small share of total domestic rice consumption) and

the resulting high rice import price elasticity. Adenauer (2008), on the other hand, found that rice consumption in Senegal was met primarily from imports, suggesting that efficiency gains from tariff reduction were limited. Although decreasing import taxes may generate some efficiency gains, decreasing VAT and other consumption taxes below optimal levels is likely to generate additional welfare losses.

40.   **Subsidy increases were much more costly and less desirable on policy grounds.** Twenty-two countries incurred fiscal costs by increasing food subsidies in 2007 or 2008 (Table 13). The fiscal cost exceeded 1 percent of GDP in 6 countries and 0.5 percent in another 5 countries. In 2008, total food subsidies are projected to exceed 2 percent of GDP in three countries, 1 percent in another three countries, and 0.5 percent in another 11 countries.

Table 13. Countries with Subsidies Greater than 0.5 Percent of GDP, 2008
(In percent of GDP)

Country	Increase (2007 to 2008)	Total subsidies (2008)
Maldives	2.9	3.6
Burundi	0.6	2.5
Timor-Leste	1.5	2.3
Egypt	0.3	1.8
Jordan	-0.1	1.7
Morocco	0.2	1.2
Indonesia	0.1	0.9
India	0.1	0.7
Turkmenistan	-0.1	0.6
Senegal	0.5	0.5
Costa Rica	0.5	0.5

Source: IMF (2008a).

41.   **Reducing food subsidies without mitigating measures can have a substantial adverse impact on the poor**. The average household budget share of food ranges from around 40 percent in middle-income countries to around 65 percent in low-income countries. While internationally traded food commodities, such as rice and wheat, typically account for a smaller share of total consumption, food budget shares tend to be substantially higher for lower income groups so that the burden of food price increases is typically highly regressive. For example:

➤   Adenauer (2008) estimated that a doubling of rice prices in Senegal would result in a 12 percent decrease in real incomes for the poorest income quintile compared to a 5 percent decrease for the richest quintile.

➤   In countries where a substantial proportion of consumption is met from domestic production, the impact can vary even more across income groups. Coady, Dorosh, and Minten (2008) found that a doubling of rice prices in Madagascar would result in an income decrease of 25 percent for urban households in the bottom three deciles, but only about 10 percent for those in the top decile. The impact for rural landless households was even greater, ranging from a 35 percent decrease for households in the bottom three deciles to over 15 percent for those in the middle of the distribution. Small rice producers and non-rice producers also exhibited losses of over 5 percent. Big rice producers, on the other hand, experienced an increase in welfare of 10 percent for those in the bottom three deciles, rising to nearly 35 percent for households in the top decile.

➢ Ivanic and Martin (2008) calculated that the first-order welfare effects on poor households of the actual increases in commodity prices between 2005 and 2007 led to an estimated increase, ceteris paribus, of 4.5 percent in poverty rates (based on a poverty line set at US$1/day).

42. **But food subsidies are a fiscally costly approach to protecting the welfare of poor households**, as a high proportion of the benefits from low food prices accrues to higher income groups. For example, the Senegal study (Adenauer, 2008) found that around 64 percent of the subsidy for rice went to the top three income quintiles. The Madagascar study found that nearly 75 percent of the benefits of lower rice prices went to the top three deciles, and subsidies essentially only transferred income from high income rural net rice producers to high income urban rice consumers.

V. ISSUES AND REFORM OPTIONS

The key policy recommendations with respect to subsidy reform are (1) pass through international prices to domestic prices to mitigate the impact on the balance of payments, promote efficiency, and contain negative externalities—although the price adjustment for some commodities may have to be gradual; (2) rein in the fiscal costs of subsidies, especially when required by macro-fiscal considerations; and (3) protect the poor and other vulnerable groups from the impact of rising prices.

A. The Importance of Pass-Through

43. **Net importing countries can improve efficiency and mitigate the adverse impact of price increases on the economy by passing these through to domestic consumers, while net exporting countries can achieve similar efficiency gains.** [11] The degree of mitigation will reflect the extent of consumption and production responses. For example, for net importers, if the import demand function is linear, then full pass-through will decrease the net impact of a doubling of import prices on the current account by a factor equal to 0.5 times the price elasticity of import demand compared to zero pass-through (see Appendix VI). This impact will increase with the import elasticity reflecting, for example, higher consumption and production elasticities or lower import shares in total domestic consumption. The import elasticity will likely increase over the long run as producers respond to higher prices and consumers adjust their capital stock—for instance, by buying more efficient cars and appliances—and can also be influenced by public policy (for instance, by promoting investments in agricultural productivity and decreasing constraints facing farmers).

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[11] While it could also be argued that the pass-through of temporary price increases could be less than full (in countries that can afford it), it is often difficult to determine ex ante whether a shock is temporary or long-lasting.

44. **Under conservative assumptions on consumption and production elasticities, the mitigating impact of full pass-through is estimated to range from roughly 10 to over 100 percent** (Table 14). For given consumption elasticities, higher values are likely to pertain in countries where production is a large proportion of total supply (e.g., food-producing net food importers) and lower values where the production share is low (e.g., fuel-importing countries without domestic crude oil).

Table 14. Share of Price Impact Mitigated by Full Pass-through

Cons. & prod. elasticities	Import share		
	Low	Medium	High
Low	-0.28	-0.15	-0.09
Medium	-0.85	-0.45	-0.28
High	-1.42	-0.75	-0.47

Note: See Appendix VI for definitions of "low," "medium," and "high."

45. **Substituting export for import, the table also gives the percentage of the benefits that would be *foregone* by exporters by not passing price increases through domestically.** Exporting countries are typically trying to protect their own consumers when they apply export restrictions or subsidize a product that they export. However, this policy may not only increase world prices, but also is actually costly to the exporting countries. Passing through prices would increase available resources and would allow consumers— especially vulnerable ones—to be protected from higher prices at a lower social cost.

46. **As discussed below, the speed of pass-through should also depend on a country's ability to implement measures to mitigate the impact of the higher prices on the poor**.

B. Tax Policy Response

47. **The appropriate level and structure of taxes should reflect revenue, efficiency, and equity objectives**. Any change in tax policy response to price increases should be consistent with these objectives. Issues with particular relevance for fuel and food include:

➢ **Maintenance of revenue in the presence of both ad valorem and specific taxes.** Fossil fuels are typically subject to both forms of tax, with specific excise taxes often addressing externalities. Assuming that demand for a particular fossil fuel is sensitive to price, an increase in price will trigger a reduction in demand and therefore in the revenue from specific excises, but may lead to a rise in ad valorem tax revenue. If the net effect of this is an increase in combined revenue that is not needed from a budgetary perspective, it could be appropriate, as some countries have done or are considering, to cut the excise tax level to contain the increase in price.

➢ **Windfall taxes.** The increase in profits engendered by the surge in oil prices has elicited calls for a windfall tax in a number of countries, including France and Italy, sometimes with the intention of using the resulting revenues to support lower income households. Levying taxes that were not anticipated when investments were made can damage a government's credibility, thereby discouraging future investment.

However, it could be argued that the recent oil price increase, and related profit boom, was not anticipated and represents a true "windfall". The best way of taxing "excess" profits, in principle, is through a permanent rent tax that would apply only to returns above a benchmark level. Absent this approach, a temporary surcharge on the corporate income tax for oil companies could distort the behavior of oil companies, which would have to subsequently include possible ad hoc changes in the tax regime in their plans. However, it does have the merit of simplicity.

➢ **Taxation of close substitutes.** It may be difficult to tax items purchased disproportionately by the poor at a lower rate if these items are close substitutes for items purchased primarily by higher-income households, because higher-income households will adjust their consumption to capture the benefits of the lower rates. This can happen with both food items—for instance, different qualities of rice—and fossil fuels—for instance, diesel and kerosene.

C. Subsidy Reform

48.   **Subsidy reform often faces several obstacles**: (1) weak capacity to target the poor; (2) lack of transparency in reporting of subsidies; (3) opposition by vested interests; (4) spillover effects; and (5) ad hoc price setting mechanisms. Reform strategies need to address these issues.

