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Research Summaries

Pricing Energy Efficiently

Lucas Davis*

Energy plays a central role in determining our overall economic well-being, from fueling our transportation systems, to heating and cooling our homes and businesses, to determining the cost and composition of goods and services produced in the economy. Energy prices determine choices both within and across energy sources, choices that are particularly important given increased concerns about carbon dioxide emissions and other external costs associated with the production and consumption of energy.

In recent work with several co-authors, I examine the efficiency of energy prices in a variety of U.S. and international settings. I explore a variety of possible rationales for government intervention in energy markets and find that observed prices often differ from those that would be dictated by efficiency considerations alone. This usually reflects governments' pursuit of distributional and other objectives which must be weighed against the distortions that are imposed by deviations from efficient pricing.

Global Fuel Subsidies

The prices drivers pay at the pump for gasoline and diesel fuel vary widely across countries. In Venezuela, for example, gasoline costs only 6 cents per gallon and diesel fuel is even cheaper. It is no coincidence that gasoline consum-

tion per capita in Venezuela is 40 percent higher than in any other country in Latin America. Fuel subsidies increase consumption above the efficient level, allowing transactions for which buyers' willingness to pay is very low.

In a recent study, I find that gasoline and diesel subsidies totaled \$110 billion worldwide in 2012.¹ The total dollar value of subsidies is largest in Saudi Arabia, Iran, Indonesia, and Venezuela, each with more than \$10 billion annually in fuel subsidies. Under baseline assumptions about demand and supply elasticities, the annual efficiency cost of these subsidies—the amount of foregone output associated with these deviations from efficient pricing—is \$44 billion, and this is *ignoring* externalities. Incorporating conservative estimates for the marginal external damages of driving doubles the estimated efficiency cost of these subsidies.

Of course, there is also an efficiency cost when fuel prices are too high. In 2012, there were about two dozen countries that subsidized gasoline, but also two dozen countries where gasoline prices were above \$7 per gallon. While it is true that traffic congestion and other external damages vary substantially across locations, these countries have prices that are difficult to justify on the basis of economic externalities associated with gasoline consumption.

The Allocative Cost of Price Ceilings

Prices coordinate actions between buyers and sellers, but they also *allocate* goods to the buyers who value them the

most. Normally in a market all the buyers who are willing to pay more than the price buy the good. This maximizes consumer surplus which is the total value that consumers place on the amount of the good they consume, less the cost of purchasing it. However, when a price ceiling is imposed in a market, there is no longer an immediate mechanism that ensures this allocation. This "allocative cost" of price ceilings has been noted, for example, in rental housing markets, but has tended to receive much less attention than the efficiency cost of too much or too little consumption.²

A particularly lucid example of an allocative distortion is the U.S. natural gas market, which was subject to price ceilings between 1954 and 1989. In work with Lutz Kilian, I find that price ceilings led to severe misallocation of natural gas in the residential market.³ While some households enjoyed access to cheap price-controlled natural gas, other households were locked out of the market altogether because new residential connections were unavailable in many parts of the country. Many of the households without access would have been willing to pay more to obtain it, but there was no mechanism that allowed these welfare-improving reallocations.

We find that the allocative cost from price ceilings averaged \$3.6 billion annually. We construct these estimates using a household-level model of natural gas demand. To estimate the model, we exploit the fact that by the 1990s the natural gas market had been completely deregulated and, in contrast to the period of regulation, all households purchasing new homes were free

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to choose natural gas. Our empirical strategy is to ask how much natural gas would have been consumed during the period of price regulation based on the household preferences revealed in the 1990s data.

Our estimates imply that the allocative cost is both large and long-lasting. In homes where natural gas was not available when the home was first constructed, households will often continue using less-preferred energy sources for many years. This lock-in effect means that the adverse effects of price ceilings can last much longer than the regulatory policies themselves. Even today, more than two decades after natural gas prices were completely deregulated, the pattern of energy use by U.S. households continues to reflect the legacy of price ceilings.

Market Structure and Two-Part Tariffs

Much like electricity, natural gas is delivered to final customers by local distribution companies. These are classic natural monopolies characterized by high fixed costs and low marginal costs. The standard prescription for achieving an efficient outcome in this context is to use a multi-part tariff. For example, with a basic two-part tariff, the regulator requires the company to set per-unit charges equal to marginal cost, yielding the efficient level of consumption and eliminating the deadweight loss associated with the monopoly. The company can then recoup its fixed costs by charging fixed monthly fees.

In practice, prices tend to differ substantially from this theoretical ideal. In work with Erich Muehlegger, I find that U.S. industrial customers face natural gas prices that are close to marginal cost, but that residential and commercial customers face prices close to *average* cost, with the vast majority of revenues coming from per-unit charges rather than through fixed monthly fees.⁴ On average, we estimate that residential and commercial customers face markups of more than 40 percent above marginal

cost. Based on conservative estimates of the price elasticity of demand, our estimates imply that the current rate structure imposes \$2.7 billion in deadweight loss annually.

Some have argued that externalities such as the potential environmental consequences of fossil fuel consumption provide a potential rationale for current rate structures. Current markups are equivalent to those that would be implied by a \$55 tax per ton of carbon dioxide emitted, a tax rate above the efficient level that emerges from most models linking climate and economic activity.⁵ Moreover, burning natural gas emits only small amounts of criteria pollutants. Thus, residential and commercial customers in the United States may already be facing prices that are above social marginal cost. This illustrates the importance of accounting for pre-existing distortions when designing carbon taxes and other policies.

