CONCEPT AND MEASUREMENT OF PRODUCTIVITY

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1. Introduction
Productivity has become a household word as almost everyone talks about it. Yet, the term ‘productivity’ means different things to different persons. As a phenomenon, it ranges from efficiency to effectiveness, to rates of turnover and absenteeism, to output measures, to measure of client or consumer satisfaction, to intangibles such as disruption in workflow and to further intangibles such as morale, loyalty and job satisfaction.

To put it bluntly, the definition of productivity is complex and this is because it is both a technical and managerial concept. Productivity is a matter of concern to government bodies, trade unions and other social institutions not minding the disagreements over its conceptualization by different groups and individuals. Hence, discussing productivity at all levels is common because of the direct relationship between productivity and the standard of living of a people. It is perceived that the more different are the goals of the different individuals, institutions and bodies that have a stake in productivity as a problem, the more different their definitions of productivity will be.

To date, at least three perspectives have dominated the field of productivity namely economics, industrial engineering, and administration. These perspectives have complicated a search for any precise definition of the concept ‘productivity’. One additional problem to the conceptualization of the term ‘productivity’ is the fact that productivity is not only to be defined and managed;
it is also to be measured. Its measurement poses no fewer problems than its definition. Perhaps, Krugman (1990) intended to assert that defining or measuring productivity is a herculean task when he asserted that “productivity isn’t everything, but in the long run it is almost everything”\(^1\).

The primary objective of this paper is to attempt to demystify productivity conceptually by examining in detail what productivity is and what it is not. Enhanced understanding of the meaning of productivity is likely to be guaranteed if its measurement is equally examined to attempt a balance between theory of productivity and practice of productivity. This paper will delve into issues of productivity measurement whereby conscious effort will be made to define what is definable, measure what is measurable and count what is countable. In sum, the aim of the paper is to expand the depth of our understanding of the concept and measurement of productivity.

The paper is organized as follows after this introduction. Section two is devoted to the examination of productivity as a concept where issues revolving around the definition of productivity are discussed. Section three examines the significance of productivity with a view to deepening our understanding of productivity as a concept. Section four examines the measurement of productivity in all its ramifications. Section five concludes the paper by attempting a response to the question of how productivity can be improved.

2. What is Productivity?

The least controversial definition of productivity is that it is a quantitative relationship between output and input (Iyaniwura and Osoba, 1983, Antle and Capalbo, 1988). This definition enjoys general acceptability because of two related considerations. One, the definition suggests what productivity is thought of to be in the context of an enterprise, an industry or an economy as a whole.

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Two, regardless of the type of production, economic or political system, this definition of productivity remains the same as long as the basic concept is the relationship between the quantity and quality of goods and services produced and the quantity of resources used to produce them (Prokopenko, 1987).

Eatwell and Newman (1991) defined productivity as a ratio of some measure of output to some index of input use. Put differently, productivity is nothing more than the arithmetic ratio between the amount produced and the amount of any resources used in the course of production. This conception of productivity goes to imply that it can indeed be perceived as the output per unit input or the efficiency with which resources are utilized (Samuelson and Nordhaus, 1995).

By way of analogy, Amadi (1991) explained that an example of productivity ratio is kilometres driven per gallon of petrol where petrol is the input and kilometres covered constitute the output. However, input measure of petrol is not used to determine the efficiency of the car’s performance. Other related factors such as speed, traffic flow, the engine’s efficiency and the fuel’s efficiency are equally involved in the computation of the input index. The output measure of kilometres driven therefore becomes a gauge of the magnitude or effectiveness of the results achieved. Expressed simply:

\[
\text{Productivity} = \frac{\text{total output}}{\text{total input}} \text{ which is identical to} \\
\frac{\text{total results achieved}}{\text{total resources consumed or}} \\
\frac{\text{effectiveness}}{\text{efficiency}}.
\]