Targeting subsidies

49.   **The absence of safety net programs and weak capacity to target subsidies are important obstacles to subsidy reform.** Price increases resulting from subsidy cuts have an adverse impact on household real income. Compensating the poor for the elimination of subsidies requires resources and a system to deliver compensation to those who need it. However, it may not be feasible to quickly put in place sophisticated safety net measures, such as targeted cash transfers, to minimize the impact of subsidy reforms.

50.   **In such cases, countries can adopt a gradual reform strategy while developing effective safety nets**:

➢ **Temporarily maintain universal subsidies on commodities that are more important in the budgets of the poor (for instance, kerosene and lower quality cereals).** These subsidies are better targeted and more cost effective (Alderman and Lindert, 1998, and Coady, Grosh, and Hoddinott, 2004). Consequently, they can be maintained until more effective mitigating measures are developed. Other subsidies can be decreased more quickly.

➢ **Identify a package of short-term measures to mitigate the adverse impact of price increases on poor households.** This requires identifying existing programs that can be expanded more quickly, possibly with some improvements in targeting

effectiveness (for instance, school meals, education and health user fees, subsidized mass urban transport, cash transfers to vulnerable groups, subsidies for consumption of water and electricity below a specified threshold). Well-targeted subsidies to farmers—including input (seed and fertilizer) subsidies, smallholder credit facilities, extension services, and improved infrastructure—could also bolster production while providing income support for low-income farmers.

➢ **Identify high priority public expenditures that benefit poor households that can be financed out of the savings from subsidy reform.** These could include education and health expenditures as well as infrastructure expenditures such as roads and electrification schemes, which also benefit middle- and higher-income groups.

➢ **Improve the targeting and design of safety net programs over time.** Targeting methods include: (1) limiting the coverage of subsidies to population groups that are likely to be poor on the basis of socioeconomic and demographic characteristics, such as the elderly, children, or the unemployed (categorical targeting), or those living in specific areas (geographical targeting); (2) linking subsidies or cash benefits to a self-targeting work or schooling requirement; or (3) as discussed above, subsidizing items that are disproportionately consumed by the poor.

Box 1. Lessons from Experiences with Price-Subsidy Reform

1. The appropriate speed of reform should be determined on a case-by-case basis. If mechanisms to protect the poor can be established quickly, rapid reform is preferable.

2. Compensation schemes that protect households from real income losses should be temporary, to be replaced with more formal social policy instruments, such as targeted welfare benefits.

3. A perfect targeting mechanism does not exist in practice, and the choice among targeting options can be restricted by lack of data on the poor, and by weak governance and administrative capacity. Self-targeting often remains the only feasible option.

4. Using income for targeting benefits in developing countries is often not practicable. Targeting benefits to households with certain characteristics can be relatively efficient in these cases.

5. A general subsidy limited to, or below, the amount consumed by the poor protects both poor households and politically vocal groups, while generating budgetary savings.

6. The political risks can be assessed by identifying the winners and losers of price-subsidy reform, in particular, and of economic reforms, in general. They can be reduced by explaining the benefits of reform to the public and by not placing an undue burden on any single group.

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51.   **The appropriate speed and modalities of reform should be determined on a case-by-case basis,** depending on the political and administrative capacity of the country. The options selected should be consistent with the macroeconomic constraints to avoid any drag on growth or stimulus to inflation. Box 1 summarizes some key lessons from experience with price subsidy reform from Gupta and others (2000). Box 2 presents the mitigating measures implemented by Gabon, Ghana, Indonesia, and Jordan when fuel subsidies were cut.

Box 2. Mitigating Measures—Country Experience

The key mitigating measures taken by Gabon, Ghana, Indonesia, and Jordan were:

Gabon

➢ National Social Guarantee Fund cash payments to the poor were resumed, while conducting a new and improved census of lower income households.
➢ Assistance to single mothers via the existing program in the Ministry for the Family was increased, as was funding for microcredit program targeting disadvantaged women in rural areas.
➢ Households with monthly electricity and water bills of less than the expenditure thresholds for subscribers who already received the social rates were eligible for free electricity and water up to a limited quantity.
➢ School enrollment fees were waived for pupils enrolled in public schools and school text books given free of charge to all primary school pupils.
➢ PRSP investments related to the expansion of rural health services, electrification, and drinking water supply were accelerated.
➢ The mass public transport network in Libreville expanded (27 buses).

Ghana

➢ Fees for attending primary and junior-secondary school were eliminated.
➢ Extra funds were made available for primary health care programs concentrated in the poorest areas through the existing Community Health Compound Scheme.
➢ Investment in the provision of mass urban transport was expanded and expedited.
➢ Extra funds were made available to expand a rural electrification scheme.

Indonesia

➢ An unprecedented cash transfer program to 19 million poor families was implemented in 2005 to mitigate the impact of fuel price increases. Beneficiary households were identified using existing targeting schemes that were to be improved over time. A similar cash transfer accompanied the fuel price increases in 2008.
➢ Some budgetary savings from reducing subsidies were reallocated to existing education, health and infrastructure programs that disproportionately benefit low- and middle-income households.
➢ The subsidies on kerosene are being reduced in conjunction with a program to increase the use of LPG as an alternative fuel source.

Jordan

➢ The minimum wage was increased, and low-paid government employees received higher wage increases than other employees.
➢ A one-time bonus was given to low-income government employees and pensioners.
➢ An electricity lifeline tariff was maintained at current low levels—electricity access is almost universal.
➢ Cash transfers were provided to other low-income households.
➢ The government announced a plan to increase funding to the National Aid Fund as part of a program to improve the design and implementation of this national safety net program with World Bank assistance.

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52.   **Over time, the most effective approach to social protection is to develop a well-targeted safety net.** Such a safety net also facilitates structural adjustment more generally. Moreover, the indexation of benefits to price changes obviates new measures each time there is a surge in inflation. As capacity improves, these safety nets can also promote social development by, for example, linking transfers to school attendance and primary health care for the children of poor households. Adenauer (2008) concluded that the obstacles to the development of social safety nets in Senegal could be overcome, especially if such programs are rolled out gradually, and technical and financial support from abroad can be obtained.

A strong public financial management system will also facilitate transparent and detailed reporting of subsidies, and thereby an assessment of their cost effectiveness. It would also allow governments to track subsidies to ensure they are delivered to their intended beneficiaries.

Promoting transparency

53.   **Subsidies are often difficult to measure and evaluate**, partly reflecting definitional and measurement difficulties. In some cases, subsidies do not appear in the fiscal accounts at all, making them difficult to track, quantify, and assess. Even when they are reflected in the fiscal accounts, they are often difficult to isolate. Inability to identify properly the costs of subsidies and the winners and losers hinders efforts to assess them properly, and the ability to undertake reforms.

54.   **Subsidies should be recorded transparently in government accounts**. Where appropriate, they should be recorded in the budget and explicitly identified. Off-budget subsidies should be identified and recorded in separate accounts. This may require improvements in the budget classification system. For fuel subsidies in particular, arrangements whereby international or national oil companies provide subsidies to consumers without explicit budget support should be clearly defined and described in budget documents (IMF, 2007).

➤   Transparency is especially important for oil exporters where the opportunity cost of fuel subsidies is the revenue foregone by not charging international prices domestically. Oil-producers that record fuel subsidies explicitly in the budget include Indonesia, Iran, Malaysia, Sudan, and Yemen. Ecuador plans to include such fuel subsidies in the 2009 budget.

➤   Some countries have implemented specific subsidy reporting systems designed to help raise public awareness. Germany has published Biannual Subsidy Reports for many years. Switzerland has implemented a subsidy database on the web, in which individual subsidies are recorded.

Overcoming vested interests

55.   **Public information campaigns can mobilize political support for reforms and help overcome vested interests**. Often the groups that capture subsidies are better organized and more powerful than the more diverse potential beneficiaries (consumers and taxpayers) of reform. The latter may not actively support reform either because they do not understand how inequitable subsidies are or may not trust the government to provide compensating benefits. To overcome these obstacles, the public should be informed about the drawbacks of existing subsidies and the benefits of reform.

