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The Economic Cost of Global Fuel Subsidies[†]

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By 2015, global oil consumption will reach 90 million barrels per day (US DOE 2013, Table A5). In part, this high level of consumption reflects the fact that many countries provide subsidies for gasoline and diesel. This paper examines global fuel subsidies using the latest available data from the World Bank, finding that road-sector subsidies for gasoline and diesel totaled $110 billion in 2012. Pricing fuels below cost is inefficient because it leads to overconsumption. Under baseline assumptions about supply and demand elasticities, the total annual deadweight loss worldwide is $44 billion. Incorporating external costs increases the economic costs substantially.

I. Fuel Prices

Figure 1 plots road-sector gasoline consumption per capita and gasoline prices for 128 countries. A plot of diesel consumption and prices is available in the online Appendix. Prices are domestic consumer prices including taxes and come from a survey administered in November 2012. The size of the circles is proportional to country population.

The figure reveals an enormous amount of variation in gasoline prices. Gasoline prices average $5.26 per gallon, but range from $0.09 per gallon in Venezuela to above $9.00 in Turkey and Norway. Diesel prices tend to be a bit lower, averaging $4.12 per gallon, with a range from $0.04 to above $7.00. This wide variation in prices is somewhat surprising because crude oil and refined products are widely traded internationally, so the opportunity cost of fuels is similar everywhere. Although there are differences in transportation, refining, and distribution costs, they can explain only a small part of the observed variation in prices.

Instead, the more important explanation for the wide variation in fuel prices is that taxes and subsidies differ widely. Among OECD countries, gasoline taxes per gallon range from an average of $0.49 in the United States, to above $4.00 in Germany and the Netherlands (Knittel 2012). Outside the OECD the range is even larger, and there are dozens of countries that subsidize gasoline and diesel, selling it for below its price in international markets. Many of these countries are in the Middle East, though Asia (Malaysia, Indonesia), Africa (Egypt, Nigeria, Algeria) and South America (Venezuela, Ecuador, Bolivia) are also represented.

Gasoline consumption tends to be high in countries where gasoline is subsidized. Saudi Arabia, for example, has experienced a ninefold increase in fuels consumption since 1971 and is now the sixth largest oil consumer in the world (Gately, Al-Yousef, and Al-Sheikh 2012). Venezuela is another particularly illustrative example. Gasoline consumption per capita in Venezuela is 40 percent higher than in any other country in Latin America, and more than three times the regional average.

Figure 2 shows the countries with the largest fuel subsidies. The implied subsidy per gallon was calculated as the difference between domestic consumer prices and international spot prices.[1] Transport, distribution, and retailing

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[1] This "price-gap" approach has been widely used in previous studies. See, e.g., IEA (2012); IMF (2013); Plante (2014). This measure captures *consumption* subsidies but not *production* subsidies. US fossil-fuel producers, for example, receive $4 billion annually in tax deductions, favorable depreciation schedules, and other production subsidies (Aldy 2013). Because there is a world oil market, production subsidies have almost no impact on consumer prices.

