Economic Cost Model Structure

The BJA economic cost model consists of three primary modules: the Loop Module, the Miscellaneous Module (which contains the cost of termination, switching, trunking, billing and collection, and other miscellaneous costs), and the Annual Charge Factor Module. These modules are contained in pages that reviewers can access by selecting the tabs that appear at the bottom of the screen. The first page (Intro) contains a table of contents and descriptive material for orientation.

The BJA model is simple, powerful, and flexible. It is simple enough to be useful to analysts other than its creators, with a reasonable compactness that allows its easy distribution for purposes of validation, replication, and adaptation. Other analysts can take the model in hand (not in a wheelbarrow) and confirm, refute, modify, and/or expand our results for themselves.

Second, the model is powerful enough to produce results with implications beyond a particular study and its particular assumptions. In large measure power is a corollary of simplicity. If the model is tailored very narrowly to the specific requirements of one company or one set of data, it is likely to be weighted down with customized features and idiosyncratic variables that prevent generalization of its results or adaptation of its categories to other data sets. Bell Operating Company cost studies are particularly prone to this over specification and specialization of models. Ours is more generalized.

Third, our model is flexible enough to apply to a wide range of cases under a wide range of scenarios--capable of answering many "what ifs" without an undue amount of coaxing. For instance, while the Benchmark Cost Model and other traditional models are designed for a monopoly market, examining the costs of a single supplier with 100% market share, the BJA model can examine costs from multiple perspectives--that of the incumbent LEC plus any reasonable number of new entrants. Furthermore, it can compare competing scenarios with different market shares for the various competitors--and with different shares of different submarkets (business vs. residential, urban vs. rural).

We attempted to make our model straightforward, flexible, and user friendly in order to avoid the “black box” syndrome, in which cost results are presented to a regulatory commission without providing any real opportunity for the parties to audit those results, to probe into the underlying assumptions, or to allow them to see how the results would be affected by changes in the assumptions.

For this and other reasons, the BJA economic cost model is somewhat streamlined. Although our model simplifies away some details of the market and the network engineering--details that could potentially be presented with more specificity--this should not be construed as a weakness. To the contrary, simplifying away some of the detail allows construction of a model that is not only readily accessible but also highly flexible and efficient. Thus, for example, our model permits many of the same data to be used for either the incumbent or a new entrant, under a variety of different scenarios concerning market shares and network configurations.

There is analogous simplicity in the well known model of "pure competition" used by economists. The pure competition model is a theoretical construct that can be easily attacked as unrealistic. Certainly, because it relies upon extreme simplifying assumptions (e.g., homogeneous products), the model of pure competition does not precisely fit any part of the real world and is easy to criticize. Yet, this same model continues to be used and relied upon for many purposes, more than 100 years after it was first developed. The very simplicity of the pure competition model is part of its strength. It is enormously useful and powerful, forcefully demonstrating important relationships between buyers and sellers, costs and revenues, in ways that are impossible to achieve in models that are more complex and sophisticated.

In general, by simplifying elements of the production process that are not of critical importance, it become practical to create a model that is more flexible, more powerful, and easier to understand and use. The model we have used in this proceeding is capable of examining a wide range of possibilities and clearly indicating the nature of the shifting relationships between the important variables. It is cost relationships and approximate levels that drive management and regulatory policy decisions, not precise numbers. By trading off some engineering detail, it becomes feasible to increase the explanatory power and range of the model in explaining the underlying economic concepts and relationships.

The Loop Module

The pages within the Loop Module calculate the economic cost of loops within a wire center, based upon user-specified characteristics. The first page of the model, *Inputs*, allows the user to input a code number corresponding to a specific wire center; the charactersitics of that wire center are listed within a lookup table on the *Wire Centers* page. In the alternative, by selecting 999, the input code for the *User Defined* page, the user can easily custom-define an individual wire center, based upon input values for a wide variety of different factors.

The primary user-inputs appear as blue colored cells within the *Inputs* page and the *UserDefined* page. The numbers in these cells would normally be varied by the user, depending upon the particular situation under study. For example, they can simulate the appearance of a particular wire center on the incumbent carrier’s network or on a new entrant’s network.

The user-modified variables on the *Inputs* page have been organized by subject area into half a dozen logical categories. Two categories, *Market Shares* and *Network Type,* allow the user to define the size and type of carrier being modeled. In the first category, the user specifies the carrier's share of the business and residence markets within the two geographic zones described above--one close to the central office, the other farther away. In the second category, the user specifies whether the carrier will build a network to serve only business customers, only residential customers, or both.

