DIFFICULTIES IN THE MEASUREMENT OF SERVICE OUTPUTS

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I. INTRODUCTION

This paper investigates difficulties which arise when constructing measures of the real output of service industries. While data on revenues of service industries are often available, a researcher interested in productivity analysis will need a measure of output which distinguishes price change over time from real output change. A fair number of studies have appeared in the literature which address service sector measurement problems. Our failure to completely solve these problems has resulted in the absence of adequate price indexes for use in the construction of output measures for many service industries. This paper attempts to review and classify these problems.

In general, the problem of measuring a service industry's output can be addressed by 1) identifying the unit of output and 2) then addressing the issue of quality change. Conceptual problems can arise with either or both of these major steps. This paper will discuss problems falling into these two broad groups.

Problems encountered in measuring output when innovations occur in an industry will also be summarized. Finally, two

general approaches which have been followed by researchers to measure services will be presented.

Discussion of quality change will be limited to conceptual problems that make the identification of change difficult for many services. There will be no discussion of the very difficult problems which arise in measuring public services and which can arise even in the classification of industries and firms as goods or services producers.

II. THE USUAL APPROACH: DEFINING THE OUTPUT AND MEASURING ITS QUALITY

When employing typical available sources of data, the usual way to measure the real output of an industry or sector is to deflate a nominal measure of output with a price index for the product. Common nominal measures of output are value of shipments for goods (adjusted for changes in inventories of work in progress and finished goods) or revenues/sales/receipts for services. Whether constructing a price index to be used for deflating nominal output or constructing some quantity type measure employing alternative data sources, *it is necessary to first specify exactly what is being purchased.* Usually this is the basic transaction unit of the product.

Once a unit of output is specified, the next step is to enumerate all the characteristics of this product which determine its price. The variation that occurs in a given characteristic either over time or among suppliers amounts to quality change.

If a product's price rises due to an improvement in one of its characteristics, we wish to attribute the increase to a quality change leading to output growth and not to an inflationary price change. Various means would have to be employed to adjust for the quality variations in the observations.

Although not a completely clean division, it is useful to separate the discussion into problems that occur when defining the basic service unit and problems that occur when controlling for quality change in either time series or inter-firm comparisons. Section VI of this paper will compare two general approaches to services measurement which attempt to capture both the basic output of the industry plus any quality change. One of the methods attempts to measure the unit of transaction of the service (the "transactions approach") while the other attempts to measure the outcomes of the service (the "outcomes approach").

III. PROBLEMS WITH DEFINING THE SERVICE UNIT

A *very general* definition of a service is useful before discussing the problem of defining the *quantity* of services. From Hill (1977), a service is a change in the condition of a person, or of a good belonging to some economic entity, which is brought about as the result of the activity of some other economic entity, with the approval of the former person or economic entity. For the sake of simplicity, we will refer to the good or person undergoing the change as

the consumer and the other economic entity causing the change as the supplier.

Given this general definition, the basic unit for measuring the quantity of services can be difficult to specify. Because services result in changes, they are intangible in many cases. Change in condition may simply mean that the consumer is now allowed to do something she could not do before purchasing the service, e.g., attend a concert.

Many services are not this abstract. For example, house painting can be directly observed and the unit specified, e.g., in number of coats, square feet, and paint grade. The output of a railroad, although intangible, can be defined as the aggregate of weighted freight ton miles and total passenger miles, see Duke, Litz, and Usher (1992). In both of these cases, though, in order to match the detail of available data, alternative specific definitions would be possible.

When measuring particular services, researchers have encountered one or more types of problems when they have tried to define the basic unit of output. Some of the major difficulties can be categorized as: enumerating a complex bundle of services; choosing among alternative representations of an industry's output; accounting for the consumer's role (which manifests itself in several ways); and clearly specifying whether we are working with a value added or a gross output model.

ENUMERATING A COMPLEX BUNDLE For some services, the transaction unit actually includes several services bundled together in a complex way. Services in the bundle may be jointly produced or interdependent. Each service in the bundle has its own set of characteristics. The implicit prices of these characteristics determine the implicit price of each service.