> ➢ For example, in early 2005 the government of Ghana used the finding of a Poverty and Social Impact Analysis that petroleum subsidies go predominantly to higher income groups to convince the public of the need to raise petroleum prices. To prepare the public for the impending price increase, extensive parliamentary discussions on the subject were broadcast on state television and radio.

Governments can also highlight that subsidized prices promote smuggling, shortages, black market activities, and corruption—if such issues are relevant in the particular country circumstances.

56. **Assuring the public that the savings will be used well and embedding the subsidy reform within a broader reform package can also help.** For example, the Indonesian government ran a campaign in 2005 that directly linked the savings from fuel price increases to a cash compensation program for the poor. A similar program accompanied the 29 percent increase in domestic fuel prices in 2008.

Addressing spillover effects

57. **Cross-border spillovers of subsidies are transmitted through different channels**. Subsidies may alter trade patterns and divert benefits from their intended recipients. Trade restrictions distort international markets, redistributing resources in a particularly counterproductive manner. Low domestic prices provide incentives for smuggling, which benefits consumers in other countries (examples include Nigeria and Venezuela in the case of petroleum products). Subsidies for intermediate inputs may also be passed through to the prices of exported goods. Subsidized energy consumption may result in higher usage with environmental consequences (excessive pollution, faster resource depletion, and global warming)—effects that are felt far beyond the territory of the subsidizing country. Rising biofuels production in advanced economies—partly in response to higher prices and, increasingly, generous policy support—has added to food price pressures.

58. **An important environmental spillover from food and fuel production is the impact on greenhouse gas (GHG) emissions** (see Appendix II). Fossil fuels represent about two-thirds of current emission of GHGs which are the leading cause of global warming. Agriculture accounts for about 13 percent of such emissions. Addressing these spillovers requires a two-pronged approach—*mitigating* the impact through appropriating pricing and *adapting* to them through changes in private behavior and public policies. Removal of subsidies and the establishment of GHG emission pricing could have substantial positive impact on future temperatures. However, these measures are likely to have substantial distributional implications both within and across countries.

59. **Lack of pass-through of international prices to domestic prices and export restrictions can have effects on global demand—a key spillover effect.** They provide perverse incentives and exacerbate the problem by increasing world prices further. To avoid

these negative international spillovers, commodity prices should be passed through to consumers and producers, and countries should refrain from imposing export restrictions.

60.   **Addressing the spillover effects of subsidies will also require multilateral cooperation**. When externalities are global, as with climate change, benefits of (potentially costly) unilateral action are limited. If other countries do not take similar action, the gains are ephemeral; if other countries do act, it can be in a country's perceived interest not to join in (the free-rider problem). Therefore, international coordination of subsidy policies—perhaps with enforcement mechanisms—could usefully be discussed in the context of regional and multilateral surveillance. Due to the distortionary impact of agricultural subsidies, the Fund continues to urge all countries to come to a prompt and ambitious conclusion to the Doha Round.[12]

Reforming price setting mechanisms

61.   **Government direct control of domestic prices has often been an obstacle to subsidy reform**. In some countries, prices of sensitive commodities such as fuel or bread are administratively set. Even if these prices are initially set or adjusted to reduce or eliminate them, subsidies can reemerge or increase again if prices are not adjusted to reflect market conditions. Political economy considerations play an important role in this context: once the government is seen as willing to cushion price increases, there will be pressures to pass on price declines, but not to pass on price increases.

62.   **Reform of the pricing mechanism is thus essential in reforming subsidies**.

➤   **The first-best solution is to liberalize prices in the context of supporting institutional arrangements as needed.** Liberalization helps depoliticize product prices. In regulated environments, people tend to see domestic prices as under the government's control and so blame the government for price increases. There is evidence that liberalized regimes tend to be more politically robust than automatic pricing formulas (Baig and others, 2007). However, liberalizing prices requires preparation. For example, some refineries have been established under concession conventions, which would make it difficult to liberalize the market before their expiration. In countries where the market for fuel products is dominated by the public sector, price liberalization would require liberalizing import and distribution activities. Regulatory frameworks may need to be strengthened, including the capacity to detect and discourage anti-competitive behavior.

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[12] FAO (2004) estimates that cotton subsidies in middle- and high-income countries amounted to US$3.4 billion during the 2003/04 season. Estimates of the impact on the world price range from 2 to 72 percent.

➢ **If markets are imperfect or if governments are concerned about excessive price volatility, they can implement an automatic pricing mechanism that adjusts prices periodically in light of changes in international prices.** Several countries have introduced such mechanisms for oil products. Often the price formulas are designed to smooth the pass-through of international prices to domestic prices. Smoothing mechanisms include moving averages, price adjustment caps and/or triggers, and price bands (see Bingham, Daniel, and Federico, 2003). Countries that at various times implemented formula-based mechanisms (in some cases temporarily) include Bolivia, Chile, Republic of Congo, Dominica, Ghana, Gabon, Pakistan, Peru, South Africa, and Sri Lanka. However, such price formulas have often been suspended or abandoned in the face of opposition to price adjustments. The challenge, therefore, is to develop pricing mechanisms that are sufficiently resilient to protect the hard-won fiscal gains from subsidy reform. It is likely that the factors that promote subsidy reform more generally also promote the resilience of pricing mechanisms.

Collaboration between the Fund and the World Bank

63. **The Fund and the World Bank can collaborate in responding to the challenges posed by the fuel and food shocks and reforming subsidies.** The Fund can help governments assess mitigating measures, their cost, and fiscal policy options to accommodate the costs of policy responses without prejudice to the sustainability of financial positions. It can also provide advice and technical assistance to its member countries on assessing the macroeconomic and fiscal consequences of subsidies. The World Bank can assist countries in the design of subsidy reform, including the establishment or strengthening of safety nets (such as school feeding, food for work, and conditional cash transfers); a better understanding of the impact of biofuels; and action on the trade front to reduce distorting subsidies and trade barriers. Fund and Bank staffs are also working with OECD staff in establishing coherence in policy advice on appropriate responses to fuel and food price increases.

APPENDIX I. CONCEPTUAL FRAMEWORK FOR THE MEASUREMENT OF SUBSIDIES

64.   **A subsidy is a form of government intervention resulting in a deviation of an actual price facing consumers and producers from a specified "optimal" benchmark price.** In an economy characterized by complete and perfectly competitive markets in which resources can be costlessly redistributed using lump-sum taxes and transfers, the marginal supply cost is taken as the benchmark price. Under these assumptions, marginal-cost pricing ensures that both consumption and production resources are efficiently allocated. When consumers pay a price lower than marginal cost, they receive a "consumer subsidy." When producers receive a price higher than marginal cost, they receive a "producer subsidy." Such departures from marginal-cost pricing result in an inefficient allocation of resources, engendering what are typically called "deadweight losses." Subsidies are also undesirable from a distributional perspective since any desired redistribution can be achieved through lump-sum taxes and transfers without generating efficiency losses. Subsidies can also result in fiscal costs that need to be financed through either higher taxes or lower public expenditures.

65.   **Deviations from the simple world described above may be used to justify subsidies or taxes, and benchmark prices for calculating subsidies should include the relevant subsidy or tax adjustment to marginal costs.** These deviations can take several forms:

➢   **In the presence of externalities, "corrective" price interventions (called Pigouvian taxes and subsidies) are an efficient policy instrument.** Externalities appear whenever markets are incomplete, and the social marginal cost or benefit of a given consumption or production activity differs from the private marginal cost or benefit that market participants face and internalize. In the presence of externalities, the perfectly competitive market outcome no longer represents the social optimum. Therefore, government intervention to align private and social incentives becomes desirable. Pigouvian taxes and subsidies achieve this objective. For example, in the fields of basic nutrition, health, and education, subsidies may be justified because these activities have social benefits that exceed the benefits that accrue to individual market participants. In these cases, the appropriate benchmark for evaluating non-Pigouvian subsidies and taxes would include the Pigouvian correction.

