

Does GNP Measure Growth And Welfare?

PRIMITIVE IN THE EXTREME AND CERTAINLY USELESS

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Delivered at New York University, New York, New York, February 13, 1975

THE question posed by the title to this lecture raises a number of deep problems of economic science. The question seems simple, yet in these few words — measurement, growth, and welfare — culminate the problems of large areas with which economists have been concerned for centuries. How nice it would be then if one could report that now we have one single concept and, indeed, one single number which could summarize variations of growth and welfare. As we shall see this unfortunately is not the case.

To begin with the problem of measurement: All sciences have to come to grips with that problem. It is an extremely difficult one and each science has its own troubles. When a measurement in any field has become possible this is rightly hailed as a great achievement, as a step forward towards new discoveries and innumerable applications. Even to have a precise measure of time is difficult: clocks are a late development in human history and to this day we try to make them more and more accurate, because so much depends on them. So it is not surprising that when it was recently reported that the rotation of the earth — our finest measure of time — may have slowed down during the last year by one second, this caused great interest in physics and astronomy. From this reaction we also get an idea of the high standards in those sciences. In other fields we measure blood pressures, barometric pressure, the composition of blood, temperature, the speed of light, etc., etc., sometimes crudely, sometimes with extraordinary precision.

Although in the physical and even in the biological sciences a great and firm tradition has built up over the centuries the matter of observation and measurement is never closed. Science is never finished; rather, for all time, science is only an approximation to the underlying reality. It may surprise you that in spite of this great tradition Einstein, as he has more than once remarked to me, has said: "Most scientists naively think they know what they should observe and how they should measure it." And he had the natural sciences in mind!

How then is the situation in the social sciences, in particular in economics? In some manner we seem to be more fortunate than the natural sciences. Nature shows itself to our senses essentially in a qualitative way and to get to numbers of high precision requires great effort and is a formidable achievement. But in economics we can count right away, for example, the number of inhabitants of a town or a country, the number of motor cars, of checks cashed, of tons of steel produced, of . . . well of almost anything — or so it seems. Since it looks to be so simple to observe and count, there is in economics — as well as in other social sciences — no tradition which would enforce high standards. Counting seems natural and what is counted is readily accepted. But that is true only up to the point where broader notions are encountered, such as "growth" and "welfare." Or even more basic, the question of what is "value" and "utility" promptly causes great difficulty. Suddenly we see that we have to have sharp *concepts*, that we must ask questions to which we normally get only qualitative, not right away quantitative, answers. There is little doubt what an individual is, or a motor car, or a

check, etc. But to observe "growth" or "utility" or "welfare" for a whole nation is an entirely different matter. Surely people are involved, and cars that can be counted, or monies changing hands and so on, but to state how the economy grows and whether welfare changes and by how much are entirely different matters. They ought to be approached with caution, respect, indeed with trepidation.

When we mention such words we know that they mean very different things to different people. In fact, for many they may mean nothing concrete or tangible. They are abstractions, possibly of a higher order. We feel that there is some reality touched, but we also know that it is a long way from that state of affairs to truly scientific objective knowledge. What we need in order to observe, and hopefully to measure, are concepts. There is no escape from that. No matter how primitive our approach may be, a concept is involved. Good, useful concepts are hard to come by.

Let us first look at "growth." That is clearly a notion that applies to an organism. The human body grows, stops growing, and eventually dies. The body has many parts and many functions. It grows not only as a whole, but parts of it grow at different rates and not for ever as already analyzed by Galileo, and the whole is of unimaginable complexity which modern biology reveals to us in a rapid though still partial manner. In the whole process of organic growth there is control, genetic planning and unified function. Can the economy be compared with this so that we could transfer the notion of organic growth from this area to our field? One thing is certain: the economy is also of the highest complexity. Consequently one must expect that even an adequate qualitative description is correspondingly difficult.

