

CROSS-SUBSIDY ANALYSIS WITH MORE THAN TWO SERVICES

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The purpose of this note¹ is to address certain misperceptions regarding the proper interpretation and application of the principles of my paper, “Cross-Subsidization: Pricing in Public Enterprises,”² the first work in the economics literature to rigorously define the concept of cross-subsidy. This paper has been of some use in subsequent scholarly research as well as regulatory proceedings in which cross-subsidization is an issue.

Unfortunately, the principles of cross-subsidy analysis established in my 1975 paper have not always been applied correctly. In this note, I address a specific question regarding the use of the “stand-alone cost” (SAC) test in a multi-service firm to determine the presence or absence of cross-subsidy. In brief, the stand-alone cost of any service or group of services of an enterprise is the cost of providing that service (at the existing or “test” demand level) or group of services by themselves, without any other service that is provided by the enterprise. A closely related concept is that of “incremental cost” (IC). The incremental cost of a service or group of services is the additional cost of providing that service or group of services over and above the cost of providing all the remaining services. For example, suppose an enterprise produced five services, $i = 1, 2, 3, 4, 5$, for a total cost of $C(12345)$, and the stand-alone cost of services 2, 3, 4, 5 were $C'(2345)$, then the incremental cost of service 1 is $IC(1) = C(12345) - C'(2345)$. In the paper, I use both incremental cost and stand-alone cost as tools to define subsidy-free prices. In brief, if the revenues of a regulated enterprise just cover total economic costs, then all prices are subsidy-free if the revenues of each service *and each group of services* is at least as great as the incremental cost of that service or group of services; equivalently, prices are also subsidy-free if the revenues of each service and each group of services is no greater than the stand-alone cost of that service or group of services. I show in the paper that under the assumption that revenues equal economic costs, these two tests for cross-subsidy are equivalent.

The specific question is: if two (out of three) services offered by an enterprise individually have revenues less than stand-alone cost, can we conclude that no cross-subsidy is being provided to the third service?

An example will help illustrate the question, and my answer. Suppose we have Services 1, 2, and 3. The three services share a common cost of \$100, which must be incurred if

¹ This note was prepared at the request of Sprint to clarify some questions concerning the application of my earlier work on cross-subsidy to address questions that have arisen in regulatory proceedings. It is not an endorsement of any regulatory position of Sprint or any other party. This note is an explication of the principles contained in my earlier work and does not constitute any deviation or modification of that work for any purpose.

² *American Economic Review*, 65(5), December 1975, 966-977.

any or all of the services are offered. Over and above this common cost, each service has an incremental cost of \$75.³ The total cost of all three services together is therefore $\$100 + \$75 + \$75 + \$75 = \$325$. The stand-alone cost of each service is \$175, as each of the services if provided by itself would have to incur the common cost and its incremental cost. Suppose the revenues from Service 1 were \$140 and the revenues from Service 2 were \$150, each less than their individual stand-alone cost of \$175. Can we conclude that the price structure is subsidy-free and no subsidy is being provided to Service 3?

If the enterprise is regulated and the total revenues are just equal to the total cost, then total revenues must equal \$325. Since the revenues from Service 1 and Service 2 together are \$290, it must be the case that the revenues from Service 3 are \$35, clearly less than Service 3's incremental cost. This would suggest that there is a subsidy, or at the very least perhaps a contradiction, in that the SAC is satisfied for all services individually (which would suggest that there is no subsidy) but the IC test is violated for Service 3 (which would suggest that there *is* a subsidy).

The answer is that at the revenues and costs of the example, there *is* a subsidy. The reason is very clear in the original 1975 paper: both the SAC and the IC tests must be applied not only to each service individually, but to *all possible groups of services*. The importance of groups of services was a key insight of the 1975 paper, but is often missed in regulatory applications. However, applying these tests to groups of services is absolutely vital to determining the presence or absence of cross-subsidy. Applying these tests merely to individual services cannot be thought of as an approximation, or "good enough." It is a fatal error, as it is in the above example.

When we apply the full set of tests to the revenues and costs of the example (assuming total revenue equals total cost), we find the following:

Services	Revenues	Stand-Alone Cost	Incremental Cost
1	\$140	\$175	\$75
2	\$150	\$175	\$75
3	\$35	\$175	\$75
1 & 2	\$290	\$250	\$150
1 & 3	\$175	\$250	\$150
2 & 3	\$185	\$250	\$150
1 & 2 & 3	\$325	\$325	\$325

It becomes immediately clear from this table that while each service passes its individual stand-alone test, Services 1 and 2 *together* fail their *combined* SAC test, as shown in the shaded row of the table, in which revenues for the two services together are \$290, while the stand-alone costs of these two is \$250.

