Performing Arts—
The Economic Dilemma

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A Study of Problems common to
Theater, Opera, Music and Dance

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TO Lionel and Iris
from an old friend
and a new one

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Anatomy of the Income Gap

In March 1720, Vanbrugh estimated that the [Royal Academy of Music subsidy] fund stood at £20,000, a sum sufficient, he thought, to maintain opera “till Musick takes such Root, as to Subsist with less aid.” Instead of less support, however, it constantly needed more . . .

It should now be clear, if it was not before, that performing organizations typically operate under constant financial strain — that their costs almost always exceed their earned income. This chapter undertakes to analyze the reasons for this income gap and to determine, on the basis of this analysis, whether the gap is likely to be a chronic phenomenon of the future as it has been of the past.

Anyone familiar with the financial history of the performing organizations knows that the gap between costs and box office receipts characteristically has increased from year to year. Sheer extrapolation would lead us to suspect that these pecuniary problems will continue to worsen. This chapter points to a far less qualified conclusion: because of the economic structure of the performing arts, these financial pressures are here to stay, and there are fundamental reasons for expecting the income gap to widen steadily with the passage of time. An understanding of the basic eco-


\[^2\] Trends in costs, earned income, contributions and deficits are examined in detail in the chapters that follow.
nomics of the live performing arts makes it clear that any other
course of events is unlikely.

To explain why this is so, we shall first have to discuss the tech-
nology of the performing arts and show in what essential respects
it differs from that of many other sectors of the economy. Here it
is helpful to treat the arts, not as an intangible manifestation of
the human spirit, but as a productive activity which provides serv-
cices to the community; one which, in this respect, does not differ
from the manufacture of electricity or the supply of transportation
or house-cleaning services. In each case labor and equipment are
utilized to make available goods or services which may be pur-
chased by the general public. In each case there is a technology
whereby these inputs are transformed into a finished product.

When the performing arts are viewed in this matter-of-fact
manner, it will be seen that the tendency for costs to rise and for
prices to lag behind is neither a matter of bad luck nor mismanage-
ment. Rather, it is an inescapable result of the technology of live
performance, which will continue to contribute to the widening of
the income gaps of the performing organizations.

Productivity Gains and the Technology of Live Performance

The record of productivity gains in the United States is truly re-
markable. For most of the twentieth century, output per man-hour
( the amount of goods and services yielded by one hour of labor)
has gone up at a steady rate of about 2½ per cent per year com-
pounded. This rate of increase means that output per man-hour
has doubled approximately every 29 years. What is important about
this observation is not the precise pace of advance but the fact that
increasing efficiency in our economy has been continuous and
cumulative. The factors responsible for productivity gains — new
technology, an increasing capital stock, a better-educated labor

force, economies of large-scale production — have combined to
produce a dramatically steady record of compounded increases in
output per man-hour.

The live performing arts have not shared fully in this growth in
productivity. Though new means of presenting performances to the
public have been developed, performing groups dependent on per-
sonal contact with the audience have been affected by them to only
a very limited degree.

The development of motion pictures and phonograph records,
radio and television has made possible a revolutionary change in
the mechanics of presentation whose proportions it is difficult to
exaggerate. This in turn has meant that the cost of providing a
given hour of entertainment to each member of the audience has
dropped precipitously. The change is probably far more radical
than that experienced in any other economic sector where vigorous
 technological progress has been observed. For example, an orches-
tral performance on television, which, we are told by the profes-
sionals, takes less than twice the man-hours of a live performance,
can reach an audience of 20 million instead of the 2,500 persons
who occupy a concert hall, thus yielding an increase in productiv-
ity of four hundred thousand per cent.

But these developments have not helped the live performing arts
directly. In fact, the competition of the mass media for both the
audience and personnel of the living arts has sometimes had se-
rious adverse consequences for the performing organizations.

To be sure, organizations providing live performance have bene-
efited from some technological innovations. Air conditioning has
made year-round operation possible for many groups that formerly
had an enforced summer hiatus, and the jet airplane has speeded
tours and decreased the cost of travel. Administrative operations
in the larger organizations have benefited materially from the
availability of new types of office equipment. But these develop-
ments have been sporadic and have had little effect on the tech-
nology of performance. They have done little to increase the hourly

* The steadiness of the growth in output per man-hour is shown vividly in
Figure VII-1 at the end of this chapter.