I find however that very few men, even few economists, or should I say regretfully, especially economists, have a real appreciation and understanding of the immense complexity of an economic system. Now I have used the word "system" but it is not even clear whether the word "system" is appropriate because we do not understand fully the organizing principles that make the economic life of a nation possible. One need only observe what happens in an ordinary person's day and what is considered to be absolutely obvious and normal. We take a bus in the morning, we take a train, we go to stores, we buy, the money is accepted with which we pay, or we pay by a check which will be presented to an anonymous institution, possibly far away, transmitted by mails about which we have no control whatsoever; the stores order and have things in stock; they set prices on the basis of the expectation of what competitors might be doing; we are buying on the same basis of expectation as to what our needs might be in the future and how they will be met; we spend our money today because we expect that our salaries or incomes from other sources actually will be paid at certain dates in the near or more distant future, etc., etc. In all this, there is no central genetic regulation, nobody who plans for all; there is no one to whom everybody is responsible. We carry a great deal of information in our heads, and that which we do not carry we can find in newspapers which gather information and are printed, again motivated only by their own self-interest, namely, to write, to publish, and to sell with

profit. At present, at this very moment, raw materials are being produced, for which there is no conceivable way of telling how they will be finally molded, into which kind of finished products they will be turned. A steel producer has no idea whether his steel will be used for the making of tanks, or ships, or paper clips.

And yet all this works and works miraculously well, although of course it is easily subject to great disturbances. The astonishing fact is not that the thing does not work well, but that it works at all. It is only when we realize the complexity of the economy that we begin to see, and possibly understand, how dangerous it is to interfere in these matters. The economic system is in addition subject to great changes, caused partly by technology, by strictly political events, partly by changes in the desires and wishes of the final consumers. There is thus more than one uncertainty element which governs everything.

The human body, or any living organism, is in many ways a very much simpler matter. However, if one knows anything at all about the body's physiology, one would find that statement horrendous, because one can hardly imagine anything more finely tuned and more complicated than let us say, the human body, not to mention the brain, which without any doubt, is the most complicated thing in the whole universe of whose existence we are aware, and whose function we clearly do not understand, although we have a tremendous amount of knowledge of it already. The fact is that the human body has one unique purpose, namely to stay functioning, and to stay alive. We cannot say that the economic system has any such clear purpose.

In the light of such observations, one should become extremely modest in making proposals for policy. In general, I would say that unless we are reasonably sure that we know what the consequences of new policy measures will be — for example of new taxes introduced, prices regulated, etc., etc. — we should leave things alone. One interferes only if one believes that one understands what the consequences of the interference are. The same is true of medicine: It took a long time to come from the witch doctor to the modern brain surgeon. While presumably the human physiology, or that of any animal or any other biological entity stays practically the same throughout centuries or millenia — although subject to evolution over hundreds of thousands of years — the economic system, to make things still more difficult, is constantly being changed, especially by technology. Technology is an interference from the outside; it is being absorbed in a manner which those who bring it into economic existence think to be profitable for them to do but whose global effects they neither understand nor care about. Clearly, this compounds the difficulties of policy, because what might have been a suitable measure to achieve desired results at one time may no longer have any validity under present or future circumstances. It takes a long time to develop a scientifically acceptable new idea of policy and while it is being born, if that happens at all, new features appear in the economic life. For example, Keynesian policy ideas of the 1930's are now being adopted by the U.S. government at a time when they have virtually no applicability whatsoever.

Thus the "growth" of an economy is a very different matter from the growth of an organism. The economy has neither a beginning nor an end. In addition, as already said, the economy certainly changes. So it is perhaps not surprising that apart from some highly technical and abstract models of economic expansion — which is not the same thing as growth — there simply does not exist a generally accepted scientific concept which would give us the basis for a reliable numerical measurement of the *rate* of growth.

But there is GNP, gross national product, i.e., the turnover in an economy in a unit period, a hallowed notion in contemporary economics. It is used with abandon. I shall say more about it later.

