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Key Economic Concepts for Envisioning Sustainable Management of Discards

by
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The following essay explains economic concepts that are important for managing product, packaging and organic discards as resources rather than wastes, and for bringing issues regarding sustainability into the discussion about solid waste management choices. The essay builds from the standard economic theory of competitive markets, and describes extensions, amendments, and alternatives required to adequately address sustainability.

Market Prices and Full Costs

In the perfect world described by economic theory for the competitive market system, costs and prices reflect all the impacts of economic activity. For all goods and services used in the economy, competitive markets establish prices that fully incorporate all costs required for production of each good or service. That is, all costs have been "internalized" into market prices, in the jargon of economics. Competition for the resources needed to produce goods and services ensures that to gain the use of a resource, you must pay at least as much as it is worth to anyone else. In this idealized setting, profit maximization by businesses and cost minimization by public agencies leads to the most efficient possible use of all resources, and to least-cost provision of essential goods and services.

Even in this perfect competitive world, calculating cost for a service may involve more than simply checking one market price. For example, the market price for curbside recycling services reflects collection and processing costs, minus the revenue from sale of recovered materials. However, from the point of view of the solid waste system manager, the recycling cost calculation should also take into account reductions in garbage collection, transfer, and/or disposal costs (i.e., avoided costs).

The need to take one step beyond simple market prices is widely recognized in solid waste management's use of the term "full cost accounting" to mean calculation of all the separate types of internalized costs for a solid waste management system. "Full cost" signifies that all the costs of solid waste that may be incurred in an organization, including all capital, administrative and indirect costs, have been recognized and summarized in calculating costs for managing solid waste. Reliance on full cost accounting points toward minimization of the cost of waste management systems as a whole, rather than judging individual activities – e.g., only the recycling program --in isolation.

Modifying the Market: Externalities

Full cost accounting is a valuable first step, but it is not the final destination. Many important environmental effects are overlooked by a full cost accounting system because they are not reflected in any market prices or costs. These effects typically are branded as "externalities", and the costs they impose are called "external costs". In general terms, an externality exists when the production or consumption of a good or service directly effects businesses or consumers not involved in buying or selling the good or service, and when those spillover effects are not fully reflected in market prices.

For example, production and consumption actions can cause emissions of pollutants to air, water or land resources. In that situation people who are less healthy as a result of, say, breathing air pollutants emitted by a factory, have been forced to pay a cost. The factory has avoided

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that cost because the economic system does not provide markets on which the right to discharge air pollutants must be purchased from those who will be impacted by these discharges. This cost is called an "externality" -- the health cost of air pollution is external to the economic activity that caused it since neither the factory nor its customers pay it. As a result of not having to pay for its air pollution, the factory charges consumers too low a price for its products. In turn, this tends to cause society to consume more of these products relative to competing products that can be manufactured without producing as much air pollution.

Suppose there were markets in which generators of air emissions had to purchase permits to release pollutants, and that pollutant releases were well behaved -- that is, air pollutants only impacted those who had permits that they were willing to sell and get dirtier air in return for more money. In this case the free exchange of permits on these markets would establish a market price for pollutant releases. In that situation the use of clean air or clean water into which to discharge pollution would be treated like any other resource for manufacturing goods and services. The factory's accountant could multiply tons emitted together with this market price for emission permits to calculate a cost for pollutant releases. This cost would reflect the free market exchange of clean air or clean water for less clean air or water in return for permits to release pollutants. And to pay this cost the factory would need to charge more for their products in order to cover this additional cost.

In the absence of markets for pollution releases, economic theory suggests that the externality problem can be dealt with by evaluating the costs imposed by pollution, and then "internalizing" those costs – forcing producers and consumers to pay for the damages that result from their actions. To name one method, externalities can be internalized through emissions taxes, with the tax set high enough to raise enough money to cover costs of the pollution.

Another internalization method is to establish limits on the amount of a particular pollutant that each generator can release, and at the same time allow generators to buy and sell permits reflecting amounts by which they are exceeding or failing to meet their emissions limits. The tradable permit system for sulfur dioxide emissions under the Clean Air Act is an example of this method.