Use of these input assumptions allows the model to simultaneously calculate the costs associated with two different networks, thereby providing direct contrasts of alternative situations. A comparison of the total costs of these two distinct network configurations directly computes the Total Service Long Run Incremental Cost (TSLRIC) of a specified service, increment, or group of customers.

The model contains numerous input assumptions (e.g., hourly labor costs) that can be readily varied to estimate costs more precisely. For instance, the model can be adjusted to estimate the extra cost of placing cable facilities under difficult conditions. In highly congested urban areas, the time required for placing cable will be relatively high, and this can be readily considered through the selection of appropriate input assumptions on this page. The results reported here reflect certain changes to input assumptions that were suggested by the parties to the Pennsylvania proceedings mentioned above, and corrects a few errors (all minor) which were identified during the course of those proceedings.

When running the model, the user can set the plant utilization factors appropriate to the study in question. A long run study would normally call for relatively high (idealized, or optimum) utilization rates, consistent with the underlying concept of a long run planning horizon, in which factory size is adjusted to accommodate the anticipated volume of production. Similarly, the page includes variables to specify the extent to which the carrier incurs structure costs (e.g., poles). Arguably, pole costs are sunk, and few if any new poles will need to be installed, even in the long run; and even if the user is modeling the extreme long run, in which poles would not be considered sunk, a factor below 100% would normally be appropriate, in recognition of the carrier's ability to rent pole attachments from others--particularly from the electric utility. Hence, only a fraction of the full cost of a new pole should be included in the cost study--particularly in the case of smaller entrants, which should often be able to attach their facilities to the incumbent's poles.

In addition to these primary inputs, the user can verify or modify numerous other variables located throughout the model. For instance, the user can control the assumptions that determine the mix of fiber optic and copper cable and can specify an all-copper network, an all-fiber/digital network, or a combination. These assumptions can be selected for each wire center, based upon the minimum cost configuration, an engineering convention, marketing considerations, or any other basis. Thus, for example, an all-fiber network could be selected if the subject carrier is positioned in the market as an all-digital carrier, even if this configuration does not yield minimum cost. For the user's convenience, most input assumptions that might be of interest are highlighted in blue.

The first page of the loop cost module, *WireCenter,* contains the detailed information concerning the number of loops and other characteristics of the wire center being modeled. The next page, *Loop Sum,* pulls together most of the cost calculations. The following page, *Network*, takes the assumptions selected by the user and builds two networks (configurations one and two) that match the selected specifications.

The next five pages primarily include data inputs concerning the cost of materials, labor time requirements, and other underlying relationships and calculations that drive the model. (For convenience, key assumptions are highlighted with blue type.) The default values included in the model reflect our general knowledge of the industry, gained over many years of experience working in this field. Since much of this knowledge has been obtained from our review of allegedly proprietary data, source documents are not available to support all of these different input assumptions. However, the user can easily verify or modify any of these figures by referring to a variety of different sources, including invoices, purchase contracts, and special studies, where available. If the user believes an input value is inappropriate, the user can easily make any changes deemed necessary, then re-run the model to see the resulting impact, if any.

Copper specifies loaded material costs of a variety of copper cable sheath sizes. It also calculates the cost per foot for engineering, placement and splicing, taking into account the estimated time requirements for these functions. All these figures can be readily controlled by the user or by anyone reviewing the model. *Fiber* includes the analogous cost information for a variety of fiber optic cable sheath sizes, plus the costs of fiber electronics. *Structures* includes similar information for the costs of poles, conduit, and trenching. The final page of this section, *AnnCost*, contains the annual cost factors used in the model.

The Miscellaneous Module

The Miscellaneous Module consists of six pages located at the front of the model. The *Inputs* page, mentioned earlier, allows the user to input a loop cost (e.g., derived from the Loop Cost module), and allocation factors for joint and common costs, along with a few other key assumptions. The user can observe the resulting composite cost of basic local exchange and switched access service on the following page, *Outputs.* The subsequent pages contain additional assumptions and detailed calculations used in developing the composite cost figure. *Termination* estimates the cost of the facilities located at or adjacent to the customer's premises. These include the network interface at the customer's premise, the drop wire running from this interface to the pole, conduit, or buried cable, and the terminal where the drop wire is connected to the distribution cable. The next page, *SwitchTrunk*, provides a simplified estimates of the cost of the end office, as well as tandem switching and interoffice trunking within the local calling area. The third page, *BillColl,* contains an estimate of the cost of billing and collection, segregated into joint and direct cost items. The final page, *AnnCost*, contains the annual charge factors used in this module. The annual charge factors we have used are developed in the Annual Cost module, but the user can readily substitute factors developed from another source, if desired.

