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Global energy subsidies: An analytical taxonomy

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ABSTRACT

Governments around the world have pledged to eliminate or sharply reduce subsidies to energy firms in order to increase economic efficiency and reduce environmental externalities. Yet definitions of subsidies vary widely and, as a result, estimates of their global magnitude vary by orders of magnitude. I review why energy subsidies are so difficult to define and measure. I show why some non-standard measures are very poor proxies for subsidy costs and in fact may vary inversely with them. In particular, recent attempts to treat unpriced externalities as subsidies yield especially misleading results. In general, energy subsidies as conventionally understood do exist but only comprise a small portion of some very large recently-reported estimates, the bulk of which are indirect measures that may have little connection with actual costs to governments or allocational inefficiencies.

1. Introduction

Energy subsidies have become a major topic of discussion among policymakers, due to a combination of concerns about costs to governments, market distortions and environmental externalities. Regarding the latter, the 2009 declaration by G20 leaders[1] asserted that removal of such subsidies would eliminate ten percent of global greenhouse gas emissions, and they called on international agencies to direct their attention to ascertaining their global scope. Estimates of the size of such subsidies have long been subject to considerable uncertainty. The OECD (2015) estimated subsidies from 2010 to 2014 within its member states plus six large partner economies (including China and India) and put the total at between US$150 and US$200 billion annually. The International Energy Agency (IEA, 2014) put the global total at a comparable US$550 billion in 2013, but a team of International Monetary Fund (IMF) economists estimated it to be ten times larger at US$5.6 trillion (Coady et al., 2015).

There is an extensive academic and grey literature estimating energy subsidies at the national level: see survey in Lin and Li (2012) as well as the country-specific studies at the Global Subsidies Initiative (https://www.iisd.org/gsi/fossil-fuel-subsidies, June 7, 2016). The elusive nature of the quest shows up at the national level as well. Koplow and Dernback (2001) examined ten estimates of US energy subsidies over the preceding two decades and found a range from $200 million to $1.7 trillion annually, thus spanning three orders of magnitude. The large range is entirely due to conflicting definitions of what constitutes a subsidy. Kojima and Koplow (2015) provide a review of the methodologies for national and global subsidy estimations with an emphasis on the difficulties of achieving a single workable definition. Country-specific studies can yield surprisingly ambiguous results as to whether domestic subsidies even exist (for example, Nwachukwu and Chike, 2011), or how to define and measure them (contrast Sawyer and Siebert (2010) and McKenzie and Mintz (2011) in the Canadian case).

Conventional subsidies, namely direct transfers to firms or consumers, definitely exist and can be highly distortionary. The IEA (2014 Chapter 9) points out, for example, that the price of motor fuel in Saudi Arabia is only one-tenth that in the EU, and that many Middle Eastern countries have capped market prices for fuels well below market levels, requiring large ongoing subsidies to producers to cover their losses. But many researchers believe that such direct fiscal transfers are only a part of the picture, so the definition of subsidies has been widened at times to include indirect measures, such as subsidies to complementary goods and the absence of charges for pollution externalities. These are, in some cases, easier to measure, but as will be shown here, they may be a poor proxy for the social welfare costs of the alleged market distortions. They are open to considerable ambiguity in interpretation, and in some cases they are not only uncorrelated with what we are trying to measure, but they may even vary inversely with it.

This paper attempts to put the discussion into a clear theoretical framework that allows a comparison of the various definitions and a deeper understanding of why they span such wide ranges. While

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[1] See http://www.g20.utoronto.ca/2009/2009communique0925.html#energy (June 7, 2016).

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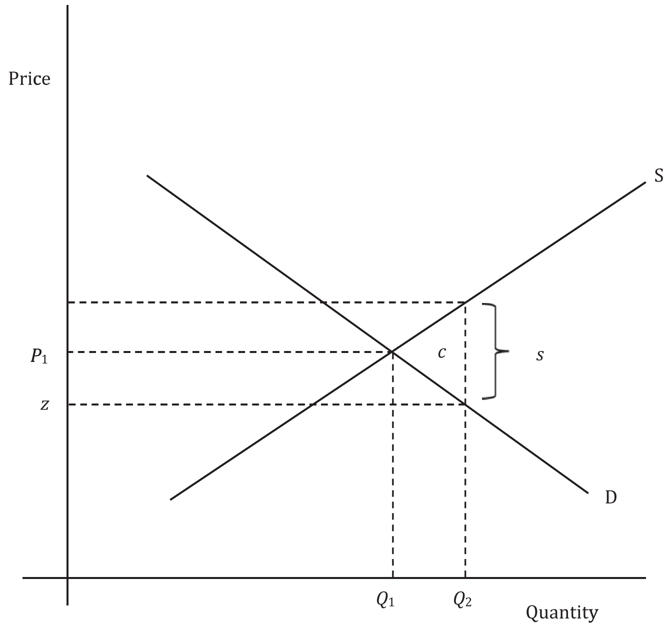

Fig. 1. Simple unit subsidies.

numerous authors have surveyed the different methodologies using qualitative concepts (e.g. Kojima and Koplow, 2015), there has been little use of microeconomic tools to provide theoretical clarity. The discussion herein will rely on relatively simple graphical models to illustrate the different cost concepts and to explain why indirect approaches can sometimes fail to correlate with what we are trying to measure.

