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How Large Are Global Fossil Fuel Subsidies?

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Summary. — This paper estimates fossil fuel subsidies and the economic and environmental benefits from reforming them, focusing mostly on a broad notion of subsidies arising when consumer prices are below supply costs plus environmental costs and general consumption taxes.
Estimated subsidies are $4.9 trillion worldwide in 2013 and $5.3 trillion in 2015 (6.5% of global GDP in both years). Undercharging for global warming accounts for 22% of the subsidy in 2013, air pollution 46%, broader vehicle externalities 13%, supply costs 11%, and general consumer taxes 8%. China was the biggest subsidizer in 2013 ($1.8 trillion), followed by the United States ($0.6 trillion), and Russia, the European Union, and India (each with about $0.3 trillion). Eliminating subsidies would have reduced global carbon emissions in 2013 by 21% and fossil fuel air pollution deaths 55%, while raising revenue of 4%, and social welfare by 2.2%, of global GDP.

Key words — energy subsidies, global warming, air pollution, efficient taxation, deadweight loss, revenue

1. INTRODUCTION

The issue of energy subsidy reform remains high on the international policy agenda. This reflects the need for countries to act on emissions reduction pledges submitted for the December 2015 Paris Agreement on climate change, opportunities for reform created by lower energy prices, and continuing fiscal pressures (set to worsen as populations age) in many countries.

The sustained interest in energy subsidy reform also reflects increasing recognition of the perverse environmental, fiscal, macroeconomic, and social consequences of fossil fuel subsidies—in fact it is difficult to think of products that are more harmful to subsidize than fossil fuels. These subsidies:

- Damage the environment, causing more premature deaths through local air pollution, exacerbating congestion and other adverse side effects of transportation systems, and increasing greenhouse gas emissions; [1]
- Impose large fiscal costs, which need to be financed by some combination of higher public debt, higher tax burdens, and lower public spending, all of which can be a drag on economic growth; [2]
- Discourage needed investments in energy efficiency, renewables, and energy infrastructure, and increase the vulnerability of countries to volatile international energy prices; [3] and
- Are a highly inefficient way to support low-income households, since most of the benefits from low energy prices leak away to the non-poor. [4]

The economic case for removing fossil fuel subsidies is clear, but in reality reform has proven difficult. [5] Understanding the size of energy subsidies, and the environmental, health, fiscal, and economic benefits from reducing them, is critical for moving the policy agenda forward as it helps policymakers craft legislation and communicate the case for reform to the general public. There is, however, an enormous range in the estimated size of energy subsidies at the global and country level (see Appendix 1). The central reason for this striking variation is a critical difference in the *definition* of what constitutes energy subsidies.

While the term "subsidy" has been widely used in the literature, its definition often varies, depending on the circumstance and application. The WTO Agreement on Subsidies and Countervailing Measures states that a "subsidy" exists when there is a "financial contribution" by a government or public body conferring a "benefit" (i.e., a "financial contribution" provided on terms more favorable than those the recipient could have obtained from the market). One definition by the OECD describes a subsidy as "any measure that keeps prices for consumers below market levels, or for producers above market levels or that reduces costs for consumers or producers". [6] However, whether "market levels" are defined as prices without government intervention (or taxes), or more broadly to include both corrective and consumption taxes, makes a critical difference.

As discussed in Appendix 1, most prior studies have focused on a narrow measure of energy subsidies—what we term "pre-tax subsidies"—which arise when consumer prices paid by fuel users are below the opportunity costs of fuel supply (e.g., many oil producers in the Middle East and North Africa traditionally subsidized petroleum consumption by setting domestic prices below international prices). This is the definition that leaders had in mind at the 2009 G20 Pittsburg meeting when they called for a phase out of energy subsidies (IEA, OPEC, OECD, & World Bank, 2010). However, economic efficiency requires that energy prices reflect not only supply costs but also (i) (most importantly) environmental costs like global warming and deaths from air pollution and (ii) taxes applied to consumer goods in general. The broader notion of energy subsidies—what we term "post-tax subsidies"—arises when consumer prices are below supply costs, plus a "Pigouvian" tax to reflect environmental damages and general consumer taxes.

Post-tax subsidies, which are the main focus here, are the relevant concept from an economic perspective, as they reflect the gap between consumer prices and economically efficient prices—the portion of this gap due to undercharging for supply costs, environmental costs, and general consumer taxes, is

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irrelevant from an efficiency perspective. Moreover, environmental damages from energy consumption are just as real as are supply costs (even if harder to measure), and any failure to fully internalize them means that some of the damages from fossil fuel use are not borne by fuel consumers and this constitutes a form of subsidy.

Clements *et al.* (2013) developed a rudimentary estimate of post-tax fossil fuel energy subsidies at a global level, using a simple extrapolation of environmental costs from a handful of country case studies available at the time. A key finding was that post-tax subsidies were much larger than pre-tax subsidies—these were estimated at $2 trillion and $492 billion worldwide respectively in 2011—reflecting the substantial, and pervasive, undercharging for environmental costs. Another finding was that, while pre-tax subsidies were mainly concentrated in developing countries, advanced economies accounted for a sizable portion of post-tax subsidies, underscoring that "getting energy prices right" is a pressing issue for advanced and developing economies alike.