Output per man-hour is the simplest and best-known measure of produc-
tivity, but it is subject to some well-known limitations. For a discussion
of more sophisticated measures, which allow for changes in the quality of labor
and in the quantity and quality of the capital stock, see John W. Kendrick,
Productivity Trends in the United States, National Bureau of Economic Re-
output yield of the performer himself, and, as we have seen, it is the salaries of performers which constitute the bulk of the outlays of the performing organization.

Though there have been improvements in lighting facilities, in the methods used to shift scenery and in a few other peripheral areas, the basic character of performance itself has stayed much the same. The playing of an instrument or the acting of a role remains today largely what it has been for centuries. From an engineering point of view, live performance is technologically stagnant.

The characteristic of live performance which precludes substantial changes in its mode of operation is that the work of the performer is an end in itself, not a means for the production of some good. When a customer purchases a typewriter, he usually neither knows nor cares how many man-hours of what kind of labor went into its manufacture. Any innovation which reduces the number of man-hours embodied in one such machine makes absolutely no difference to its buyer — except, of course, insofar as this affects its price. But in live performance matters are quite different. The performers' labors themselves constitute the end product which the audience purchases. Any change in the training and skill of the performer or the amount of time he spends before the audience affects the nature of the service he supplies. For, unlike workers in manufacturing, performers are not intermediaries between raw material and the completed commodity — their activities are themselves the consumers' good.

The immediate result of this technological difference between live performance and the typical manufacturing industry is that while productivity is very much subject to change in the latter, it is relatively immutable in the former. Whereas the amount of labor necessary to produce a typical manufactured product has constantly declined since the beginning of the industrial revolution, it requires about as many minutes for Richard II to tell his "sad stories of the death of kings" as it did on the stage of the Globe Theatre. Human ingenuity has devised ways to reduce the labor necessary to produce an automobile, but no one has yet succeeded in decreasing the human effort expended at a live performance of a 45 minute Schubert quartet much below a total of three man-hours.

In the live performing arts there is as little room for productivity increases through the accumulation of capital as there is for new technology. In manufacturing, capital accumulation, the provision of more and increasingly powerful machines and equipment which do not represent new inventions, has undoubtedly made an important contribution to the average product of a unit of labor. As business prosperity has enabled firms to devote more money to equipment, output per man-hour has risen correspondingly. Analogously, in the living arts the availability of more rehearsal rooms can save some performer time, and larger theaters can enable them to serve larger audiences with a given expenditure of effort. But where does one go from there? More expensive costumes for the acting group? More and larger drums for the orchestra? It is clear that since capital equipment plays so small a role in the productivity of live performance, accumulation offers little promise of enhancing output per man.

This is not meant to imply that increased efficiency or innovation is totally impossible for the arts or that increases in productivity per man-hour are completely precluded. We shall see, for example, that economies of larger-scale operations can increase productivity through the agency of longer seasons. Yet the arts cannot hope to match the remarkable record of productivity growth achieved by the economy as a whole.

Moreover, the performing arts find themselves in this position largely as a result of their inherent technology — something which is out of the hands of their managements and beyond the reach of the efficiency expert.s

A colleague who took exception to some of these arguments brought to our attention the following statement, which we reprint from the Bulletin of the American Association of University Professors, Autumn 1955. The first few paragraphs appeared previously in Harper's Magazine for June 1955, as an "anonymous memorandum circulating in London, 1955." Apparently the statement had been published before that in the O & M Bulletin, the house organ of His Majesty's Treasury of the Courts, by permission of the Ministry of Transport Bulletin.

**HOW TO BE EFFICIENT WITH FEWER VIOLINS**

The following is the report of a Work Study Engineer after a visit to a symphony concert at the Royal Festival Hall in London:

For considerable periods the four oboe players had nothing to do. The number should be reduced and the work spread more evenly over the whole of the concert, thus eliminating peaks of activity.

All the twelve violins were playing identical notes; this seems unnecessary
At this point it would be useful to present statistics on productivity trends in the arts. We could then put to a direct test our hypothesis that productivity increases in this sector have been negligible — certainly smaller than productivity gains in the economy as a whole. Unfortunately this is impossible, in part because the outputs and inputs of the arts are difficult to measure or even to define satisfactorily, and in part because no major effort has as yet been made to overcome these difficulties. We can, however, report some of the preliminary results of a study of productivity trends in the entire service sector of the economy, much of which suffers from productivity limitations similar to those besetting the performing arts.