➢   **Deviations from perfect competition may justify some form of price subsidy.** The case of a natural monopoly with fixed costs and decreasing marginal costs is illustrative. Without any government intervention, marginal cost pricing is unsustainable, as it would lead to losses. Monopoly pricing would lead to prices higher than marginal costs and suboptimal production levels. One option in this case would be to impose marginal cost pricing through regulation and subsidize the producer to offset the losses incurred. In this case, the benchmark price would be the marginal cost price.

➢ **When lump-sum taxes are not feasible and government operations must be financed by indirect taxes, benchmark prices will include these taxes as well as marginal costs.** One of the key lessons from the optimal commodity tax literature is that prices and taxes will be a function of both the demand and supply conditions in product markets. For example, under constant returns to scale production technologies and zero cross-price demand elasticities, the "Ramsey Rule" for optimal commodity taxes states that tax rates should differ across commodities and vary inversely with own-price demand elasticities. Therefore, minimizing the inefficiency associated with such taxes requires that taxes should be relatively high on those goods for which demand is typically less price elastic. On the other hand, in the presence of sufficiently large administrative and compliance costs associated with differential taxes, a flat rate tax structure may be optimal. In either case, optimal taxes should be included in the benchmark prices used to identify and measure subsidies. Any shortfall of actual from optimal taxes can be referred to as a "tax subsidy." [13]

➢ **When lump-sum transfers between households are not possible, optimal commodity taxes (and thus benchmark prices) should be adjusted to reflect the distributional impact of taxes.** For example, relative to Ramsey taxes, taxes should be adjusted downwards on commodities consumed disproportionately by low-income households ("necessities") and upwards on commodities consumed disproportionately by high-income households ("luxuries"). These adjustments reflect a trade-off between efficiency and distributional objectives, so that any distributional gains come at an efficiency cost. The distributional gains should also be assessed against those that could be achieved via alternative transfer instruments such as targeted direct transfers. Although the latter may be imperfect and require incurring administrative costs, they may still constitute a more efficient transfer mechanism.

➢ **When more than one of the above conditions obtain, the specification of benchmark prices would have to allow for interactions among them.** This makes the specification and measurement of benchmark prices even more problematic.

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[13] Note also that any cross-country comparisons of tax subsidies must take into account the fact that optimal taxes can vary across countries depending on, among other things, a country's choice of government size and financing method. A country with relatively low taxes may have no tax subsidy, while a country with higher taxes could have a tax subsidy.

APPENDIX II. EXTERNALITIES IN FOSSIL FUEL AND FOOD MARKETS: IMPLICATIONS FOR POLICY

66.   **Food and fuel production give rise to externalities that are heterogeneous in nature**. These include short-term, localized effects (such as health risks due to air pollution or reduced water quality due to fertilizer use) as well as long-term effects (such as soil salinization due to irrigation) and even global effects (such as global warming). These externalities cause a divergence between the private and social cost/benefit of consumption/production. Tax/subsidy policies can be used in these cases to align the social and private (market) cost/benefits. Evaluating the extent of any externality is essential for designing policies to correct for externalities. However, this is complex and uncertain in practice.

67.   **Environmental spillovers from fossil fuel combustion vary widely by fuel, location, and technology**. Coal and diesel combustion, for example, tend to cause adverse health effects due to high emissions of sulfur dioxide and particulates. Domestic stoves for heating and cooking often expose households to pollutants, implying high health costs. Emissions of greenhouse gases (GHGs) impose external costs on the global economy and on future generations—in the form of long-term climate degradation and increased damages from extreme weather events. The extent of these costs, and those arising from the required policy response, remain uncertain but are likely to be significant for many countries, particularly in the developing world (although they may be positive for countries in northern latitudes at lower levels of warming). Other important spillover effects include congestion and accident risk from transport.

68.   **Global and local environmental spillovers from agriculture are significant**. Conversion of pasture and forested land due to agricultural expansion has led to biodiversity losses. Water storage and irrigation cause a range of environmental impacts, including excess withdrawal of ground-water and increased salinity of aquifers. Agriculture accounts for approximately 13 percent of total GHG emissions—primarily from energy inputs to fertilizer, by-products of livestock rearing, and impact on deforestation (which contributes approximately a further 18–20 percent of total emissions).

69.   **Expansion of biofuel production has potentially significant spillovers across environmental and food markets**. In particular, the recent increase in corn prices, likely to be at least partially related to diversion of corn to ethanol production in the United States, has also raised the cost of producing meat and poultry and exacerbated the tight supply situation in soybean and wheat markets. Biofuels production may also cause agricultural expansion into forested areas, with ensuing habitat destruction and biodiversity losses. Other environmental effects include increased carbon emissions and negative impacts on air, water, and soil quality. Some forms of biofuel production, particularly from waste by-products, may reduce GHG emissions considerably, while others—such as bioethanol production from corn and beet—are more likely to increase them.

70. **Managing this broad range of externalities is a difficult exercise fraught with uncertainty**. It requires understanding the nature, extent, and distribution of economic and welfare-related effects and evaluating elements not otherwise priced in a market economy. In the case of long-lived externalities, such as climate change, intertemporal aspects are critical—requiring analysis of impacts far into the future, and factoring in effects of control policies. Aggregating effects over time also requires a choice of a discount rate, which has been the focus of much discussion and debate. Furthermore, interactions among the different markets accentuate these difficulties. For example, subsidies for biofuels primarily designed to reduce GHG emission in road transport, divert agriculture production with implications for food prices. Similarly, producer subsidies for food exacerbate inefficient conversion of forests into croplands.

71. **Addressing pollution emissions externalities requires a two-pronged approach**. *First*, mitigating their effect through appropriate externality pricing (such as taxation, cap-and-trade, or 'hybrids' of the two) and technological changes (for example, to expand the set and reduce the cost of substitutes for fossil fuels). Difficulties in estimating the appropriate externality price is a major obstacle in this regard. For example, estimates of emissions pricing vary widely reflecting the technical complexities and judgments involved. *Second*, adapting to the externalities through changes in private behavior and public policies—for example, to reduce information and other barriers, tailor public services such as health to evolving risk profiles, and foster effective insurance and credit markets. However, shortage of quantitative evidence on the likely cost and benefits of adaptation is a major impediment to implementing adaptation measures.

72. **Externality pricing is likely to have substantial distributional implications both within and across countries**. For example, carbon pricing will affect the level and distribution of households' real income through their own use of fossil fuels and indirectly through the prices of other commodities. The strength and nature of these effects depends on how far the burden is borne by final consumers (through increased prices) rather than fuel suppliers (including owners of fossil fuels)—which is often affected by patterns of market structure and regulation. They will depend too on patterns of consumption and production: the effect through gasoline prices is more likely to be regressive where car ownership is high, and that through kerosene more regressive where it is used for household lighting and heating. In addition, fuel taxation has the potential to redistribute scarcity rents among countries, for example, between petroleum importing and exporting countries.

73. **Dealing effectively with externalities will require international cooperation when vulnerabilities extend across borders.** For example, the harm caused by GHG emissions is felt by the entire global community, albeit to differing extents. Countering this requires slowing and then cutting global emissions. But each country would prefer others to shoulder the costs of doing so. Overcoming this "free rider" problem will require international coordination—potentially extending across a range of policy areas including trade; improved understanding of the country-level risks and opportunities; greater fiscal transparency; and,

technical as well as financial capacity building support for countries least able to bear the costs or implement solutions. Similarly, efficient adaptation—while generally dealt with at local and national level—will also require international coordination to increase capacity, and manage regional and other cross border effects—for example, where countries share common water resources. Thus, policies would need to be designed to deliver efficient mitigation and adaptation while also ensuring that the distribution of benefits and costs are perceived as fair. A crucial task of policymakers, including international organizations, is to design such policies, encourage and facilitate such agreement, and ensure implementation.