In effect, productivity becomes the attainment of the highest level of performance with the lowest possible expenditure of resources. It represents the ratio of the quality and quantity of products to the resources utilized.
It is evident in the literature on productivity that almost all the definitions of productivity centre on ‘outputs’ and ‘inputs’. Unfortunately, definition of either output or input or both may sometimes pose more difficulty to the understanding of what productivity is. For output, it is in the form of goods if visible and services if invisible. Input on the other hand is less easily defined. Since production (creation of goods and services) is a team effort thereby making the demand for inputs to be interdependent, various elements (inputs) are involved in the production of output. This makes the definition of input more complex than that of output. To ease this problem of defining inputs, it is common a practice to classify inputs into labour (human resources), capital (physical and financial assets), and material. Again, in an attempt to circumvent the difficulty of defining inputs, productivity is sometimes defined as goods and services produced by an individual in a given time. In this sense, time becomes the denominator of output with the assumption that capital, energy and other factors are regarded as aids, which make individuals more productive.

Olaoye (1985) observed that productivity as a concept can assume two dimensions: namely total factor productivity (TFP) and partial productivity. The former relates to productivity that is defined as the relationship between output produced and an index of composite inputs; meaning the sum of all the inputs of basic resources notably labour, capital goods and natural resources. Eatwell and Newman (1991) captioned total factor productivity as ‘multi-factor productivity’. For the latter, output is related to any factor input implying that there will be as many definitions of productivity as inputs involved in the production process whereby each definition fits a given input. For example, when output is associated to per man-hour or per unit of labour, this definition of productivity is a partial one and it relates to labour productivity. Partial factor productivity is equally known as average product. Symbolically, if \( Y \) stands for output, and \( F_i \) for any individual factor, we have \( \text{APF} = \frac{Y}{F_i} \) where APF is the average
product. It only measures how the output per unit has changed over time, ignoring the contributions from other factors to the detriment of production process reality.

NECA\(^2\) (1991) observes that it is more common in productivity studies to see emphasis placed on labour productivity. By coincidence, at the national level, labour productivity translates to what is known as human productivity. It is the type\(^3\) of productivity that affects directly the purchasing power of the population since:

\[
\text{National productivity} = \frac{\text{Gross National product}}{\text{Working Population}}
\]

Theoretically, it goes without saying that there is a link between per capita income of an economy and such economy’s marginal labour productivity.

One justification for the special emphasis on labour productivity is perhaps because labour is a universal key resource. The term labour productivity implies the ratio of physical amount of output achieved in a given period to the corresponding amount of labour expended. By implication, productivity here means the physical volume of output attained per worker or per man-hour.

However, apprehension exists on the definition of labour that is suggestive of the fact that labour productivity is an expression of the intrinsic efficiency of labour alone. Indeed, productivity is more of the end result of a complex social process involving science, research, analysis, training, technology, management, production plant, trade union, and labour among other inter-related influences.

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\(^2\) NECA means The Nigerian Employers Consultative Association.

\(^3\) At the level of industry or workshop, other kinds of productivity exist. Notable ones include direct labour cost productivity, capital productivity, direct cost productivity, total cost productivity, foreign exchange productivity, and energy productivity and raw materials productivity among others.
To this end, it must be appreciated that the definition of productivity partially is purely to satisfy the demand of theoretical curiosity. Practically, the interdependence nature of the demands for factors implies that it is impossible to say precisely and clearly how much output has been created by any one of the different inputs taken by itself. The phenomenon is like attempting to answer the question: which is more essential in producing a baby, a mother or a father?

Some common misunderstandings exist about productivity. First, productivity is not only labour efficiency or labour productivity even though; labour productivity statistics are essentially useful policy-making data. Productivity is much more than just labour productivity and needs to take into account other inputs involved in the production process. Two, productivity is not the same as increase in output or performance. Sumanth (1984) described this misconception as the confusion between productivity and production. Output may be increasing without an increase in productivity if, for example, input costs have risen disproportionately. One useful way to combat this misconception is to be conscious of the trend of input costs particularly by relating output increases to price increases and inflation. This approach is often the result of being process-oriented at the expense of paying attention to final results. Bureaucratic settings are more prone to this misconception of productivity.