For some services, the problem is so complicated that it is difficult to enumerate all the services and/or to keep them separate so that we can eventually match price change for the entire bundle with changes occurring in the individual services. These are the cases we are interested in here.

An example of the complex bundle problem occurs in the retail trade industry. When a consumer goes to the supermarket to shop, he is buying a shopping basket full of food. Through the markup the store adds to the food prices, he is also buying a complex bundle of services from the store itself. We only observe a single price, the markup, for all of the services.

Oi (1992) enumerates some of the elements which the store may include as part of the service bundle. They are: consummating transactions; assembling, displaying and providing information on goods; making the goods available at times and places convenient to customers; supplying additional services like delivery and credit; and processing

goods into more suitable forms (e.g., the deli counters at a supermarket).

We can refer to the banking sector for another example of bundled services. When a customer has a checking account, the bank provides safekeeping and accounting services as well as facilitating bill paying. Further, many of the bank services are interdependent so that the provision of one service may include the provision of others which cannot be transacted for separately.

ALTERNATIVE REPRESENTATIONS OF OUTPUT For some industries, there is not an obviously correct way (or adequate data) to describe all of their outputs or functions in terms of transaction units. Banking is the example that has received much attention.[1] Rather than describing the transaction units, researchers have made different assumptions as to the way underlying services are attached to the activities or products of a bank. The activities or products are then the output measure. In the literature, there is not agreement upon which of the different representations is best.

Banks transform liabilities (deposits) into assets (loans). They also facilitate the economy's payment system as one way to attract deposits. Specifying transaction

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1 The discussion in this section draws upon papers by Triplett (1992), Colwell and Davis (1992), and Fixler (1993). Those papers also contain summaries of the problems researchers have encountered when measuring bank output.

units to describe all of the services the bank provides while performing these functions is the difficulty.

Outside of special accounting treatments of banking in the national income and product accounts of some countries, there have been two different points of view leading to different approaches to measuring the industry's output. One is the production approach; the other is the financial intermediation approach.

For the production approach, banks are viewed as firms which use capital and labor to carry out various activities associated with loan and deposit accounts. Output is then measured as the number of accounts or transactions carried out for each product.

For example, the measure of bank output underlying the BLS industry productivity measure includes as major service functions: 1) deposits; 2) loans; and 3) trust department activities. The demand deposit function is measured in terms of the number of checks transacted and of electronic fund transfers, and the time and savings accounts in terms of the number of transactions.

For the intermediation approach, the focus remains on the bank as a financial firm whose goal is to choose an optimal portfolio. Of interest is the optimal dollar amount in each product the bank provides. These nominal balances are related to services because the financial services are assumed to attach to each dollar in the account. According

to this approach, the values of loans and investments are the outputs.

For either approach, it is difficult to classify and incorporate demand deposits as inputs or outputs in a model. It is possible to view them as outputs because customers acquire them for safekeeping, accounting, and bill paying purposes. On the other hand, deposits, when viewed as liabilities and a source of funds for the bank, should be classified as inputs. Researchers have adopted various criteria for making this determination (see Triplett (1992) for a summary of those methods).

Triplett describes why the various criteria have not satisfactorily resolved the dilemma. In brief, the value of the services should be included in *both* a bank's output and in a bank's input costs. The bank pays (or barters with) depositors for these inputs (funds) at least in part with outputs (services).

But to include the value of deposits is problematic because some of the services are not explicitly priced. Researchers and national income accountants have had to rely on various ways to impute the prices of and control for quality variation[2] in the services.

ACCOUNTING FOR CONSUMER INVOLVEMENT The essence of this problem is that consumers supply an input or consumers must be involved for a service to take place. For example, if a

2 See, for example, Fixler and Zieschang (1992) for a study of the use of bank branches as a proxy for the quality of financial services delivered.

band plays to an empty stadium, Hill notes that there is no output because there are no consumers. Further, there is no way to put this live performance into inventory and consider it to be an output. This situation is unlike that for a goods producing industry, such as the auto industry, where a car can be produced, put into inventory, and be counted as output even though a consumer does not buy it.