APPENDIX III. DEFINITIONS AND CALCULATIONS OF FUEL PRICE PASS-THROUGH AND FUEL TAXATION

74.   **The paper discusses the extent to which countries have passed through increases in international fuel prices to domestic consumers as well as the fiscal implications of fuel pricing.** This appendix describes the methodologies used to calculate the extent of pass-through and the degree of fuel price taxation or subsidization, and discusses the interpretation of these results. Appendix Table 1 presents the evolution of international fuel prices for gasoline, diesel and kerosene since end-2003. Nominal international prices

Appendix Table 1. Nominal International Prices of Petroleum Products Since end-2003

Product	2004	2005	2006	2007	2008
		Percentage increase (cumulative)			
Gasoline	21.7	74.9	86.8	168.5	222.2
Diesel	39.8	92.5	108.2	189	274.1
Kerosene	35.9	85.5	103.9	184.9	268.8
		Share of total increase (percent)			
Gasoline	9.8	23.9	5.4	36.8	24.2
Diesel	14.5	19.2	5.7	29.5	31.0
Kerosene	13.4	18.5	6.8	30.1	31.2

Source: Staff estimates based on OECD and IEA data.

in U.S. dollars of these three petroleum products increased by between 222 percent and 274 percent from end-2003 to mid-2008. After an initial price increase up to end-2005, prices changed little in 2006 but this was followed by a more rapid increase since end-2006. Over 60 percent of the increase in prices up to mid-2008 occurred since end-2006.

Fuel price pass-through

75.   **The calculation of fuel price pass-through is intended to capture how countries have passed through increases in international fuel prices to domestic retail prices.** Price pass-through (P) was calculated as the absolute change in domestic consumer prices divided by the absolute change in international prices, with all prices denominated in local currencies, i.e.:

$$P = \frac{q_1 - q_0}{p_1 e_1 - p_0 e_0}$$

where q_t is the domestic consumer price in period t in local currency units, p_t is the international price in period t at the nearest world hub in U.S. dollars, e_t is the exchange rate in local currency in period t per U.S. dollar, and all prices are nominal.

76.   **For a given change in U.S. dollar prices, the extent of pass-through will therefore reflect movements in domestic currency-dollar exchange rate as well as changes in domestic fuel taxes and consumer prices.** For example, if the exchange rate does not change over the period, then fixed ad-valorem tax rates will result in a pass-through of more than 100 percent (or tax-inclusive pass-through will be higher than tax-exclusive

pass-through), while fixed specific tax levels will result in a pass-through of exactly 100 percent. In the presence of both ad valorem and specific taxes, the appropriate tax policy on revenue and efficiency grounds when prices rise would be an increase in the absolute (specific equivalent) tax per liter and a decrease in the percentage (ad valorem equivalent) tax per liter. Where both specific and ad valorem taxes are levied on a particular fuel, this result would obtain automatically. This would also lead to more than 100 percent pass-through to tax-inclusive prices.

77.   **The interpretation of pass-through for a particular country is complicated by the fact that it can be sensitive to the choice of start and end dates**. This is especially true if prices are not set by the market or automatically adjusted (see Baig and others, 2007, for a more detailed discussion). For example, high pass-through can reflect the fact that a country is reducing the size of initial subsidies as well as passing through new changes in international prices. So pass-through can look very high when international prices change little but domestic prices increase substantially to eliminate existing subsidies. Therefore, for any given time period, there is not a one-for-one correspondence between pass-through levels and the level of consumer prices across countries.

78.   **While the median country fully passed through international price increases in gasoline and diesel by end-2006, it has not done so since then.** For gasoline, pass-through was high in 2004 but fell back by end-2005 as international prices continued to increase (Appendix Table 2). Pass-through then increased over 2006 as international prices stabilized. However, the rapid increases in international prices during 2007 were not passed through so that pass-through decreased substantially. For diesel and kerosene, pass-through was initially low but approximately full pass-through was achieved by end-2006.

Appendix Table 2. Median Pass-through in Fuel Prices from end-2003 to end-2007
(Percent)

Product	2004	2005	2006	2007
Gasoline	182	114	139	103
Diesel	88	95	115	86
Kerosene	82	82	92	68

Note: Based on data from 90 countries for gasoline, 88 for diesel, and 64 for kerosene.

Source: Staff estimates based on OECD and IEA data and data provided by the authorities.

However, as with gasoline, pass-through decreased over 2007 as rapid increases in international prices were not passed through to domestic consumer prices.

Consumer subsidies

79.   **Information on the extent of subsidization of fuel prices facing consumers is not always directly available from government accounts.** This reflects the fact that fuel subsidies may not be recorded explicitly on the budget, e.g., when a state-owned enterprise is responsible for importing and distributing fuel products and its fiscal position is not consolidated with the budget. In this case, increasing subsidies can show up as lower tax revenues, or lower (higher) profits (losses) of state-owned enterprises.

80.   **Calculation of the magnitude of consumer subsidies requires the choice of an appropriate benchmark price and information on domestic consumer prices and fuel consumption.** Appendix I discusses issues surrounding the appropriate choice of benchmark prices. The estimates of the magnitude of subsidies presented in the paper are based on a benchmark price taken as the international U.S. dollar price for the relevant fuel product at the nearest international hub adjusted by a US$0.07 per liter to allow for the cost of shipping the products from the hub to the country, as well as US$0.07 per liter to cover the distribution and retailing costs within the country. The domestic distribution and retailing costs were based on the per liter costs in the United States (Energy Information Administration (EIA), 2008). These are slightly higher than the adjustments used in Gupta and others (2003), partly because some of the costs—for instance, insurance—are related to the value of the product. For importers, the benchmark for fuel importers is thus the U.S. dollar price plus US$0.14 while for fuel exporters it is simply the U.S. dollar price (since the margins cancel out). Fuel consumption levels are based on OECD and IEA data.

81.   **The calculation of subsidies will be sensitive to the choice of benchmark prices, including distribution margins.** These costs would vary from country to country. In particular, some pricing formulas include significantly higher margins for domestic distribution and retailing costs. In some cases, these costs have been very generous, providing high returns to distributors and retailers on their activities. The subsidy estimates could be off by several cents per liter in either direction. This would not qualitatively change the results. Rather, an increase in transportation costs of US$0.01 would decrease estimated taxes or increase estimated subsidies by this amount in importing countries, and by twice this amount in exporting countries. However, it could cause a country that has small price subsidies to appear as if it has low taxes and vice versa. The above benchmark also implicitly takes the situation of zero fuel taxes as optimal so that subsidy estimates will be under-estimates to the extent that positive fuel taxation is desirable. For this reason, the paper also calculates subsidies based on a US$0.50 fuel tax level.

82.   **Net tax rates vary substantially across fuel products and regions according to income level, oil trade status, and pricing regime.** Whereas the median tax rate for gasoline and diesel are 57 and 22 percent of the before-tax price, respectively, the median for kerosene is -7 percent (Appendix Table 3). Oil exporters have high subsidy rates, especially for diesel and kerosene. Tax rates are especially high in high-income OECD countries. Tax rates in countries with automatic pricing formulae and with liberalized pricing are also substantially higher than for countries where prices are adjusted in an ad hoc manner. To the extent that the margins allowed to domestic distributors are too generous in some countries, these consumer taxes are being used to subsidize excess profits and estimated taxes will be higher than observed taxes. There is also evidence that whereas median ad valorem net tax rates have decreased, median equivalent specific tax levels have increased.

Appendix Table 3. Median Fuel Tax Rates by Group, end-2007
(Percent)

	Gasoline	Diesel	Kerosene
Income Group			
High-income OECD	157	103	-17
High-income non_OECD	74	1	-82
Upper middle-income	41	21	-16
Low er middle-income	23	-1	-24
Low income	63	29	11
Region			
AFR	82	42	3
APD	44	11	-10
EUR	151	103	90
MCD	-10	-44	-51
WHD	30	8	-17
Oil Trade			
Importer	72	31	5
Exporter	1	-34	-51
Pricing Regime			
Ad Hoc	14	-25	-33
Formula	75	37	14
Liberalized	41	18	19
All	*57*	*22*	*-7*
Number of countries	126	124	71

Note: Tax rates are defined as the difference betw een domestic retail prices and benchmark prices divided by benchmark prices

Source: Staff estimates based on OECD and IEA data and data provided by country authorities.