The Annual Charge Module

The annual charge module computes the annual carrying charge for a variety of expected plant lives which can then be paired to specific plant items such as copper cable or poles. The module relies upon debt/equity ratios and annual cost rates which can be input by the user, as well as a tax rate. A levelizing process is used to spread the cost of investments over the entire economic life of the item. The module develops factors that can be inserted into the Loop Module and Miscellaneous Module. In the studies developed for this Report, we used an equity ratio of 60%, an equity cost of 12%, a debt cost of 8.5%, and a composite state and federal tax rate of 42.96%.

Assumptions

Distance and Density

Consistent with typical industry practice, the model assumes that cable connecting a central office with the individual end-user premises can be modeled as a tapering tree/branches configuration, with the sheath size of the branches diminishing as they move away from the wire center and toward the loop terminations. Within the model, downsizing occurs at intermediate nodal points in various sectors. The model establishes specific cable sizes and lengths that are reflections of the input assumptions selected by the user. For simplicity, the model assumes that the serving area is square, with the central office located at the center of the serving area.

The model takes into account at least one important complication that is often overlooked: it recognizes that systematic differences can exist in population density that may lead to cream skimming. It does this by incorporating a two-zone density taper. The inner zone (one-fourth the total area) would normally contain a higher density of loops per square mile, based upon the assumption that the most efficient plant configuration will site the central office as close as possible to the population center, in order to minimize the average loop length.

Planning Horizon

Our assumptions are long run and forward looking. Therefore, the model assumes almost complete variability in the size and design of the cable plant serving the central office. However, the model generally assumes central offices would remain in approximately the same location as the incumbent carrier's. This is sometimes referred to as a "scorched node" model, as opposed to a "scorched earth" model. The scorched earth approach can potentially be simulated with this model, provided the user adjusts certain inputs, including the average loop length and the numbers of loops served by the wire center. These modifications could potentially yield some reduction in costs when modeling a new entrant with a relatively small market share, requiring fewer central offices to efficiently serve a particular exchange.

Technology

In a long run study, most production factors are variable, and the optimal, most cost-effective technology would normally be assumed--the optimal technology that results in the lowest total cost for the relevant level of output--not necessarily the lowest cost for a particular service. For example, fiber optics may be used, if this sufficiently reduces the cost of serving broadband business customers, regardless of whether this increases or decreases the long run cost of serving residential customers in the same area. In practice, technology decisions are often driven by marketing and other considerations, in addition to cost minimization in the purest sense.

The user can adjust the model to simulate a variety of different copper/fiber plant configurations and thereby observe the resulting impact on the average cost and total service incremental cost of serving both residential and business customers. The studies included in this report are based upon networks composed entirely of traditional analog copper cable, since this is the predominant technology in use by most incumbent carriers, and it is the primary technology of interest in the context of unbundled loop network elements. By far the most important loop network elements that will be purchased on an unbundled basis are copper wires running from the end users to the incumbent's wire center.

Incumbents and New Entrants

Clearly, the industry is currently undergoing an enormously important change as it evolves away from a quasi-monopoly local exchange environment to one that permits and encourages competitive entry. Accordingly, we constructed a model that can develop cost estimates for both incumbents and new entrants. For purposes of this Report, we estimated the long run costs that are incurred by the incumbent carrier.

Incremental Service Definitions

Although the flexibility of the model allows it to explore a great variety of different incremental service definitions, in this Report we focus on three increments: the cost of adding residential service to a network that would otherwise serve only business customers, the cost of adding business service to a network that would otherwise serve only residential customers, and the cost of adding unbundled loop service to a network that would otherwise serve only the incumbent's retail customers.