Now I want to point out only *one* of its quantitative features: It is expressed by a *single* number, a so-called scalar. We discussed organic growth of, say, a human body. Would anybody in his senses imagine that there could be a single scalar number which would adequately describe the development of a human from babyhood to maturity to old age: the growth of the body, of the mind, of capabilities? The idea is so grotesque and ludicrous that we can dismiss it from the outset. We have just seen that the economy too is of high complexity and that therefore its description, or rather its changes, could be given and measured — accurately, without the slightest error of measurement — by one scalar number is equally absurd. If one could design a method whereby changes are at least recorded by a vector — i.e., a number that has many components — it could be a very different matter. I know of no such effort. Of course a "vector" is a more sophisticated concept and would not be useful for the simple and trivial interpretations which the single, scalar, unit makes so easy. Just to show the absurdity and limitation of this popular alleged "concept" consider the following:

Anything that leads to a transaction in monetary form, which is where goods and services change hands against money, is recorded as *positive*, no matter what is being sold, it enters GNP. It may have been sales of goods already stocked, it may have been a car just coming out of a factory: it does not matter. Neither does it matter *what* it is: Atomic bombs, drugs, cars, food, aesthetic pollution by new billboards, . . . you name it. Clearly that goes against common sense. Why should all products and services be treated alike? If I do not like more nuclear weapons why should I accept a measurement that includes them as part of the "growth" of the economy? Of course one could argue that one is only interested in *transactions*. But then one would have a great deal of explaining to do how more transactions can possibly be related to "welfare." Does the uncontrolled increase of cancer cells in a child mean "growth"?

There are other equally well-known difficulties. Many services are rendered and many goods are produced that never enter a market. Thus they escape GNP. As has been noted by many, if housewives were being paid by their husbands GNP would rise although there would not be one iota of difference in production or services. There are many other similar situations.

Another trouble with the GNP concept is that it measures, or rather expresses, as *positive* also the *malfunctions* of the economic system or society. To wit: if we are stuck in one of the thousands of traffic jams, if airplanes are stacked and cannot land on schedule, if fires break out and other disasters occur, that require repair — *up goes the GNP*. More gasoline is used, fares go up, overtime has to be paid, and so on. It would be difficult in any other science to find a "measure" which tells simultaneously opposite stores of the functioning of a complex system in *one* single scalar number! If we merely improve the scheduling of airplanes and stagger the times of automobile traffic, and nothing else is changed — *down goes GNP!* It goes *up*, on the other hand, if industry pollutes the air and we create other industries which remove the polluting substances.

So we see that there is real trouble with the basic underlying notion of GNP. It is not an acceptable scientific concept for the purposes it is used. The fact that it violates common sense might be considered not too critical. There are, after all, many concepts in physics which common sense could never create or judge, or might reject, such as, for example, "curved space." But these concepts are the product of powerful theories and are needed when a scientific field is already well developed. But the GNP action is nothing of this kind. It expresses a trivial idea which is clearly accessible to scrutiny by common sense. Therefore its current, indiscriminate uses are suspect and it is certainly questionable that it should be used to tell us about growth and welfare.

At this point it is proper to recall Einstein's remark about the fact that it seems to many obvious what one should observe. Surely transactions occur all the time in the economy, but that does not mean that they offer the proper way to describe the functioning of the economy. Perhaps only *some* transactions may give us the desired information, only a selection made on the basis of a powerful theory. But what we see is that the corrections — or better changes — of GNP figures that are made by elimination of the effect of seasonal variations, of price changes, etc., therefore obtaining a stable basis, eliminating the influence of distortion caused by inflation, in no way touch the fundamental issues and objections.

GNP is a *global* notion. It is undifferentiated. It falls into the pattern of modern *macro*-economics where the attempt is made, perhaps largely under the influence of Keynes, to relate, say, the *total* quantity of money in circulation to *total* employment, *total* output of industry, etc. It is tempting to do so and would simplify economic reasoning enormously if one could discover strict interdependencies. Yet there is great danger in these efforts; for example, the same increase in the quantity of money will have very different consequences when it goes to consumers rather than to producers. This is obliterated when one restricts oneself to the macro entities.

It is interesting to note that modern science goes in exactly the opposite direction: more and more, finer and finer distinctions are being made. First one has a molecule, then an atom, then the electron, then more and more elementary particles, even subparticles and only by these steps does one arrive at a better understanding of matter. Or in biology: there was only cancer: now we know that there may be 100 different kinds, each with different effects and possibly calling for different treatments. So it is everywhere. But GNP, as an alleged global measure, runs precisely counter to the spirit of modern science even on these grounds.

I am tempted here to quote St. Augustine: "For so it is, oh my Lord God, I measure it, but what it is that I measure I do not know."