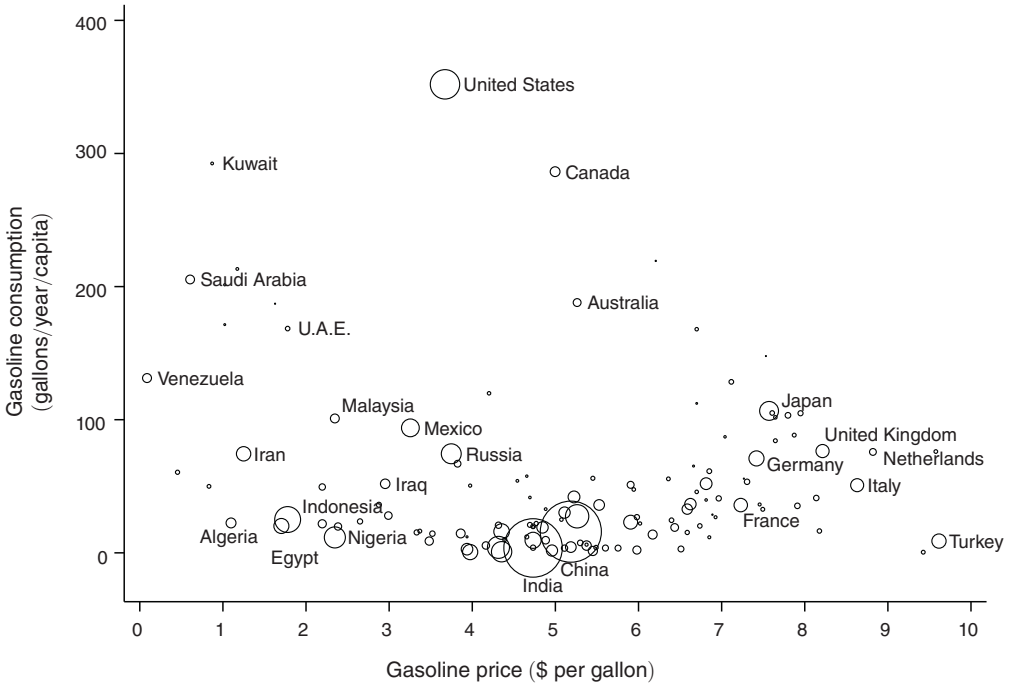

FIGURE 1. GASOLINE CONSUMPTION AND PRICES WORLDWIDE

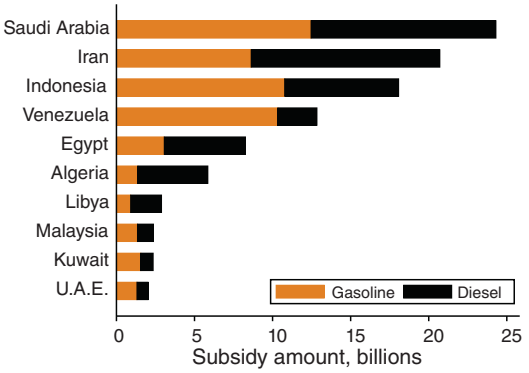

FIGURE 2. DOLLAR VALUE OF FUEL SUBSIDIES IN 2012, TOP TEN COUNTRIES

costs were incorporated following IMF (2013). The implied subsidy per gallon was then multiplied by road-sector consumption of each fuel to calculate the total dollar value. By this measure, there are 24 countries that subsidize gasoline, and 35 countries that subsidize diesel. The United States, by this measure, does not subsidize gasoline or diesel.

Total subsidies worldwide in 2012 were $110 billion, with about $55 billion each for gasoline and diesel. The top ten countries represent 90 percent of total global subsidies. Many of these countries are major oil producers. Fuel subsidies have long been viewed in many oil-producing countries as a way to share the resource wealth with a nation's citizens. This is not the view in all major oil-producing countries, however. Prices are at or above market in Iraq ($2.95 per gallon for gasoline), Mexico ($3.26), Russia ($3.74), and Canada ($5.00).

The following section calculates the deadweight loss from these fuel subsidies. This focus on countries with *low* fuel prices is somewhat arbitrary. Just as there is deadweight loss from prices that are too low, there is also deadweight loss from prices that are too high. The United Kingdom ($8.21 per gallon), Italy ($8.63), Netherlands ($8.82), and Turkey ($9.61), for example, would all seem to be possible candidates. While it is true that traffic congestion and other external costs vary substantially across locations, these countries have prices that are high enough that it becomes difficult to justify on the basis of externalities (Parry and Small

2005). Governments with both low and high prices are presumably pursuing some objective (e.g., redistribution, revenue collection, etc.) but these goals must be weighed against the distortions that are imposed.