The customer involvement forces us to confront some difficult issues when we measure certain services. First, we must distinguish between services and outcomes so that we clearly specify what is being transacted. Second, the measures need to account for the fact that output can be dependent upon the number of consumers. Finally, we must account for the provisions that the suppliers make to accommodate situations where it is uncertain if and when the consumer will purchase the service.

To correctly specify a service output, we need to separate the change in the consumer brought about by the supplier from other changes that might occur when the service is provided. The service cannot extend to benefits or outcomes that the provider cannot supply. We might choose to measure output in terms of outcomes rather than in terms of transactions, as we will discuss later. Even if we pursue this alternative route, to assign responsibility correctly to a given supplier (or sector), it is necessary first to enumerate carefully only those outcomes due to the supplier's efforts.

Hill presents an example which occurs in medical care. In Hill's view, when a doctor consults in her office with a patient and recommends a course of action for an ailment, giving the advice is the service. The patient's condition has been changed because he now possesses the knowledge the doctor has transferred. The patient's physical condition may improve because he follows the doctor's advice. This outcome is not the service. Even if the patient's condition worsened, the service was still performed. The easiest way to view this is that the patient will be billed for an office visit regardless of the outcome. The patient's expectations regarding the probability of success of following the recommended course of action will affect the price paid for the advice and will be discussed below as a component of quality.

In Hill's example of the doctor, he assumes that the information has passed from the doctor to the patient. Another illustration of the complications caused by consumer participation is a situation in which a teacher is teaching a class of poor students. The teacher is trying to impart some of his knowledge directly to the pupils through instruction. But because of the students' inability to receive this information, there is no change in their condition. Hill argues that the teacher's effort is wasted and cannot be counted as productive. There is no output.

However, it is reasonable to argue that if someone is paying the teacher to be in the classroom, the teacher must

be providing some service. This particular confusion can be cleared up by specifying what the teacher agrees to provide and what the students or their parents expect to receive. The teacher agrees to appear in front of the class and to deliver lectures. Even if the students learn nothing, the teacher is enabling them to meet the legal requirement that they must attend school until a certain age. Viewed this way, there actually is an output.

Another complication due to consumer participation comes from the case of collective services. A collective service is provided when changes occur in several persons or to the goods of several economic entities as the result of the action of a single economic entity with the permission of all concerned. Here the output can be viewed as dependent upon the number of consumers.

For example, a bus company provides a collective service when several passengers ride on one of its buses. Or, in a more complicated case, the radio and television broadcasting industry provides a service to other industries which advertise on the airwaves. The broadcast industry's output is dependent upon the size of its audience. Further, the output can be dependent upon its *share* of the audience advertisers wish to reach. For a brief discussion, see Griliches (1992).

Collective services involve notions related to output and productivity. Hill discusses two of them. First, as the number of recipients goes up, it is necessary to account for

a congestion factor. For example, in education, an increase in the student-teacher ratio may lead to a reduction in quality. An example of an attempt to quantify the congestion factor and make an adjustment may be seen in Mukerjee and Witte (1992). They attempt to adjust the output of the day-care industry for quality change by measuring the number of staff-class hours divided by a weighted index of the number of children. The weights account for the varying needs of children of different ages. (This example also illustrates how the distinction between issues of defining output and issues of quality can become fuzzy.)

A second notion raised by Hill regarding collective services is that the number of recipients may decline for reasons beyond the control of the service provider. For example, the number of students may change due to changing demographics. This will lead to reduced output and, if the number of teachers is unchanged, to lower productivity. Hill says that this is the correct result and that we should not confuse the efficiency or skill of the provider with productivity.

A further example of the difficulties due to consumer participation is one in which both of the prior problems are faced. That is, we must separate the service from the outcome and there are multiple consumers. Hill discusses measuring the output of spectator events and suggests that

perhaps it would take a psychologist to measure the change in condition of the spectators.

Rather than attempt this, we could examine the conditions of the "contract" between the ticket holder and the team. When a fan buys a ticket to a ball game, the team does not guarantee a win and a nice feeling for the fans but rather that it will show up and play the game. The fans know this is all that is guaranteed but buy the tickets because they enjoy watching the game regardless of outcome. One could argue that the number of tickets sold represents the output because it represents the number of people allowed to view the game.