In an attempt to draw the line between productivity and output increase, the term ‘productivity growth’ is sometimes introduced whereby it denotes the rate of growth of the level of productivity. For example, if output per worker is 1000 units in 1998, and it grows to 1250 units in 1999, then it is said that productivity growth was 25% per year on the assumption that prices and input costs are constant.
The third misconception about productivity is the confusion between productivity and profitability. Profitability is a function of the extent of price recovery, even when productivity has gone down. Again, high productivity may not always go with high profit if goods and services produced efficiently and effectively are not in demand. Confusing productivity with efficiency or effectiveness can equally cloud the meaning of productivity. Efficiency means producing high-quality goods in the shortest possible time. It is important to ask if goods produced efficiently are actually needed. Also, effectiveness refers more to the production of results. In the private sector for instance, effectiveness could mean making profit and preserving future market share. According to Scott (1983), efficiency and effectiveness are actually measures of performance just as productivity is equally a measure of performance.

Another misconception is a mistake of believing that cost cutting always improves productivity. Whenever this is done indiscriminately, it can even bring about productivity decline in the long run. It is equally not to be believed that productivity can only be applied to production. In reality, productivity is relevant to any kind of organization or system including services, particularly information. For example, improved information technology alone can give new dimensions to productivity concepts and measurement. Recent advancement in information technology seems to be suggesting that labour productivity may actually be subordinate to the productivity of capital and other scarce resources such as energy or raw materials.

The concept of productivity is also being linked with quality of output; input and the interacting process between the two. An important element is the quality of the work force, its management and its working conditions as it has come to be

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4 In the definition of productivity, efficiency goes with the denominator (input) and effectiveness the numerator (output)
noticed that rising productivity and improved quality of working life go hand in hand.

In a nutshell, productivity is concerned with efficiency and effectiveness simultaneously. Lawlor (1985) sums up productivity as comprehensive measures of how efficient and effective an organization or economy satisfies five aims: objectives, efficiency, effectiveness, comparability and progressive trends. No matter how it is perceived, productivity implies that there is an incremental gain in what is produced as compared with the expenditure on measures utilized.

3. The Significance of Productivity

The importance of productivity to economic growth and development can hardly be over-emphasized. It remains the basic problem of economic progress, as it is required at both the early stages of development as well as in the permanent process of re-equipping the production apparatus of any nation.

Wen (1993) employing the use of a diagram revealed that there are three sources of growth. First is the traditional source of growth that is captured by the move from a point like A to B along $T_1$ consequent upon input increases from $x_1$ to $x_2$. The second source of growth is rooted in institutional innovation that eliminates restraints in resource allocation such that more output is produced with the same amount of inputs. The move from the interior point C to the frontier point A depicts growth on account of institutional re-engineering. The third source of growth is technological progress, which shifts the production function outwardly, that is from $T_1$ to $T_2$ since $T_2$ initially is not available (see figure 1).

The key to growth is an increase in productivity (Wonnacott and Wonnacott, 1986). Thus:

\[^5\] Other measures of performance include quality of work life, innovation and profitability.
Productivity as a source of growth has moved to center stage in analyses of growth of developing economies in recent years. Earlier, the focus was mainly on the growth of capital, through greater mobilization of resources. As investment levels have increased substantially in most developing countries and the scope for further increases becomes more limited, attention has naturally turned to productivity improvements which offer a complementary route to growth by getting more out of limited resources.

(Ahluwalia 1991:191)

Figure I: Sources of Growth

Sources: Wen (1993), p. 3

To this effect, productivity is discussed at all levels because of its direct relationship with the standard of living of a people. At the level of an individual, it is rational to argue that, the standard of living of any man is the extent to which he is able to provide himself and his family with the things that are necessary for sustaining and enjoying life. The greater the amount of goods and services produced in any economy or imported into such economy, the higher its average standard of living will be. Uche, (1991) identified four important channels by which higher productivity impacts on standard of living, these are:

(i) larger supplies both of consumer goods and of capital goods at lower costs and lower prices;
(ii) higher real earnings;

(iii) improvements in working and living conditions, including shorter hours of work; and

(iv) in general a strengthening of the economic foundations of human well-being.