In spite of the fact that the service sector includes many industries which have recently benefited from important technological changes (insurance and finance, for example, now make extensive use of electronic data processing equipment), output per man-hour has gone up much less rapidly in this sector than in the goods sector. Over the entire period 1929–1961, output per man-hour increased 2.5 per cent per year in the goods sector and only 1.6 per cent per year in the service sector. In the postwar period the difference has been even more pronounced: output per man-hour in the goods sector has increased at a compound rate of 3.1 per cent per year as compared with 1.7 per cent per year for services. The magnitude of this difference can be illustrated by noting that a quantity growing at a rate of 3.1 per cent per year doubles in less than 25 years, whereas a quantity growing at a rate of 1.7 per cent per year requires more than 40 years to double.\(^4\)

**On Productivity and Cost**

It is clear that the limits to technological improvement which characterize the live performing arts must affect their costs of operation. On first consideration it might be thought that these handicaps would only prevent costs from going down; it is by no means obvious that they can impose rising expenditures on performing organizations.

Rising costs could be avoided if the arts were to exist in isolation. But, in fact, they must operate within a complex economy. And the interrelationships of the various sectors of the economy, together with the inability of the arts to achieve a sustained increase in productivity, make ever-higher costs an inevitable characteristic of live performance.

To understand these cost relationships it is necessary to consider in general terms what differential rates of growth in productivity within the economy imply for the relative costs of its various outputs.\(^7\)

Let us imagine an economy divided into two sectors, one in which productivity is rising and another in which it is constant,

\[^7\]The source of these data and some alternative calculations are presented in Appendix Table VII-A.

\[^4\]There is nothing new in these observations on the effects of differential rates of productivity change on costs and prices. See, for example, Tibor and Ann Scitovsky, "What Price Economic Progress?" Yale Review, Autumn 1959. Only the application of these to the state of the arts is relatively new. Some of the general ideas are suggested in Poggi, in some of the annual reports of the Royal Opera, and in Toffler, Chapter XI, esp. p. 163 ff. See also Jean Fourastié’s interesting comparisons of productivity rates, by century and nation, in his *The Causes of Wealth*, The Free Press, Glencoe, Illinois, 1960, Chapter IV.
the first producing automobiles, and the second, performances of Haydn trios. Let us suppose that in automobile production, where technological improvements are possible, output per man-hour is increasing at an annual rate of 4 per cent, while the productivity of trio players remains unchanged year after year. Imagine now that the workers in the automobile industry recognize the changes which are taking place and persuade management to agree to a matching rise in wages. The effect on the auto industry is easy to trace. Each year the average worker’s wage goes up by 4 per cent, but his labor output increases by exactly the same percentage. As a consequence, labor cost per unit (the ratio between total labor cost and total output) remains absolutely unchanged. This process can continue indefinitely in our imaginary world, with auto workers earning more and more each year, with costs per car remaining stationary, and with no rise in automotive prices necessary to maintain company profits. If the number of hours worked by auto workers does not decline, the total output of the economy must increase, for more and more vehicles will come off the assembly lines every year.

But what of the other industry in our little economy? How is trio performance faring in this society of growing abundance? Here we must consider several alternatives. At one extreme is the case of a typical performer whose wage remains constant year after year, so that none of the economy’s prosperity rubs off on him. His ability to buy goods and services does not increase at all. This implies more than is obvious at first, for it means that the musician must become increasingly impoverished. If an auto worker’s wages go up every year at a compound rate of 4 per cent, before very long an instrumentalist, with his fixed remuneration, will come to be considered very poor, both by himself and by others. This in turn will presumably discourage some people from becoming musicians and will encourage movement into the automobile industry.

Consider now a second alternative for the music sector of our economy. Suppose that the trio players somehow succeed in getting their wages raised, and that their standard of living keeps up with that of the auto workers. What does this situation imply for the costs of trio performance? If the earnings of string players increase by 4 per cent per year while their productivity remains unchanged, it follows that the direct labor cost per unit of their output must also rise at 4 per cent, since cost per unit is equal to total cost divided by the number of units of output. If in a forty hour week the string player provides just as many performances as he did the previous year, but his wage is 4 per cent higher, the cost per performance must have risen correspondingly. Moreover, there is nothing in the nature of this situation to prevent the cost of performance from rising indefinitely at a compound rate. So long as the musicians are successful in resisting erosion of their relative incomes, the cost per performance must continue to increase along with the performer’s income. Rising costs will beset the performing arts with absolute inevitability.