APPENDIX IV. ENERGY SUBSIDIES IN EUROPE AND TRANSITION ECONOMIES

83.   **Most EU countries have reduced or eliminated energy subsidies (both direct and indirect) over the past two decades**. Energy pricing is much less of an issue in these countries since prices are already at economic levels. Instead their energy policy has relied more on the use of grants, taxes, regulatory instruments, and support for R&D. There has also been greater emphasis on internalizing negative environmental externalities and developing renewable and alternative energy technologies.

84.   **Energy subsidies are still in effect in transition economies**. These countries continue to subsidize energy consumption usually through price controls that hold end-user prices below the cost-recovery levels.

Energy subsidies in EU countries

85.   **Energy subsidies in EU countries are guided by four main objectives**:[14]

➢   **Protecting domestic energy industries**: This is the case with subsidies for coal mining in Germany and Spain; for peat in Finland and Ireland; and biofuels in France and Italy. Denmark abolished the payment of royalties on gas and oil production, and Ireland has implemented a pre-exploration preferential tax scheme for oil.

➢   **Industrial policy objectives**: An important reason behind subsidies for renewable energy technologies is to develop a technological lead over competitors in other countries.

➢   **Environmental concerns:** Some of the subsidies encourage the development and deployment of more environmentally friendly technologies and energy sources.

➢   **Equity objectives:** Most EU countries use social welfare systems and other means to achieve this goal. However, some countries continue to subsidize energy consumption to protect the poor from high energy costs, for example, through low tax rates on heating fuels. Subsidies have been granted by Denmark, Greece, Ireland, and Spain to extend the gas network to guarantee security of supply and promote the economic development of regions where the standard of living is low.

➢   **Most common forms of energy subsidy in the EU include the following:**

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[14] Subsidies to corporations are regulated by the EU treaty. State aid regulation establishes that "a measure—including subsidies—constitutes state aid if it is granted by a member state or through state resources, affects prices and/or distorts or threatens to distort competition, favors certain undertakings or the production of certain goods, and/or affects trade between member states" (Art. 87, EU treaty).

> **Grants and credit instruments**: These may take the form of soft loans and interest-rate subsidies to producers or consumers of energy. For example, the Danish government subsidizes up to 30 percent of investments in energy efficiency or conservation in industry and commerce, in addition to tax rebates on such investments for energy-intensive firms.

> **Fiscal instruments**: Differential taxation is sometimes used to encourage or discourage the production and use of certain types of fuels These include subsidized VAT rates for oil and gas consumption and preferential tax rates for certain industries. Several European countries have introduced a carbon tax to reduce GHG emissions. European countries have also introduced new energy and environmental taxes as part of a so-called Ecological Tax Reform, for example through establishing minimum excise duties on all energy products in 2004.

> **Regulatory instruments**: Regulations requiring or encouraging consumers to purchase a given fuel from a particular source, usually domestic and sometimes at a regulated price, have been introduced in several countries. Germany introduced subsidized tariffs for wind-generated electricity. France requires the partially state-owned utility to purchase wind power at prices above cost.

> **Public funding of research and development**: The governments of almost all OECD countries undertake energy R&D, either directly or indirectly through support for private sector programs. Energy R&D funding for European IEA member countries increased by about 20 percent in real terms between 2000 and 2006. About 40 percent of this spending goes to the nuclear energy sector, followed by 15 percent for fossil fuels.

86.   **The magnitude of such subsidies could be substantial.** Reduced VAT rates for oil and gas consumers in the United Kingdom is estimated to cost around €1.4 billion. Between 2002 and 2006, state aid for the coal sector in EU-27 countries amounted to about €31 billion.[15, 16] In Denmark, reduced rates of energy and carbon dioxide taxation for energy intensive industries implied an off-budget subsidy of about € 0.6 billion.[17] In addition, governments indirectly subsidize electricity and gas sectors by financing extension of distribution network.

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[15] The EU legislation regulating the granting of aids up to that date was Decision 3632/93/ECSC. Since the expiry of the treaty, state aid to the coal sector has been treated as general state aid according to EU rules.

[16] The EU-10 countries are: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia. The EU-12 comprises the EU-10 countries plus Bulgaria and Romania, which joined the EU in 2007. The EU-27 comprises the EU-25 plus the EU-12.

[17] Energy Subsidies in the European Union: A Brief Overview, EEA Technical Report 1/2004. Figures are for 2001.

Energy subsidy reform in new EU members

87.   **Energy subsidies were drastically reduced during the pre-accession period in the ten new member states (EU-10) that joined the EU in 2004.** Energy subsidy reform was mandatory only in situations of illegal state aid support to energy producers, as the EU legislation does not contain a specific regulation on energy subsidies, similar to that for agricultural subsidies and state aid.[18] Mulas-Granados, Koranchelian, and Segura-Ubiergo (2008) report that in some countries such as Bulgaria, Hungary, Romania, and Slovakia, and, the decline in subsidies was more than 60 percent. In some cases lower electricity subsidies were compensated with increased gas subsidies. In Latvia and Poland, energy subsidies increased.[19] There is also a trend toward increased use of subsidies (with EU co-financing) to promote new technologies for energy efficiency and renewable sources.

European non-EU countries and transition economies

88.   **This region includes some of the countries providing the largest energy subsidies.** Shortcomings in the pricing arrangements (in particular for natural gas and electricity) stem from the unfinished reform agenda and less than ideal regulatory frameworks. While countries in Central and Eastern Europe, and some in South East Europe (e.g., Bulgaria and Romania) appear to have established cost-recovery levels, the situation is different for CIS and Balkan countries:

➢   The 2006 IEA's World Energy Outlook estimated that in 2005 Russia had the largest energy subsidies in U.S. dollar terms, amounting to about US$40 billion per year, mostly on natural gas and electricity. Energy subsidies in Ukraine, through lower prices to end users of diesel, natural gas, electricity, and coal were also estimated to be substantial.

➢   Some countries, such as the Azerbaijan, Kyrgyz Republic, Tajikistan, and Uzbekistan, have tariffs that are not yet adequate to ensure short term financial viability (World Bank, 2006). Other countries, such as Azerbaijan and Serbia, were selling gas at a price lower than their import costs. In most countries, short term financial viability was found to depend on of improving operational efficiency in terms of loss reduction, and better metering, billing and collection than on raising tariff levels substantially.

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[18] According to Council Directive 90/377/EEC of June 29, 1990: "Member states must ensure that gas and electricity undertakings communicate to the Statistical Office of the European Communities their prices, details of price systems in use and the breakdown of consumers . . . twice a year." Thus, the Directives calls for improved transparency but does not cover energy price subsidies.

[19] Both countries were granted a transitional arrangement to implement the provisions of the electricity market until 2008 and 2009, respectively.

➢   Subsidies in the Balkan region are concentrated in the electricity sector (IEA, 2008). While there has been progress toward establishing full-cost recovery prices, low tariffs and weak payment discipline remained serious problems (e.g., Bosnia and Herzegovina, FYR Macedonia, and Serbia). Cross-subsidies from business customers to households are significant across the region. Several countries have plans to reform their energy subsidies. Croatia is planning to have cost-reflective tariffs by 2010; and Montenegro has plans to eliminate energy cross-subsidies in the medium term.

APPENDIX V. BIOFUELS: OPPORTUNITIES AND CHALLENGES

89.   **Biofuel opportunities**. Biofuels are expected to have a positive impact on the environment, energy independence, and rural development:

➢   **Environmental.** Substituting biofuels for fossil fuel has the potential to reduce environmentally harmful greenhouse gas emissions. Currently, only 1 percent of global transport energy comes from biofuels. Some countries, including in the EU, aim at increasing the use of biofuel in the transport sector to about 5 percent of total energy consumption by 2015.

➢   **Energy independence**. Countries with little or no fossil fuel aim at increasing the share of renewable energy in their energy balances to improve energy security by reducing dependence on imported energy resources.

➢   **Rural development**. Given the expected positive impact of biofuels on the environment and energy supply, biofuels are seen as a possibly large market for agriculture producers. The expansion of biomass production for the biofuel industry could offer the agriculture sector possibilities for diversification and job creation. However, as biofuel production offers significant economies of scale, opportunities for small-scale farmers might be limited.

