Productivity Measures Miss the Value of Environmental Protection

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The objections raised against environmental regulations most often stem from the perception that they cost businesses and consumers too much and that they stifle innovation and productivity. It's not that Americans don't want a clean environment; but many groups—business interests especially—feel that they're paying too high a price. Reinforcing this perception, numerous economic studies conclude that environmental regulations have significantly reduced the rate of growth in industrial productivity. Since productivity growth is the key to sustained improvement in real incomes, this is a particularly damning indictment—one that has fueled repeated efforts to dilute or delay new regulations and to curtail enforcement of existing ones.

The claim that environmental regulation has dragged productivity growth down is certainly plausible. The great productivity slowdown in the early 1970s—after two decades of rapid improvement—roughly coincided with enactment of the Clean Air and Clean Water acts and the substantial industrial investments required to comply with the resulting regulations. It is also true that environmental protection in the United States is expensive. Pollution control now costs more than 2 percent of gross domestic product.

Nonetheless, much of the alleged burden that environmental protection measures impose on the economy is illusory. The misperception arises because our measures of economic progress count the costs of protecting the environment but ignore the costs of not protecting the environment. Environmental degradation raises health care costs and lowers labor productivity through illness; it raises costs in primary industries by lowering yields in agriculture, forestry, and fisheries; it spoils recreational and tourist industries; and it increases maintenance costs throughout the economy to deal with soiling, corrosion, and other pollution effects. Not least of all, it lowers consumers' welfare directly. Many of these costs are not adequately reflected in economic statistics nor correctly attributed to environmental degradation. The result is a pronounced bias in evaluating the economic impacts of pollution control.

This bias is particularly pronounced in the current methodology for measuring productivity growth. Productivity measurements keep track of the efficiency with which industries transform their inputs into outputs. Output per worker is a measure of labor productivity. Should output grow more rapidly than labor inputs, labor productivity increases. However, labor productivity is a simplistic measure. The more equipment and materials a worker has to work with, the more the worker can produce. A more sophisticated measure of productivity growth compares the rate of growth of output to the growth rate of all inputs—labor, capital, and materials. This more comprehensive indicator is called multifactor productivity. In actual measurement, an industry's various outputs are weighted by their relative market prices and combined. Similarly, the industry's various inputs are weighted by their relative costs and also added. The growth rates of the two indices are compared: if output is growing by 4 percent per year and input use is increasing by 2.5 percent per year, then multifactor productivity in that industry is growing by 1.5 percent per year.

In this framework, economists have found it easy to show that pollution control expenditures mandated by environmental regulations have reduced
productivity. If a factory installs a wastewater treatment plant, its capital and operating go up without any commensurate increase in marketed output. If an electric utility switches to more expensive low-sulphur coal, its fuel costs increase without any greater output of electricity. In both cases, measured productivity falls if calculated using the current method. Various economic studies have found that environmental expenditures have accounted for anywhere between 8 and 44 percent of the decline in productivity growth in heavy industries over the past two decades, the electricity sector being the hardest hit.

The problem here is that the current method is scientifically and economically flawed. The physical laws of conservation of matter and energy ensure that all the materials and energy that are inputs to an industrial process also appear as outputs in some form. All of the sulphur in the coal burned by a power plant is discharged as scrubber sludge or as atmospheric emissions of sulphur oxides. All of the carbon, lead, arsenic, cadmium, and other trace materials in the fuel also reappear as ash or emissions. Any competent industrial engineer can draw up a materials and energy balance for an industrial process detailing where all the inputs go—some into product and some into waste. Consequently, in physical terms, inputs and outputs must always grow at the same rate.

The current productivity measure arrives at different growth rates for inputs and outputs only by ignoring an entire class of outputs: the unsalable and often harmful wastes discharged into air, water, or land. This is a drastic omission because the volume of such industrial wastes is huge. Each year, to produce nearly 5 billion tons of salable commodities, the U.S. economy uses more than 10 billion tons of crude materials, discharging 5 billion tons of waste materials before anything at all is sold. In addition, 2 billion tons of the materials that are sold, mostly fossil fuels and agrichemicals, are used in ways that disperse them directly into the environment. Productivity measurements ignore these residual outputs because they lack market prices.

For decades, environmental economists have evaluated the efficiency of measures to reduce emissions by comparing pollution damages averted and pollution-control costs incurred. Environmental economists, with long-standing Environmental Protection Agency (EPA) support, have estimated pollution damages for most regulated pollutants, and successive congresses and administrations have required EPA to incorporate such estimates in regulatory impact and cost-benefit studies. The accepted criterion of efficiency in environmental regulation is that the damages averted should exceed the costs incurred. Unfortunately, the current method for productivity measurement completely ignores this concept of economic efficiency. By counting only the costs of controlling emissions while ignoring the damages emissions create, the current methodology implies that any environmental protection that raises industrial costs reduces productivity, no matter how much larger the damages averted.

In fact, a firm that converts more of its inputs into valuable outputs and less into harmful pollutants is achieving an important efficiency gain that current productivity measures completely ignore. Case studies of the electric power and the pulp and paper industries demonstrate the significance of this omission (Repetto et al.). Over the 1970s and 1980s, these industries raised their marketed outputs per unit of emissions very rapidly in response to environmental regulations (see figures 1 and 2). In other words, while adding value through increased production these industries were subtracting costs to society through reduced emissions. This improvement overshadowed rather meager increases in output per worker, output per unit of capital, or output per unit of materials—the improvements captured by conventional "single-factor" productivity measures.