II. Deadweight Loss

Subsidies create deadweight loss by enabling transactions for which the buyer's willingness-to-pay is below the opportunity cost. The total amount of deadweight loss depends on the elasticities of demand and supply. The more elastic are demand and supply, the larger the deadweight loss from pricing below cost. In the short run, demand and supply for crude oil are both inelastic (Hamilton 2009). However, the economic cost of subsidies depends on the *long-run* elasticities. Estimates in the literature for the long-run elasticity of demand for transportation fuels tend to range from −0.6 to −0.8 (Brons et al. 2008). The analysis which follows adopts −0.6. Total global deadweight loss is 18 percent higher with −0.8 and, in the other direction, 24 percent lower with −0.4.

Demand is described using a constant elasticity demand function with a scale parameter that varies across countries and fuels. As described in the online Appendix, current prices and consumption levels are first used to calculate the complete set of scale parameters. These demand functions are then used to predict consumption at market prices and to calculate deadweight loss. Preliminary calculations suggest that estimates of deadweight loss would be similar with a linear demand curve, but it would be useful in future analyses to more fully explore alternative functional forms.

Supply is assumed to be perfectly elastic. The infrastructure for transportation, refining, and distribution can be scaled up at near constant marginal cost, so what matters is the long-run supply elasticity for crude oil. This elasticity is extremely difficult to measure empirically, but in the long run there clearly is a great deal of scope for global oil producers to respond to crude oil prices. This is particularly true with improved shale oil techniques and other emerging technologies that have opened up vast new production areas. Incorporating less than perfectly elastic supply would decrease the estimated global deadweight loss only modestly because fuel consumption in most countries is small relative to the world oil market.

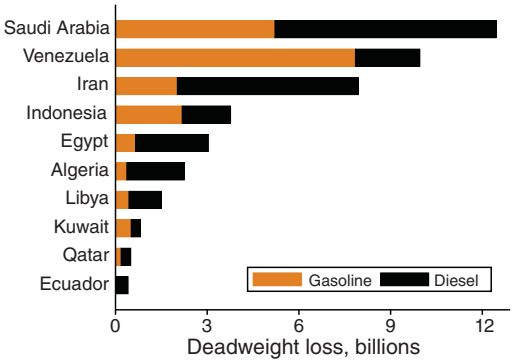

FIGURE 3. DEADWEIGHT LOSS FROM FUEL SUBSIDIES IN 2012, TOP TEN COUNTRIES

Under these assumptions, the total global deadweight loss from fuel subsidies in 2012 is $44 billion. This is split roughly evenly between gasoline ($20 billion) and diesel ($24 billion). Figure 3 reports deadweight loss by country. Saudi Arabia takes the top spot with $12 billion in deadweight loss. Venezuela is No. 2 with $10 billion.

In 2012, Venezuela had the cheapest fuels on the planet, so even though the total dollar value of subsidies is higher in Iran and Indonesia, the subsidies in Venezuela impose more economic cost because the subsidy per gallon is so high. Deadweight loss increases approximately with the *square* of the subsidy amount so it is concentrated among countries with the largest subsidies. The big two, Saudi Arabia and Venezuela, represent 50 percent of total global deadweight loss while representing only 34 percent of the dollar value of subsidies.

When expressed per capita the pattern of deadweight loss is similar. Saudi Arabia remains in the top spot, with $450 in annual deadweight loss per capita. Indonesia, Egypt, and Ecuador fall out of the top ten and are replaced with Bahrain, Brunei, and Oman. See the online Appendix for details.

III. Incorporating External Costs

Fuel subsidies are different from subsidies in most other markets because of the substantial external costs of driving. Parry, Walls, and

Harrington (2007) goes through the complete list, calculating that for the United States, marginal external damages are $1.11 per gallon. Carbon dioxide emissions are an important component, but this also includes emissions of local pollutants, traffic congestion, and accidents. This calculation also reflects that many externalities scale by miles traveled, rather than by gallons consumed, and so marginal external damages depend on the fraction of the demand elasticity that comes from reduced mileage.