If a fan believes there is a greater chance of good play and success and, consequently, a better psychological outcome for himself, he is more willing to pay a higher ticket price. Thus, fans are likely to pay more to see a good team rather than a poor team (or to pay more than the year before if the home team has improved). If the team improves but ticket prices don't change, more fans are likely to pay the given price. From a measurement perspective, if the price of tickets or attendance rise, we have to make the difficult determination of whether the team has improved. (This psychological transformation of the fans can also be viewed as part of the quality dimension which will be discussed in the next section.)

Finally, because of consumer participation, we must account for any provisions made to accommodate the uncertain

occurrence of consumer demand. This issue can be illustrated by again referencing Oi's study of retail trade. In general, to buy goods in a retail store, a customer must allocate time and resources in order to determine the right good to buy, at what price, and then to get the product home. The customer receives greater service if his time for the shopping transaction is reduced. For example, the store will choose its location(s) in order to serve customers by allowing them to reduce their travel time. These particular functions performed by the store determine a part of its output. In this example, one of the outputs is convenience which is difficult to measure.

Further, if and when the consumer will arrive to shop is not certain. Oi notes that a store will tolerate idle (pseudo idle) clerks so that when a customer arrives, he may be served without an unacceptable delay. We need to account for this service in the store's output measure. A further comment will be made in the next section on quality change.

Feldstein (1969) pointed out the need to account for uncertain demand in the context of medical care. One way to accommodate the uncertain occurrence of medical problems is to design the sector with excess capacity. The more excess capacity, the less a patient will have to wait to have a problem treated. If this quality component is ignored, greater capacity will involve greater costs without greater output. This would be mistakenly viewed as low productivity. Feldstein argues that ignoring this excess

capacity would be as wrong as measuring the fire department's productivity by the number of fires fought per fireman.

VALUE ADDED VS GROSS OUTPUT There are two concepts of output that are commonly used when an industry's output is measured. The first is gross output which equals the actual goods or services production of the industry. The second concept is value added which equals gross output minus the industry's purchases of materials and services from other industries.

Due to the intangible nature of many services, it is not obvious how these concepts apply in some studies. This can lead to arguments in the literature. Two papers on the insurance industry illustrate this point.

A discussion of a paper on the fire and casualty insurance industry by Hornstein and Prescott (H&P) (1991) provides an illustration of these two concepts. The paper first defines the output in terms of the gross revenues of the firm. Thus, output is equal to the number of contracts sold valued at base period prices. Claims are represented by the replacement durable goods provided by the industry and are treated by H&P as intermediate inputs into the industry. We can envision the insurance industry buying replacement durable goods and passing them through to the claimants. H&P then calculate value added output by subtracting these claims from gross output.

Another approach is developed by Hirshhorn and Geehan (H&G) (1977) for the life insurance industry. H&G employ data on "administrative" costs associated with the different products (policies) sold by the industry. H&G weight together the various products in different time periods with the base year unit costs of administering the contracts. Even though they do not label it as such, applying the base year unit administrative cost (including purchases from other industries but not claims) to weight the number of policies of a given type yields a measure of "real administrative costs" which is effectively the value added of the industry.

Denny (1980) criticized the H&G measure by arguing that consumers buy insurance to avoid risks and an output measure should reflect the quantity of risk shifted to the insurance company. He suggests the use of base year premiums to evaluate the services provided. This is a gross output notion because output based upon premiums will include administrative costs plus claims.

H&G counter that Denny's suggestion will yield only a measure of funds processed by the industry. The life insurance industry offers protection because it has created the facilities for pooling risks; the activities associated with maintaining its capacity to pool risks is the service provided by the industry. Implicitly, they argue that the risk is shifted from the consumer to the pool and not to the

company and that the pool (or claims) is an intermediate input.

Thus, viewed from within an H&P framework, Denny is actually criticizing H&G for choosing a value added output notion rather than criticizing them for an incorrect definition of output. There are reasons to prefer one concept of output to the other but that is not the focus of the Denny and H&G debate.

IV. QUALITY VARIATION

The quality determining characteristics of many services can be numerous and changes or variations in a particular characteristic can be large. Properly measuring the quality dimension can be as important in the determination of real output as measuring the number of the basic service units.

