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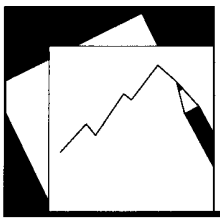

IMF Working Paper

The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka

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The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka

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Abstract

With the recent jump in world oil prices, the issue of petroleum product pricing has become increasingly important in developing countries. Reflecting a reluctance of many governments to pass these price increases onto energy users, energy price subsidies are absorbing an increasing share of scarce public resources. This paper identifies the issues that need to be discussed when analyzing the fiscal and social costs of fuel subsidies. Using examples from analyses recently undertaken for five countries, it also identifies the magnitude of consumer subsidies and their fiscal implications. The results of the analysis show that—in all of these countries—energy subsidies have significant social and fiscal costs and are badly targeted.

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I. INTRODUCTION

Government control of the domestic prices of petroleum products is a common feature in developing countries. In some cases, governments directly control import levels, domestic distribution, and domestic prices. In other cases, the private sector can freely import and distribute petroleum products, but governments set domestic price ceilings and compensate private sector distributors to cover ensuing losses. It is also common for prices to be set by a formula that anchors domestic prices to import prices, with adjustments for distribution margins and domestic taxes. These pricing formulas may be implemented by either government-controlled or independent pricing boards.[2] A recent review carried out by the IMF found that, out of the 48 developing and emerging economies considered, only 16 could be classified as liberalized (i.e., with the private sector determining prices without having to explicitly seek government permission), 9 countries fixed prices according to an automatic formula, and 16 directly controlled prices and adjusted them on an ad hoc basis.

Governments that directly control prices often impose price subsidies that keep domestic prices below border prices. This is particularly the case when international fuel prices increase sharply and governments are reluctant to pass these increases fully on to the domestic prices of petroleum products.[3] Where pricing formulas are in use, their application is often temporarily suspended or permanently abandoned—six of the reviewed countries had recently abandoned formula pricing. In a number of countries, fuel subsidies were projected to exceed 2 percent of GDP in 2005 even after recent substantial increases in domestic prices (e.g., Azerbaijan, 12.7 percent; Bolivia, 3.1 percent; Ecuador, 3.6 percent; Egypt, 4.1 percent; Indonesia, 3.2 percent; Jordan, 5.8 percent; and Yemen, 9.2 percent). In some countries, these expenditures were as least as large as public education and/or health budgets. For example, in Indonesia and Yemen, total subsidies were higher than the health and education budgets combined.

The recent sharp increases in world oil prices are, however, not unusual.[4] Since reaching a 28-year low in late 2001, oil prices have climbed by over 200 percent in constant U. S. dollars through November 2005. While such an increase is substantial, it is important to place it in historical context. Over the past 35 years, oil prices have fluctuated widely. Using real import prices for the United States as an illustration (Figure 1), prices initially jumped in

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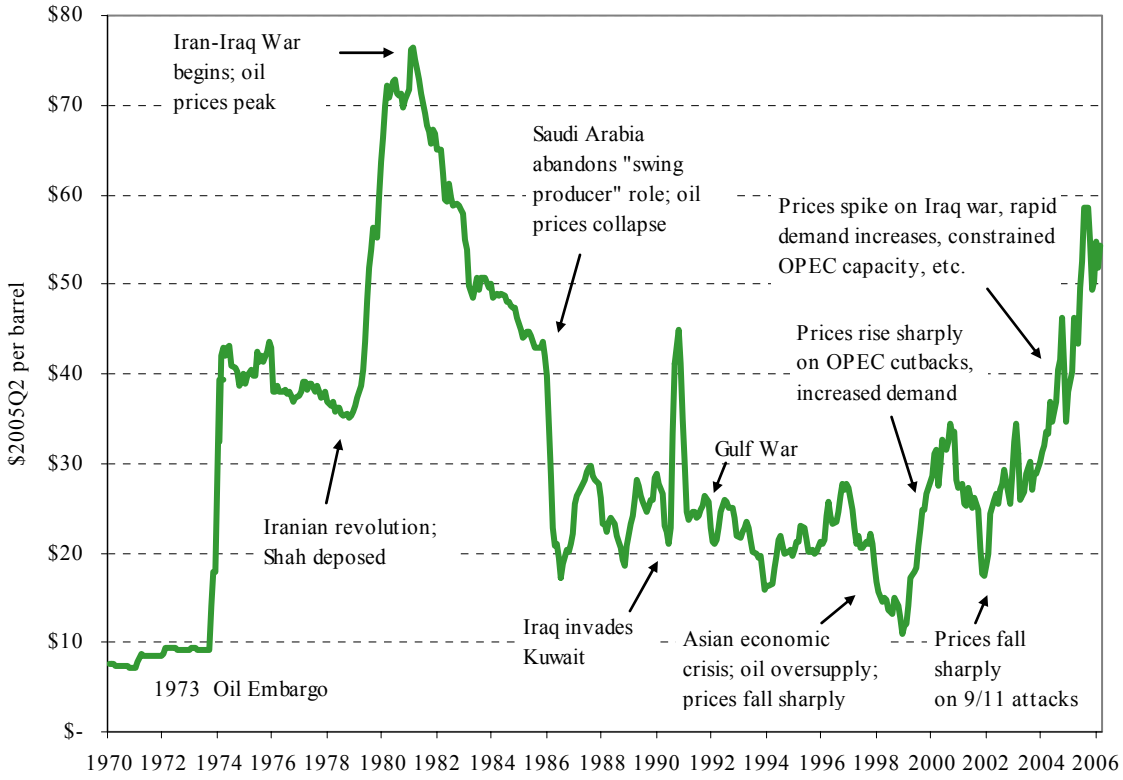
[2] In order to avoid sharp and frequent changes in domestic prices, automatic formulas typically use an average of past world prices and trigger changes in domestic prices once the average change in world prices exceeds a certain range. These formulas often also include an element of taxation. See the *Regional Economic Outlook* for Sub-Saharan Africa (May 2006) for a discussion of how countries in this region dealt with higher energy prices. For a discussion of the welfare and fiscal implications of alternative price smoothing rules, see Federico, Daniel and Bingham (2001). See Gupta and Mahler (1995) and Gupta and others (2000, 2003) for reviews of experiences with petroleum pricing in developing and developed countries.

[3] We will use the terms "fuel subsidies" and "petroleum product subsidies" interchangeably throughout the paper.

[4] Between July 2003 and August 2005, the international price of crude oil increased by more than 200 percent, from US$26 to US$60 per barrel. This increase is perceived to reflect structural changes generating higher demand (e.g., from relatively high growth in India and China), low stocks, and short-term supply constraints.

1973, with the Arab oil embargo. They jumped in the late 1970s and early 1980s, after the Iranian revolution, reaching a peak of almost $76 a barrel (2005 prices) in February of 1981. Prices fell steadily through the mid-1980s and, until recently, fluctuated primarily between $20 and $30 a barrel. Despite the huge recent increases, real oil prices have not yet reached the highs of the early 1980s.

Figure 1. Major Events and Real Price of U. S. Oil Imports, 1970–2006



Although they are politically popular, fuel price subsidies have adverse consequences for both government finances and the efficient use of energy and often result in shortages. [5] Large subsidies redirect public expenditures away from more productive spending or contribute to unsustainable budget deficits. Low fuel prices fail to provide the appropriate incentives to households to be more efficient in their use of energy, which would mitigate the

[5] Increasing domestic fuel prices is often an extremely politically sensitive issue, especially in crude oil-producing countries. For example, increases in Yemen in July 2005 led to widespread social disruption, which resulted in 22 deaths and hundreds injured. Similar public reactions have occurred in the past in Ecuador (1998), Indonesia (1998), Nigeria (2000), and Venezuela (1990). However, Gupta and others (2000, p. 13–14) conclude that such "violent reactions to subsidy reform are the exception rather than the norm, and often are not triggered by the reform alone."

overall adverse effect of higher world prices on the economy.[6] In fact, given that energy demand is inelastic and that there are negative consumption externalities associated with its use, taxation of petroleum products is generally regarded as an efficient way to raise government revenue.[7] Moreover, this paper will argue that universal energy subsidies are not a cost-effective way to protect the real incomes of poor households, since they involve substantial leakage of benefits to higher-income groups. Although the removal of fuel subsidies can often be regressive, especially where kerosene prices are increased substantially, the high underlying inequality in consumption results in higher-income households bearing a disproportionately high share of the total burden. Therefore, large cost savings (or, equivalently, greater protection) can be provided through the use of better-targeted subsidies, transfers, or other social expenditures.

The focus in this paper is primarily on evaluating the magnitude and distribution of fuel subsidies, with special emphasis on the likely impacts of their removal on the poorest households as well as alternative approaches to mitigating these adverse effects. In this sense, it sets out in detail how to implement the methodological approach identified in Gupta and others (2000b, Appendix 3). To this end, we draw on recent evaluations for Bolivia, Ghana, Jordan, Mali, and Sri Lanka. The format of the paper is as follows. In Section II, we summarize the methodology used to calculate the magnitude of consumer subsidies and their distribution across households at different parts of the income distribution.[8] In Section III, we summarize the findings from some background studies on specific country cases. It also describes some of the possible mitigating measures that might be adopted to protect low-income households from higher fuel prices. Finally, Section IV identifies some general policy lessons regarding the reform of fuel pricing.

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[6] For example, Iran, which has some of the lowest prices in the world, is one of the most energy-intensive countries in the world.

[7] It is possible that other, second-best considerations may dilute the argument for relatively high taxation of commercial energy. For example, high energy prices may encourage rural households to switch to the use of already overexploited natural resources such as fuelwood. However, a more efficient policy response to such overexploitation may be to directly manage these resources more efficiently and to improve access by these households to commercial energy sources. Note also that large cross-price effects between alternative commercial energy sources suggest that distorting their relative prices is a very inefficient approach to achieving distributional or environmental objectives. It is quite common for low kerosene prices to lead to inefficient substitution toward kerosene and illegal adulteration of diesel or gasoline. Such substitution toward low-taxed commodities results in revenue losses so that higher average tax rates are required to raise a given amount of revenue.

[8] We use the term "income distribution" to represent the distribution of consumer welfare. We typically use total household consumption per household member to proxy for welfare. For simplicity, we refer to the distribution of this variable as the income distribution.

II. Magnitude, Financing, and Distribution of Consumer Subsidies[9]

A. Consumer Price Subsidies and Their Financing

To calculate the magnitude of consumer subsidies, one needs to compare an actual consumer price with a reference price that captures the true opportunity cost of domestic consumption. Since most countries are either net exporters or net importers of petroleum products the appropriate reference price is the relevant border price, i.e., world prices adjusted for trade and transport costs to the country's border. In the case of an exporting country, the border FOB price minus trade and transport margins represents the forgone revenue from consuming domestically instead of exporting. In the case of an importing country, the border CIF price plus trade and transport margins represents the cost of domestic consumption. These reference prices can be viewed as "efficient" prices in that they maximize the sum of consumer and producer surpluses.

The difference between the actual consumer price and the reference price for each petroleum product represents the unit subsidy (actual less than reference) or tax (actual greater than reference) for that product. It is not uncommon for some products to be subsidized, while others are taxed. Multiplying this difference by annual product consumption and summing across products gives the total fuel subsidy (or the total cost of the subsidy). Comparing the actual to the reference price also provides the basis for identifying how much actual prices need to increase to eliminate the subsidy.