There is a third alternative, which, in fact, comes closest to what we find in practice. Wages of performers do rise, but they do not always manage to keep up with wages in the rest of the economy. Because performers frequently are dedicated individuals who are willing to work under economic conditions which would be considered appalling in other activities, the performing arts are relatively insensitive to general wage trends, especially in the short run. Even in the long run, earnings in the performing arts may lag behind wages in occupations which provide less in the way of psychic income. Whereas most unskilled workers, for example, are likely to regard the hourly wage as their primary reward for working, the typical performer presumably receives, in addition, considerable pleasure and personal satisfaction from his work. The important point is that, as the general level of real income increases over time, people may well feel that they are better able to afford to pursue careers which offer relatively lower money incomes but larger psychic incomes.

It is largely for these reasons that performing arts organizations in financial difficulty have often managed to shift part of their financial burden back to the performers and to the managements, who also are often very poorly paid by commercial standards. The levels of income in this broad field must be considered remarkably low by any standards, and particularly so in light of the heavy investment often made by the artists in their education, training and equipment.

However, all of this makes no essential difference to the logic of
our analysis. With productivity per man-hour roughly constant, *any increase in wage rates, however modest, must lead to a corresponding increase in costs.* If wages go up 6 per cent elsewhere in the economy, but performer incomes rise by only 2 per cent, the direct labor cost of each performance must also increase by 2 per cent unless there is an offsetting reduction in the number of labor hours per performance.

It is important to recognize that price inflation plays no role in the logic of our analysis either. That is, so long as the wages of musicians in this two sector economy increase at all, the cost of a live performance will rise relative to the cost of an automobile, *whether or not the price level is changing;* the extent of the increase in the relative cost of the performance will depend *directly* on the rate of growth of productivity in the automobile industry.8

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8 In our illustrative case the change in relative costs was associated with some over-all inflation. While the cost and the price of an automobile remained constant, the cost and, presumably, the price of a live performance went up, causing an increase in the economy-wide average price level. However, this inflationary effect is a consequence of the assumption that auto workers’ wages and musicians’ wages both rose as fast as productivity in the automobile industry. This need not happen. Suppose wages of both auto workers and musicians were to rise at a rate of 2 per cent per year rather than 4 per cent per year. In this case automobile costs would decline by about 2 per cent per year, while costs per performance would increase by 2 per cent. If the industries each accounted for half of the economy’s sales (and thus received equal weights in the consumer price index), there would then be no increase in the general price level — but there would be the same increase in the relative costs of a live performance as in the previous, inflationary case. While inflation per se may have various effects on the performing arts (and we shall return to this subject later), it is the relative change in the costs of a live performance which is of paramount importance, and therefore the accompanying degree of inflation need not concern us here.

It should be noted in passing that the President’s Council of Economic Advisers has attempted to see that wages in each industry go up no faster than the average increase in productivity for the economy as a whole (2 per cent in our example), even though productivity in any one industry may be increasing more rapidly than in others. This policy is based explicitly on the proposition just spelled out — that this kind of wage behavior can produce shifts in relative costs without leading to inflation. (See *Economic Report of the President,* January 1963, and *succeeding Reports.*) It is also interesting that some well-known models of the inflationary process are based on the premise that the Council’s admonitions will not be heeded, that in fact workers in a technologically progressive industry, such as automobile production, will receive wage increases in excess of the economy-wide average rate of increase of productivity, and that these “excessive” wage increases will be emulated by service industries (like the performing arts) which experience little if any gain in productivity. Thus, our first model, positing a 4 per cent increase in wages and productivity in the auto industry, will have a familiar ring to many economists. (The best-known discussion of this model of the inflationary process is by Charles L. Schultze, in *Recent Inflation in the United States,* 86th Cong., 1st sess., Joint Committee Print, Study Paper No. 1, Government Printing Office, Washington, 1959.)

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8 See the Note at the end of this chapter for a discussion of statistical evidence on the general relationship between productivity and costs — evidence that strongly supports our analysis.
note that output per man-hour in the private sector of the economy has been increasing slightly more rapidly in the postwar years than in the earliest part of the century.

On the Economics of Ticket Pricing

We turn now to the other side of the income gap relationship — to the subject of earned income and, more particularly, to the principles of pricing as they apply to the performing arts.