Accounting for quality variation can be difficult. There are various techniques which have been employed[3]. For example, a statistical technique is available which allows us to account for variations over time or among suppliers in the characteristics of some products. The "hedonic" approach, as the technique is commonly called, has proved very useful to researchers. Once we specify the transaction unit, the technique is used to derive the relationship between the product's price and the characteristics of the product. This information can then be used to adjust a price index to remove the effects of the quality variation.

3 See, for example, BLS (1992) pp. 191-193 for a summary discussion of the quality adjustment problem in the context of the BLS Consumer Price Index program.

(See, for example, Griliches (1971) for a further discussion of this technique and some examples of its use.)

To make quality adjustments we would need to specify the differences among products. Quality differences can sometimes be easily observed. It is possible to tell that one motel has a swimming pool while another does not. This is a problem similar to one frequently encountered for goods and is not of particular interest here.

Sources of difficulties in identifying and controlling for quality variations in services include dealing with a complex bundle of services. Even for non-bundled products, the units can be non-standardized to a large degree with respect to quality. Further complications are due to the existence of situations where the supplier knows more about the probable outcome of a service than does the consumer. Finally, the consumer's role in the provision of a service must be addressed with respect to the quality of the service.

Not only is the complex bundle of services an issue when trying to define the basic service unit but also when trying to control for quality. Each of the bundled services will have characteristics which can vary and, because of their intangible nature, be hard to identify. The complexity of the product results in many elements which can vary over time and among suppliers but be reflected in only a single price.

For example, when a store hires more clerks to speed up check out and save the customer time, a characteristic of the "consummation of sale service" has been changed. We would need to label this an increase in quality. If the markup were raised to pay for the extra staff, it would be necessary to remove this increase from the markup before calculating price change.

Sometimes a simple basic unit, like an hour of a lawyer's time, can be specified as an output. However, these units are not standardized.[4] One reason for this is that the quality level of a given output unit is at least partially a function of the probability that the consumer will achieve the outcome he desires after purchasing the service. Or, for multiple possible outcomes, there would be a probability for each outcome.[5]

Typically clients hire defense attorneys on an hourly basis. The consumer will make a decision on which lawyer's time to purchase by considering the price of and expected benefits from the available lawyers' services. If we then look at the hours spent by a defense lawyer as a measure of output, a highly skilled practitioner's hours will be considerably more valuable than those of a novice because

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4 Hulten (1985) notes that for services provided by doctors, lawyers, and barbers, for example, output depends as much on the quality of the product as on the hours spent in production.

5 This discussion of services and the issues of uncertainty and information draws upon a paper by Holmstrom (1985).

the skilled lawyer is more likely to win the case for her client.

The difference in probability of winning a case between the two lawyers may depend more upon their relative skill levels than the difference in hours spent on the case. This difference in skill can be due to differences in the two lawyers' innate talent, training and experience. It can also change over time for each of them.

Whether the transaction unit is simple or complex, what further complicates the problem is that the quality dimension can be difficult for the consumer to determine. The supplier often has better information than the consumer on which to make the determination. This issue is referred to as the problem of asymmetric information. A simple example is where a doctor knows the chance of success for a procedure better than does the patient.

There are two reasons why the consumer is less informed than the practitioner regarding the probable outcome. First, there is a situation labeled "moral hazard" where a consumer is unable to observe the actions taken by the supplier. The practitioner may not make his best effort because the client is unable to observe the effort.

Second, there is "adverse selection" which refers to a situation where the client cannot observe the qualifications of the practitioner or the conditions under which he operates. A patient may not be able to judge the competency

of his doctor and a consumer may not be able to judge that all the work done by her auto mechanic was necessary.

The market place may address the asymmetric information problem through the introduction of such things as contingent fees or warranties. As another correction, the market place may offer the practitioner's reputation as a way to overcome the asymmetry.

Asymmetric information can make service measurement and analysis difficult. First, we have to make sure the relevant market corrections are contained in the service. If a warranty is part of a service, any change in it needs to be accounted for in a measure.