If all externalities were internalized, then market outcomes would be efficient, just as in the basic theory of competitive markets, because all producers and consumers would be paying for all impacts caused by the production and consumption of the goods and services they use. However, in practice there are significant obstacles to internalization of externalities. Unlike market prices, which are calculated automatically by the interaction of supply and demand (the "invisible hand"), the correct valuation of externalities is a difficult and time-consuming process. It is often prohibitively expensive and sometimes even intractable to trace the pathways of pollutants through an ecosystem and assess all the resulting damages in physical, let alone monetary, terms. Even when such an assessment is completed, care may be needed in applying the results to avoid political or social objections.

For example, it is often problematical to establish the price at which all those whose health is impacted by emissions would be freely willing to tolerate those emissions. Some economists advocate the use of carefully constructed public opinion surveys to assign monetary values to externalities (the so-called "contingent valuation" method). Ideally, this tells us what a representative sample of the population believes the externalities to be worth. In practice, though, most people have no experience in assigning prices to environmental impacts, and give wildly divergent answers to questions such as the cost of reduced visibility at the Grand Canyon due to air pollution (a classic case in which different studies arrived at very different answers).

Another difficulty is that surveys have not been done for most environmental problems, creating a temptation to use inappropriate approximations and shortcuts. Last year a major cost-benefit analysis, commissioned by EPA for use in setting a new standard for arsenic levels in drinking water, needed to assign a monetary value to non-fatal cases of bladder cancer throughout the nation.[1] Lacking any study of bladder cancer, the analysis simply used an estimate of the costs for a case of bronchitis, adjusted only for inflation, derived from a survey done in 1990 in one city in North Carolina.[2] This approach obscures several key possibilities: the North Carolina city may be atypical; real values placed on health problems may have changed in the last ten years; and bladder cancer may be valued differently from bronchitis. Yet EPA could not afford to do an up-to-date, nationwide study of the valuation of bladder cancer.

Even when valuation estimates are available, there are often analytical and philosophical questions about their interpretation. Many environmental problems involve some increased risk of death. Thus, internalization of externalities appears to require a dollar value for a human life. The currently accepted value, about $6 million in 1999 dollars, is based almost entirely on economic analyses of the wage premium required to induce blue-collar men to enter risky occupations in the 1970s and 1980s.[3] (It has been adjusted for inflation since the original studies, but is otherwise unchanged.) Use of the $6 million number is becoming standard in environmental economics. However, it begs both the practical question of whether job choices made by a subset of the population in the past should be a universal standard today, and the philosophical question of whether it is acceptable, on religious or ethical grounds, to assign a dollar value to human existence.

Despite these limitations and pitfalls, valuation of externalities can be a powerful tool when done properly. With enough ingenuity, ways can often be found to produce meaningful numbers. Use of tradable permits for emissions, for example, appears to solve the problem: regulators simply set a cap on total emissions, and then the market establishes the price for the right to those emissions. Under the Clean Air Act, sulfur emissions are limited to a total of roughly half the 1980s peak; coal-burning power plants, the principal emitters, determine the price for those emissions permits by bidding for them.

Yet the related problem of selecting an appropriate cap remains: the sulfur limit was not based on science, but was a negotiated settlement, heavily influenced by estimates of the cost of sulfur reduction. Moreover, there are limits, in terms of administrative cost and complexity, to the number of separate emissions trading systems that can be established and operated simultaneously. In practice, trading systems are likely to apply only to the best-known or most problematical pollutants.

Full plus External Costs of Solid Waste Management Systems

Choices by solid waste managers about the degree to which they should manage some or all of a particular waste through prevention, recycling or disposal options are heavily influenced by perceived costs. Because all three methods include activities that have external costs, ignoring these externalities may lead to erroneous waste management choices.

For example, prices for virgin material and energy resources may not fully reflect all environmental, public health and economic development impacts caused by extraction, refining and use of those resources. In turn, costs for disposal of product discards and their replacement in the product and services consumption chain by items manufactured from virgin resources ignore these external non-market costs of virgin resource use.

Furthermore, tipping fees (prices) for disposal may not fully reflect all present and future impacts caused by waste disposal facilities. When these non-market costs—which in this example occur upstream geographically and downstream in time as a result of waste disposal—are significant, *traditional market-price-based costs provide an incomplete basis* *for choosing among or prioritizing waste management options such as waste reduction, recycling and disposal.*

In discussing the costs of managing solid wastes it will be useful, therefore, to distinguish two main types of costs:

- *Internalized full costs* - costs of all transactions within the solid waste economic system that are tracked using standard accounting principles. Examples include costs for labor, equipment such as collection trucks or landfill compactors, administration and management, and environmental controls.
- *Externalized costs* - involuntary costs that arise outside the solid waste economic system as a result of transactions within that system. Examples for solid waste include uncontrolled releases of pollutants from: virgin materials and energy extraction, refining and use in manufacturing; recycled materials use in manufacturing; collection and hauling vehicles; recyclables processing and organics composting facilities; and disposal facilities.