Methodological Comparison to the Benchmark Cost Model

At ¶137 of the NPRM the Commission suggested one method of establishing proxy price ceilings would be through the use of the Benchmark Cost Model (BCM), and some of the parties have lended support to this suggestion. The BCM estimates the average cost of providing a loop to each household in each Census Block Group (CBG). To date, the BCM has not been designed to estimate incremental costs. The BCM excludes any consideration of single line business, multiline business, and public telephone service loops. In effect, the BCM estimates the average cost of providing loops to every household in a stand-alone context. This methodology ignore the economies of scale and scope that arise when residential service is provided on a network that would otherwise serve business customers in any event. Clearly, the BCM does not provide TSLRIC estimates.

The most recent Hatfield model, a variant of the BCM model, does consider business loops. It provides an estimate of average cost per loop for a network which includes both business loops and residential loops. While this model acknowledges the existence of business subscribers it does not focus on the incremental effects of adding residential subscribers to a business network (or vice versa). Instead, it computes the average cost of serving the composite group of both business and residence customers. Accordingly, it does not provide an estimate of TSLRIC, such as the change in cost which occurs as residence customers are added to a network serving business customers. In this regard, the Hatfield approach is only slightly different from the BCM. It fails to isolate the incremental costs that are incurred by serving (or that can be avoided by not serving) a specific group of customers, given that a core group of other subscribers will be served in any event.

Both the BCM and the Hatfield model develop the average cost of providing service to a specified geographic area, assuming no other services are being provided. This is not consistent with the "incremental" concept, and is clearly an average costing approach. As TSLRIC is normally defined, costs should be calculated assuming the firm continues to provide all other services to all of its other customers.

By varying the "service" or "group of services" that is studied, the incremental concept can be applied in a variety of different ways, with widely varying results, as demonstrated in this Report. As a general matter, TSLRIC will tend to vary, depending upon the specific increment which is studied.

Regardless of whether one looks at a service or group of services, or a customer or group of customers, the increment being studied should be small enough to provide results that provide some insight into the manner in which the carriers costs change as it expands or contracts its volume of output, given that many other services and customers will be served in any event. Typically, this can best be achieved by defining a relatively small increment which is added to a network that would otherwise serve a large number of other customers. When the increment being studied is very small, relative to the core level of service that remains constant, the cost estimate will likely be somewhat similar to marginal cost. In contrast, if a very large increment is studied, the results are likely to be similar to average cost.

The clearest distinction between marginal and average costs relates to the manner in which fixed costs are treated. Average total costs include the total of all fixed and variable costs, divided by the number of units of output. In contrast, marginal cost includes only the rate of change in variable costs as output increases.

Consider, for example, the cost of a pole. Under the economist's definition, the average cost per loop would include the total cost of the pole divided by the number of new loops attached to the pole. This is the type of cost calculated in the BCM and Hatfield studies. It is not a valid estimate of marginal or incremental cost.

Continuing with this example, the marginal cost of a loop most likely will exclude any costs of the pole, which are unlikely to vary much, even in the long run. The same number of poles is often adequate to handle a wide variation in the number of loops. Some might argue that in the long run, all costs are variable, and thus poles would not be considered a fixed cost in a long-run study. Even if one views the long run in this manner, however, the marginal cost associated with poles would be far lower than the corresponding average cost. Instead of dividing the total cost of the poles by the number of loops, the long run marginal cost would consist of the change in the cost of poles associated with an increase or decrease in the number of loops mounted on those poles. The marginal cost of poles most likely would be very low, or even zero, in the long run, despite the fact that the cost of poles is considered variable. The reason is simple: the change in the total cost of poles resulting from changes in the number of loops generally would be very small, or zero.

Admittedly, on some occasions the size of the pole might increase slightly as the number of loops (and total weight of the cable) increased; or perhaps the spacing of the poles would be reduced for the same reason. However, the increase in pole costs would normally be far less than proportional to the rate of increase in the number of loops, and thus the long-run marginal cost would be far less than the average total cost.

In other words, even in the long run, where the number and size of the poles can be optimized, and this optimizing process considers the number of loops, there will be very little if any resulting variation in costs. This means that the rate of change in the cost of poles will be extremely small, or zero, and thus the marginal cost associated with poles will be nearly zero, even in the long run. The same principle holds true for other fixed costs, such as the cost of attaching the cable to the pole.

The cost of attaching a small cable, such as one containing 25 loops, will not differ greatly from attaching a much larger cable, such as one containing 900 loops. With the notable exception of splicing costs, most cable costs vary less than proportionally with variations in the size of the cable.