Second, unless we make some adjustments in our analysis, we may assign output and productivity growth to the wrong industry. This mis-assignment occurs if the market price of the service does not accurately reflect the service being purchased from the industry being studied. One possibility is that the corrections to the asymmetry problem may be made by other industries such as the malpractice insurance and the legal industries.

Suppose a doctor takes out a malpractice insurance policy and raises the prices he charges his patients. His patients may be better off because they are better protected from the effects of asymmetric information. There is no inflationary price increase for the total package of medical treatment plus insurance coverage. However, the resulting

output increase is due to the insurance industry and not to the medical industry.

Finally, Griliches notes the role of the consumer as being a source of quality variation in services. An illustration of this is the earlier example of the teacher teaching poor students. Because a poor student absorbs less information than a good student, it might be argued that the teacher in charge of the poor students has poorer quality output than does a teacher with good students.

V. CAPTURING INNOVATIONS[6]

When the service sector is described as being difficult to measure, one frequently mentioned reason is that it is a sector in which rapidly changing technologies have occurred or been employed. The concern is that these advances have lead to innovations that produce quality and productivity changes that are difficult to capture. The use of computers by service industries is a frequent example. Baily and Gordon (1988) point out that due to the greater use of computer power, retailers can monitor and control stocks better and can offer customers a larger variety of goods and reduce the occurrences of goods being out of stock.

The innovations we are interested in accounting for can be classified in one of two ways. The first are those that increase the effectiveness of a service and are referred to as product innovations. For example, an innovation may

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6 This section and Section VI draw on Hill (1977), Feldstein (1969), and Griliches (1992).

result in a higher success rate in the diagnosis of a particular disease. It may also allow for the diagnosis of a disease with less pain and fewer complications for the patient.

The second category of innovation is labeled process innovation. Here the effectiveness of a service is not altered but it becomes possible to provide the service with fewer resources. Griliches provides the example of the new laser based gall bladder treatment. With this technique, it is possible to treat gall bladder problems with presumably the same success rate as under prior procedures but using fewer resources.

Both types of innovations can present difficulties in measuring service output and productivity. Product innovations lead to quality change and the difficulties it can present. Process innovations lead to difficulties in matching inputs with outcomes. Suppose a process innovation results in a new medical procedure as in Griliches' example. If the new procedure is treated as a new service, it will be related to its own inputs and the old procedure related to its inputs. None of the productivity gains due to achieving certain outcomes, e.g., "cures", with fewer resources will be captured. It should be noted that accepting Hill's framework would preclude us from using "cures" as an output measure.

In some particularly difficult cases, both product and process innovation can be present. The advances in the

personal computer industry are an illustration from the goods sector. Here, new models are cheaper than their inferior predecessors. This has been referred to as "costless" quality change.

VI. TRANSACTIONS VS OUTCOMES

To this point we have discussed some general problems that will be encountered when trying to define the service unit and account for quality changes. There are two general approaches that researchers have followed when addressing these problems. For some services, one way is more appropriate than the other.

The first approach is to measure the service transaction unit itself with appropriate adjustments for quality change. The service unit would be specified as that which is contracted for either explicitly or implicitly. The other is to measure the outcomes resulting from the performance of such a service.

Let us first consider the direct measurement of the transaction. Returning to earlier examples in this paper, specifying the transaction unit for railroads, while not without complications, is relatively straight forward. Even though implementing the procedure may not be simple, there are many other services that are good candidates for the transactions based approach. In fact, the BLS uses the transactions approach to measure productivity for individual service industries representing about 42 per cent of workers in the service sector of the private business sector.

However, quantifying a doctor's advice to her patient would be difficult. Referring to Hill's approach, which we could describe as a transaction approach, it would be necessary to price the bits of information transferred from doctor to patient. It would then be necessary to adjust the price of the bits of advice for any change in the probability of a successful cure when the advice is followed. This quality change could be due to the doctor's increased experience[7]. Or, it could be due to a breakthrough in medical knowledge which makes a given unit of advice more likely to lead to a "cure", i.e., a product innovation.

A quality adjustment would require us to value the change so that the price of the service before and after the change can be made comparable. Here, it will only be noted that valuing quality change can be very difficult in many cases[8].