In any industry we expect prices to bear a reasonably close relation to costs, especially in the long run. Therefore, if cost per performance increases steadily, it seems only natural to expect ticket prices to increase at about the same rate. Of course, if this were to happen (and it seems to be the general impression that it is just what has happened), then, assuming that attendance was unaffected, operating deficits would increase exactly in step with costs and prices, all going up at a rate of, say, 4 per cent per year. So long as revenues kept up with costs, the income gap would increase in absolute amount, but it would not increase relative to total expenditures. However, as will be shown in Chapter XI, ticket prices have in general lagged behind costs of performance.

How does one account for the lag in the rate of increase in prices? In offering our explanation we emphasize that this situation, too, contains elements which can be considered structural, and consequently the problems cannot be expected to disappear by themselves or through any dosage of “sound management” — that mysterious solvent so often proposed as the answer to any pecuniary problem.

Three basic influences can be expected to restrict severely the rate of increase in ticket prices:

1. the disinclination of individual arts organizations to raise their prices, on moral grounds;
2. the place of the arts in the ticket purchaser’s hierarchy of necessities; and
3. the forces of competition.

The first reason for expecting some lag in ticket prices lies in the doctrine of “just price,” which colors the attitudes of those who supply performance as well as those who attend it. Since a per-

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forming organization is generally a dedicated group, firmly convinced of the value of its product to society, it is natural that it should seek to distribute its services as widely and as equitably as possible. The group is usually determined to prevent income and wealth alone from deciding who is to attend its performances. It wishes to offer its product to all who care to avail themselves of it — to students, to the impecunious, to those who are not yet devotees but who might learn to appreciate it, and to a variety of others whom high prices might deter from attending.¹⁰

It is easy to visualize what might happen to the performing arts if their prime objective were profit maximization. One can envision the nation’s performing arts reduced to a vestigial state, with a very small number of theaters and orchestras catering to an exclusive group of persons who could afford to pay the very high and ever-rising prices necessary to keep them going.¹¹

There are clear-cut cases where management continues to resist price increases even though there is an excess demand for the organization’s services. The Metropolitan Opera is a case in point. Despite the fact that tickets must be rationed and most of the performances are typically sold out, the Metropolitan has not raised prices to the levels the traffic will bear. It is presumably not morally acceptable to turn the Metropolitan Opera House into an institution analogous to an exclusive restaurant in terms of the magni-

¹⁰ The manager of one well-known non-profit organization assured us repeatedly that moral principles have nothing to do with the pricing decisions of his organization. Prices are kept low and deficits are maintained, he insisted, simply because this is the most effective way to raise money. While there is no doubt an element of truth in this statement, it is surely something of an exaggeration, even in his own case. More generally, we are convinced that most officials of performing arts organizations are completely sincere in asserting that low prices, in and of themselves, are one of their important policy objectives.

¹¹ The Broadway theater world comes closer to conforming to the profit maximization model than any other segment of the performing arts. Most investors on Broadway, notably the corporations which have been backing a number of musicals in recent years, doubtless go into the theater for the money they hope to make. The fact that the annual number of new productions on Broadway, especially the number of serious plays, has declined significantly (see Chapter III) is certainly in line with what one might expect to follow from a profit maximization goal. Nevertheless, even the Broadway theater is not a case of pure pursuit of profits. At least a few “angels” apparently invest more because of a commitment to the theater and a sense of psychic pleasure in participation than out of a calculated assessment of profit possibilities.
tude of its prices and the economic class of its clientele — and such a policy might also hurt fund raising.\textsuperscript{12}

It is noteworthy, however, that higher education has instituted rather substantial price increases in recent years despite the fact that educators share the performing groups' reluctance to raise their fees. True, the colleges and universities have tried to soften the effect of tuition increases on less affluent students by increasing scholarships and making loans more easily available, but tuition levels have gone up by significant amounts nonetheless.

This brings us to the second influence that has held back ticket prices and kept them from rising as rapidly as tuitions. The explanation may lie, at least in part, in the difference in the intensity of demand for the services of the arts organizations and the colleges. Higher education has come to be regarded as a career requisite by a substantial segment of the population, who are willing to pay whatever price is demanded of them. But few people class the arts along with food, shelter, clothing, medical care — and now education — as items which must be purchased and paid for no matter what their cost. If performance becomes too expensive, most people can manage to get along without it. It is not easy to document this assertion, but there is much impressionistic evidence that it is valid. In any event, even if those who set ticket prices merely believe this to be true, their assumption will inhibit plans for raising admission costs.