At the national level, steady growth in productivity guarantees non-inflationary increases in wages as well as solves pressing problems of unemployment, increased trade deficit and an unstable currency (exchange rate). In business, productivity improvements can lead to more responsive customer service, increased cash flow, and improved return on assets and greater profits. As revealed by economic theory, more profits will translate to availability of investible funds for the purpose of capacity expansion and the creation of new jobs, hence, increased productivity becomes a panacea to unemployment problem. Enhanced productivity will equally contribute to the competitiveness of a business or an economy in both domestic and foreign markets. For example, if labour productivity in one country declines in relation to productivity in other countries producing the same goods, a competitive imbalance will be created involving divergence in cost functions. If the higher costs of production are passed on, the economy’s industries will lose sales as customers are justified turning to the lower cost suppliers. Alternatively, if the higher costs are internalized by industries, their profit will decrease. The direct implication of absorbing higher costs of production by industries is to decrease production or keep production costs stable by lowering real wages. It goes without saying that notable economic problems like inflation, an adverse balance of trade, poor growth rate and unemployment are offspring of low productivity. Scott (1985) confirmed this conjecture in his model for a low-productivity trap as shown in figure 2. The significance of productivity as implied in figure 2 is that increased
productivity can indeed break the vicious cycle of poverty and unemployment, and by direct argument low-productivity trap itself.

Apart from the link between productivity and the general well being of a nation, productivity is of great importance in economic analysis. For example, when it is combined with population and output trends, it is used in economic growth models to forecast output and employment, as well as the distribution of manpower and other resources between different sectors of an economy or industry. In essence, productivity provides the basis for analyzing the relative dynamism of different economic activities. Again, interests in productivity and what is happening to it are directed towards being able to know something about the process of technical change. This is so because economic growth, technical change and productivity are closely related.

**Figure 2: Model for a Low-Productivity Trap**

- Low productivity growth (compared with input prices especially labour and energy)
- Lagging capital formation (and insufficient capital-labour ratio)
- Lower utilization of domestic plant capacity
- Rising prices (domestic and export goods)
- Sluggish sales (in domestic and foreign markets)
- Rising unit (labour and energy) cost

Source: Scott, 1985, P.8
4. Measurement of Productivity

Put simply, productivity measurement is the quantification of both the output and input resources of a productive system. The intent is to come up with a quantified monitoring index. The goal of productivity measurement is productivity improvement, which involves a combination of increased effectiveness and a better use of available resources.

While productivity can be given the sort of shorthand definition as the ratio between output and input, what productivity really is as well as how it can be measured has always provoked a great deal of controversy among experts. In essence, it can be said that the measurement of productivity is only simple conceptually. In practice, however, both measurement of outputs and inputs involves aggregation problem, and this problem alone has situated productivity measurement in the realm of complexity. For example, the question of how to aggregate different products that do not have constant quality or characteristics constitutes the veil to be removed from output measurement. In the same vein, the problem of how to aggregate the different types of inputs into a well-defined composite unit remains a critical one on the side of input measurement.

To solve output and input aggregation problem, particularly when heterogeneous inputs and outputs are combined, some authors have suggested that inputs should be added up in ‘constant price’ money values. The same thing should be done for output (Iyaniwura and Osoba, 1983, David, 1972). The loophole in this approach is that the resultant productivity index will be economic productivity and not physical productivity, which, obviously, should convey more meanings to most of the users of productivity measures. Added again to the input measurement problem is the question of how to measure capital input. Consequently, preference is often expressed for a single factor measure of productivity, and it is common to see emphasis being placed on
labour input. Three reasons are sometimes put forward to justify the use of labour input for purposes of partial productivity measurement, these are:

(i) labour is regarded as the most important factor of production;
(ii) labour is the most easily quantified factor of production;
(iii) labour is the only factor of production that has conscious control over its contribution to output.