Whether or not the full consumer subsidy is reflected in the government budget (i.e., as an on-budget fiscal cost) will depend on the market structure of the petroleum sector and the government financing strategy. For example, consider the simplified case presented in Figure 2 where the country has a publicly owned refinery that produces Q^c at an average (equal to marginal) production cost of P^c. Assume also that a public sector firm is responsible for importing fuel when demand exceeds domestic supply. The reference border price is P^m, the subsidized consumer price is P^s, at which consumers (including households and firms) consume Q^s, and imports are $(Q^s - Q^c)$.[10] The total consumer subsidy is thus represented by the area (A + B + C).

If the government does not reimburse the refinery or importer for selling at P^s, then refinery profits are reduced by area A and the importer incurs a loss equal to areas (B + C). In other words, the consumer subsidy is financed by changes in the net profits of the two public sector firms. Notice also that the refinery still makes profits at the subsidized price, but that the importer makes a loss. Such losses are often financed by borrowing from the banking system and would be picked up by a comprehensive measure of public debt. Only if the government makes an explicit transfer to the public sector firms will the consumer subsidy be made explicit in the budget. If only the importer is compensated for losses—that is, the reduction in

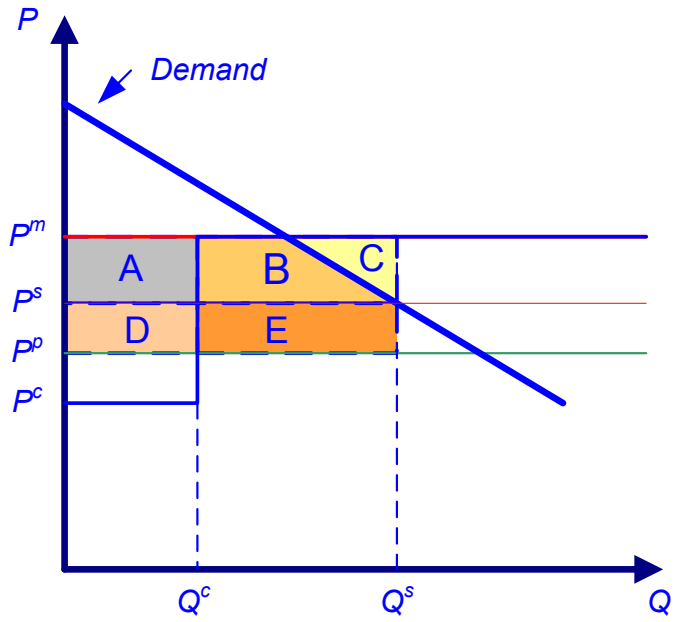
[9] More details on these issues are provided in Appendixes I and II.

[10] To simplify exposition we are implicitly assuming that domestic trade and distribution margins are zero.

profits of the refinery are not reimbursed—the subsidy expenditure will fall short of the total consumer subsidy by area A. This often happens in practice.

If petroleum products are taxed, the reference import price should include any existing taxes. For example, in Figure 2, if P^m includes a tax and public enterprises are still required to sell at P^s, then the net price to producers and importers is reduced to P^p (= P^s – *tax*). In this case, the net profits of public enterprises are decreased further by area (D + E), and the government receives revenue (D + E). The tax simply shifts revenue from the public enterprises to the budget, with no change in public sector finances. Often governments will respond to higher border prices by decreasing fuel taxes, while maintaining consumer prices at P^s, i.e., raising P^p, so as to avoid any affect on profitability of public sector firms or consumer welfare. In this case, government revenue absorbs the fiscal cost of the increase in the subsidy. Improving the fiscal position by the full extent of the consumer subsidy then involves increasing prices to the reference price, P^m, with public sector firms receiving (P^m-*tax*).

Figure 2. Magnitude and Financing of Consumer Subsidies



B. Welfare Impact of Higher Fuel Prices

Typically the bulk of petroleum is consumed indirectly through household consumption of other goods and services that use petroleum products as inputs. Therefore, the welfare effect of higher fuel prices—or, equivalently, lower fuel subsidies—on household real incomes will depend both on the *direct effect* of higher prices for petroleum products consumed by households and on the *indirect effect* arising from higher prices for other goods and services consumed by households to the extent that higher petroleum costs are passed on to consumer prices.

Direct effects

Calculating the *direct effect*, and how it is distributed across income groups, essentially requires information on the level of direct consumption of various petroleum products (e.g., gasoline, kerosene, diesel, and liquefied petroleum gas (LPG)) by individual households across the national income distribution. The main source of information is typically a household survey containing expenditures by each household on individual fuel products. A "first-order" estimate of the direct real income effect of fuel price increases can be calculated as follows. For each household one calculates the budget share of fuel expenditure items, i.e., fuel expenditures divided by total household consumption. Multiplying budget shares by the percentage increase in price due to the increase in fuel prices gives a first-order estimate of the real income effect of the price rise, which assumes that fuel consumption stays fixed. This overestimates the real income effect since, in practice, households can reduce this impact by substituting away from fuel.[11]

The incidence of the real-income effect can be analyzed by examining how the magnitude of the effect varies across the income distribution. Typically household per capita consumption, possibly adjusted for family composition, is taken as the best proxy of household welfare. Based on this measure, households can be allocated to quintiles or deciles of the national distribution. One can then analyze the incidence of the real income effect by calculating the average percentage real income loss for each decile or quintile. If the percentage real income loss is higher (lower) for low income households, then the incidence is said to be regressive (progressive).

Indirect effects

Identifying the magnitude of the *indirect effect* requires an estimate of the effect of higher fuel costs on the prices of other goods and services consumed by households. These price effects can be estimated using an input-output table of the economy showing the energy intensity of each sector and a simple model of the effect of higher fuel costs on prices (such a model is presented in Appendix II).[12] As with the direct effect, the indirect real-income effect can be calculated by multiplying the budget shares of the various goods and services by the estimated percentage price increases in these sectors. The incidence of the indirect effect can be determined by estimating the effect separately for households across the national income distribution.

The *total real income effect* is calculated as the sum of the direct and indirect real income effects, and the incidence can also be determined by calculating the average effect for households in different parts of the income distribution. In practice, reflecting the high

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[11] For a discussion of the theoretical foundations of this approach in the context of price and tax reforms, see Ahmad and Stern (1984, 1991), Newbery and Stern (1987), and Deaton (1997).

[12] Using the "distributional characteristic" widely used in tax reform analysis, Hughes (1987) summarizes the results of the application of a similar model to that used here to analyzing fuel price increases in Indonesia, Thailand, and Tunisia. Hope and Singh (1995) derive estimates for the direct impact of price increases for kerosene and electricity during the 1980s in Colombia, Ghana, Indonesia, Malaysia, Turkey, and Zimbabwe.

proportion of fuel consumed in the production and distribution of goods and services, the indirect effect accounts for over half of the total effect.

Approximation errors

How much, these "first-order" impacts overestimate the welfare effect of higher fuel and other prices will depend on how easily households and firms can in practice switch their consumption away from fuels and goods and services with relatively high-price increases towards those with relatively low increases. For example, consider the case where fuel prices increase by 50 percent, the initial budget shares for fuel and other goods and services are 0.05 and 0.95 respectively, and the initial cost share of fuel in the production of other goods and services is 20 percent. The price increase for other goods and services will depend on the ability of producers to substitute between fuel and other inputs. With the assumption of a zero elasticity of substitution maintained in the input-output framework, the price of other goods and services would increase by 10 percent (0.2 * 0.5). Our first-order estimate of the real-income loss would be 12 percent (1.5 * 0.05 + 1.1 * 0.95 - 1).

Alternatively, if we assume that production is characterized by a unitary elasticity of substitution, the price increase for other goods and services would be 8.4 percent ($1.0^{0.8} * 1.5^{0.2} - 1.0$). If we also assumed that consumer preferences exhibited unitary (marginal) elasticity of substitution, the total loss of real income would be 10.5 percent ($1.5^{0.05} * 1.084^{0.95} - 1.0$). The first-order estimate is an upper bound on the loss in real income, and the bias increases with the elasticities of substitution in production and consumption. Reasonable estimates of the elasticities of substitution in production and consumption are likely to be less than one, however, so the alternative estimate is likely to be biased downward. The first-order estimate is much easier to calculate, provides a bound on the real-income effect, and is likely to closely approximate a more sophisticated estimate. Finally, since one expects that short-run substitution elasticities are smaller than long-run elasticities, the first-order estimate will be a better approximation of the short-run welfare impact.

C. Alternative Approaches to Mitigation

The adverse impact of fuel price increases on already poor households is often highlighted as a key constraint on the removal of fuel subsidies. It is, therefore, important that the removal of subsidies be accompanied by measures to mitigate the adverse effects on the poorest households. In addition, it is important to emphasize that the budgetary savings from reducing fuel subsidies can be used to increase expenditures in areas that are typically seen as having higher priority, e.g., increasing access to or the quality of education and health services or physical infrastructure, or used to reduce taxes. In the context of reducing budget deficits, the counterfactual to fuel subsidy removal can be seen as a reduction of these social expenditures, an increase in taxes, or higher inflation, all which can have more adverse effects on the poor.

Ideally, governments would already have in place a social protection system that can be used to safeguard the real incomes of the poorest households.[13] If such a system is in place and is well designed and implemented, then it provides the most cost-effective approach to social protection. In a sense, access to such a system promotes the generation of efficiency gains associated with structural adjustment more generally by addressing directly any concerns regarding possible adverse affects on low-income households. In the context of price increases resulting from subsidy reforms, the desired transfer to low-income households can be maintained in real terms by inflation indexing the transfer.

If such a system is not available, either because no such program currently exists or that which exists is not effective, then a government's ability to protect the poor from price increases in the short term is restricted. Introducing an effective program from scratch obviously takes time, but so too does reforming an existing program. In this situation, the gradual withdrawal of subsidies may be warranted, while a more effective social protection mechanism is developed. This can be combined with some shorter-term measures that increase the resources available to any existing informal social assistance programs delivered through existing networks of community, religious, or other nongovernmental organizations. In addition, access costs to other public services, e.g., fees for education or health services, can be reduced in the poorest rural localities and urban districts. The particular approach used will obviously depend on the specific characteristics of each country, especially the nature of its social institutions and the extent of existing access to public services.[14]

In order to signal to the public its intention to use the budgetary savings more effectively, government can specify the expenditures to be financed by these savings. For example, it can announce the allocation of savings to the expansion of access to quality education and health services, electricity, or roads in rural areas. Or budgetary savings can be used to promote low-cost urban transport networks or investments in electricity, roads, and transport. In these cases, however, it is important to avoid immutable earmarking, which will only reduce the government's ability to respond to future challenges.

III. COUNTRY CASE STUDIES

In this section, we summarize the results from a set of country studies that applied the approach described above to evaluate the impact of proposed increases in the prices of petroleum products on household real incomes. The country case studies analyze (actual or hypothetical) price reforms in Bolivia, Ghana, Jordan, Mali, and Sri Lanka. The structure of this section follows that of the previous section. Subsection A summarizes market structure,

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[13] This point is made by Gupta et al (2000, p. 4) in the context of subsidies in general. They argue that the speed of subsidy reform can be faster when an effective social protection system exists in a country. Many of the countries in their sample adopted a gradual approach to subsidy reform, while simultaneously adapting existing social protection instruments or establishing a new safety net.

