ENERGY

The case for market intervention rests on bad analysis

On the Failure of Market Failure

By Paul Ballonoff

Governments often use the alleged existence of market failures to justify their regulation of markets. But 40 years of regulatory scholarship have made most analysts skeptical of market-failure claims. Despite the lack of academic support for the existence of market failures, government agencies continue to invoke failures. An excellent case in point is a 1995 study by three researchers at Lawrence Berkeley Laboratory (LBL) who claim to demonstrate market failure in the commercial lighting supply industry.

SUMMARY OF THE LBL STUDY

Ballasts are an important operating component of florescent lights, and consume a significant part of the energy used in their operation. The LBL argument is that even though high-efficiency lighting ballasts cost more initially than traditional fixtures, the longer expected lifetime and lower electricity use more than offset the initial higher costs. Using the jargon of finance, investments in ballasts by companies would have extraordinarily high rates of return relative to other uses of capital. Nevertheless, high-efficiency ballasts did not achieve significant market penetration without intervention by federal and state governments in the 1990s to create standards that effectively mandated their use.

The details of the LBL argument are easily summarized. First, the authors calculate the average cost of electricity in 1993 for three classes of commercial buildings that they describe very generally as having "high," "average," and "low" use of electricity. To estimate the return on investment from the use of ballast lighting, the authors must make assumptions about the trend in electricity prices over the lifetime of the fixtures. They assume that the price of electricity remains constant, an assumption that they claim reflects the perspective of forecasters in the late 1980s and early 1990s who expected little change in real electricity prices over the following 10 to 15 years. Using the assumption of constant electricity prices, the LBL study argues that the return on investment from conversion of traditional florescent lighting to lighting using advanced-technology ballast fixtures ranges from 37 to 199 percent. The spread results from their analysis of two forms of new ballast technology: a more advanced, more efficient, and higher-cost ballast designated as "F40" and a somewhat less advanced but lower-cost ballast designated as "F96." Both types are said to be more efficient than traditional fixtures.

Because the returns estimated by the LBL study are much greater than those available from alternative investments (the annual return on the S&P 500, for example, has averaged more than 10 percent for the 20th Century), the failure of ballasts to achieve widespread use absent government intervention would appear to be

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inconsistent with economic rationality. The government mandate that firms must use the newer-ballast lighting would appear to be a policy success that corrects a "market failure."

ANALYSIS OF THE LBL STUDY

the lbl study makes four errors. the authors use average rather than marginal costs to estimate returns on investments in the new ballasts. Their analysis does not reflect the decline in the marginal costs of electricity over time. The life expectancy of the lighting fixtures is defined from an engineering rather than an economic perspective. And cases that would have produced lower return estimates were incorrectly dropped from the study.

Average vs. Marginal Costs People make consumption decisions on the basis of marginal rather than average costs. Thus the decision to replace ballast lighting depends on savings that result from less electricity use. But not all costs consumers face in their utility bills actually vary with electricity use.

Utility bills frequently use what are called two-part tariffs. The first component consists of fixed charges that do not vary with customers' use of electricity, including the capital and maintenance costs of the transmission and distribution system as well as the costs of reading meters. All customers pay their prorated portion of fixed costs every month regardless of how much electricity they use. The second component of a two-part tariff consists of variable or marginal charges, like fuel costs, that vary with electricity production.

Electricity customers will invest in lighting fixtures that are more expensive initially, but use less electricity, only if the savings that result from less electricity use—the variable portion of the two-part tariff—are large enough. Thus an analysis of more efficient lighting fixtures should calculate the benefits using only the variable portion of the two-part tariff rather than the average price of electricity, which includes both fixed- and variable-cost components.

How much error was introduced by the lbl study's use of average- rather than marginal-cost data? Using U.S. Department of Energy data, I estimate that variable charges were only 39 percent of total electricity charges in 1993. If the 39 percent figure is applied to a 7.5 cent per kilowatt-hour (kWh) average cost for high-use customers cited in the lbl article, the average variable charge becomes 2.9 cents per kWh.

Even the 2.9 cent estimate is probably too high because it is an average of three low marginal-cost energy sources— nuclear (2.2 cents per kWh), fossil (2.3 cents per kWh), and hydro (.65 cents per kWh)— and one higher marginal-cost source— gas turbine (4.0 cents per kWh). If the marginal costs of different sources are weighted by their percentage of total production, the average marginal cost is 2.5 cents per kWh.

Nevertheless, if we use 2.9 cents per kWh and recompute returns for consumers using advanced-technology F40 ballasts in high-, average-, and low-intensity use, we obtain return estimates of 71.9, 33.7, and 22.9 percent respectively. For the less-advanced F96 ballasts, estimates of returns are 28.0, 13.6, and 9.3 percent, respectively. In contrast, the lbl authors, who used the 7.5-cent price for electricity, found returns *three to four times higher* for the F40 ballasts (199, 104, and 73 percent, respectively) and similarly higher for the F96 ballasts (98, 53, and 37 percent, respectively).

Declining Electricity Costs If the use of average- rather than marginal-cost data in the lbl study was its only error, a plausible case might be made for the existence of market failure, at least for the F40 ballasts. Would rational buyers in well working markets ignore returns as high as 72 percent? What else might be contributing to the reluctance of customers to invest in ballast lighting?