When we now talk about "*welfare*" we are entering upon a field where other great difficulties arise. Economists have struggled with the problem of welfare for centuries. Countless many volumes have been written about it but one has not yet come to a resolution. It is therefore likely that using a primitive notion such as GNP to measure that much disputed thing will come to nought. But first let us examine briefly where the difficulties lie with respect to economic "*welfare*." Most of us will think at first of our own, personal situation: possessions, income, stability of income, needs (as perceived), health, obligations to others, prices of the goods and services to be bought over some more or less specified period of time: in short our personal welfare is composed of many variables. Over time some variables may go up while others go down. Do these movements cancel out? In some cases it is obvious; income may rise in the same proportion as the prices of the goods I want and so all stays the same. But when some prices of relevance to us go up and others go down then it is not so obvious whether and how our individual welfare has been affected.

Now men are different in age, incomes, wants, positions, desires. The difficulties arising here could be overcome by broad classifications of people, by the law of large numbers and other such devices. But that still does not tell us about "*welfare*" because the principal attribute of the latter is in the last analysis what value or utility people attach to their possessions and income. What determines value has puzzled economists for ages. Is there an objective value applicable for everyone, in any circumstance, at any time? How is value produced? What affects value? The answers have ranged from the assertion that there are absolute values to the state-

ment that the economic value of an object is only what you can sell it for: "*Res tantum valet quantum vendi potest*," which is certainly true for shares on the stock market, though there is also the assertion of an "*intrinsic*" value which is supposed often to differ in both directions from the sales value. Though all this may seem to be a confusing situation there is today no doubt that — apart from the few remaining adherents of the superseded labor value theory — utility attributed by individuals to goods and services is all that matters. Utility is based on individual preferences and these are related to the objective, technical characteristics of the desired goods and services. The individual can compare the utilities he expects to derive from them even though the goods are all different. One can even find out that individuals can construct numbers for their preferences, so that they are better guided in their attempt to obtain a maximum of expected utility by suitable choice and corresponding expenditure overtime of their money or other income. This utility, derived from all goods and services, then is individual, personal, welfare.

But here we come to an end: Utility is strictly an individual matter. Exactly the same bundle of goods will have a very different utility for different persons. So much is obvious in a gross sense and need here not be elaborated any further. But what does *not* follow is that we can compare utilities of different individuals. The fact is precisely that different individuals *are* different. Only if they were identical, like the famous twins, would they have the same utility functions. Perhaps even with them there may be differences because who can look into their brains to make sure that there are no differences in their wishes, preferences, ideas and ideals? Of course it is likely that persons in a given income class have similar needs and are concerned about the prices of similar bunches of goods. But if I take a good from A, for whom it has some utility, and give it to B, for whom also it has some utility, it does *not* follow that I have diminished A as much as I have improved B's position. Once more: utilities of different individuals are incomparable. There is now no known way to make them comparable, to find out objectively whether I transfer the same utility (for example by taxation) from one to the other.

Economists have thought of one way which seems to give us information about general welfare, which is what we are really interested in and what GNP is somehow expected to measure. It is the notion of the so-called *Pareto optimum* which says the following: if we look at a community and add a good to one party without at the same time diminishing any other party of that community, then we can say that the welfare of the whole group has increased. This seems plausible and harmless and we find the Pareto optimum extolled and used in almost every textbook in economics. Yet how can we find out whether this principle holds? Only by questioning — since there is no objective way of making this statement. When does a person feel diminished? This might even happen when something is given to him that he does not want or cannot use (while for others it might be desirable and useful). Does A feel diminished when someone else gets an addition? This can certainly happen even when nothing is actually *taken* from him. It is an entirely different matter whether in a group one individual is given \$1 or \$1,000,000, though formally the idea of the Pareto Optimum is preserved. Common sense tells us otherwise. And how do we even find out whether someone benefits or is diminished? Certainly by interpersonal comparison of utilities, which we know we cannot make. So we have to ask them. Do they tell us the truth? Necessarily? Always? May they not be playing a game in order to extract some greater benefit? So we see that this seemingly innocent and seemingly workable concept is applicable at best under severely restrictive conditions which may never be given in reality.