In addition to being based on involuntary exchange (remember the earlier example: people living downwind from the factory have no choice but to breath the polluted air, and they are not compensated by the factory), externalized costs differ from internalized costs in that, as discussed above, they are not easily measured in monetary terms, even when the causes of the impacts - e.g., pounds of a pollutant released - are measured quite precisely. Because external costs appear to be somewhat ubiquitous throughout solid waste management systems, overcoming these measurability issues and developing methods to account for external costs in parallel with traditional internalized full costs is critical to evolving a system for management of discards as resources rather than wastes.

Time Horizon and the Discount Rate

Cost impacts, whether internalized or externalized, of today's solid waste management choices may occur far into the future. One example of this phenomenon involving internalized costs was provided in a study several years ago of costs at King County's Cedar Hills landfill.[4] At the time of that study, reducing disposal at Cedar Hills by one ton saved about $7 in current operating costs.

When solid waste management choices are made on the basis of only current year costs, then, in this example, estimated disposal costs savings (i.e., avoided disposal costs) from a waste reduction or recycling program amount to just $7 per ton diverted. However, it is reasonable for the solid waste manager's time horizon to encompass the opening and closing of landfill cells, landfill improvements, final closure, and post-closure maintenance. One must then take into account these future costs, as well as future cost savings resulting from diversion of an additional ton of waste today. Also, after Cedar Hills reaches capacity King County expects to begin exporting waste. Waste diversion puts off the landfill's closure date, and, thus, avoids for some additional time expending an estimated $38 per ton to export waste.

Adding in these future costs of today's waste disposal yields the estimate that waste diversion today avoids between $16 and $29 per ton diverted, instead of just $7, depending on whether savings in the future are discounted at, respectively 5% or 0%. A near-zero discount rate implies a willingness to spend one dollar today on a diversion program that would not save a dollar until, say, twenty years in the future. On the other hand, a discount rate above 25% implies that one wouldn't spend a penny today to save a dollar twenty years from now. A 5% discount rate implies a willingness to spend fifty cents today to save a dollar 14 years in the future.

Variable (or Marginal) Costs

After being sure that the time frame is long enough to capture all important internal and external costs and benefits, and after deciding what discount rate to use, one must estimate which costs remain fixed and which go up or down as discards increase or decrease. Some costs depend directly on the amount of waste handled, such as current landfill operating costs in the example above. These are termed "variable" costs. Other costs, such as administrative and planning costs, may not change as waste quantities change, especially for smaller changes in tonnage or shorter time horizons during which to make adjustments. These are termed "fixed" costs.

In the case of management methods with mostly variable as opposed to fixed costs, total costs are very sensitive to changes in tonnage managed. A method having mostly fixed costs, on the other hand, exhibits relatively constant total costs as tonnage increases or decreases.

Economists and accountants use a concept called "marginal cost" that is closely related to variable cost. Marginal cost is the amount by which total costs increase when quantity, say tons of discards managed by a particular method, goes up by one. A solid waste system will tend to have minimum total cost when the marginal cost of managing another ton with one method, say waste prevention, is about the same as the marginal cost of handling an additional ton with any other method. In that case, moving tonnage from one waste management method to another won't change total costs.

Thus, the rule of thumb -- to minimize total system costs, increase the use of waste management methods with lower marginal costs and reduce the use of those methods with higher marginal costs.

Pricing the Future

Costs and prices, with or without valuation of externalities, are snapshots in time. They reflect the impacts and resource requirements of current economic activity. A great deal of effort often is expended analyzing solid waste system costs in an effort to assure cost-effective waste management choices. This analysis may include a time horizon long enough to encompass the closing of current landfills. In rare cases the analysis may also address certain externalized costs -- landfill greenhouse gas emissions, for example.

By contrast, many of the most urgent and most intensely debated environmental problems concern our impact on the future that lies beyond the closing of current landfills, encompassing that time horizon by which all externalized costs of today's solid waste management choices will have to be paid. This raises the issue of long-run sustainability. In addressing that issue there are at least two difficulties with using the tools of economic analysis, one relating to the risk of irreversibility and the other to the paradox of future generations, which move the discussion beyond internalizing externalities.