Measuring the service transaction unit can also miss the productivity gains from process innovation. As noted in the last section, this occurs because the process which uses fewer resources can be due to a new procedure which is treated as a new service according to the transaction approach.

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7 For productivity measurement, the increased experience represents a larger input on the part of the doctor in the form of increased labor input. It is important to reflect the increased output, or there would be a productivity decline.

8 For a discussion and resolution of a few of the thornier issues in valuing quality change, including "costless" quality change, see Triplett (1983). Trajtenberg (1990) provides an in depth discussion of valuing changes due to product innovations.

Rather than attempting to measure the transaction units or procedures for services like medical consultation, the alternative is to measure the outcomes of the services. First, with the outcomes approach, there is no need to specify all of the elements of the basic transaction unit. Instead, it would be necessary to specify some quantifiable outcomes measure like "cures".

Second, some difficult quality changes would be captured---those reflecting the fact that a desired outcome is more probable. The outcomes based output measure would increase with these quality changes. Product innovations that lead to a greater number of the desirable outcomes would also be captured.

Third, the outcomes approach directly captures the effects of process innovations. Griliches' example of the laser-based gall bladder procedure is an illustration. By comparing "cures" to resources, we capture productivity gains.

Unfortunately, the outcomes approach is not without problems. It may be difficult to avoid blurring the distinction between service transactions and outcomes. In some cases, either too much of the outcome is credited to the service supplier or some output of the supplier is not captured by the outcomes measure.

Jorgenson and Fraumeni (1992) measure the output of the educational system in terms of outcomes as equal to the difference in individuals' lifetime market and nonmarket

incomes due to the student population completing the current year of schooling. Future income due to education is derived from current wages for persons who have completed different levels of education.

However, as noted by Griliches, this requires some strong assumptions. One of them is that the differences in current wages for persons of a given age and sex are primarily due to differences in education and not to other factors, for instance, differences in ability. Additionally, as argued in the earlier example of the teacher and the poor students, it is possible to have an output in the education industry without an increase in future wages.

Further, not all quality change and product innovation may be captured. Although Griliches did not offer the use of gall bladder cures as a completely specified proposal, it is still possible to use his example to illustrate the fact that not all product innovation may be captured with the outcomes approach. Assuming an unchanging success rate, counting cures would not account for product innovations that resulted in less pain for the patient during the procedure. Further, certain quality dimensions, such as excess capacity in the treatment system, would be missed with the outcomes approach.

Finally, it may be difficult to identify that part of the outcome due to consumer involvement. For example, cures may increase when a medical procedure is applied to less sick patients. This would make it difficult to assign

responsibility for productivity gains to a particular industry.

VII. SUMMARY

Solow (1991) argues that some of the issues that have been raised in the literature to indicate that services are more difficult to measure than goods are more folk-beliefs than verified conclusions. In this paper we have reviewed and categorized some of the problems which arise in quantifying the output of service industries. Without comparing these problems to those encountered for goods, it can still be seen that the measurement of many service outputs is very difficult.

BIBLIOGRAPHY

Baily, Martin Neil and Robert J. Gordon, "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power", *Brookings Papers on Economic Activity*, 2, The Brookings Institution, Washington, D.C., 1988.

Baumol, W. J., S. A. B. Blackman, and E. N. Wolf, *Productivity and American Leadership: The Long View*, The MIT Press, Cambridge, Mass., 1989.

Colwell, R. J., and E. P. Davis, "Output and Productivity in Banking", in *Productivity Concepts and Measurement Problems: Welfare, Quality and Productivity in the Service Industries*, eds. Ernst Berndt, Peter Englund, and Lennart Hjalmarsson, *The Scandinavian Journal of Economics*, Vol. 94 Supplement, 1992.

Denny, Michael, "Measuring the Real Output of the Life Insurance Industry: A Comment", *The Review of Economics and Statistics*, 62, (Feb. 1980).

Duke, John, Diane Litz and Lisa Usher, "Multifactor Productivity in Railroad Transportation", *Monthly Labor Review*, (August 1992).

Feldstein, Martin S., "Some Problems in the Measurement of Productivity in the Medical Care Industry: Discussion", in

Production and Productivity in the Service Industries, ed. Victor Fuchs, 139-46, NBER Studies in Income and Wealth, New York, 1969.