Not only are the marginal costs of electricity lower than the estimates used in the lbl study, they are also declining over time. The constant average price for electricity used in the lbl study reflects neither actual nor anticipated electricity costs. For example, during the early nineties, when the paper was written, *energy costs were actually declining, and were anticipated to fall* (and indeed are still falling). The Department of Energy reports that from 1990 through 1994 per-kilowatt-hour production costs for nuclear plants fell from 2.291 cents to 2.086 cents, for coal plants from 2.372 cents to 2.180 cents, and for gas turbine and other small scale plants from 5.356 cents to 3.216 cents. Only at hydro plants did costs rise, from 0.593 cents to 0.743 cents.

In short, the average variable charges that would be faced by a hypothetical investor in ballasts fell by about 10 percent while the lbl paper was being researched. And neither the lbl's constant-price assumption nor my recalculated estimates reflect current and future falling energy costs. The expected benefits from investment in ballasts are much lower than the claims made in the lbl study and are even lower than my recalculation.

Optimistic Estimates of Ballast Life The authors of the lbl study make problematic assumptions about the life expectancy of the ballasts, namely, they assume 5 years of service for high-usage customers and up to 17 years for low-usage customers. These estimates appear to have been calculated by dividing the expected lifetime of ballasts in hours by the average operating hours per year for each class of use.

The lbl methodology assumes that ballasts will be replaced only because they wear out. But building managers also may replace lighting fixtures for other reasons, in which case life expectancies of less than 17 years are possible. For example, building managers might replace all ballasts at once rather than replace ballasts at the end of their expected lifetime. When high-use ballasts wear out after 5 years of use, for instance, an entire building may be redecorated. The authors tell us that the high-use class constitutes 30 percent of their sample. When 30 percent of the ballasts fail, managers may take remedial actions toward all ballasts. A five-year lifetime may also be more realistic because the period over which equipment is depreciated for tax purposes is five years.

To obtain a somewhat more realistic estimate of the benefits of conversion to ballast fixtures, within the lbl framework, one might compute returns using operating lifetimes of 5 years for all fixtures and a variable cost of 2.9 cents that is constant during the lifetime of a fixture. Under such assumptions, the returns on the installation of the F40 ballast are 71.9, 22.3, and 6.1 percent in high-, average-, and low-use scenarios, respectively. The returns for the F96 ballasts drop to 28.0, -*3.3*, and -*14.3* percent, in high-, average-, and low-use scenarios, respectively. According to the lbl study, 30 percent of ballasts are in "high" use, 40 percent in "average" use, and 30 percent in "low" use. *Thus the negative estimated returns (which are for average and low use) represent 70 percent of the F96 market, and the low-use return of 6.1 percent represents 30 percent of the F40 market.*

Returns would be even lower if the weighted marginal cost of 2.5 cents per kWh were used rather than the unweighted estimate of 2.9 cents per kWh.

Improper Case Selection A final but important problem with the lbl analysis is the decision rule for case selection. The lbl authors removed from their data 80 cases that had average costs higher than 20 cents per kilowatt-hour because "such prices are likely the result of data problems." But the numbers in their sample are not prices at all; they are average bills per kilowatt-hour. Thus the high average-cost records are not the result of data problems. Rather they probably represent facilities with low use, which benefit the least from reducing their electricity use through ballast installation. Removal of those records eliminated the cases that would have yielded the lowest return estimates.

A CLOSER LOOK AT TWO-PART TARIFFS

Inconsistent Classifications and Their Cost Implications My analysis of the benefits of ballast lighting assumes that the marginal costs of electricity production as found in doe data coincide with the variable-charge portion of electricity consumers' bills. Although the use of two-part tariffs by utilities over the last 20 years has improved the efficiency properties of electricity prices, the classification of utility costs as "fixed" and "variable" is not consistent across utilities nor with economic definitions. Costs are more commonly classified into four categories: energy (fuel), power (generation plant), distribution and transmission facilities, and metering and billing. Very roughly stated, these costs represent 33, 33, 30 and 3 percent, respectively, of total utility costs.

In some billing systems, generation plant costs and some or all of the other facilities costs are recovered in the variable rather than fixed portion of consumers' bills, even though such facility costs are not easily (if at all) avoided by the utility if consumers change their short-run use of electricity. Thus in some utility systems almost the full average cost is avoidable by short-term consumer actions. In such systems, the return on ballast investments would be higher than I have computed, approaching those found by the lbl study.

Policy Implications But the lesson is not that the lbl authors are correct and I am not. If, in fact, a consumer can avoid billings representing 66 percent or more of costs by reducing electricity use, but the utility's costs fall by only 33 percent, then the correct conclusion is that the billing systems are poorly designed. Any economist would recommend that rates be changed to reflect more accurately the division between fixed and variable costs. Such changes are well within the power of government to correct because, in general, state regulatory commissions approve rates in the first place. Instead, the authors of the lbl study suggest that government should use its power to force consumers to "invest" in "profitable" light fixtures that they have ignored.

That peculiar advice alone should cause one to think deeply about the "evidence" of market failure presented by the lbl authors. The claim that consumers, apparently en masse, have failed to invest in opportunities that yield returns approaching 200 percent is so startling, so counter-intuitive, that it invites skepticism. Such skepticism is justified.

CONCLUSION

the lbl analysis of market failure with regard to commercial lighting ballasts is deeply flawed. If anything, the study proves that businessmen probably acted rationally by not widely adopting the newer-technology ballasts. Given that the story about commercial lighting ballasts is the premier example of market failure used by the energy conservation lobby to justify government intervention in energy markets, the case for intervention is weak.

readings

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