In economic theory, market decisions are reversible. There is no problem of extinction: a “species” such as 8-cylinder automobile engines could disappear when gasoline prices soared after the oil crises of the 1970s, then reappear when prices dropped. The natural environment, unfortunately, does not work that way. If mining and logging drive a species to extinction, it will not come back when the demand for metals and paper declines. If carbon dioxide emissions from energy use accelerate climate change, at some point damages become irreversible and cannot simply be undone by later emission reductions. Typically, we do not know in advance exactly when the point of irreversible loss will be reached; by the time we are sure, it is sure to be too late.

This problem has led to interest in the “precautionary principle.” If there is a risk of irreversible damages, it is better to err on the side of caution. The prudent course is to minimize emissions and impacts, while seeking to learn more about the precise nature of the risks involved. The precautionary principle, it should be noted, argues for *more* environmental protection and emissions reduction than would be achieved by current markets, even if all externalities were internalized.

A second (though related) problem concerns the impossibility of representing future generations in the market today. The market excels at balancing supply and demand among those who are currently buying and selling. It does not reflect the wants and needs of future generations, because they are obviously not participants in any current market transactions. In that sense, impacts of current economic activity on future generations might be called externalities. But measurability issues are so intractable in this instance that the externality concept provides virtually no guidance for current solid waste choices.

Much of the discussion of sustainability involves provision for the future; there is a widespread belief that future generations should enjoy an environment no worse than ours. Yet there is no way, even in theory, to represent the desires of future generations in the marketplace today. Any attempt to do so is logically circular: the attitudes and preferences of future generations do not yet exist, but are created, in part, by our actions today; thus we cannot say that our actions today are guided by knowledge of what future generations want.

Like the precautionary principle, the paradox of future generations must be addressed by policy decisions that step outside of the market framework: we know that we have some responsibility to the future, but the market cannot tell us how much. In general, both principles typically point toward more concern for the environment than would be warranted on the basis of market principles alone.

About The Monthly UnEconomist

This monthly online newsletter available at www.ZeroWaste.com (or www.SoundResource.com) intends to provide insight and analysis on the everyday economics of recycling and the unpriced or underpriced environmental benefits of reducing waste disposal and replacing virgin-content products with products manufactured from recycled materials. In addition to *The Monthly UnEconomist*, Sound Resource Management's website ZeroWaste.com also offers recycling markets price history graphs, reports on a variety of topics including the economic and environmental benefits of recycling, and GarboMetrics - elegant, yet not mysterious tools and spreadsheet models for solid waste and recycling.

These materials are all available for no charge at www.ZeroWaste.com. User feedback is encouraged via info@ZeroWaste.com, and substantive comments will be published in our newsletter whenever they add to our understanding of recycling.

As an example of newsletter content, some issues of the *UnEconomist* analyze northwestern and northeastern U.S recycling market prices for nine recycled materials (mixed paper, ONP, OCC, glass containers, tin cans, UBC, PET bottles, HDPE natural bottles, and HDPE colored bottles). These prices are tracked by online graphs updated quarterly.

In addition, some issues of the *UnEconomist* are devoted to GarboMetrics, economic models for managing and analyzing solid waste and recycling. These newsletter issues explain the structure and use of GarboMetric models provided at ZeroWaste.com for such purposes as designing garbage customer rate structures and correctly comparing garbage rates in different communities. GarboMetric models and corresponding issues of *The Monthly UnEconomist* can be downloaded at no charge from www.ZeroWaste.com.

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[1] U.S. Environmental Protection Agency, *National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Proposed Rule*, June 22, 2000.

[2] Viscusi, W. Kip, Wesley A. Magat and Joel Huber, "Pricing Environmental Health Risks: Survey Assessments of Risk-Risk and Risk-Dollar Trade-Offs for Chronic Bronchitis," *Journal of Environmental Economics and Management*, Vol. 21, 1991, pp. 32-51.

[3] Viscusi, W. Kip, *Fatal Trade-Offs: Public and Private Responsibility for Risk*, Oxford: Oxford University Press, 1992.

[4] "Recycling Cost/Benefit Analysis: Methodology and Estimates," prepared for King County Solid Waste Division by Sound Resource Management Group, Inc., April 29, 1996; and "Review of Waste Export and Waste Forecasting Models," prepared for King County Solid Waste Division by Sound Resource Management Group, Inc., December 12, 1995.