In reality we determine, of course, social preferences and act accordingly. We tax people and transfer income to others. We build public works, establish museums, run a military force and so on. But all this is the product of *political* decision processes, based on voting or on dictates, with only vague ideas of what might be good for the society and increase its "welfare." But there is no strictly scientific unchallengeable basis. There is power or at best persuasion.

The upshot of all this is that "welfare" is an elusive concept, that has, however, great intuitive appeal but means different things to different people and groups of people. It is a concept that slips through our net the moment we want to make it objective in a scientific sense. I say this with all due respect to the many economists past and present who have given so much thought to this matter. Many valuable attempts have been made, but as so often in science, much has to be discarded that was once considered to be acceptable. There is a great challenge here to economic science to find some day a satisfactory expression and to tell us then also how to measure welfare.

A promising development is the study of the so-called "social indicators." This movement recognizes that a positively valued social development depends on the simultaneous changes in many variables: An increase in production is not good if it is accompanied by more pollution, or a rise in income without at least no deterioration of its present distribution. Incidentally, note that when I speak of "deterioration of income distribution" I appear to be able to say in a scientifically objective way when a particular income distribution is "better" than another. This would again involve interpersonal comparisons of utility which we know have to be ruled out. Yet common sense tells us that, to take an extreme case, if 90 percent of the national income goes to 5 percent of the population that country is hardly better off than when possibly even a smaller income is distributed more equally among the inhabitants. This clash of insight with our inability to make scientifically acceptable statements is most disturbing.

There are countless many interrelated factors on which welfare, whether personal or communal, depends. Even to describe them, to enumerate them and to put them into a coherent picture is a difficult task. Any differentiation which leads away from simple global expression is in the right scientific spirit which forces us to make more and more distinctions. There is no doubt that such qualitative, descriptive work has to precede any measurement, and it may give us even now already the basis for rough comparisons of different states of the same country and some glimpses of comparing the welfare in different societies.

This is what GNP is supposed to disclose to us — nay, more: even to measure with extraordinary precision! A poorly defined and hard to capture, yet exceedingly important phenomenon such as welfare allegedly measured by another one, GNP, that records nothing better than the total — I am almost inclined to say "hodgepodge" — of transactions in the economy. The idea has no chance of finding any scientifically valid justification whatsoever. It is once more, as in the case of growth that one demands of a single, simple scalar number to produce wonders of measurement.

Of course, attempts have been made to improve upon the GNP concept, for example by considering GDP (gross domestic product) in order to exclude foreign transactions, or attempts to arrive at some measure of *net* output so that the "productivity of an economy" can be determined. Such efforts go clearly in the right direction, namely that one must make finer and finer distinctions however conceptual difficulties arise than too. For example, the notion of "productivity" applies more easily to physical processes where we observe physical inputs and outputs. These can also be expressed in monetary terms though this is not a simple matter. However, in the U.S. economy

today perhaps only 40 percent of activity involves physical output; the rest is "services." And no one has come forth with good ideas as how to measure "productivity" of lawyers, doctors, teachers, policemen, hospitals, scientists, musicians, actors, etc., etc. Yet they all have some kind of "output", conceivably even a "net" output. . . . But what is it and how do we compare these heterogeneous services with each other? And though it would be good to differentiate what is hoped for is again a primitive, single, scalar number!

Now let me turn to the way in which one deals with the numbers purporting to measure GNP. Let us forget for the time being all that was said in criticism of GNP. Let us merely look at the measurement itself.

Measurement is demanding, and accurate measurement exceedingly so. It may interest you that even today we do *not* know the Moon's *precise* distance from the Earth — though man has visited the Moon! What is more, incidentally — and I shall come back to that in an application to economics — we cannot prove, in general, the stability in the large of the Moon's orbit around the Earth. We can only prove it "in the small." For the whole proof we would need to know the Moon's behavior from the beginning to the end. Exactly the same is true regarding the *entire* planetary system. Should not these two considerations make us economists exceedingly modest and cautious when it comes to the discussion of measurement of complex economic-social situations and of the stability of the economic universe?

But what happens in reality?