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We propose an alternative method for measuring productivity growth, one that corrects the flaws and biases built into the current measure. The proposed measure extends the output index to include all industrial outputs, both salable products and undesirable wastes. Marketed products are weighted according to their relative prices, as before. But wastes and effluents are weighted negatively according to the damages inflicted on the economy by the release of an additional ton. As a result, the aggregate value of output grows faster when industries reduce pollution than the conventional measure implies. This method ensures that the benefits of pollution control are captured in the record of productivity growth along with the costs.

This modification significantly changes the record of productivity growth in pollution-intensive industries. According to the conventional estimates, multifactor productivity declined by an average of 0.35 percent per year in the electric power sector between 1970 and 1991, with the sharpest reductions coming during the 1970s when pollution was reduced
the most (see table 1). According to the revised method, productivity actually increased over these two decades in the electric power sector, by at least 0.38 percent per year and perhaps by 0.68 percent per year, and the biggest gains were realized during the 1970s. The productivity increases stemmed mainly from the sector’s improving output mix as more goods and fewer “bads” were produced.

In the pulp and paper industry, another sector that causes considerable pollution, the results are similar. The conventional multifactor productivity measure increased by 0.16 percent per year, on average. The revised methodology suggests a growth rate of 0.36 or as high as 0.44 percent per year, depending on the damage assumption. This rate of growth is more than twice as fast as that given by the standard measure (see table 2). Again, the only difference is that the conventional measure gives the sector no “credit” for improving its output mix, so the productivity gains in pollution-intensive sectors are greatly understated.

The adjustments to productivity growth measures for the agricultural sector are much less dramatic. Although environmental damage from agriculture takes many forms, the only effects for which economic costs have been estimated satisfactorily are those from sheet and rill soil erosion. Sediment and silt builds up to fill reservoirs, block navigation channels, and interfere with water conveyance systems (Ribaudo). Eroded material also harms aquatic ecosystems and may limit fishing and boating. One study estimated the total off-site costs of eroding cropland at nearly $3.5 billion per year (Clark et al.). Fortunately, soil erosion has been reduced in recent years—especially from cropland, from which total erosion fell by 30 percent from 1982 to 1992.

The agriculture sector achieved rising output per unit of labor, capital, and materials between 1977 and 1992, in keeping with its favorable record of multifactor productivity growth (see figure 3). The increase in output per unit of soil erosion outpaced all other measures of single factor productivity gain, but this source of improvement is left out of conventional measurements.

Adjusting the conventional multifactor productivity estimates requires expressing erosion damages as a share in “total” agricultural output (marketed output and environmental damage reduction together). Under one assumption, these environmental costs fell from more than 5 percent to less than 2 percent of the value of total output from the sector. However, the value of farm commodity outputs was inflated by a variety of price support programs, so the true importance of environmental damages is somewhat understated by these figures (see table 3).

The revised estimates of productivity growth are higher than the conventional ones. However, compared to the results for the electricity and pulp and paper sectors, the adjustments are relatively small. At most, the adjusted productivity growth rates are approximately 14 percent higher (equivalent to 0.31 percentage points).

Extending the scope of the study to include damages from chemical and nutrient run-off and wind erosion would probably reveal a greater differential between conventional and adjusted measures. For example, one study found that off-farm wind erosion costs may be of similar magnitude to off-farm water erosion costs (Huszar) and wind erosion probably also declined as soil cover improved due to the Conservation Reserve Program and conservation compliance.

If the results of the pulp and paper case study are extrapolated to other pollution-intensive sectors (chemicals, metals, non-metallic minerals, oil and gas, and transportation) and the revisions for the electric power industry are factored in, while the conventional estimates are left untouched for other industries, it appears that over the period 1970–91 productivity growth in the nonfarm private business sector as a whole was understated by a substantial 32 percent. Distortions in conventional productivity measurements of the record of...
environmental and economic improvement are too large to ignore.

Agencies concerned with environmental protection and economic productivity in the United States should collaborate to introduce an unbiased measure of productivity growth. It is important to have an unbiased indicator that accurately captures the economic impacts of environmental protection, on which we now spend about 2 percent of gross domestic product. The EPA should develop and publish consistent time-series data on emissions of regulated air and water pollutants on an industry-by-industry basis. The EPA should also continue to refine and make available estimates of marginal pollution damages for such emissions, recording regional and intertemporal variations. These estimates will be valuable not only for measuring productivity growth but for other types of analysis of regulatory efficiency and priority setting.

The Bureau of Labor Statistics, which is responsible for making the government's productivity estimates, should undertake a joint study with EPA to develop a revised set of multifactor productivity growth estimates for pollution-intensive sectors that includes the gains accruing to pollution reduction. Agricultural and natural resource economists could contribute by helping to determine the costs of off-farm economic damages from pollution. These revised estimates should cover past decades to capture the true impact of environmental protection on U.S. productivity. They should be published by the Bureau of Labor and other government agencies. Accurate and unbiased indicators of economic and environmental progress can be a useful guide to policy and can help to dispel the confusion that now surrounds the relation between the two.

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