Fixler, Dennis J., "Measuring the Financial Service Output and Prices of Commercial Banks", *Applied Economics*, 25, 1993.

Fixler D., and K. Zieschang, "Incorporating Ancillary Measures of Process and Quality Change into a Superlative Productivity Index", *Journal of Productivity Analysis*, 2, 1992.

Griliches, Zvi, "Introduction", in *Output Measurement in the Service Sectors*, ed. Zvi Griliches, NBER Studies in Income and Wealth, Volume 56, The University of Chicago Press, 1992.

Griliches, Zvi, ed., *Price Indexes and Quality Change: Studies in New Methods of Measurement*, Harvard University Press, 1971.

Hill, T. P., "On Goods and Services", *Review of Income and Wealth*, 123(4), 1977.

Hirshhorn, Ron, and Randall Geehan, "Measuring the Output of the Life Insurance Industry", *The Review of Economics and Statistics*, 59, (May 1977).

Holmstrom, Bengt, "The Provision of Services in a Market Economy", in *Managing the Service Economy: Prospects and Problems*, ed. Robert P. Inman, Cambridge University Press, New York, 1985.

Hornstein, Andreas, and Edward C. Prescott, "Insurance Contracts as Commodities: A Note", *Review of Economic Studies*, 58, (October 1991).

Hulten, Charles R., "Comment: Measurement of Output and Productivity in the Service Sector", in *Managing the Service Economy: Prospects and Problems*, ed. Robert P. Inman, Cambridge Univ. Press, New York, 1985.

Inman, R., ed., *Managing the Service Economy: Prospects and Problems*, Cambridge Univ. Press, New York, 1985.

Jorgenson, Dale W. and Barbara M. Fraumeni, "The Output of the Education Sector", in *Output Measurement in the Service Sectors*, ed. Zvi Griliches, NBER Studies in Income and Wealth, Volume 56, The University of Chicago Press, 1992.

Mukerjee, Swati and Ann Dryden Witte, "Measurement of Output and Quality Adjustment in the Day-Care Industry", in *Output Measurement in the Service Sectors*, ed. Zvi Griliches, NBER Studies in Income and Wealth, Volume 56, The University of Chicago Press, 1992.

Oi, Walter Y., "Productivity in the Distributive Trades: The Shopper and the Economies of Massed Reserves", in *Output Measurement in the Service Sectors*, ed. Zvi Griliches, NBER Studies in Income and Wealth, Volume 56, The University of Chicago Press, 1992.

Solow, Robert M., "Introduction", in *Productivity Concepts and Measurement Problems: Welfare, Quality and Productivity in the Service Industries*, eds. Ernst R. Berndt, Peter Englund, and Lennart Hjalmarsson, *The Scandinavian Journal of Economics*, Vol. 94 Supplement, 1992

Trajtenberg, Manuel, *Economic Analysis of Product Innovation: The Case Of CT Scanners*, Harvard University Press, Cambridge, Massachusetts, 1990.

Triplett, Jack E., "Comment", in *Output Measurement in the Service Sectors*, ed. Zvi Griliches, NBER Studies in Income and Wealth, Volume 56, The University of Chicago Press, 1992.

Triplett, Jack E., "Concepts of Quality in Input and Output Price Measures: A Resolution of the User-Value Resource-Cost Debate", in *The U.S. National Income and Product Accounts: Selects Topics*, ed. Murray F. Foss, NBER Studies in Income and Wealth, Volume 47, The University of Chicago Press, 1983.

U.S. Department of Labor, Bureau of Labor Statistics, *BLS Handbook of Methods*, BLS bulletin no. 2414, Washington, D.C., Bureau of Labor Statistics, 1992.

Weisbrod, Burton, "Productivity and Incentives in the Medical Care Sector", in *Productivity Concepts and Measurement Problems: Welfare, Quality, and Productivity in the Service Industries*, eds. Ernst R. Berndt, Peter Englund, and Lennart Hjalmarsson, *The Scandinavian Journal of Economics*, Vol. 94, Supplement, 1992.