Look at the mountains of economic statistics pouring forth continuously from the Government and from business: Millions of numbers, immense detail as well as comprehensive aggregates and sophisticated index numbers. Many numbers have been, so to speak, laundered, for example seasonal variations are eliminated in order to show the alleged true movement of some activities. Some numbers are obtained by carefully studied sampling processes; powerful statistical theory is used in many instances and sampling errors are carefully spelled out.

But there is one characteristic that pervades all: we virtually never encounter the words "perhaps," "approximately," "about," "maybe," and so on, or see a sign saying: " $\pm x$ percent." In that there is a great difference from the natural sciences where it is customary, nay standard, to ask immediately what the error of observation might be. A notable exception is S.N. Kuznets who in his valuable work on national income has shown that those figures may have an error in certain classes of income of even more than 20 percent. Though his studies have been gratefully accepted by the economic profession there is little evidence that these errors are duly considered and their implication is carried over to other fields. Obviously if there are errors in aggregates there are errors in their component parts.

Error there must be. There is no perfect measurement, no matter how good the underlying concept, no matter how fine the measurement tool. Some things seem easy to measure, e.g., to count the number of inhabitants in a country, but it may surprise you that at the U.S. Census of 1950, about 5 million people — equivalent to a good size American city, say Chicago — were not counted as was later found out in a careful study.

Other censuses may have been better or worse. In some Asiatic countries the population count is said to have errors of ± 20 percent and who knows the population of China or of some African countries? For very gross comparisons this may not matter too much but the frequently and freely used international per capita income data are usually meaningless unless countries are very similar to each other and the true intervals are short.

Errors vary enormously. In physics the finest measurement, I am

told, is that of the Ritchie constant whose error is an unbelievable 10^{-4} . Yet cross-section data for nuclear reactors may have an error of ± 50 percent. But the reactors work! So this shows that the extent of admissible error depends on the *use* for which the measurement is needed. Of course, the smaller the error, the better. Reduction of error is usually expensive and how much one wants to spend on error reduction depends again on the importance of the use of the measurement or observation. If a good number has to be combined with a poor one there is not much point in making the good number even better.

Since errors range from very small to very large, is there a generally accepted standard? The answer is that one should always state honestly what error is involved, in whatever field. This is common in physics and I regret to say almost totally lacking in economics and the other social sciences. With this I refer to the basic errors in variables, i.e., errors in the basic observations not to sampling errors and the like. There will have to be a change in attitudes, in demands, in standards. No compromise is possible. It is difficult to determine the various errors because, when the data were put down, no effort was made to discover the inevitable error. And virtually all these numbers are not the result of scientific approaches to the different phenomena. They originate from business transactions, from administrative regulations, etc. Prices are found in shops and factories, export and import quantities and values are recorded on papers accompanying the commodities, investment figures and profits and total sales are found on balance sheets, incomes on income tax returns, and so on.

To give but a few indications of what one finds: import and export figures of many countries, taken from the respective two sources, often differ by 20, 30 or even 100 percent both for value or quantity. This applies even to the trade in gold! The total quantity of money in circulation in the U.S. is supposedly not known to within perhaps \$20 billion. Yet pick up almost any basic economic or population statistic and you will find that figures are given without further comment or warning to 9, 10 and more digits. At what point do these figures lose their significance? Is it the same point in all series, in a majority of series? No discussion, no commentary, nothing: Just an uncritical abandonment to figures.

Now we come to the point of looking at the *calculations* which are made with the GNP figures.

It is well to start by quoting a statement made by one of the greatest mathematicians of all time, C. F. W. Gauss: "The lack of mathematical insight shows up in nothing as surprisingly as in unbounded precision in numerical computations." There are countless many illustrations for such activity, not only in economics but in all social sciences. This is another sign for their lack of maturity compared to the physical sciences. There seems to be a love for meaningless digits. Norbert Wiener, also an eminent mathematician, upon looking at material described in my book, *On the Accuracy of Economic Observations* (1963), observed to me: "Economics is a one-digit science." I would be inclined to say that this is true for parts of it, but there are a few parts where two, perhaps even three, digits are admissible and where our power of interpretation is great enough to handle such fine detail.