[14] A more detailed discussion of alternative approaches to protecting poor households is available in Gupta et al (2000). Coady, Grosh, and Hoddinott (2004) provide a detailed discussion of alternative methods of targeting transfers in developing and transition economies.

the approach to fuel pricing, and the magnitude of fuel subsidies. Subsection B describes the magnitude of the real income effect from the withdrawal of subsidies, and how it is distributed across the direct and indirect effects and across different household groups. Finally, Subsection C discusses alternative approaches to protecting the real incomes of poor households in the face of fuel price increases. We conclude by describing the policy responses of the various governments. Table 1 provides a summary of the reforms and their impacts discussed in more detail below.

A. Market Structure, Pricing Regime, and Fuel Subsidies

Of the five countries, only Bolivia is an exporter of crude oil, and all of the countries except Mali have oil refineries. The Tema Oil Refinery in Ghana produces about 70 percent of Ghana's consumption requirements and buys crude from Nigeria at a discount on world prices. The refinery has a monopoly on the production and importing of refined products, but recent reforms have allowed for private tendering for importing. The distribution of petroleum products is privatized, although with a significant public sector presence. Until early 2005, Jordan had a tradition of buying crude oil at concessional prices from neighboring countries (originally Iraq, more recently Saudi Arabia). This oil is refined by the Jordan Petroleum Refinery Company into petroleum products, which are sold on the domestic market at controlled prices. The government reimburses the refinery for any losses relative to a "cost-plus" basis. The Ceylon Petroleum Corporation in Sri Lanka imports crude oil to produce refined petroleum products. Domestic production meets only around 50 percent of domestic consumption requirements with the gap met from imports. The production, import, and distribution of petroleum products were the exclusive domain of the refinery up to 2002 when private sector participation in import and distribution was allowed. Mali imports all of its consumption needs.

All the countries, except Jordan, previously used and have recently abandoned automatic pricing formulas for setting the domestic prices of petroleum products. Bolivia introduced a pricing formula in 1996 as part of a major restructuring of the petroleum sector, but abandoned it in the late 1990s. Ghana introduced a formula in January 2003, while simultaneously increasing prices by an average of 90 percent. The formula was effectively abandoned in early 2003 when continued increases in world prices were not passed onto consumers. Sri Lanka introduced a pricing formula in 2002, but this was suspended in early 2004. Mali introduced a formula in 1994, but abandoned it in 2003. Until mid-2005 domestic prices tracked world prices and included a significant element of taxation. The concessional prices on crude oil received by Jordan helped avoid the need for either high domestic prices or automatic formulas until recently.

The decision to directly regulate domestic prices below border prices has resulted in substantial fiscal costs in the form of explicit budgetary subsidies and forgone revenue. Bolivia kept domestic prices low through a combination of explicit subsidies, lower tax rates, low refinery prices, and subsidized crude oil for the refinery. Prices were fixed from mid-2000 to early 2004, with only small increases since then. In 2004, the total consumer subsidy reached 4.3 percent of GDP, of which only 2.6 percentage points showed up on the budget in the form of explicit subsidies and forgone revenue. Low prices also led to

Table 1. Summary of Empirical Evidence on Real Income Impact of Fuel Subsidies

	Bolivia	Ghana	Jordan	Mali	Sri Lanka
Background	Automatic formula introduced in 1996 as part of sectoral reforms - abandoned in late 1990s. Low prices maintained by explicit subsidies, lower producer prices and decreasing taxation. Resulted in increasing subsidies, smuggling abroad and demand shortages.	Automatic formula introduced in January 2003 together with an average price increase of 90 percent. Formula subsequently abandoned when world oil prices increased, but new one (which includes taxes) has recently been introduced.	By 2004, receipt of crude oil on concessional terms was expected to end, and fuel subsidies were rising. In early 2004, the government announced intentions to gradually eliminate subsidy over four-year period and in line with a pricing formula that would include taxes.	Pricing mechanism is ad hoc. Until early 2004, domestic prices increased to cover most of world price rise (aided by substantial appreciation of currency against the US dollar).	Monthly pricing formula was introduced in 2002 with Rs. 2 per month cap on increase allowed for each product. This was suspended in early 2004. VAT on diesel was suspended. Now effectively an ad hoc pricing regime.
Size of fuel subsidy (percent of 2004 GDP)	Total subsidy equal to 4.3 percent, of which only 2.6 percent shows up in budget in form of explicit subsidy and forgone revenues	Explicit subsidy of 2.2 percent (In 2003 also reached 2 percent of GDP)	3.2 percent (In 2005, this was projected to increase to 8.5 percent if no action taken. Subsequent price increases meant that the actual subsidy bill was 5.8 percent of GDP in 2005)	2 percent loss in tax revenue due to decreasing tax rates and exemptions for some sectors (especially mining).	2.1 percent (but also energy taxes – VAT on diesel and excises on gasoline - raised 1.2 percent)
Price increases (simulated)	Raising prices of gasoline and diesel to world prices and LPG by 67 percent.	Restoring a formula price that includes taxes	Eliminating subsidies and imposing a standard general sales tax at 16 percent.	Raising oil prices by 34 percent to mimic increases in world price between 2001 and 2005.	Raise average oil prices by 36.7 percent to reach formula prices.
Kerosene	n.a.	49 percent	80 percent	34 percent	94 percent
LPG	67 percent	108 percent	48 percent	34 percent	n.a.
Diesel	40 percent	67 percent	77 percent	34 percent	40 percent
Gasoline	40 percent	17 percent	No change since tax>16 percent	34 percent	14 percent
Other	n.a.	50 percent (Fuel Oil)	77-84 percent	34 percent	n.a
Total	50 percent	50 percent	68 percent (excl. gasoline)	34 percent	37 percent

Table 1. Summary of Empirical Evidence on Real Income Impact of Fuel Subsidies (concluded)

	Bolivia	Ghana	Jordan	Mali	Sri Lanka
Aggregate real income impact (range from bottom to top income quintiles)					
Direct	1.6 percent (1.8-1.7)	1.9 percent (2.9-1.4)	2.0 percent (3-1.7)	0.9 percent (0.9-0.1)	1.2 percent (1.8-1.1)
Indirect	3.3 percent (4.1-3.0)	6.7 percent (6.2-6.8)	2.4 percent (2.3-2.4)	0.8 percent (0.9-0.9) (1.1 if electricity included: 1.0-1.2)	1.2 percent (1.2-1.2)
Total	5.0 percent (5.8-4.7)	8.5 percent (9.1-8.2)	4.4 percent (5.4-4.1)	1.7 percent (regressive, U) (1.9 if electricity incl.)	2.4 percent (2.9-2.2)
Share of subsidy received by poorest 40 percent					
Direct (kerosene)	n.a.	29.5 percent (39.7 percent)	22.9 percent (33.3 percent)	22.6 percent (35.4 percent)	27.2 percent (40.0 percent)
Indirect	n.a.	21.4 percent	19.8 percent	24.4 percent	23.0 percent
Total	15.3 percent	23.0 percent	21.2 percent	23.9 percent	25.1 percent
Policy response	Increased price by 10 percent for gasoline and 23 percent for diesel – the latter was reduced to 15 percent after social unrest. No plans for further increases. No specific mitigating expenditures implemented.	Prices increased on average by 50 percent in February 2005 together with package of expenditures to mitigate impact on poor. Set up independent authority to implement pricing system.	In July 2005, government increased domestic prices by around 27 percent to reduce subsidies to 3 percent of GDP in 2005. Also introduced mitigating measures. Because of further increases in world prices, domestic prices were increased by 14 percent in September 2005. Government intends to fully liberalize the pricing of fuel products by 2008.	Considering reintroducing a pricing formula.	Prices of all petroleum products were increased in the first half of 2006 to limit increases in fuel subsidies.

substantial smuggling to neighboring countries facing higher domestic prices.[15] In Ghana, explicit subsidies to the refinery and distributors to compensate for below-formula prices reached 2.2 percent of GDP in 2004, equivalent to around 3.2 percent on an annualized basis. Tax revenue from fuel products accounted for nearly 4 percent of GDP in 2004. Consequently, the incidence of the subsidies fell entirely on the refinery and distributors.

In Jordan, explicit net subsidies on petroleum products were 3.2 percent of GDP in 2004 and, in the absence of price increases, would have increased to over 8 percent in 2005. Gasoline has traditionally been taxed, generating revenues equivalent to 1.2 percent of GDP in 2004, which were used to cross-subsidize products. Despite several domestic price increases, net fuel subsidies are expected to reach about 2 percent of GDP in 2006. In Mali, aided by a substantial currency appreciation against the dollar, domestic prices were above international prices until mid-2005. Since then, price increases have been restrained reducing excise tax rates. Petroleum products have traditionally been taxed, with the tax component in pump prices ranging from over 20 percent for kerosene to nearly 50 percent for gasoline. The revenue losses have been estimated at 2 percent of GDP for 2004, largely on reducing excise tax rates. In Sri Lanka, formula prices included value-added tax (VAT) on diesel and gasoline as well as excises on all products. The VAT on diesel was eliminated in August 2005 and the domestic prices of diesel and kerosene were below import parity. The total fiscal cost of subsidies was estimated at 2.1 percent of GDP on an annualized basis, but subsequent price increases meant that the outturn for 2005 was approximately a subsidy level equivalent to 1.1 percent of GDP.

Domestic price controls have resulted in significant distortions on petroleum products that vary across products.[16] In Bolivia, the ex-refinery domestic prices for regular gasoline and diesel fell to about 70 percent of international prices by early 2005, while for LPG the domestic price fell to one half of the reference export price. To bring the domestic consumer prices in line with the international average and restore excise tax rates to their 2000 level, retail prices for diesel and regular gasoline would have to increase by around 40 percent, and prices for LPG would have to double. In Ghana, raising prices to formula prices would have required a 50 percent average increase in prices in early 2005, ranging from 17 percent for gasoline to 108 percent for LPG. In Jordan, domestic prices for gasoline were substantially above equivalent import prices in early 2005, with an implicit tax rate on regular gasoline of 42 percent and on premium of 60 percent. The price increases necessary to eliminate the subsidies on other products were substantial, ranging from 59 percent for diesel to 65 percent for fuel oil used in the generation of electricity. Moving to a situation where petroleum products faced the same 16 percent general sales tax as other final goods, the required price increases for these products would be even more substantial, ranging from 77 percent for diesel to nearly 84 percent for fuel oil used in electricity generation.

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[15] Similar problems with smuggling subsidized fuel to neighboring countries with higher prices have been encountered in Iran, Iraq, Nigeria, and Yemen.

[16] Typically subsidy rates are higher for kerosene than for diesel, although absolute diesel subsidies are typically substantially higher due to higher consumption levels. Gasoline usually carries lower subsidies and is often taxed. The import cost of gasoline, diesel, kerosene, and LPG are approximately equal.

B. Real Income Effect of Increasing Petroleum Product Prices

It is clear from above that restoring the pricing formula in each country would require substantial increases in domestic petroleum prices. Using the approach outlined earlier, this section presents estimates of the likely impact of these price changes on household real incomes, and how it is distributed across households with different income levels. These estimates were obtained from individual country-specific analyses that evaluated the effects of increasing fuel prices to international levels (see Table 1 for the required increases in each country).

The direct effect on households depends on the total budget share for petroleum products as well as the distribution of expenditure across individual products.[17] The *direct effect* on household real incomes of the price increases considered ranges from 0.9 percent for Mali (where simulated price increases were lowest) to 2 percent for Jordan (where simulated price increases were highest). In all cases, the direct effect is either approximately distributionally neutral (Bolivia and Mali), or regressive (Ghana, Jordan and Sri Lanka). Where it is regressive, it reflects the combination of the high importance of kerosene for the poorest households and relatively high price increases for this product. In Bolivia, kerosene was not an important fuel, while in Mali low-income households are hardly affected by gasoline price increases.