While the definition of cross-subsidy and the arithmetic of the example are clear, the economic logic of it may not be so clear. For a complete exposition of the issue, the

³ For example, if each service produced 7500 units at a constant marginal cost of \$0.01, incremental cost would be \$75.00.

original article is the best and clearest source. However, I quote in brief from this article to motivate the above mathematical definition: “If the provision of any commodity (or group of commodities) by a multicommodity enterprise subject to a profit constraint leads to prices for the other commodities no higher than they would pay by themselves, then the price structure is *subsidy-free*” [italics in original]. In the example, the provision of Service 3 through the profit-constrained enterprise leads to higher prices for Services 1 and 2. If Service 3 were eliminated from the product set of the enterprise, then total costs would decline from \$325 to \$250, and the current revenues from Services 1 and 2 of \$290 would exceed \$250. Therefore, the price of at least one of the remaining services would have to decrease in order for total revenues to equal total costs. Thus, the provision of Service 3 (at these revenues and costs) “leads to higher prices for the other commodities higher than they would pay by themselves.” Result: subsidy.

The example of the question provides an excellent opportunity to focus on the role of *groups* of services, rather than just services individually, in cross-subsidy analysis. The importance of groups of service in cross-subsidy analysis is impossible to over-emphasize, and yet it may be overlooked in regulatory work. Unfortunately, as the simple example shows, such oversight can lead to fatal errors in the analysis. Clearly, performing the subsidy analysis on all groups of services may substantially increase the cost analyses needed to support the subsidy analysis. But avoiding the hard work will almost surely lead to a flawed analysis, as in the example.

Further Considerations for Practical Application of Subsidy Analysis

The simplicity of the example belies a host of both theoretical and practical complexities in the application of subsidy analysis in practice. In brief, these complexities are easily accommodated without undermining the basic theory. I describe several such complexities and outline their resolution below:

The case of total revenues not equal to total cost. In price-regulated enterprises, the norm would be that total revenues would equal total economic cost. In non-regulated enterprises, the norm would be that total revenues would at least equal and possibly exceed total economic cost (we ignore the case of long-run losses, as the enterprise would shortly go out of business). In this case, the equivalence of the SAC tests and the IC tests no longer holds, but the concept of cross-subsidy is still valid. Under these assumptions, the stockholders of the firm become a “player” and the analysis must consider effects on this group as well as on services. The focus of cross-subsidy analysis shifts entirely to the IC tests; the SAC tests are not helpful under conditions of positive economic profits.

The services in question are cross-elastic. This case is dealt with in the paper, and requires some adjustment in the cross-subsidy test to consider incremental revenues as well as incremental costs. With cross-elasticities, the removal of a service may result not just in a loss of that service’s revenue, but in changes to the revenues of other services as well. This effect must be accounted for in the practical application of the test, as described in the original article.

How are the firm's services defined? This seemingly simple question masks a number of important issues. For example, suppose a service actually consists of many different "rate elements," one for each component of the service. Is each rate element a service, for purposes of subsidy analysis? How about a tapered rate schedule? Is every element of the taper a separate service?

In brief, the answer is that anything the enterprise assigns a separate price to can and should be treated as a separate service. If for other purposes the word "service" is reserved for a larger grouping of component prices, then this larger grouping is included in the subsidy test as a group of services, as discussed above. The more detailed analysis ensures that customers that use some service components more intensely than others will not inadvertently be subsidizing customers with other component usage patterns within the larger service grouping.

A more difficult problem arises if the enterprise bundles services together into a single price that could more logically be offered separately. In this case, treating the bundle with its single price may lead to problems. Presumably, if regulators are concerned that bundling may produce hidden subsidies, then they may require the services to be unbundling and priced separately.⁴ Clearly, this would facilitate the subsidy analysis. However, absent an unbundling directive from regulators, such analysis would not be possible.

Shouldn't we be more concerned with customers being subsidized rather than services? This issue was taken up in my paper (with S. Levinson), "Subsidy-Free Prices and Anonymous Equity,"⁵ in which I examine the relationship between services being subsidy-free and customers being subsidy-free. The most stringent form of customer subsidy-free is called "anonymous equity;" the requirement that services be subsidy-free is a necessary but not sufficient condition for prices to be anonymously equitable. Therefore, the classic cross-subsidy analysis is the most helpful starting point for a more complete analysis of possible subsidy flows among customers.

What is the proper method for measuring incremental and/or stand-alone cost? While these cost definitions are quite clear conceptually, the practical implementation of measurement methods has been perhaps the most vexing problem in regulatory economics over the past forty years. Dispassionate scholars disagree on cost measurement methods, and parties to regulatory proceedings usually have very different views of appropriate methods. The FCC uses TELRIC (Total Element Long Run Incremental Cost) as a basis for cost advice to the states for pricing unbundled network elements from incumbent local exchange companies to competitive local exchange companies, but this standard has been hotly disputed in the courts and by academics. The measurement issues are beyond the scope of cross-subsidy analysis, although clearly the value of the analysis depends critically upon the validity of the cost estimates.

⁴ Unbundling of local loops for telephone companies was mandated by the Telecommunications Act of 1996, and implemented by the Federal Communications Commission and state regulators. This unbundling required separate prices be set for each unbundled element.

⁵ *American Economic Review*, 71(5), December 1981, 1083-1091.