The principal calculations to which GNP figures are subjected are rates of change, presumably rates of *growth*, because that is what the world has been made aware of. Governments everywhere look hypnotized at these calculations and are judged by the number generated even for the short intervals of a quarter year — incidentally so brief a period that one must be astonished that (even given modern means of communications) all the hundreds of thousands of underlying figures could be collected: all this without any error whatsoever! Or, if — heaven forbid — there are errors that they

very kindly distribute themselves in such manner that they all cancel out?

The facts are, of course, quite the contrary: there must be errors: after all, we live in a "stochastic universe," which means that the world is to a large measure indeterminate. And that errors in economic observations would cancel out precisely — of that no one has given proof and no one will ever be able to do so in general.

I shall give two illustrations of calculations. Suppose you have two consecutive GNP numbers — whatever their absolute values be — such that the second one is 3 percent larger than the first one, assuming each one to be perfect. Now assume that the first is, however, understated (i.e. has an error) by -1 percent, the second overstated by +1 percent, then the rate of growth, instead of being 3 percent is in fact +5.08 percent. Quite a difference! But if, the other way around, the first is faulty by -1 percent and the second by 1 percent, then the rate of growth is only 0.96 percent. What is reality? A *one* percent error one way or the other is tiny, by almost all standards. Recall that in physics, a paradigm for measurement, observations with only a 3 percent error is frequently a very good and useful measurement. What happens to our growth rates if we repeat what was just done for ± 3 percent? In the first case, instead of the error-free 3 percent basic change, we obtain +9.37 percent; in the second case -3 percent. So the economy, as represented by an alleged error-free change in GNP statistics, instead of having grown by 3 percent, may have grown by 9.37 percent or decreased by -3 percent. This is the result of trivial calculations. Precisely for being so trivial they show the grossness of the (tacit) assertion that the "true" rate of change, or "growth" is allegedly ± 3 percent.

Of course, if the errors in the two underlying GNP figures would not only go in the same direction — i.e. being each either positive or each negative — and in addition were to be *identical*, then nothing would change, the rate would stay the same. But even if they should go in the same direction but were to differ from each other in consecutive years, the rate of change could no longer remain at the alleged error-free value.

Simple as these considerations are, they are basic. They illustrate precisely the importance of the just quoted statement from Gauss. To make matters worse, one is now no longer satisfied with yearly comparisons, but uses quarterly data. For these the same arrangements apply. In fact, the situation is worse, because in gathering the thousands of underlying figures, there are delays, corrections, etc., in spite of the availability of electronic computers at certain stages. This is true whether yearly or quarterly figures are collected. The respective statistical offices naturally want to do as good a job as possible and so they are led to correct the initially given figures because faults are discovered over time. Indeed, the yearly GNP, or even the much finer National Income Statistics, often take up to *ten* years until the final figure is presented. In the course of these successive revisions there are plus and minus changes. Expressed as percentages of the initially given figures the revisions are of the order of 2, 3, or sometimes more percent. And over the years, some corrections go up, some go down for the *same* year. Clearly, quarterly figures are subject to even more, and also bigger corrections. Now all this plays havoc with the initially calculated rate of change, presumably of growth. Finally, even when after many years a definite figure is stated (different *always* from the first one!) that figure is not and cannot be free of some remaining error of observations. Recall that no measurement is absolute, that we live in a stochastic universe and that science — no matter how well developed — is only an approximation to reality.

Now it is peculiar that governments are submitting to be judged by as primitive numbers as those here discussed. It is not that one would want to deny that there exists some intuitive notion of

"growth," that some parts of this phenomenon can be expressed numerically, but that all can be put into one single number that is free of all possible faults: that is unacceptable. What is more, these numbers are supposed to be comparable over long periods of time and internationally. Whether it be India or Sweden or China or Japan or the U.S.: the precise rates of growth are compared with each other. For some countries even the number of inhabitants is only vaguely known. It is difficult to see why statesmen would expose themselves to this kind of evaluation. Economists have to share in the blame. They have introduced the notion of "fine tuning" of the economy, the idea that one could control the whole economy so precisely that its performance could be judged by the second digits of growth rates, when in truth even the first digit is in doubt. One hears a little less, however, about the fine tuning recently in view of the fact that rather gross events such as much unemployment, high

interest rates, steep monopolistically controlled oil price increases are with us. "Fine tuning" would require frequent switches in policy given the many factors which determine economic life but such switches are not only not welcome but can hardly be made, given the inherent slowness in political processes.