Refining these estimates of external costs is an important area of active research. A team from the IMF is attempting to calculate country-specific estimates of marginal external damages for 140 countries (Parry, Lis, and Li forthcoming). Preliminary estimates show large variation in damages across countries. This reflects, for example, differences in traffic congestion between countries with and without large urban populations. Moreover, the overall level of damages tends to be high, typically exceeding $1.11 per gallon.

Eliminating subsidies for gasoline and diesel would, with a −0.6 demand elasticity, decrease global fuel consumption by 29 billion gallons per year. At $1.11 per gallon this excess consumption imposes external costs worth $32 billion annually. Combined with the estimated deadweight loss ($44 billion), the total economic cost of fuel subsidies is $76 billion annually. The global market for gasoline and diesel was $1.7 trillion in 2012, so this is 4 percent of the market.

This is the economic cost of pricing fuels below *private* cost. An alternative calculation would be to measure the deadweight loss relative to the full social cost of fuels consumption. This would include the deadweight loss ($44 billion) and external cost ($32 billion) from pricing below private cost, but also the additional welfare loss from units transacted for which willingness-to-pay is above private cost but below social cost.

Total deadweight loss under this counterfactual is $92 billion. Figure 4 reports results by country. Much of the increased deadweight loss in this alternative calculation comes from the United States, where gasoline and diesel prices are above private cost but below social cost. When ranked by country, the United States appears in spot No. 4, behind only Saudi Arabia, Venezuela, and Iran.

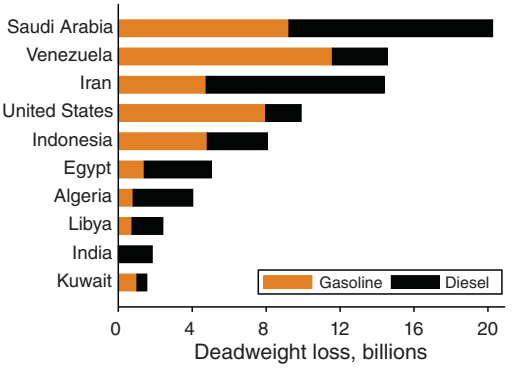

Figure 4. Deadweight Loss Relative to Full Social Cost, Top Ten Countries

IV. Conclusion

Previous studies have calculated the dollar value of global fuel subsidies (IEA 2012; IMF 2013), but this article goes one step further and calculates the deadweight loss. While undoubtedly these calculations could be refined substantially, the analysis makes it clear that fuel subsidies are not just benign transfers from sellers to buyers. Under reasonable assumptions about supply and demand elasticities, the economic cost of overconsumption is very large.

Fuel subsidies also have a large impact on government budgets, requiring taxes to be higher than they would otherwise, and inhibiting the ability of government to address other fiscal objectives. Expenditures on energy subsidies in many of these countries exceed public expenditures on health, education, and other key components of government spending. Understanding these fiscal impacts is an important priority for future work.

It is also important to continue studying the distributional consequences of fuel subsidies. Studies have tended to find that fuel subsidies are not particularly effective at redistribution (Arze del Granado, Coady, and Gillingham 2010; IEA 2011; Sterner ed. 2012), but more work is needed. One of the major priorities is to understand how cash transfer programs can be best designed to mitigate distributional impacts of subsidy reform.

Finally, in future work it will be important to expand the analysis to include other energy markets. Fuel subsidies are only one part of a

larger set of energy subsidies. Coal, natural gas, and electricity, for example, are all widely subsidized. Recent analyses of the broader energy sector find that the total dollar value of global energy subsidies is almost $500 billion annually (IEA 2012; IMF 2013), and much more can be done to understand and quantify the economic costs of these policies.

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