Table 2 presents estimated budget shares by product and income group for each country. The budget shares for petroleum products range from 3.1–4.4 percent. The 6.6 percent share for Jordan includes spending on electricity, which accounts for 2.3 percent of total spending. In general, diesel is mainly consumed in production, with households consuming relatively small quantities. In all countries except Ghana and Jordan, low-income households allocate a lower proportion of their budget to energy. In Ghana, the relatively high budget share for low-income households reflects the relatively high usage of kerosene. In Jordan, where the budget shares are similar across all income groups, electricity accounts for a relatively high share of energy consumption—the budget share for petroleum products is highest in the top quintiles.

In all countries, gasoline is consumed primarily by higher income households, whereas kerosene is relatively more important in the budgets of lower income households. In Ghana, Mali, and Sri Lanka, where kerosene is extensively used, it is the dominant component of the energy budget for lower-income households, accounting for over 67 percent in all cases. In Jordan, where electricity access is almost universal, kerosene expenditures are relatively less

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[17] Typically kerosene is used for lighting and heating, especially where households do not have access to electricity. Diesel is typically used in goods and passenger transport, agriculture (e.g., pumps and engines) and industry—the latter two channels are incorporated through the indirect effects. Gasoline is typically used for transport. Diesel and kerosene are near perfect substitutes since large quantities of kerosene can be added to diesel fuel without much impact on vehicle performance—low kerosene prices relative to diesel thus usually result in the diversion of kerosene to the automotive diesel sector. Adulteration of gasoline with kerosene in other than small quantities can cause damage to vehicles. In the long run, gasoline and diesel are close substitutes, e.g., through the switching from gasoline- to diesel-powered vehicles with an associated worsening of air pollution.

important for lower income households. LPG consumption is low for all households in Ghana and Mali and relatively high for lower income groups in Bolivia and Jordan, but more important for higher income groups in Sri Lanka.

The *direct effect* on household real incomes of the price increases considered ranges from 0.9 percent for Mali (where simulated price increases were lowest) to 2 percent for Jordan (where simulated price increases were highest). In all cases, the direct effect is either approximately distributionally neutral (Bolivia and Mali), or regressive (Ghana, Jordan and Sri Lanka). Where it is regressive, it reflects the combination of the high importance of kerosene for the poorest households and relatively high price increases for this product. In Bolivia, kerosene was not an important fuel, while in Mali low-income households are hardly affected by gasoline price increases.

Table 2. Fuel Budget Shares, by Income Quintiles
(In percent of total consumption)

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All
Bolivia						
LPG	2.6	2.3	2.1	1.7	1.1	1.5
Gasoline and diesel	0.0	0.0	0.3	0.5	2.5	1.6
Total	2.6	2.4	2.4	2.2	3.6	3.1
Ghana						
Kerosene	5.9	4.1	3.4	2.4	1.6	3.5
LPG	0.0	0.0	0.0	0.1	0.2	0.1
Gasoline	0.1	0.1	0.2	0.2	2.1	0.6
Total	6.0	4.2	3.6	2.5	3.9	4.2
Jordan						
Kerosene	1.0	0.7	0.6	0.3	0.3	0.6
LPG	1.8	1.3	1.2	0.7	0.7	1.2
Gas regular	0.9	1.4	1.9	2.3	2.3	1.7
Gas premium	0.0	0.1	0.2	1.1	1.1	0.3
Diesel	0.3	0.4	0.4	0.9	0.9	0.5
Electricity	3.1	2.3	2.1	1.8	1.8	2.3
Total	7.1	6.1	6.3	7.1	7.1	6.6
Mali						
Kerosene	2.0	1.5	1.5	1.3	0.9	1.5
Gasoline	0.6	0.7	0.7	1.1	2.0	1.0
Diesel	0.0	0.0	0.0	0.1	0.1	0.0
Charcoal	0.1	0.1	0.3	0.5	0.9	0.4
Electricity	0.0	0.1	0.2	0.5	1.5	0.4
Total	2.7	2.4	2.7	3.5	5.4	3.3
Sri Lanka						
Kerosene	1.8	1.2	0.9	0.8	0.4	1.0
LPG	0.1	0.2	0.2	0.6	1.4	0.5
Gasoline and diesel	0.0	0.2	0.3	0.5	1.6	0.5
Electricity	0.8	1.1	1.1	1.5	2.1	1.3
Total	2.7	2.6	2.6	3.4	5.4	3.3

The *indirect effect* on household real incomes ranges from 1.1 percent for Mali to 6.7 percent for Ghana. In all cases, the magnitude of the indirect effect is at least equal to that of the direct effect. With the exception of Sri Lanka, the indirect effect is dominant when the electricity price effect is included in this effect. In all cases except for Bolivia, the distribution of the indirect effect is either very slightly progressive or neutral. In Bolivia, where the analysis focused only on the indirect effect of higher fuel prices on the prices of food and public transportation, the indirect effect was strongly regressive.

The *total effect*, i.e., combined direct and indirect effects, ranges from nearly 2 percent for Mali to 8.5 percent for Ghana. A simple averaging across country studies suggests that a 50 percent average increase in fuel prices results on average in a 4.6 percent decrease in real incomes. In all cases except Mali, the distribution of the total effect is regressive. For Ghana, Jordan, and Sri Lanka, this reflects the distribution of the direct effect, given that the indirect effect is approximately neutral in these countries. In Bolivia, the indirect effect is more regressive than the direct effect. In Mali, the total effect is approximately neutral—in fact, the percentage decrease in real income is somewhat smaller for the middle quintile compared to the top and bottom quintile.

Although the removal of fuel subsidies is regressive (or, at best, neutral), it is still the case that a substantially higher proportion of the aggregate burden is borne by higher income groups. This, of course, reflects the very unequal distribution of income in these countries: a regressive distribution of the burden simply means that the share borne by low-income groups is greater than their share of total income. Conversely, the share of low-income groups in the benefits from fuel subsidies is also relatively low. For example, the share of the poorest 40 percent of households in the total benefits from fuel subsidies ranges from 15.3 percent for Bolivia to 25.1 percent for Sri Lanka. Therefore, between 75–85 percent of subsidy benefits accrue to the richest 60 percent of households.[18]

Even an equal uniform transfer to all households would be better targeted than existing subsidies, since 40 percent of benefits would accrue to the poorest 40 percent of households. The very poor targeting of fuel subsidies is not surprising; almost any universal consumption subsidy will disproportionately benefit the rich since they, by definition, account for a relatively high proportion of total income and consumption. Even the direct subsidy, which reflects subsidies to kerosene, involves substantial leakage to the non-poor, with 70–80 percent accruing to the top 60 percent of households. One would expect a reasonably effective direct transfer program to target substantially better than this, and a recent review of transfer programs in developing countries by Coady et al (2004) provides ample empirical evidence of such programs in developing countries. The following section expands further on this issue.

[18] Similar findings have been reported for other countries: in the early 1990s, the top 20 percent of households in Venezuela received six times the subsidy received by the bottom 30 percent. A study of fuel subsidies in Indonesia in 1999 found that only 20 percent of subsidy benefits went to the poorest 30 percent of households.

C. Identifying Alternative Approaches to Mitigation

Although a relatively low proportion of fuel subsidies reaches low income households, it is still the case that these households can suffer a substantial decrease in real income as a result of their withdrawal. For example, the percentage decrease in real income for the poorest income quintile ranged from 1.8 percent for Mali to 9.1 percent for Ghana. Even the relatively low declines for Mali (1.8 percent) and Sri Lanka (2.9 percent) should be assessed in the context of the extreme poverty of these households, and some households within this income group will suffer more substantial losses than others. These impacts are also relatively large when compared to growth in real income. For example, the 1.8 percent decline in real incomes for Mali is relatively large when compared to recent per capita real-income growth rates, which have averaged 2–3 percent per annum. It is important for any reform strategy to identify alternative and more effective mechanisms for providing and appropriately targeting protection.

More generally, beyond an exclusive emphasis on the poor, it is important to identify more desirable uses for the budgetary savings from the withdrawal of fuel subsidies. The very poor targeting performance of universal fuel subsidies means that it should be possible to identify more effective social protection mechanisms that protect the poorest households from increases in fuel prices and still have substantial savings left over to allocate to higher priority expenditures or tax cuts that benefit the population more broadly. Persuading the population that budgetary savings will indeed be used in this fashion is a crucial component of the political economy of the reform process.[19] Moreover, if it is likely that any savings will be squandered on programs that benefit an elite and politically connected minority, then (unfortunately) fuel subsidies in reality may be an attractive second-best policy. In such a situation, improving governance should be the highest priority reform.[20]

Use of existing safety nets

In practice, how to compensate poor households will depend on whether an effective social safety net already exists. If it does, then some of the budgetary savings can be used to expand the program, e.g., expanding eligibility for cash or ration card transfers as well as increasing their value. A well-designed transfer program can avoid distorting economic decisions, while both ensuring extensive coverage of poor households and minimizing leakage to higher income groups. Fuel subsidies, on the other hand, encourage an inefficient level and composition of fuel consumption and, at the same time, transfer substantial public resources to higher income groups. In the case of Sri Lanka, a national safety net does exist, and the study demonstrated that its core component, the Samurdhi food stamps program, was

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[19] In Indonesia, for example, public perception was that any expansion of existing safety net expenditures would likely be captured by higher income households. To counteract this, the government introduced an unprecedented cash (as opposed to in-kind) transfer, delivered directly to most eligible households via an extensive network of post offices. This program helped avoid a repetition of the riots, deaths and widespread social and political disruption that accompanied previous fuel price increases. It is still unclear how effectively this program has been implemented.

[20] See Esfahani (2002) for a political economy interpretation of policy reform in the context of fuel subsidies.

substantially better targeted than kerosene subsidies. Under this program, 52 percent of transfers accrued to the poorest 40 percent of households compared to 41 percent of kerosene subsidies. The program also had extensive coverage of lower income households—63 percent of the poorest 20 percent of households received transfers compared to the 78 percent who benefited from fuel subsidies.

Although existing safety net programs may provide an attractive alternative to kerosene subsidies, often their current design and implementation effectiveness could be substantially improved. In the case of Sri Lanka, the World Bank has been identifying better targeting mechanisms. Under the existing program, eligibility is determined by local administrators through Samurdhi organizations and is, in principle, based on the assessment of household income and economic status. The proposed targeting mechanism was to be based on a proxy-means targeting approach that identified poor households by attaching a numerical weight to various household socio-economic characteristics to calculate a household score. Households would then be chosen if their score was below a certain threshold score. Simulations for Sri Lanka indicated that this scheme could significantly improve targeting, with the proportion of transfers accruing to the bottom 40 percent increasing to 67 percent (mainly at the expense of the highest income group) and coverage of the poorest 20 percent of households increasing to 82 percent. A similar simulation was undertaken for Ghana estimated that 65 percent of transfers would accrue to the poorest 40 percent of households compared to a corresponding 40 percent for kerosene subsidies.