Summarizing: We would of course like to know whether and how much and in what direction the economy has grown and how economic welfare has been changed, presumably been improved. We would like to have good, trustworthy numerical expressions for both. Alas, the GNP concept is primitive in the extreme and certainly useless for any adequate expression of "growth." "Social welfare" is still so difficult and controversial a notion that, without overcoming the inherent great conceptual difficulties we cannot indicate any measure at present which is scientifically unchallengeable and does not involve political, moral, or whatever other prejudices.

Capital Formation And Individual Freedom

A TIME TO CRY "WOLF"

By WILLARD C. BUTCHER, *President, The Chase Manhattan Bank*

Delivered before the Economic Club of Chicago, Illinois, February 20, 1975

I'M very disturbed about what I see taking place in this country. I am disturbed about the economy — not so much that we are in a recession as some of the senseless ways we try to get out of it. Not so much by inflation as by the fact we try to counteract and make up for it, rather than cure it.

I am disturbed by the fact that people aren't being told enough about the essential nature of our economy and our economic problems. I am distressed by the media, and by what seems to be either their failure to understand what makes our economy work, or their inability or unwillingness to communicate that knowledge.

I am disturbed by the kind of politics-as-usual in Washington that puts less emphasis on solving our problems than on who will get the credit if they are solved, or the blame if they are not. And I'm disappointed in much of the nation's business community, which is either too indifferent, too resigned, or too frightened to communicate forcefully with the people.

I am troubled by the erosion of personal freedom that has taken place and continues to take place, and by the complacency with which many Americans surrender their right to make choices, to render judgments, and to exercise control over their own lives and destinies.

Fundamentally, I am concerned over the way we are giving up, bit by bit, what America really stands for. And before this evening is over, I hope to have transmitted to you some of my sense of unease and alarm.

My subject today is capital formation and economic policy, which takes in a lot of territory. So let's look at where we stand, where we want to go, and what we need to get there.

To start with, our total private capital plant today amounts to some 3.2 trillion dollars, of which 1.8 trillion dollars represents our industrial capacity. Almost two-thirds of that amount — or 1.1 trillion — was developed and invested in just the past ten years.

It was a tremendous achievement. But it was not enough. We did not meet some of our country's basic needs.

It was not enough because our industrial plant today is deficient.

It is estimated that it is fully two years older than that of Europe and Japan, and there is a fundamental correlation between modern plant and productivity. A tabulation of growth rates by the OECD of twenty advanced economies for the 1960-1970 decade put the United States pretty close to the bottom — in eighteenth place, with average annual growth of only 4 percent. Japan headed the list with an 11 percent growth rate.

It's significant that in this period Japan was putting about a third of its GNP into investment spending, while we put less than a sixth of ours to work as capital. To catch up and to stay caught up can cost as much as \$225 billion over the next ten years.

Our capital investment has not been enough because we fell behind our needs in financing the search for more sources of energy. For energy self-sufficiency alone, it is estimated that we in this country will have to provide about \$850 billion over the next ten years, which equals about 80 percent of our total industrial investment in the past ten years.

It was not enough because we have fallen short of meeting our transportation needs — for mass transportation of people and more energy-efficient transport of goods, which means mainly by rail. That could require a ten-year investment of another \$225 billion.

Then there is the matter of our employment needs. There is no better — indeed no other — way to create new jobs than by supplying capital to provide the tools, the supplies, and the materials that jobs require. Economists tell us that it takes anywhere from \$20,000 to \$30,000 in capital investment to back up every worker in American industry.

All in all, to meet these needs over the next ten years will require more than twice as much capital as the last ten. How have we arrived at that figure? Considerable economic analysis indicates that from today until early 1985, investment spending of 2.5 trillion constant dollars is projected, on the assumption that we will see a continuation of our relatively slow growth rate of 4 percent a year. Add in inflation, at a presumed rate of approximately 5 percent a year, and that comes to 3.6 trillion current dollars. If inflation were to be