Since the Clements *et al.* (2013) study, Parry, Heine, Lis, and Li (2014) have developed much more refined estimates—at the country-level for over 150 countries—of the environmental costs of fossil fuel products. For example, their estimates of air pollution costs incorporate country-level data on emission rates, population exposure to pollution, mortality rates for pollution-related illness, and the value of a statistical life.

This paper expands the emerging literature on post-tax energy subsidies in several dimensions. First, it provides a far more sophisticated estimate of global energy subsidies using the country-level estimates of environmental costs in Parry *et al.* (2014), combined with data on fuel consumption, prices, and actual taxes/subsidies compiled from a variety of sources. Second, it provides the first detailed estimates of regional and country-level energy subsidies using individual estimates for 155 countries. [7] Third, it provides simplified estimates of the global and regional environmental, fiscal, and social welfare gains from eliminating these energy subsidies.

The main findings of the paper are as follows:

- Global energy subsidies are large: post-tax energy subsidies are estimated at $4.9 trillion worldwide in 2013 and projected to reach $5.3 trillion in 2015, or 6.5% of global GDP in both years. The 2015 post-tax subsidies are 16 times as high as pre-tax subsidies ($333 billion). The post-tax subsidy estimate for 2011 is over twice that in Clements *et al.* (2013) and the difference reflects several factors, most importantly a large increase in estimated damages from local air pollution (see Appendix 4).
- Mispricing from a domestic perspective accounts for the bulk of the global subsidy: local air pollution accounted for 46% of the subsidy in 2013, under-taxation of broader vehicle externalities (e.g., congestion, accidents) 13%, undercharging for supply costs 11%, and for general consumer taxes 8%, while global warming accounted for 22% of the subsidy. In other words, 78% of the subsidy reflects domestic pricing distortions, implying that unilateral reform of energy subsidies is mostly in countries' domestic interests.
- Coal subsidies are especially large: coal accounted for 52% of the post-tax subsidy in 2013 (given its high environmental damage and that no country imposes meaningful excises on its consumption), petroleum 33%, and natural gas 10%.
- Post-tax subsidies are pervasive across advanced and developing economies and among oil-producing and non-oil-producing countries alike. But these subsidies are especially large (about 13–18%) relative to GDP in Emerging and Developing Asia, the Middle East and North Africa region, and the Commonwealth of Independent States. [8]
- In absolute terms, subsidies are highly concentrated in a few large countries: China's subsidy was $1.8 trillion in 2013, followed by the United States ($0.6 trillion), Russia, the European Union and India (each about $0.3 trillion), and Japan ($0.2 trillion).
- The gains from subsidy reform are substantial and diverse: getting energy prices right (i.e., replacing current energy prices with prices fully reflecting supply and environmental costs) would have reduced global carbon emissions in 2013 by 21% and fuel-related air pollution deaths by 55%, while raising extra revenue (accounting for smaller fuel tax bases) of 4% of global GDP and raising social welfare by 2.2% of global GDP. There is considerable variation in these gains across regions and countries however.

While there are many caveats (discussed below) to the estimation procedures and findings, the policy implications of the paper are clear: energy subsidies are very large and their removal (which entails levying Pigouvian taxes) would generate substantial environmental, fiscal, and economic welfare gains.

The rest of the paper is organized as follows. Sections 2 and 3 describe respectively the conceptual framework and estimation procedures. Section 4 presents the main results and sensitivity analyses. Section 5 offers concluding remarks.

2. CONCEPTUAL FRAMEWORK

This section discusses in turn the concept of efficient energy prices, the definition of energy subsidies, and the methodology used for measuring the benefits of price reform. We focus on subsidies for primary fuels—coal, natural gas, gasoline, diesel, and kerosene—and also electricity. Data constraints (e.g., lack of external cost estimates by country) prevent inclusion of some broader oil products (jet fuels, home heating oil, etc.) and in this sense our energy subsidies are understated, but only moderately. [9]

(a) *Efficient energy prices*

The efficient consumer price for an energy product (against which post-tax subsidies are measured), consists of the supply cost, a Pigouvian tax, and a general consumption tax. We discuss each in turn.

(i) *Supply cost*

For products traded across regions, the supply cost can be measured by the international reference price of the finished product as this reflects the cost faced by importers or revenue forgone by exporters. [10] We assume that petroleum products, natural gas, and coal are all tradable products—natural gas is typically classified as a tradable good as it is transported through pipelines and in liquefied form (Energy Information Administration (EIA), 2014).

In contrast, electricity is treated as a non-traded good (due to limited integration of power grid networks across borders). Here the supply cost is the domestic production cost or "cost-recovery" price, with costs evaluated at international reference prices.

(ii) *Pigouvian taxation*

When use of a product by a firm or household generates an external cost, efficient pricing requires that consumers face a

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