2. Transfers and tax expenditures

The most common way of measuring subsidies is the price gap approach (Koplow and Dernback, 2001), which involves comparison of an actual net-of-tax price to a reference net price, multiplied by a quantity. Deviations from the reference price can arise due to direct, or simple transfers, or by reducing a tax rate below the level that ought to be charged. The difficulty of defining the reference price will be a recurring theme in this analysis.

2.1. Simple transfers

Fig. 1 shows a supply and demand diagram for fossil energy with a simple subsidy in the form of a transfer to the purchaser of s per unit. The incidence of the subsidy is not affected by whether the transfer is to the buyer or the seller. In the absence of the subsidy the market price would be P_1 and the quantity would be Q_1. The subsidy introduces a gap of s per unit between the buyer's price and the seller's marginal revenue, resulting in a new market equilibrium at Q_2 units. If demand is inelastic the change in quantity will be relatively small, and vice versa. The magnitude of unpriced externalities will depend on the size of the quantity shift, so in this case, market conditions that make the effect of the conventional subsidy larger (for example, elastic demand) will also make the unpriced externality magnitude larger, in other words subsidies and induced externalities are correlated and one can serve as a proxy for another.[2] However, as we shall see, this is not always the case.

There are two appropriate cost measures for the simple case: the cost to the government (denoted herein S_G) and the social welfare cost (denoted herein S_W). The cost to the government is $S_G=sQ_2$. This is the amount that should appear in the government's spending accounts, and it is the amount the government would save if it canceled the subsidy. In this case if s is known the price gap does not need to be computed.

The social welfare cost is somewhat different. S_G itself is just a transfer but the cost to society of raising it includes the marginal excess burden of taxation, denoted MEB_T (per dollar). The Harberger triangle associated with Q_2 is c, which represents the resource misallocation of fuel production costs that exceed consumption benefits. Hence the social welfare cost of the subsidy is $S_W=c + (sQ_2 \times MEB_T)$. An economist estimating the size of the subsidies would try to ascertain S_G while an economist estimating the social welfare costs of the subsidies would be trying to estimate S_W. The more elastic the demand, the larger will be both S_W and S_G.

Subsidies in this form are relatively rare, and surveys of international subsidy magnitudes yield estimates of S_G that only account for a small fraction of the reported totals. Koplow and Dernback (2001) reported that, in US studies, transfers were typically under \$10 billion (1999\$) annually, and in the few studies which quantified more general categories of subsidies this contributed only one or two percent of the reported total.

The IEA (2014) reports that a particularly common form of subsidy in developing countries is a regulatory cap on the selling price of fuel coupled with a producer subsidy to cover losses. This situation can also be represented in Fig. 1. If the price cap is imposed at z and the producer is indemnified against losses, the market quantity will be Q_2 and the losses to the producer will be s per unit. The rest of the analysis would be the same.

2.2. Tax expenditures

Fig. 2 illustrates a situation in which fossil energy is subsidized by applying to it a tax rate lower than some reference rate. The reference tax rate is denoted t_R, and the associated market quantity is Q_3. Suppose the tax rate on fossil fuels is reduced to t_F. This in turn yields a market outcome of Q_4 per unit. What is the subsidy in this case?

If an analyst were to compute the tax differential times the market quantity, $Q_4 \times (t_R - t_F)$, this would overstate the size of the subsidy since at t_R we would not observe the quantity Q_4, so the government would not save that amount if the policy were canceled. The proper estimate of the cost to the government is the net increase in revenues if the policy were canceled, which is

$$S_G = t_R Q_3 - t_F Q_4.$$

In principle this may be a positive or negative number but because fuel demand is relatively inelastic it is probably a positive number, i.e. a net cost. In contrast to the simple case, therefore, the more elastic the demand, the lower is S_G and indeed the higher the likelihood that the net cost is negative. If demand is inelastic the subsidy cost will be relatively larger but the effect on the market quantity will be smaller, which implies a smaller effect on pollution externalities. So in this case there is an inverse relationship between the subsidy costs S_G and the potential magnitude of unpriced externalities: the conditions that yield a larger subsidy magnitude yield a smaller effect on pollution.

Another challenge arises when computing the social welfare cost. There is a reduction in deadweight loss from reducing the tax on fuels which is shown in Fig. 2 as area $a+b+c$. We assume that the policy must be revenue-neutral, so if the net effect is to reduce government revenues the difference must be made up by raising another tax, which we will assume has a marginal excess burden of MEB_x. So the net social welfare cost of the tax expenditure is

$$S_W = MEB_x \times (t_R Q_3 - t_F Q_4) - a - b - c.$$

Even if the first term is positive the whole expression may yield a

[2] Greenhouse gas emissions are closely tied to energy use and are therefore affected by the market quantity, but there are many other factors that have important effects, including demand parameters in other markets, international domestic policies and global trade patterns. For examples, see Li et al. (2015, 2014) and Li and Lin (2013).