Of course, such performance assumes effective implementation, so sufficient resources also need to be devoted to improving implementation as well as design of programs. Since this may take time, the potential for using existing safety net programs may be limited in the short run. For example, in Jordan, the primary safety net program, The National Aid Fund, had been established in 1986 after the elimination of food subsidies. Although it is the most comprehensive transfer program in the country and manages to target transfers to the poorest households, its coverage of the poorest households was extremely low. Over 50 percent of its transfers accrued to the poorest quintile and over 75 percent to the bottom 40 percent of households. This compares very favorably to the distribution of kerosene subsidies in Jordan, where less than 15 percent of benefits reach the poorest quintile. However, the program covered only 14 percent of the lowest income decile and less than 12 percent of the lowest quintile. The challenge is, therefore, to maintain the program's ability to channel funds to low-income households without incurring higher leakage as the program expands to cover a substantially greater proportion of low income households. Since this could only be achieved by investing resources in improving the design and implementation of the program, this program could not be used to effectively mitigate the adverse impact of subsidy withdrawal in the short run, so that alternative approaches would be required.

Short-term mitigation measures

In the absence of an effective social safety net, the particular approach used to provide short-term protection will depend on the specific characteristics of each country, especially the nature of social institutions. Governments can often undertake a number of immediate expenditure measures to signal the government's intention to protect the poorest households from the adverse effects of price hikes. For example, user charges for education and health

services can be reduced or eliminated in the poorest rural and urban areas. Public works programs can be temporarily expanded. Such programs not only protect household real incomes, but can contribute to expanding the human and physical asset base of poor households. Extra funds (in cash or kind) may be provided for informal social assistance programs delivered through any existing network of community, religious, or NGO bodies. For example, since Bolivia does not have a dedicated safety net program, the distribution of LPG through religious and community organizations may be an effective short-term measure to mitigate the impact on the poor. However, it is important not to incur sizeable fixed costs for programs that may be very small in size and of a temporary nature. Neither should the creation of reform-specific measures be encouraged since, in an environment where widespread structural reforms are needed, this can give rise to a myriad of duplicative and ineffective programs. A well-designed safety net system helps avoid such bad outcomes and facilitates structural reform more generally.

In Ghana, where a dedicated safety net was not available, the government packaged fuel price increases with a range of expenditure measures. Fees for attending primary and junior secondary school were eliminated. Extra funds were made available to an existing program, the Community Health Compound Scheme, to enhance primary health care in the poorest areas.[21] Planned investment in the provision of mass urban transport was expanded and expedited. In Jordan, the minimum wage was increased, as were the salaries of low-paid government employees. A one-time bonus was given to low-income government employees and pensioners.[22] Following the price increase in early 2006, the government provided a direct cash transfer on an income-tested basis to the poor and improved the targeting of the National Aid Fund—the main instrument for social assistance.

Relative to fuel subsidies, targeting extra public expenditures using detailed information on the characteristics of the poor can substantially reduce leakage to higher income households. For example, simple geographic targeting (concentrating extra social expenditures on households living in the poorest areas) can result in a much higher proportion of the expenditures benefiting poor households. However, this excludes poor households living in other areas. Since poverty rates in these excluded areas are lower, reducing under coverage without a deterioration in leakage requires finer targeting methods, such as means testing (eligibility based on income, or on a predicted income based on household socio-economic characteristics), or community targeting (eligibility determined by community actors, such as teachers or community leaders, deemed to have better knowledge regarding households'

[21] Both the Community Health Compound Scheme (which targets areas without basic health facilities and provides a community nurse, basic infrastructure, training, and basic transportation) and an education "capitation grants" scheme had been identified in the country study as potential uses of budgetary savings from eliminating fuel subsidies. The latter program had been in existence since September 2004 in 40 of the most deprived districts in the country (out of a total of 138 districts).

[22] For Jordan, targeted increases in the minimum wage and pensions for low-paid government employees, poorer workers, and retirees had been identified in the country study as potential ways for mitigating the adverse effects of fuel price increases on the poor. Note also that one-time bonuses may generate future budgetary claims if these are expected every time prices increase.

economic welfare). Evidence across a number of developing countries indicates that these approaches to targeting can be effective.

Changing the level and structure of electricity prices may also help to protect some poor households from fuel price increases. For example, many countries charge a lower residential "lifeline tariff" for electricity consumption below a certain "lifeline limit." It is important to keep this limit at or below the quantity typically consumed by poor households to better target the subsidy. The subsidy can be clawed back from higher-income households by adjusting the tariffs for higher consumption levels. Such measures can often be introduced relatively quickly. In Jordan, where electricity access is almost universal, and electricity is the most important source of energy for the poor, higher fuel prices were not passed on to the subsidized lifeline rate, which was maintained at its existing level.

However, a lifeline tariff is ineffective when poor households are not connected to the electricity network. For example, for Sri Lanka, the redistributive potential of tariff restructuring and non-linear pricing was examined. It was estimated that under the existing subsidized tariff structure less than 15 percent of the subsidy accrued to the poorest 40 percent of households. It was also found that although restructuring the tariff could improve targeting, its ability to do so was severely limited not only by the lack of access by poor households to the electricity network, but also by the low correlation between electricity use and income among those with access. Under the most redistributive simulation, which involved tariffs above cost recovery at high usage levels, less than 8 percent of the subsidy accrued to the bottom quintile and only 23 percent to the bottom 40 percent of households.

Improving social protection in medium term

Where the availability of short-term mitigation measures is limited, fuel subsidies can be reduced gradually while simultaneously enhancing the government's capacity to target social assistance. This approach was applied in Jordan, where the government is eliminating subsidies over several years. However, there is an obvious trade-off in terms of lower budgetary savings. This trade-off can be reduced by decreasing the subsidies to some products more gradually than others. For example, one might maintain kerosene subsidies, while reducing other subsidies gradually over a year or two. In Jordan, the prices for kerosene and LPG were increased more gradually and emphasis placed on improving the effectiveness of the National Aid Fund over time. Distortions of relative prices should be avoided when possible, however, to prevent inappropriate and counterproductive substitution among fuels. The Jordan country study focused on a more gradual withdrawal of LPG subsidies precisely because kerosene subsidies were seen as being already relatively high and further distortion of its relative price would encourage even greater inefficient fuel substitution.

Improving social protection is just one of several options for making government spending more productive and equitable. Typically, increasing spending on nutrition, health, and education is seen as a priority in developing countries. Other priority areas include expansion of the electricity and roads network in rural areas. Such investments are likely to benefit lower income groups for whom existing access and utilization rates are relatively low—in more technical terms, the *marginal benefit incidence* of these expenditures is likely to be

strongly progressive. In the present context, increasing the poor's access to electricity provides a relatively cheap source of energy both in terms of monetary and environmental cost. Using budgetary savings to expand the existing rural electrification scheme was a prominent component of the expenditure package introduced by the Ghanaian government simultaneously with fuel price increases. The incidence of the benefits from these expenditures was found to be strongly progressive.

In the long run, the best way of avoiding wasteful public expenditures on distortionary and badly targeted fuel subsidies may be to insulate price setting from political pressure as much as possible. Both Ghana and Jordan have made moves in this direction. In mid-February 2005, when the Ghanaian government increased petroleum prices by on average 50 percent, it also announced its intention to introduce a new pricing formula in order to remove the government from pricing decisions.[23] In addition, it also emphasized its commitment to continue sectoral reforms that would further increase private sector participation in the import and distribution of petroleum products. In June 2005, the government established the National Petroleum Authority to monitor the implementation of the pricing mechanism and facilitate the withdrawal of government from the politically sensitive issue of petroleum pricing. The composition of the authority includes representatives from government, oil-marketing companies, trade unions, and non-governmental organizations such as the association of Ghana Industries, as well as various experts. This system seems to be working since prices were increased again in June, August, and October of 2005 in response to a continued increase in world petroleum prices and, in 2006, quarterly price adjustments were replaced by monthly price adjustments in order to reduce short-term subsidies when international prices continued to increase. The Jordanian government also intends to move to an automatic pricing formula and greater liberalization of the sector, which will also include taxes, once the current subsidies have been phased out.

IV. Concluding Remarks

With the substantial increase in world oil prices since 2003, the issue of petroleum product pricing—and energy pricing more generally—has become increasingly important in developing countries. Reflecting the reluctance of many governments to pass these price increases onto energy users, energy price subsidies are absorbing an increasing share of scarce public resources, thus curtailing flexibility to increase—or even maintain—social and infrastructure spending. A common justification given for continued subsidies is to curtail adverse effects on poor households. Other justifications include, for instance, efforts to maintain competitiveness, or avoid inflationary pressures.

This paper identifies the issues that need to be discussed when analyzing the fiscal and social costs of fuel subsidies. Using examples from analyses recently undertaken for five countries (Bolivia, Ghana, Jordan, Mali, and Sri Lanka) that used similar methodologies, it quantifies the magnitude of consumer subsidies and their fiscal implications. It also describes the

[23] The pricing formula includes excise and value-added taxes as well as a "mitigation levy" to raise funds estimated at 0.35 percent of GDP to finance mitigating expenditures.

approach used to evaluate the magnitude of the impact of price reforms on the real incomes of households and how these are distributed across households at different parts of the income distribution. Finally, it discusses alternative approaches to mitigating the adverse effects of price increases on poor households.

The most important finding is that energy subsidies are badly targeted in all the countries analyzed here. This even holds true for kerosene, for which subsidies are often promoted as a way of protecting the poor. Reflecting this, the real income burden resulting from the withdrawal of energy subsidies is borne disproportionately by higher-income households. That said, lower income households do suffer sizable real income decreases from subsidy removal, and any credible policy strategy, therefore, needs to address the mitigation of these adverse effects.

By far the most efficient and effective way to protect the poor is to allocate some of the budgetary savings from the elimination of fuel subsidies to a well-targeted social safety net that has high coverage of poor households and little leakage to nonpoor households. To the extent that existing social safety net programs do not exist or are badly targeted, the gradual removal of fuel subsidies can help protect the real incomes of the poor, while the targeting of existing programs is improved or new programs are developed. For example, kerosene subsidies may be maintained while other subsidies are removed. However, there may be substantial efficiency, as well as revenue, costs associated with such a strategy. Therefore, it is important that alternative mechanisms are developed as rapidly as possible and fuel subsidies phased out accordingly.

The paper also highlights the important role that ex ante poverty and social impact analysis can play in informing the policy debate and influencing policy responses. To be effective, such policy debates must clarify the main issues that needed to be addressed and evaluate a menu of policy responses. Poverty and social impact analysis can play an important role in achieving these goals.

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APPENDIXES

I. IDENTIFYING MAGNITUDE AND FINANCING OF FUEL SUBSIDIES

The quantification of price subsidies for petroleum products and their implications for the budget can be complicated. This appendix will address these issues in several steps. First, we define price subsidies under alternative market regimes. Second, we define alternative measures of aggregate subsidies, distinguishing between consumer and producer subsidies. Finally, we discuss the manner in which aggregate subsidies are financed and the consequent implications for government finances.

A. Defining Consumer Price Subsidies

A petroleum product price subsidy received by consumers is simply the difference between an appropriately defined *reference price,* and the price actually charged. The problem encountered in quantifying subsidies is the determination of the appropriate reference price. We start from the assumption that the appropriate reference price is the marginal social cost of consuming the particular product. Three prices can—either individually or in combination—meet this criterion. The choice depends on whether the product is traded *in the absence of the subsidy* and the direction of the trade flow. Abstracting for the moment from domestic distribution costs, the three options are:[24]

- *Export price* ($p^x = p^* - t^x$): For simplicity, we assume a single, exogenously determined "world" price, p^*, to which the cost of transportation, t^x, to the border is subtracted to obtain the export price.