90.   **Biofuel challenges**. First-generation biofuels—made from sugar, starch, vegetable oil, or animal fats using conventional technology—are relatively ineffective and inefficient, cause high fiscal costs, and have an adverse impact on food supply:

➢   **Low effectiveness**. Taking into account emissions from production and transport, life-cycle emissions from first-generation biofuels frequently exceed those of traditional fossil fuels. In addition, research suggests that, on the same area of land, forests could absorb up to nine times more carbon dioxide than first-generation biofuels could save. Finally, trade barriers have also impeded the use of the most efficient biofuels.

➢   **Cost efficiency**. At current factor prices, first-generation biofuels are not cost competitive with existing fossil fuels. Therefore, many governments support biofuels through consumption incentives (fuel tax reductions), production incentives (tax incentives, loan guarantees, direct subsidy payments), and mandatory consumption requirements. The cost of the support measures for biofuels is significant. According to estimates, the total support provided by OECD countries amounted to US$11 billion in 2006, with the United States and the EU providing subsidies of close to US$5 and US$6 billion, respectively (Steenblik, 2007). Tariffs on biofuels are a contentious issue in the World Trade Organization.

➢ **Competition with food for human consumption**. Large scale producers of feedstock redirected part of the biomass from food production to the biofuel industry, which reduced the food supply. The United States reportedly used 20 percent of its 2006/07 maize crop to produce ethanol (World Bank, 2008c), and the IEA (2004) reported that 43 percent of the cropland would be needed for biofuel production if the United States and EU grows according to current plans. Rosegrant (2008) presents estimates that diverting biomass from food production to biofuel production accounted for 30 percent of the recent increase in weighted average grain prices.

91.   **Outlook.** Second-generation biofuels—made from a wider range of biomass, such as straw, grasses, and wood (lignocellulosic material) and using advanced (and currently noncommercial) conversion technologies—could reduce production costs and achieve significantly higher reductions in greenhouse gas emission. Biofuel producing countries—including Germany, the United Kingdom, and the United States—are working toward commercially viable second-generation technologies to make biofuel a more viable energy resource.

APPENDIX VI. MITIGATING THE IMPACT OF PRICE INCREASES

92.   **The most efficient response to increasing world prices for energy and food is to fully pass through these price increases to domestic consumers.** Full pass-through provides the appropriate incentives for producers and consumers to increase production and decrease consumption. Such responses act to decrease the net adverse impact on net importers and reinforce the gains to net exporters.

93.   **The extent of mitigation provided will depend on the magnitude of these production and consumption responses.** This can be seen from the following simple illustration. Let the initial world price for the good be p, the change in price be Δp, the initial level of net imports be M and the change in net imports due to the price change be ΔM. The impact of such a price increase will then depend on whether or not the increase is fully passed through to consumers.

   ➢   With *full pass-through*, if the import demand function is linear, then the aggregate loss in welfare experienced by consumers and producers (FP) is given by $\Delta p.M + 0.5(\Delta p.\Delta M)$, where ΔM <0 for a price increase. In the absence of any existing taxes and subsidies, the fiscal impact of full pass-through is zero. Therefore, the aggregate impact on consumers and producers also captures the aggregate impact on the country.

   ➢   With *zero pass-through*, domestic prices do not change so that the aggregate welfare impact on domestic consumers and producers is zero. But, since the government now has to subsidize the domestic price, there is a fiscal cost equivalent to $\Delta p.M$, which is also the aggregate impact on the country (ZP).

94.   **The extent of mitigation provided by full pass-through can then be calculated using the above analysis** as:

$$\frac{ZP - FP}{ZP} = 1 - \frac{FP}{ZP} = 1 - \frac{\Delta p.M + 0.5(\Delta p.\Delta M)}{\Delta p.M} = -0.5\frac{\Delta M}{M} = -0.5\eta.\rho,$$

where $\eta < 0$ is the price elasticity of net import demand and ρ is the proportional increase in world price. The price elasticity of net imports can be calculated as:

$$\eta = \eta_C \frac{C}{M} - \eta_Y \frac{Y}{M},$$

where C is total consumption of the good, Y is total production and $\eta_{C,Y}$ denote the price elasticities of consumption and production respectively.

95.   **Appendix Table 4 provides estimates of the import elasticity of demand as a function of the consumption and production elasticities of demand and the share of net imports.** Production and consumption elasticities will increase with the time horizon over

which they are calculated, as consumers and producers have more time to respond or as government policy has longer to react (for instance, by reducing the production constraints facing producers or adopting environmental policies that promote energy conservation). For the values simulated (low, medium, and high consumption and production elasticities of -0.1, -0.3, and -0.5, respectively, and low, medium, and high import shares of 30, 50, and 70 percent,

Appendix Table 4. Import Elasticities

C & Y elasticities	Import share		
	Low	Medium	High
Low	-0.57	-0.30	-0.19
Medium	-1.70	-0.90	-0.56
High	-2.83	-1.50	-0.93

respectively), the import price elasticities will range from -0.2 to almost -3. The share of the impact of a price surge that will be offset by full pass-through is one-half of the import price elasticity.

96.   **With existing taxes, the welfare impacts of full pass-through calculated above would need to account for the change in existing tax revenues due to the change in net import demand.** For a price increase, this results in a decrease in import revenues, which is a welfare loss. However, the net revenue impact should also account for indirect revenue impacts due, for example, to consumers switching to other taxed goods. To the extent that substitute goods are similarly taxed, these indirect revenue effects will be small.