The third reason for expecting ticket prices to be relatively stable lies in competition from the mass media. Ticket prices are held down by the very fact that there exist close and low-priced substitutes for live performance. As dramatic productions can be seen in the movies or on television and not only on the stage, and music can be heard on records and on radio, the price of live performance cannot be allowed to get too far out of line.

We see then that technological development, which places live performance at such a cost disadvantage, entraps it at both ends, as it were. The pattern of technological change causes costs of live

\textsuperscript{12}The effect on fund raising is debatable. The same manager who argued that principles have nothing to do with ticket pricing maintained that contributions to his organization continued to rise even in years when it raised its ticket price scale.

performance to rise progressively, while at the same time it limits prices through the competition of the mass media.

Some Ameliorative Measures

Under the stress of the mounting operating deficits which plague the performing arts, all sorts of schemes have been suggested and all sorts of experiments are being undertaken. A variety of cost saving methods have been proposed and tried out. Thus, a number of Broadway producers have recently dispensed with out-of-town, pre-opening tryouts, and several cities seeking to provide music to the public have turned from the full-scale symphony to smaller, less expensive chamber orchestras. The spate of two and three character plays on Broadway during the 1964–65 season has also been interpreted as an economy measure undertaken in response to financial pressures.\textsuperscript{13}

Performing arts organizations can also reduce the rate of increase in their unit costs by permitting the quality of their product to deteriorate, through fewer rehearsals, the use of less well trained performers, shoddy costumes and scenery, and so on. But such a course is never popular with organizations dedicated to quality, and, furthermore, it can lead to a loss of audience and community support. Nevertheless, it is not an uncommon “temporary” expedient, imposed by the realization that the cutting of corners may be the only alternative to abandonment of the enterprise.

There have also been experiments with ticket pricing which seek to disguise price rises or to attract larger audiences. For example, in many cases price scales have ostensibly remained unchanged, but

\textsuperscript{13}See New York Times, January 24, 1965, Section II, p. 1. However, by the middle of the following season, no new small-cast productions had been mounted and, as a matter of fact, several very large-cast dramas were opened. Our own data (see Appendix Table VII–B) going back to 1895 show no evidence of any over-all trend toward smaller casts, though this may be accounted for, at least in part, by the rising number of musicals. There has, in contrast, been a decrease in the number of productions of intermediate cast size. What the experiences of the two or three character productions did show was that such a play can have a rather long and fairly profitable run even though the house is far from being filled to capacity. In this respect these plays were able to achieve a return to the theater economics of perhaps four decades ago.
a number of formerly inexpensive seats have been transferred to higher price brackets. Some producers have experimented with variations in scales of ticket prices over the course of the week, trying out higher prices for days in the latter part of the week, when audiences are larger and presumably willing to pay higher admission fees.

However, if this chapter’s analysis is valid, all measures such as these are in the nature of palliatives. Once-and-for-all reductions in cost cannot indefinitely offset the cumulative pressures which technological advance in the rest of the economy will continue to impose on the arts.

This chapter has proposed a set of analytical hypotheses which can explain the observed difficulties of the performing arts and can, therefore, serve as a guide to policy. We have offered various pieces of evidence as partial tests of the hypotheses, but have only speculated on the course of costs and receipts in the various performing arts. The next chapters will report on the relevant historical trends and will thereby permit us to test further the model described.

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A Note on Semi-logarithmic Graphs

Both parts of the accompanying graph (Figure VII–1) use exactly the same data to show the record of productivity change in the American economy since 1909, but the data are plotted on an ordinary graph scale in part A and on a semi-logarithmic scale in part B. Since semi-logarithmic graphs will be used many times in subsequent chapters, a brief explanation of their properties is in order for the benefit of readers who are unacquainted with this device.

The basic advantage of a semi-logarithmic graph is that it shows more clearly than an ordinary graph whether the percentage rate of growth has increased or decreased from one year to another.

Suppose an initial $200 grows at an unchanging rate of 100 per cent per year over a number of years. This means it rises to $400 during the first year; to $800 during the second year; to $1,600 the third year and so on. Although the percentage rate of growth is constant, the absolute change increases in each year because of compounding: previous accumulations grow from year to year along with the initial amount. An ordinary graph of these figures (like A in Figure VII–1) would curl upward more and more steeply as one moves from left to right, but this curvature would conceal the fact that the percentage rate of growth has been constant.