- *Import price* ($p^m = p^* + t^m$): This price is based on the same "world" price, but with (a potentially different) transportation cost added.

- *Marginal cost of domestic production* (p^d): We assume, in this case, a regulated or government-owed monopoly, allowing prices to be set at marginal cost. We also assume that the capital stock is fixed in the short run, yielding an upward-sloping supply curve, and used efficiently.

The import price is always higher than the export price, and both prices exist, regardless of whether trade takes place. The choice of the reference price depends on the relationship between the marginal domestic cost and the import and export prices *at the quantity demanded in the absence of the subsidy* (q^*). There are three possibilities for this relationship, each of which leads to one of the prices specified above.

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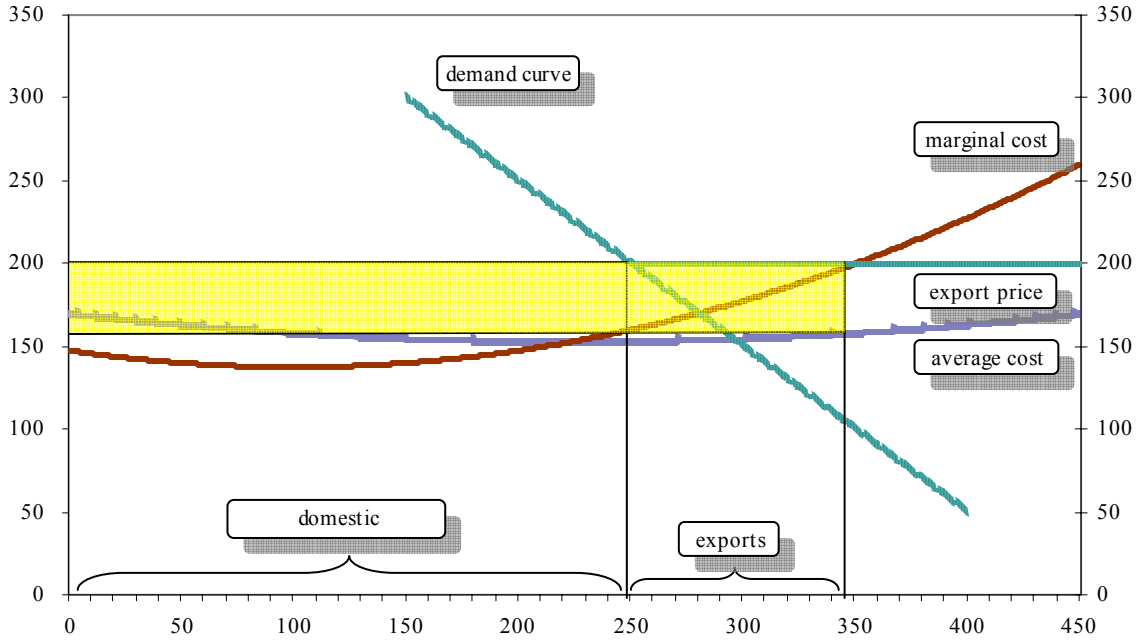
[24] Throughout, we assume that the country has no monopoly or monopsony power on the world market. However, in the presence of such power, our discussion goes through if the world price is replaced by the marginal revenue or cost at world prices. See Gupta, and others (2004) for discussion of an endogenous world price.

Export cases

If $p^m > p^x > p^d(q^*)$, the country can profitably export in the absence of the subsidy. If the country can still profitably export in the presence of the subsidy, the choice of the export price as the reference price is obvious and simple. The export price is both the marginal and average cost of meeting the increased demand generated by the imposition of the subsidy. Absent the subsidy (Figure 3), domestic consumption would be limited to the amount demanded at the export price (the effective demand curve is kinked), and the remainder of production would be exported. The domestic producer would enjoy profits denoted by the shaded area. With the subsidized price (broken line in Figure 4), domestic consumption would expand to the intersection of domestic demand and the subsidized price, and exports would decrease. The resource cost of the subsidy would be the shaded area. This area is an upper bound on the benefit to consumers, which is equal to the part of the shaded area to the left of the domestic demand curve. It is identical to the benefit to consumers if demand is perfectly inelastic.

Figure 3. Demand and Supply in Presence of Exports



If the imposition of the subsidy increases demand enough that production for export is no longer profitable, the calculation of a reference price is more complicated. In this case (Figure 5), the resource cost of the subsidy equals the shaded area, as in the previous case, *plus* the triangular area to the right of the intersection between the marginal cost curve and the export price. Consequently, the reference price is a weighted average of the export price and the average cost of supplying the increased demand, with the weights equal to the unsubsidized demand and the increase in demand, respectively. The shaded area is still an upper bound on the benefit to consumers, but is now a lower bound on the resource cost.

Figure 4. Price Subsidy in Pure Export Case

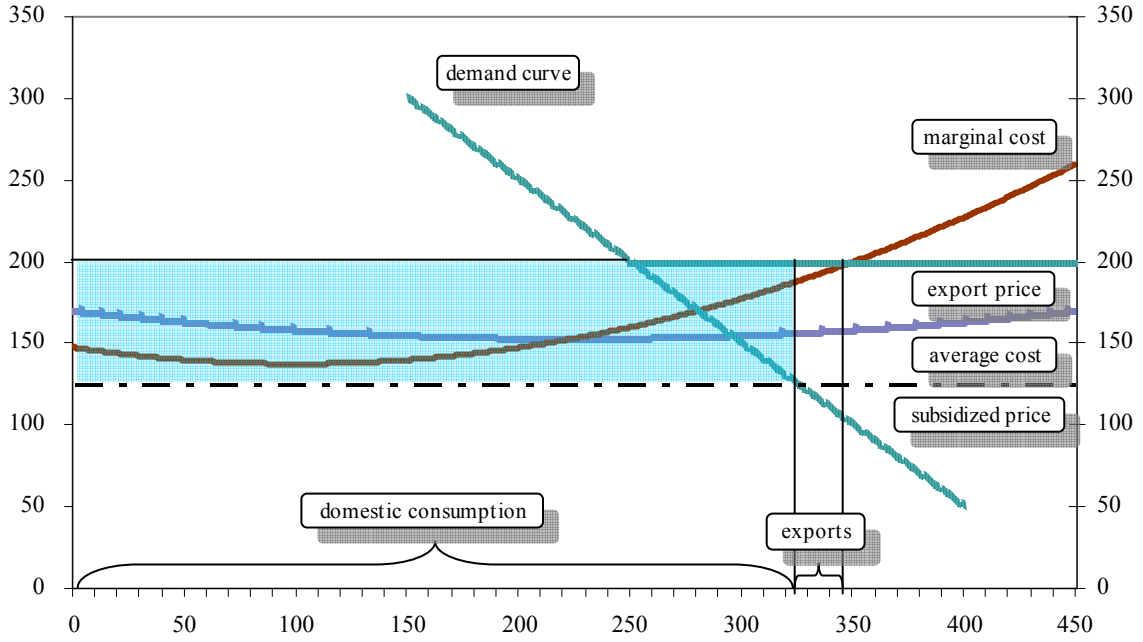
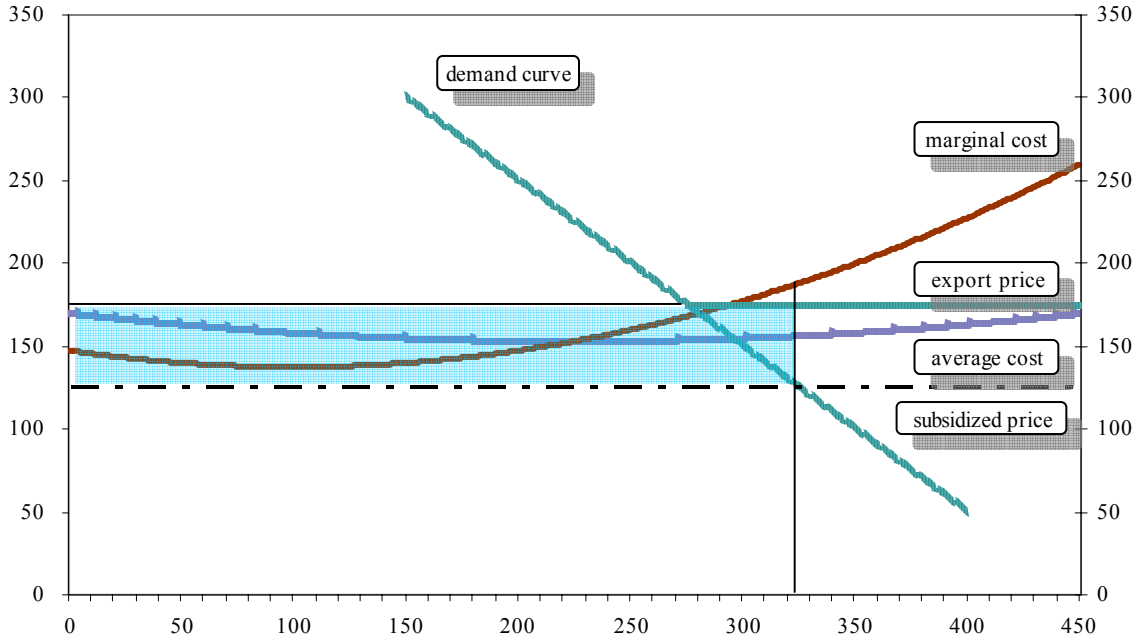


Figure 5. Price Subsidy in Mixed Export/Nontraded Case



Non-traded case

If $p^m \geq p^d(q^*) \geq p^x$, the country has no incentive to either import or export in the absence of the subsidy. The appropriate reference price, however, depends on whether the country

imports in the presence of the subsidy. To place the choice of the reference price in perspective, consider first Figure 6, which depicts demand and cost curves for a hypothetical government-owned or regulated refinery. We assume that the regulated price is set at the intersection of the demand and marginal cost curves to maximize the sum of consumer and producer surplus. Consequently, in this example the refinery operates above its minimum average cost, and the refinery accrues profits equal to the shaded rectangle.

Figure 6. Regulated Pricing in Nontraded Case

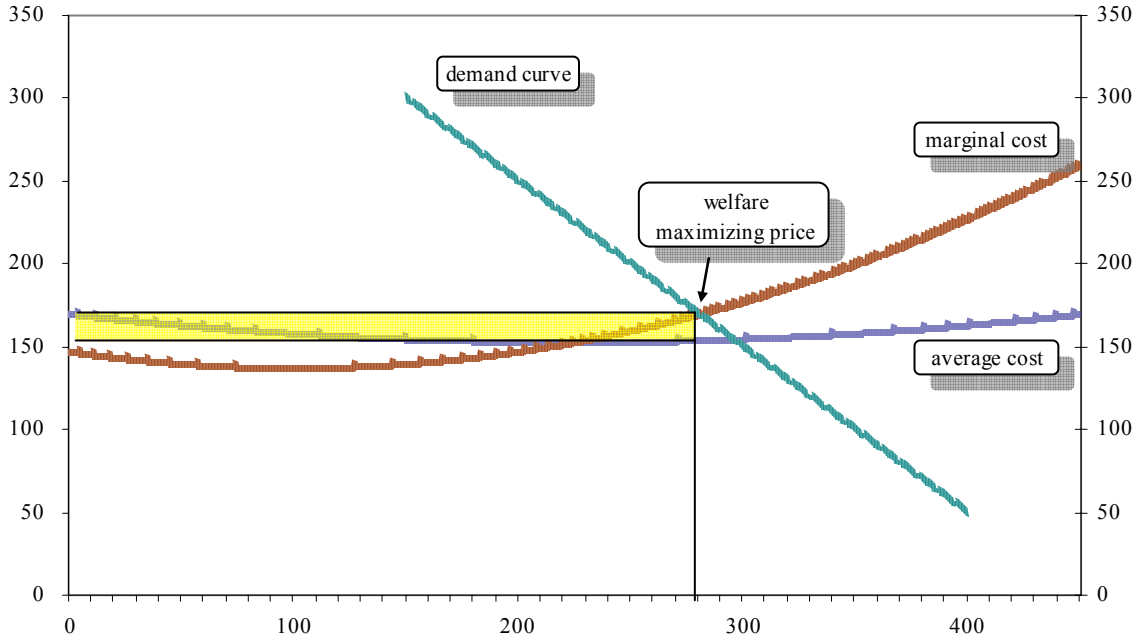


Figure 7 introduces a subsidized price—represented again by the broken line—to the above example. The subsidy elicits a movement along the demand curve to a new higher equilibrium quantity, determined by the intersection of the demand curve and the subsidized price. As in Figure 5, the resource cost of providing the subsidy is equal to the shaded area plus the small triangle to the right of the intersection of the marginal cost and demand curves and above the shaded area. The shaded area—which uses the price in the absence of the subsidy as the reference price—is still an upper bound on the benefit of the subsidy for consumers and a lower bound on the resource cost.

