Fossil-fuel subsidies – methodology and assumptions

The price-gap approach

The IEA estimates subsidies to fossil fuels that are consumed directly by end-users or consumed as inputs to electricity generation. The price-gap approach, the most commonly applied methodology for quantifying consumption subsidies, is used for this analysis.[1] It compares average end-user prices paid by consumers with reference prices that correspond to the full cost of supply. The price gap is the amount by which an end-use price falls short of the reference price and its existence indicates the presence of a subsidy. In a given economy, the basic calculation of subsidies for a product is:

$$\text{Subsidy} = (\text{Reference price} - \text{End-user price}) \times \text{Units consumed}$$

The data required for the price-gap calculations are extensive. End-user price and consumption data are drawn from IEA data and, where necessary, from government sources and other reports. Furthermore, the estimate is sensitive to reference prices, which are calculated for fuels on the basis of international prices. Electricity reference prices are derived from annual average-cost pricing (see below for further explanation of how reference prices are calculated).

For economies that export a given fossil-energy product but charge less for it in the domestic markets, the domestic subsidies are implicit; they have no direct budgetary impact so as long as the price covers the cost of production. The subsidy, in this case, is the opportunity cost of pricing domestic energy below international market levels, *i.e.* the rent that could be recovered if consumers paid world prices, adjusting for differences in variables such as transportation costs. For net importers, subsidies measured via the price-gap approach may be explicit, representing budget expenditures arising from the domestic sale of imported energy at subsidised prices, or may sometimes be implicit. Many economies, Indonesia for example, rely extensively on domestically produced fuels, but supplement domestic supply by importing the remainder. In such cases, subsidy estimates represent a combination of opportunity costs and direct expenditures.

Estimates using the price-gap approach capture only interventions that result in final prices to end-users below those that would prevail in a competitive market. While such subsidies account for the majority of subsidies to fossil fuels, there are numerous others that are not captured by the price-gap approach. It does not, for example, capture subsidised research and development or subsidies for fossil fuel production. Estimated based on the price-gap approach therefore understate total fossil-fuel subsidies as well as their impact on economic efficiency and trade. Despite these limitations, the method is a valuable tool for estimating subsides and for undertaking comparative analysis of subsidy levels across economies to support policy development.

Reference prices

For net importers, reference prices are based on the import parity price: the price of a product at the nearest international hub, adjusted for quality differences if necessary, plus the cost of freight and insurance to the net importer, plus the cost of internal distribution and marketing and any value-added tax (VAT). VAT was added to the reference price where the tax is levied on final energy sales, as a proxy for the tax on economic activities levied across an economy. Other taxes, including excise duties, are not included in the reference price. For net exporters, reference prices were based on the export parity price: the price of a product at the nearest international hub, adjusted for quality differences if necessary, minus the cost of freight and insurance back to the net exporter, plus the cost of internal distribution and marketing and any VAT. All calculations are carried out using local prices and the results are converted to US dollars at market exchange rates.

[1] Kosmo (1987), Larsen and Shah (1992) and Coady *et al.* (2010), for example, have used this approach.

Assumed costs for transporting oil products vary according to the distance of the country from its nearest hub; these are taken from average costs as reported in industry data. Average internal distribution and marketing costs for oil products in all economies are assumed to be equal to costs in the United States ($0.08 per litre for gasoline and diesel). For natural gas and coal, transport and internal distribution costs are estimated on the basis of available shipping data.

Reference prices are adjusted for quality differences, which affect the market value of a fuel. Reference prices are assumed to be below observed import prices in some cases, such as steam coal in India, which relies heavily on low-quality domestic coal but imports small volumes of higher quality coal.

Unlike oil, gas and coal, electricity is not extensively traded over national borders, so there is no reliable international reference price. Therefore, electricity reference prices were based on annual average-cost pricing for electricity in each country (weighted according to output levels from each generating option). In other words, electricity reference prices were set to account for the cost of production, transmission and distribution, but no other costs, such as allowances for building new capacity. They were determined using reference prices for fossil fuels and annual average fuel efficiencies for power generation. An allowance of $15/MWh and $40/MWh was added to account for transmission and distribution costs for industrial and residential uses, respectively. To avoid over-estimation, electricity reference prices were capped at the levelised cost of a combined-cycle gas turbine (CCGT) plant.

Some authorities regard the above method of determining reference prices as inappropriate. In particular, a number of energy resource-rich economies are of the opinion that the reference price in their markets should be based on their cost of production, rather than prices on international markets as applied within this analysis. The basis for their view typically is that natural resources are being used to promote their general economic development, and that this approach more than offsets the notional loss of value by selling the resource domestically at a price below the international price. The counter-argument is that such an approach results in an economically inefficient allocation of resources and reduces economic growth in the longer term.

Subsidies to the poor

The IEA estimates the share of fossil-fuel subsidies that were captured by the lowest 20% income group (quintile). Global estimates are based on eleven economies that provide fossil-fuel consumption subsidies and for which adequate household data was available: Angola, Bangladesh, China, India, Indonesia, Pakistan, Philippines, South Africa, Sri Lanka, Thailand and Vietnam. The estimates combine subsidies by fuel with household expenditure and income surveys, along with other data, such as vehicle ownership. The lowest income quintile was analyzed as this group is the most in need of financial assistance, is generally below the international poverty line, and household data is commonly reported by income quintiles.

Several factors contribute to the variation in subsidies to the poor, including: the total amount spent on energy subsidies, the distribution of wealth, the availability of infrastructure (e.g. an electricity grid connection or owning a vehicle), as well as the types of fuels that were subsidised. In countries where the lowest income quintile represented a larger share of national income, subsidies are generally better captured by the poor. The existence of energy infrastructure also affected the distribution of subsidies by fuel. For example, electricity subsidies were more likely to reach poor households in China, with an electrification rate of 99%, than they were in India, with an electrification rate of 65%. Countries with subsidy programs for fuels more often used by the poor, particularly kerosene as opposed to LPG or gasoline, were also more successful in delivering subsidies to the lowest income quintile.

The analysis is limited by available data and necessary assumptions. In most cases, the available household surveys and other data are from prior to 2010. All of the data is from 2004 or later, with the exception of 1998 data used for Angola. Changes in the distribution of wealth amongst households since the last household survey would impact the estimates. The estimates are also dependent on the following assumptions: all subsidies paid to commercial and industrial sectors were passed on to consumers, divided amongst income quintiles by their share of total household expenditures; households from all income levels

pay the same energy prices; for the lowest quintile, the share of each transport fuel consumed is equal to the share of household expenditures. These conservative assumptions suggest that the subsidy estimates to the lowest quintile are likely overestimates, particularly for transport fuels.