In future work it would be interesting to perform a similar study for electricity, another market characterized by high fixed costs and low marginal costs. In the United States in 2012, the average retail price of electricity was 10 cents per kilowatt hour, while the average wholesale price was only about 3 cents. Most of the 7-cent differential goes toward the transmission and distribution infrastructure. These costs are mostly fixed, not marginal, yet again only a small proportion of revenue is collected through fixed monthly fees. Electricity cannot be cost-effectively stored, making it considerably different from natural gas, but nonetheless it would be valuable to do a careful analysis of the efficiency consequences of current rate schedules.

Distributional Considerations

Policymakers often use taxes and subsidies on energy purchases to pursue distributional objectives even when such policies conflict with economic efficiency. Some argue, for example, that current rate structures in U.S. electricity and natural gas markets help low-income households by shifting costs to high-vol-

ume consumers. Although this view is widely held by regulators and rate-payer protection groups, there is surprisingly little direct empirical evidence.

In recent work with Severin Borenstein, I use nationally representative data to calculate the distributional impact of a transition to marginal cost pricing in U.S. natural gas markets.⁶ We find that the correlation between natural gas consumption and household income is positive, but surprisingly weak. Our analysis highlights several confounding factors that help explain the weak correlation. For example, we document a *positive* correlation between household income and energy efficiency. Low-income households tend to live in homes with older furnaces, less insulation, and single-pane windows.

The weak correlation between natural gas consumption and household income means that current price schedules deliver only a modest amount of redistribution. Under baseline assumptions, we find that current price schedules impose more than \$1 in deadweight loss for every \$1 that is transferred to the bottom two income quintiles. We also show that even a modest increase in needs-based energy assistance would more than offset the distributional impact of price reform for most low-income households.

The idea of combining price reform with cash transfers arises frequently in discussions of energy markets. Several countries have recently reduced subsidies available for gasoline and diesel fuel, for example, while simultaneously increasing funding for cash transfers. This pairing makes the reforms more politically palatable and potentially makes it possible to improve both efficiency and equity at the same time.

Conclusion

Studies like the ones described above move us closer to understanding the sometimes complex efficiency and distributional implications of energy prices. One of the over-arching themes in these studies is the high economic cost of

departures from marginal cost pricing. These costs tend to be underappreciated by policymakers in part because the inefficiencies are largely borne by a diffuse set of energy consumers. However, because energy markets are very large, the total economic cost of these distortions can also be very large.

¹ L. Davis, "The Economic Cost of Global Fuel Subsidies," NBER Working Paper No. 19736, December 2013, and forthcoming in American Economic Review Papers and Proceedings. See also International Monetary Fund, "Energy Subsidy Reform: Lessons and Implications," 2013.

² E. Glaeser and E. Luttmer, "The Misallocation of Housing Under Rent Control," NBER Working Paper No.

6220, October 1997, and American Economic Review, 93 (2003), pp. 1027–46.

³ L. Davis and L. Kilian, "The Allocative Cost of Price Ceilings in the U.S. Residential Market for Natural Gas," NBER Working Paper No. 14030, May 2008, and Journal of Political Economy, 119 (2011), pp. 212–41.

⁴ L. Davis and E. Muehlegger, "Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing," NBER Working Paper No. 15885, April 2010, and RAND Journal of Economics, 41 (2010), pp. 791–810.

⁵ See for example M. Greenstone, E. Kopits, and A. Wolverton, "Estimating the Social Cost of Carbon for Use in U.S. Federal Rulemakings: A Summary and Interpretation," NBER Working Paper No. 16913, March 2011, published as

"Developing a Social Cost of Carbon for Use in U.S. Regulatory Analysis: A Methodology and Interpretation," Review of Environmental Economics and Policy, 7 (2013), pp. 23–46; and W. Nordhaus, "Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model," NBER Working Paper No. 17540, October 2011.

⁶ S. Borenstein and L. Davis, "The Equity and Efficiency of Two-Part Tariffs in U.S. Natural Gas Markets," NBER Working Paper No. 16653, December 2010, and Journal of Law and Economics, 55 (2012), pp. 75–128. See also S. Borenstein, "The Redistributional Impact of Non-linear Electricity Pricing," NBER Working Paper No. 15822, March 2010, and American Economic Journal: Economic Policy, 4 (2012), pp. 56–90.

School Assignment and School Effectiveness

Parag Pathak*

A growing number of U.S. households have the opportunity to send their children to public schools outside of traditional neighborhood boundaries. Over the last decade there has been a proliferation of research on the design of centralized choice systems intended to make it easier for children to exercise choice. Millions of students have been assigned to schools using mechanisms either directly or indirectly inspired by academic work.

In recent research with several co-authors, I explore the equity, efficiency,

and incentive properties of these choice systems. Aside from these properties, centralized assignment generates valuable data and quasi-experimental variation that can be used for evaluation of various educational practices and policies. I have worked with several researchers to exploit this variation to study productivity differences between schools and school models.

Immediate Acceptance

One of the most common school assignment systems is based on the concept of *immediate acceptance*: when applicants apply to a school, they are offered a seat immediately if they qualify. A mechanism based on this principle was in place in Boston until 2005, and hence it is commonly known as the Boston mecha-

nism.¹ A large number of Local Education Authorities in England also employed this mechanism, called First Preference First.

One issue with this mechanism is that applicants do not have the incentive to rank their desired schools truthfully. That is, ranking a competitive school first may harm a student's chances at lower-ranked schools, creating strategic pressure on the applicant. Should an applicant take a risk at the school she really wants, or instead rank a safe choice first? In work with Tayfun Sönmez, I show that if families do not understand these incentives and rank their choices truthfully, then sophisticated families who understand the rules of the game benefit at the expense of the unsophisticated.²

The poor incentive properties of immediate acceptance systems led author-