A slightly more complicated situation occurs if the marginal cost of production at the subsidized demand level is above the import price. In this case (Figure 8), domestic production will be limited to the quantity at which the marginal cost curve crosses the import price. This reduces the per-unit and aggregate cost of the subsidy and, concomitantly, the reference price. It also reduces the error introduced by using the shaded area as a measure of resource cost.

Figure 7. Introduction of Subsidized Price: Nontraded Case

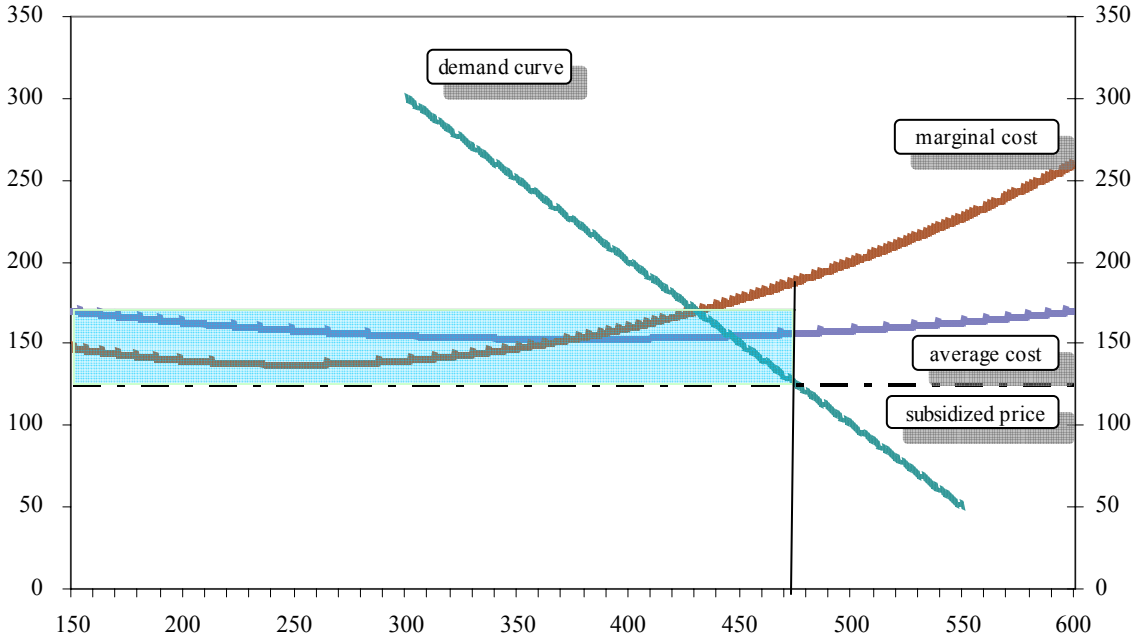
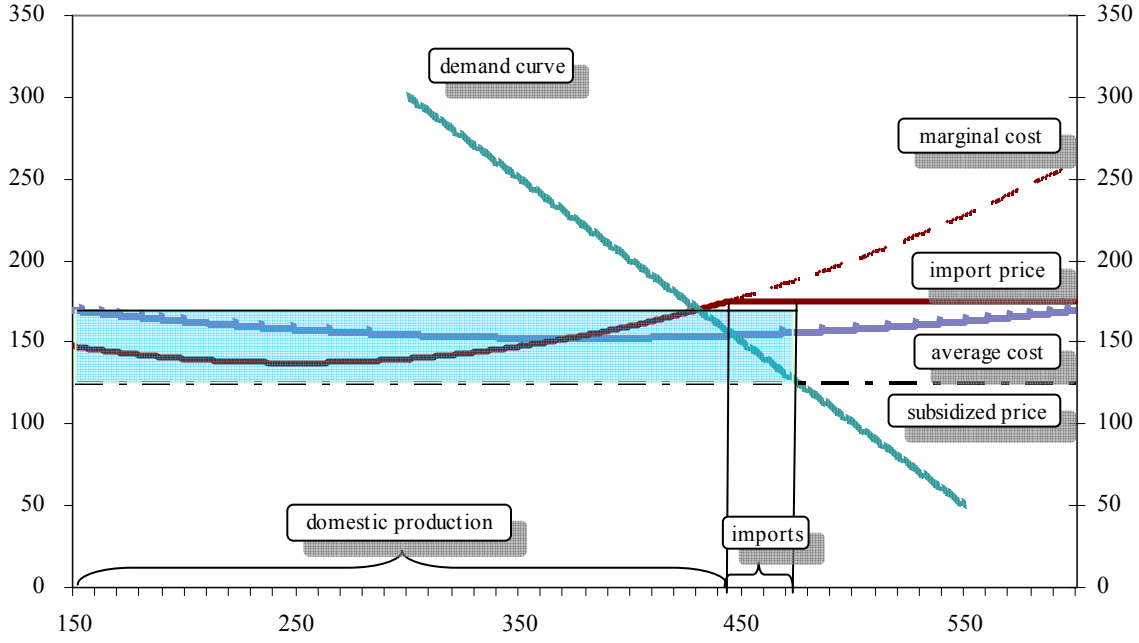


Figure 8. Domestic Production and Imports

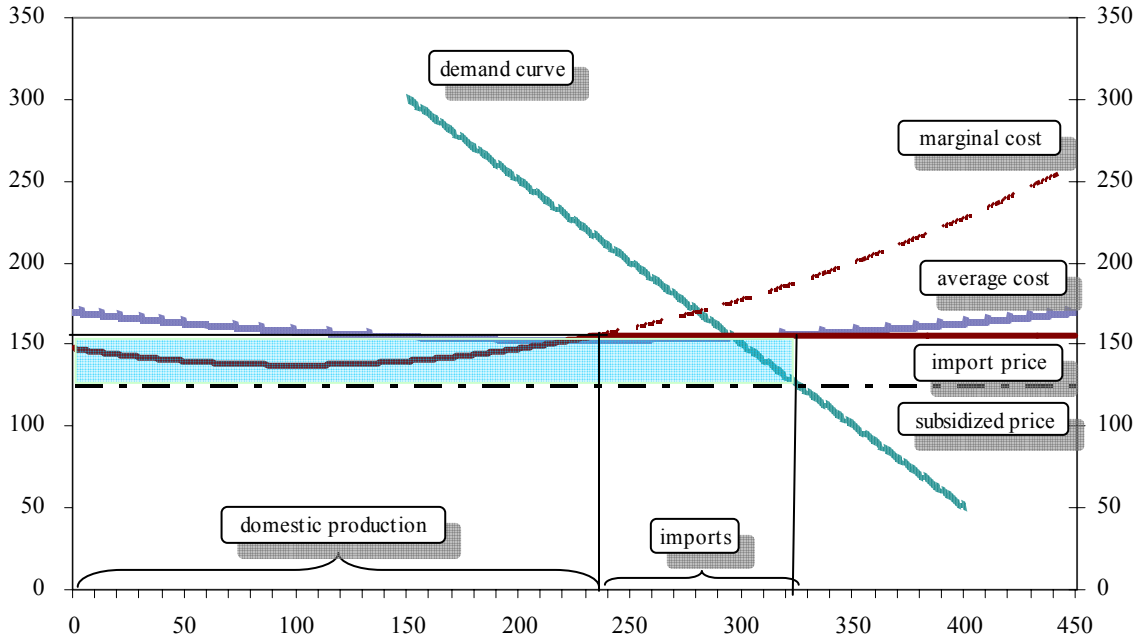


Pure import case

Finally, if marginal demand is met through imports even in the absence of the subsidy, the choice of the import price as the reference price is again obvious and simple. In this case (Figure 9), the import price is both the average and marginal cost of meeting the increase in

demand engendered by the subsidy. The shaded area in this case is the exact resource cost and, again, overestimates the benefit for consumers by the area to the right of the demand curve.

Figure 9. Pure Import Case



Practical implications

To summarize, the export price is the reference price if the country is an exporter even in the presence of the subsidy. The import price is the reference price if the country imports even in the absence of the subsidy. The reference price depends solely on the marginal cost of domestic production in the pure nontraded case—that is, when there is not trade either with or without the subsidy. In cases where the imposition of a subsidy causes an exporting country to stop exporting or a non-trading country to start importing, the reference price depends on a weighted average of the appropriate traded price and the marginal cost of domestic production.

In practice, it would be impossible to systematically apply these reference prices. Only in the pure exporter and importer cases would we know the counterfactual price in the absence of the subsidy. In fact, it will usually be necessary to use the price in the presence of the subsidy as the reference price. The errors caused by this compromise are likely to be quite small, as long as the elasticity of demand is low. In the estimation of the benefits of consumer subsidies, it is common to assume that the elasticity of demand is zero. In this case, the quantity does not change when a subsidy is introduced, the consumer benefit and the social cost are identical, and both can be measured without error. Even if the elasticity of demand is not zero, the error introduced by using the price in the presence of the subsidy is small as long as the elasticity of supply is high—that is, as long as the marginal cost curve is relatively flat.

B. Quantifying Aggregate Consumer and Producer Subsidies

Consumer subsidies

Once the appropriate reference prices have been identified and allowing for domestic distribution costs, aggregate consumer subsidies (S_c) can be measured as:

$$S_c = \sum_i q_i \left(p_i^{ref} + d_i^{ref} - p_i^c \right), \tag{1}$$

where q_i, p_i^{ref}, d_i^{ref} and p_i^c are the quantity, reference price and distribution costs, and actual consumer price of the i^{th} refined petroleum product, respectively.

Producer subsidies

As noted above, the reference price for a domestic refinery is defined as the marginal cost of production, conditional on efficient use of the existing capital stock. If a domestic refinery is operated inefficiently, but fully compensated for its cost of production, it receives a subsidy over and above that accruing to consumers, defined as:

$$S_p = \sum_i q_i \left(p_i^p - p_i^{ref} \right), \tag{2}$$

where p_i^p is the price at which the domestic producer is reimbursed for its output of the i^{th} product. A domestic distributor could also benefit from a similarly defined implicit subsidy equal to:

$$S_d = \sum_i q_i \left(d_i^d - d_i^{ref} \right), \tag{3}$$

where d_i^d is the price at which the distributor is reimbursed for its handling of the i^{th} product.