Appendix Table 5. Energy Consumption Across and Within Countries

Million of metric tons oil equivalent	Distribution within country						Distribution across country					
	Oil	Natural Gas	Coal	Nuclear Energy	Hydro electric	Total	Oil	Natural Gas	Coal	Nuclear Energy	Hydro electric	Total
US	39.9	25.2	24.3	8.1	2.4	100.0	23.9	22.6	18.1	30.9	8.0	21.3
Canada	31.8	26.3	9.5	6.6	25.9	100.0	2.6	3.2	1.0	3.4	11.7	2.9
Mexico	57.4	31.3	5.9	1.5	3.9	100.0	2.3	1.8	0.3	0.4	0.9	1.4
Total North America	40.0	25.7	21.6	7.6	5.2	100.0	28.7	27.6	19.3	34.7	20.6	25.6
Argentina	31.9	53.8	0.5	2.2	11.6	100.0	0.6	1.5	0.0	0.3	1.2	0.7
Brazil	44.5	9.1	6.3	1.3	38.8	100.0	2.4	0.8	0.4	0.4	11.9	2.0
Chile	55.8	13.9	11.6	0.0	18.7	100.0	0.4	0.2	0.1	0.0	0.8	0.3
Colombia	34.4	23.1	8.8	0.0	33.6	100.0	0.3	0.3	0.1	0.0	1.4	0.3
Ecuador	76.6	2.2	0.0	0.0	21.1	100.0	0.2	0.0	0.0	0.0	0.3	0.1
Peru	47.9	17.4	2.8	0.0	31.9	100.0	0.2	0.1	0.0	0.0	0.6	0.1
Venezuela	37.5	35.9	0.1	0.0	26.6	100.0	0.7	1.0	0.0	0.0	2.7	0.6
Other S. & Cent. America	59.4	20.8	1.8	0.0	18.0	100.0	1.6	0.8	0.1	0.0	2.7	1.0
Total S. & Cent. America	45.6	21.9	4.0	0.8	27.7	100.0	6.4	4.6	0.7	0.7	21.6	5.0
Austria	41.5	24.6	9.8	0.0	24.1	100.0	0.3	0.3	0.1	0.0	1.1	0.3
Azerbaijan	36.2	59.5	0.2	0.0	4.3	100.0	0.1	0.3	0.0	0.0	0.1	0.1
Belarus	28.4	71.2	0.4	0.0	0.1	100.0	0.2	0.7	0.0	0.0	0.0	0.2
Belgium & Luxembourg	56.1	20.7	7.6	14.8	0.8	100.0	1.0	0.6	0.2	1.8	0.1	0.7
Bulgaria	26.5	13.7	39.6	16.2	4.0	100.0	0.1	0.1	0.3	0.5	0.1	0.2
Czech Republic	22.9	18.5	43.6	13.7	1.3	100.0	0.3	0.3	0.6	1.0	0.1	0.4
Denmark	51.4	22.6	26.0	0.0	0.1	100.0	0.2	0.2	0.1	0.0	0.0	0.2
Finland	38.7	13.3	16.6	19.7	11.6	100.0	0.3	0.1	0.1	0.9	0.4	0.2
France	35.8	14.8	4.7	39.1	5.6	100.0	2.3	1.4	0.4	16.0	2.0	2.3
Germany	36.2	23.9	27.7	10.2	2.0	100.0	2.8	2.8	2.7	5.1	0.9	2.8
Greece	63.5	10.6	23.7	0.0	2.2	100.0	0.5	0.1	0.3	0.0	0.1	0.3
Hungary	31.2	43.3	11.8	13.5	0.1	100.0	0.2	0.4	0.1	0.5	0.0	0.2
Iceland	33.6	0.0	2.9	0.0	63.5	100.0	0.0	0.0	0.0	0.0	0.3	0.0
Republic of Ireland	62.6	28.5	7.1	0.0	1.7	100.0	0.2	0.2	0.0	0.0	0.0	0.1
Italy	46.4	39.0	9.7	0.0	4.9	100.0	2.1	2.7	0.6	0.0	1.2	1.6
Kazakhstan	17.6	29.6	49.8	0.0	3.0	100.0	0.3	0.7	0.9	0.0	0.3	0.5
Lithuania	32.2	37.9	2.7	24.7	2.4	100.0	0.1	0.1	0.0	0.4	0.0	0.1
Netherlands	52.9	36.4	9.6	1.0	0.0	100.0	1.2	1.3	0.3	0.2	0.0	0.8
Norway	22.5	8.5	1.0	0.0	68.0	100.0	0.3	0.1	0.0	0.0	4.3	0.4
Poland	25.7	13.1	60.5	0.0	0.7	100.0	0.6	0.5	1.8	0.0	0.1	0.9
Portugal	60.1	16.3	13.8	0.0	9.8	100.0	0.4	0.1	0.1	0.0	0.3	0.2
Romania	27.2	37.1	22.7	4.0	9.1	100.0	0.3	0.6	0.3	0.3	0.5	0.4
Russian Federation	18.2	57.1	13.7	5.2	5.9	100.0	3.2	15.0	3.0	5.8	5.7	6.2
Slovakia	21.6	30.1	22.7	19.8	5.9	100.0	0.1	0.2	0.1	0.6	0.1	0.2
Spain	52.4	21.0	13.4	8.3	4.9	100.0	2.0	1.2	0.6	2.0	1.0	1.4
Sweden	33.5	1.9	4.4	30.4	29.9	100.0	0.4	0.0	0.1	2.5	2.1	0.5
Switzerland	39.1	9.1	1.4	21.7	28.7	100.0	0.3	0.1	0.0	1.0	1.2	0.3
Turkey	30.6	31.0	30.5	0.0	7.9	100.0	0.8	1.2	1.0	0.0	1.1	0.9
Turkmenistan	19.3	80.7	0.0	0.0	0.0	100.0	0.1	0.7	0.0	0.0	0.0	0.2
Ukraine	11.3	42.8	28.9	15.4	1.7	100.0	0.4	2.2	1.2	3.4	0.3	1.2
United Kingdom	36.2	38.1	18.1	6.5	1.0	100.0	2.0	3.1	1.2	2.3	0.3	1.9
Uzbekistan	11.6	82.8	2.8	0.0	2.8	100.0	0.1	1.6	0.0	0.0	0.2	0.4
Other Europe & Eurasia	33.9	18.4	24.3	2.3	21.1	100.0	0.7	0.6	0.6	0.3	2.4	0.7
Total Europe & Eurasia	31.8	34.8	17.9	9.2	6.3	100.0	24.0	39.4	16.8	44.3	26.6	26.9
Iran	42.1	55.0	0.6	0.0	2.2	100.0	1.9	3.8	0.0	0.0	0.6	1.6
Kuwait	55.3	44.7	0.0	0.0	0.0	100.0	0.4	0.4	0.0	0.0	0.0	0.2
Qatar	18.3	81.7	0.0	0.0	0.0	100.0	0.1	0.7	0.0	0.0	0.0	0.2
Saudi Arabia	59.2	40.8	0.0	0.0	0.0	100.0	2.5	2.6	0.0	0.0	0.0	1.5
United Arab Emirates	36.2	63.8	0.0	0.0	0.0	100.0	0.6	1.5	0.0	0.0	0.0	0.5
Other Middle East	67.1	27.7	4.3	0.0	0.9	100.0	1.9	1.2	0.2	0.0	0.1	1.0
Total Middle East	51.1	46.9	1.1	0.0	0.9	100.0	7.4	10.2	0.2	0.0	0.7	5.2
Algeria	34.5	63.3	1.9	0.0	0.3	100.0	0.3	0.8	0.0	0.0	0.0	0.3
Egypt	48.4	45.6	1.4	0.0	4.6	100.0	0.8	1.1	0.0	0.0	0.4	0.6
South Africa	20.2	0.0	76.5	2.3	0.0	100.0	0.7	0.0	3.1	0.5	0.2	1.2
Other Africa	58.8	20.5	5.5	0.0	15.2	100.0	1.8	0.9	0.2	0.0	2.5	1.1
Total Africa	40.1	21.8	30.7	0.9	6.5	100.0	3.5	2.8	3.3	0.5	3.1	3.1
Australia	34.7	18.6	43.6	0.0	3.1	100.0	1.1	0.9	1.7	0.0	0.5	1.1
Bangladesh	24.4	72.1	2.0	0.0	1.6	100.0	0.1	0.6	0.0	0.0	0.0	0.2
China	19.7	3.3	70.4	0.8	5.9	100.0	9.3	2.3	41.3	2.3	15.4	16.8
China Hong Kong SAR	63.7	10.1	26.3	0.0	0.0	100.0	0.4	0.1	0.2	0.0	0.0	0.2
India	31.8	8.9	51.4	1.0	6.8	100.0	3.3	1.4	6.5	0.6	3.9	3.6
Indonesia	47.5	26.5	24.3	0.0	1.7	100.0	1.4	1.2	0.9	0.0	0.3	1.0
Japan	44.2	15.7	24.2	12.2	3.7	100.0	5.8	3.1	3.9	10.1	2.7	4.7
Malaysia	41.1	44.3	12.1	0.0	2.5	100.0	0.6	1.0	0.2	0.0	0.2	0.5
New Zealand	40.1	19.4	9.8	0.0	30.7	100.0	0.2	0.1	0.1	0.0	0.8	0.2
Pakistan	30.7	47.5	7.9	0.9	12.9	100.0	0.5	1.1	0.1	0.1	1.1	0.5
Philippines	55.9	12.4	23.9	0.0	7.8	100.0	0.4	0.1	0.2	0.0	0.3	0.2
Singapore	88.9	11.1	0.0	0.0	0.0	100.0	1.2	0.2	0.0	0.0	0.0	0.5
South Korea	46.0	14.2	25.5	13.8	0.5	100.0	2.7	1.3	1.9	5.2	0.2	2.1
Taiwan	45.6	9.2	35.7	8.0	1.5	100.0	1.3	0.4	1.3	1.5	0.2	1.0
Thailand	50.3	37.2	10.4	0.0	2.2	100.0	1.1	1.2	0.3	0.0	0.3	0.8
Other Asia Pacific	32.5	15.4	39.4	0.0	12.7	100.0	0.7	0.5	1.1	0.0	1.6	0.8
Total Asia Pacific	31.2	10.6	49.9	3.2	5.1	100.0	30.0	15.3	59.7	19.8	27.3	34.3
TOTAL WORLD	35.6	23.8	28.6	5.6	6.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: British Petroleum (2008).

Note: Primary energy comprises commercially traded fuels only. Excluded, therefore, are fuels such as wood, peat and animal waste which, though important in many countries, are unreliably documented in terms of consumption statistics. Also excluded are wind, geothermal and solar power generation.

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