A semi-logarithmic scale (like that used in part B of Figure VII–1) is designed to correct for this compounding phenomenon. It uncompounds a cumulative growth history and, if the percentage rate of growth has been constant, it transforms the graph that curls upward into one that is relatively straight. It does this by the simple device of compressing the vertical scale more sharply the higher one goes in the graph. On a conventional graph equal numbers are evenly spaced — the first inch above the origin represents, say, $100, the second inch $200, the third inch $300, etc. In the corresponding semi-logarithmic graph the higher one goes the more closely the numbers are spaced. If the distance between the $100 and the $200 level is still one inch, the second inch mark represents $400 rather than $300, a third inch would bring us up to $800, and so on. In other words, on a semi-logarithmic graph the vertical scale is compressed just enough to undo the compounding effects.

The “semi” in the appellation “semi-logarithmic” indicates that only one of the two axis scales has been distorted in the manner indicated. The word “logarithmic” appears because the uncompounding effects obtained by compressing the vertical scale are the same as those which one would obtain by plotting logarithms of the dollar figures on ordinary graph paper.

Thus, the first of the two diagrams in Figure VII–1 represents productivity data with all of their compounding included, while the second gives the same information after the compounding has been removed. The fact that in diagram A the quantity on which successive percentages are calculated keeps changing tends to obscure the actual percentage change; in the years since about 1935, for example, the rate of increase seems to be rising steeply. But if one were to place a ruler along the points in diagram B for the years since about 1935, he would notice that they form an almost
perfectly straight line. The linearity of the relationship means that the annual percentage rate of growth of productivity has in fact been almost constant.

A more rigorous way of estimating the steadiness of the rate of growth employs a measure called the “coefficient of determination” (R²) of the regression used to calculate the average annual rate of increase. This measure tells us how closely the dots cluster about a straight line. If the dots fit very closely, R² is approximately unity; if the dots do not form a linear pattern, R² is approximately zero. For the period 1947–1964 in the present instance, the R² has the very high value of .99, meaning that 99 per cent of the variation in the output per man-hour figures is accounted for simply by the linear trend.

A Note on the Statistics on Productivity and Costs

The central proposition of this chapter, that the cost of a live performance can be expected to rise relative to costs in general, is investigated specifically in the next chapter, where we present the results of our studies of cost trends in the performing arts. Before ending this more general discussion, however, we shall cite some of the work being done in related fields in support of the fundamental analytical point we have been making — that differential rates of increase in productivity among industries lead to predictable differences in rates of increase in costs.

Kendrick’s monumental study of productivity trends in the United States is the source of one relevant piece of evidence. In this study Kendrick correlated changes in total factor productivity among industries with changes in “unit value added” (a measure of the amount spent by buyers, after the cost of raw materials is deducted, on each unit of a commodity) for the whole period between 1899 and 1953 and for various sub-periods. The results were fully consistent with our theoretical expectations: unit value added (net prices to consumers) tended to increase most in industries where productivity increased least, and vice versa.

Kendrick, Chapter 7, especially pp. 200–1.

Kendrick ran his correlations for a set of 33 major industries and a set of 80 manufacturing industries, in six sub-periods. The correlations were neg-
As indicated earlier, we have evidence that productivity has increased less rapidly in the service sector than in the goods sector, and so a direct comparison of the movement of relative prices in these two sectors is also very much to the point. The most appropriate price measures — the G.N.P. implicit price deflators, by major type of product — show that prices rose 11 per cent in the service sector and only 4 per cent in the goods sector between 1958 and 1962.15

Comparison of the more widely known service price index with the wholesale price index also yields clear-cut results. During the postwar period 1947–1964, the service price index went up at an average rate of 3.3 per cent per year, whereas the wholesale price index rose only 1.5 per cent per year. During the last three of these years, when productivity seems to have risen unusually fast, the wholesale price index rose imperceptibly (.03 per cent per year); while the service price index went up 1.89 per cent per year.17

In short, the available data are entirely consistent with the predictions generated by the simple theoretical model described earlier in this chapter.


17 The average annual rates of increase given in this paragraph were calculated by fitting a trend line to annual observations. The basic data came from the Economic Report of the President, January 1965.