Producer subsidies will typically be very difficult to measure. They require a reference price that is never observed in the presence of producer subsidies. Consequently, it is more likely that the production inefficiencies will be incorrectly incorporated into the reference prices used to measure consumer subsidies—that is, p_i^d is likely to be incorrectly substituted for p_i^{ref} in equation (1). It should be easier, however, to identify the existence of a producer subsidy is the case in which a carefully estimated import price is lower than the cost of domestic production, making the import price an upper bound on the reference price. Even in this case, however, quantifying the producer subsidy will be difficult, since the efficient price for domestic production could be below the import price.

C. Financing Subsidies

Subsidies can be financed through the budget, by reducing profits in or imposing losses on state-owned enterprises or the private sector, or by creating implicit cross-subsidies. If budget

resources are used to finance the subsidies defined above, they should appear as explicit, on-budget outlays, with offsetting revenues as appropriate. In the case depicted in Figure 7, for example, the budget should at least include outlays to compensate the refinery for the actual losses caused by the introduction of the subsidy (equal to the resource cost of the subsidy—shaded area in Figure 7—minus the profits earned in the absence of the subsidy—shaded area in Figure 6). If the refinery is state-owned, government revenue will also decrease because the refinery no longer generates profits. If it is privately owned, revenue will decrease to the extent that the profits would have been taxed.

Subsidies are often financed indirectly and excluded from the budget. The case in which only the actual losses of a refinery appear in the budget is one case, although it is relatively benign since the net fiscal cost—resource cost less lost profits or lost tax revenue—is correctly represented. If the refinery is state-owned, one could argue that the full resource cost of the subsidy—the shaded area in Figure 7, for example—should appear as an outlay, with an adjustment on the revenue side to reflect the replaced profits—the shaded area in Figure 6, for example.

More generally, the government may control prices along the production and distribution chain, without compensating the regulated companies for the ensuing losses. For distributors, this will typically engender losses that cannot be sustained in the long run. The same is true for refiners, except when the refiner earns profits on its exports and can recoup some its losses through this channel. Alternatively, the government may set the prices of some petroleum products below their relevant reference prices and some above, effectively imposing an earmarked tax—that is not reflected in the budget—on the consumers of the unsubsidized products.

Preferential tax treatment of petroleum products can represent a form of "relative" subsidization (or a so-called "tax expenditure"). Many countries respond to high energy prices by reducing taxes on these products. At the very least, countries may not be willing to impose the higher-than-normal tax rates that the relative low demand elasticity and potential negative externalities of these products would suggest. Moreover, countries may not even impose the normal sales or value-added tax rates to these products in an effort to shield consumers from the rising prices of crude oil.

II. Evaluating Size and Distribution of Real Income Effects

This appendix sets out the details of the approach used to evaluate the likely impact of increases in petroleum prices on the real incomes of households as well as the approach to identifying alternative measures that help mitigate the associated adverse effects. Typically the bulk of total petroleum products is not consumed directly by households, but indirectly through their consumption of other goods and services that use petroleum products as inputs. Therefore, the welfare effect of higher petroleum prices on household real incomes will depend both on the *direct effect* of higher prices for petroleum products consumed by households and on the *indirect effect* arising from higher prices for other goods and services consumed by households to the extent that higher petroleum costs are passed on to consumer prices.

Modeling the direct effect, and how it is distributed across income groups, essentially requires information on the level of direct consumption of various petroleum products (e.g., gasoline, kerosene, diesel, LPG) by households in different parts of the national income distribution. Modeling the indirect effect requires a model of price shifting behavior. Below we start by describing the model underlying our calculation of the price effects resulting from the increase in the price of petroleum products, which are intermediate as well as final goods. This is followed by a discussion of how the resulting price changes can be translated into changes in real income and used as the basis for an analysis of the distributional impact of price changes.

A. Price-Shifting Model

To analyze the distributional consequences of price changes for commodities that are intermediate goods one needs to specify a price-shifting model that allows one to identify how higher petroleum costs are shifted on to prices in other sectors of the economy. The implications of higher costs for output or factor prices will, of course, depend on the structure of the economy; e.g., whether commodities are traded internationally or non-traded, the nature of commodity taxes, and whether prices are controlled by the government. We, therefore, start by grouping commodities into three broad classifications reflecting the assumed relationships between higher production costs and output prices:

(i) *Cost-Push Sectors*. These are sectors where higher input costs are pushed fully on to output prices. We can, therefore, (loosely) think of these as non-traded commodities.

(ii) *Traded Sectors*. These are sectors that compete with internationally-traded goods and whose output prices are determined by world prices and the import or export tax regime. Therefore, higher input costs are not pushed forward onto output prices so the brunt of these higher costs is borne through lower factor prices or lower profits.

(iii) *Controlled Sectors*. These are sectors where output prices are controlled by the government. Therefore, the relationship between output prices and production costs depends on if and how the government adjusts controlled prices. If controlled prices are not adjusted then the burden of higher costs will be borne by factor prices, profits or government revenue.

When modeling *price changes* it is useful to think of "aggregate" commodity categories (e.g., the aggregate categories available from an input-output table) as made up of a certain proportion of cost-push, traded and controlled commodities, with these proportions given by α, β and γ respectively. For each sector, these proportions should obviously sum to unity and never be negative, i.e. $0 \leq (\alpha, \beta, \gamma) \leq 1$ and $\alpha + \beta + \delta = 1$. The technology of domestic firms is captured by a standard input-output coefficient matrix, A, with typical a_{ij} denoting the cost of input i in producing one unit of output j – think of units of output defined such that they have a user price of unity so that price changes below can be interpreted as percentage changes. Consistent with the interpretation of A as capturing an underlying Leontief (i.e., fixed coefficient) production technology, we can interpret a_{ij}'s as the change in the cost of producing a unit of j due to a unit change in the price of input i.

For *traded* sectors, user prices, q^*, are determined by world prices, p^w, and by trade taxes (including tariffs and sales taxes), t^*:[25]

$$q^* = p^w + t^* \tag{1}$$

In this sense, foreign goods are deemed to be perfectly competitive with domestically produced traded goods. Changes in the user prices for traded sectors are then given by:

$$\Delta q^* = \Delta p^w + \Delta t^* \tag{2}$$

and both terms on the right hand side will be specified exogenously by the reform package under consideration.

For *controlled* sectors, producer prices are determined by pricing controls (say, $\tilde{p}$) and we can think of domestic taxes as zero for convenience so that

$$\tilde{q} = \tilde{p} \tag{3}$$

Alternatively, one could think of the difference between user prices and average unit production costs as an implicit tax. The formula for price changes is then given simply as:

$$\Delta\tilde{q} = \Delta\tilde{p} \tag{4}$$

where the right hand side is specified exogenously in the reform package.

For *cost-push* sectors, the relationship between user and producer prices is given by:

[25] The notational convention used in this section is that lower case italics represent row vectors and upper case italics represent matrices.

$$q^c = p^c + t^c \tag{5}$$

where q^c is the price paid by users of a commodity and p^c the price received by producers, the difference between these being any sales or excise taxes, t^c, imposed by the government. Producer prices are, in turn, determined as follows:

$$p^c = p^c(q, w) \tag{6}$$

where q are the user costs of intermediate inputs and w are factor prices. For these sectors, cost increases are assumed to be fully pushed forward onto user prices so that factor payments are fixed. From (5) one gets:

$$\Delta q^c = \Delta p^c + \Delta t^c \tag{7}$$

Using (6), the input-output coefficient matrix and assuming factor prices are fixed, the change in producer prices is derived as:

$$\Delta p^c = \Delta q^c \alpha A + \Delta q^* \beta A + \Delta \tilde{p} \gamma A \tag{8}$$

where Δ signifies a price change, all price changes are interpreted as 1xn row vectors where n is the number of commodity groups, (α, β, γ) are now nxn diagonal matrices, and A is an nxn input-output coefficient matrix. Substituting in from (7) and (2) one gets:

$$\Delta p^c = \Delta p^c \alpha A + \Delta t^c \alpha A + \Delta p^w \beta A + \Delta t^* \beta A + \Delta \tilde{p} \gamma A \tag{9}$$

so that:

$$\Delta p^c = \Delta t^c \alpha AV + \Delta p^w \beta AV + \Delta t^* \beta AV + \Delta \tilde{p} \gamma AV \tag{10}$$

where $V=(I-\alpha A)^{-1}$ with I being an nxn identity matrix. The typical element of the inverse matrix V, v_{ij}, captures the combined direct and indirect use of cost-push sector i used to produce one unit of cost-push sector j. Notice that if the only price changes are changes in controlled prices then we have $\Delta t^c = \Delta p^w = \Delta t^* = 0$ so that the final term of (9) gives the effect on cost-push sectors of a change in these controlled prices and also $\Delta q^c = \Delta p^c$. The change in sector aggregate prices is then given by:

$$\Delta q = \Delta q^c \alpha + \Delta q^* \beta + \Delta \tilde{q} \gamma \tag{11}$$

In our applications below we assume that all petroleum products are within the controlled sector and all other products are cost-push sectors. Given that the domestic trade and transport sectors are the main consumers of petroleum products and the effect on traded good prices would come through this component, this assumption is likely to be a good approximation to reality.

B. Applying Model

Applying the model to an evaluation of the likely real income effect of petroleum price increases and its distribution across different income groups requires two sets of data. Firstly, information on consumption patterns across households is needed, including direct household consumption of petroleum products (e.g., consumption of gasoline, diesel, liquid petroleum gas, and kerosene). Typically consumption patterns for petroleum products differ substantially across households with, for example, low-income households allocating a relatively high proportion of total consumption to the consumption of kerosene and a relatively low share to gasoline. It is important to validate how adequately consumption of petroleum products is captured by the household survey used, e.g., by dividing total consumption expenditures for each product by the price pertaining at the survey date to get physical quantities and comparing total physical consumption to secondary data on aggregate national consumption.

Secondly, information on the production structure of various sectors of the economy is required, i.e., an input-output matrix showing the use of various sectoral inputs in the production of sectoral outputs, in particular, information on the use of petroleum products as inputs by various sectors. Often only information on the aggregate amount of petroleum product inputs, i.e., not broken down by different petroleum products. In this case, one can try to use secondary information to disaggregate these sectors, which involves disaggregating the petroleum product inputs for each sector in the economy, as well as disaggregating the petroleum product technology by product type. Alternatively, one can undertake the analysis of indirect price effects using an aggregate petroleum price change, while using the disaggregated information available in the household data to evaluate the direct effect for each petroleum product separately.

Using information on the likely increases in petroleum product prices, (10) can be used to evaluate the impact on consumer prices for the range of sectors available in the input-output table. The detailed consumption information available in the household data can be mapped into the input-output sectors to get the budget shares for each commodity category and for each household. Multiplying the budget shares for each commodity category by the corresponding price increase for that commodity gives the percentage change in household real income due to that specific price increase. The direct effect is the aggregate of these real income changes across petroleum products and the indirect effect is the aggregate of these real income changes across all other commodities. To analyze the distribution of these real income effects, households can be categorized by income groups—typically this is based on some household total consumption measure such as per capita consumption or consumption per adult equivalent—and, for each income group, look at the average of the real income effect as a percentage of total household income. The direct and indirect effects are added to get the total effect. Where the percentage loss in real income increases (decreases) with household income, the distribution of the total burden is said to be progressive (regressive).

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