A measure or index of aggregate output divided by the observed quantity of a single input thus became the earliest approach to productivity measurement. This index-number approach based upon the use of single or partial factor productivity measures has one unique advantage: computational simplicity and feasibility, save that the required aggregate labour input data are available. The greatest shortcoming of partial factor productivity measures, particularly labour productivity measures is its inability to identify the causal factor accounting for observed productivity growth. For instance, substitution of capital for labour, the introduction of more (labour) efficient vintages of capital, the realization of economies of scale and the employment of better-trained manpower will all show up in an index of output per man-hour.

Emerging literature on productivity measurement of late indicate that early productivity measures revolve around the value of aggregate output per man-hour of labour input despite the problems associated with measuring labour input. At the moment, productivity research has focused more on total factor productivity (TFP) measures, where comprehensive aggregates of outputs and inputs are of interest. It is helpful to note that production theory remains the basis for analyzing the factors that explain output level changes. It is known from available literature that, the rate of output depends on three factors:

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6 Labour input itself is also difficult to measure. For example, it is sometimes suggested that labour must be defined and classified along the line of mental and physical efforts. It is fundamentally wrong to assume homogeneity for labour when differences are evident in terms of sex, age and aptitude.
Arising from these three factors behind productivity changes are three possible explanations for differences in total factor productivity. These are differences in productive efficiency, the scale of production, and the state of technology, depending on the specific assumptions\(^7\) that are made with respect to the production function and the market conditions.

Beyond the level of partial factor productivity measurement, the growth of output can be decomposed into two: the contribution of changes in inputs and in total factor productivity. The production function indicates the contribution of additional inputs to increases in output and the residual otherwise called ‘multi factor productivity growth’ or less formally the Solow residual is attributed to total factor productivity change.

Under the assumptions of constant returns to scale and competitive markets, the rate of growth of output can be written as follows:

\[
g_y = ag_b + (l-a) g_k + q
\]

Where \(g_y\), \(g_b\), and \(g_k\) are the growth rates of output, labour, and capital respectively, and \(a\) is the share of labour in output; while \(q\) measures that part of growth that cannot, under the maintained assumptions, be explained by either growth of labour or capital.

To this end, recent productivity debate has been concerned with total factor productivity (TFP) measures that are based on comprehensive aggregates of

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\(^7\)The assumption of competitive equilibrium suggesting that factor of production is paid the value of their respective marginal products and constant returns to scale are often made.
outputs and inputs. Antle and Capalbo (1988) identified two major approaches to total factor productivity measurement, these are:

(a) the growth accounting (index number)
(b) the econometric approach.

The Growth Accounting Approach to TFP Measurement
Growth accounting represents a technique for estimating the contribution of different factors to economic growth. With the aid of marginal productivity theory, growth accounting decomposes the growth of output into growth of labour, land, capital, education, technical knowledge and other miscellaneous sources. In addition, growth accounting approach to TFP measurement is operationalized by finding the difference between growth of output and the growth of the weighted sum of all inputs, to obtain output growth associated with what Solow (1957) call technical change or residual.

The growth accounting approach involves compiling detailed accounts of inputs and outputs, aggregating them into input and output indexes, using these indexes to calculate a TFP index. The theory of index numbers is uniquely crucial to the aggregation of inputs and outputs. The exact relevance of the index numbers theory to productivity measurement is in the sense of the economic assumptions about the underlying aggregation functions.

Three examples of indexes are Laspeyres exact index, geometric exact index, and Tornqvist – Theil index that approximates the Divisia index. The Laspeyres indexing procedure is believed to be exact for, or imply, a linear production function in which all inputs are perfect substitutes in the production process. Similarly, the Tornqvist index, which is a discrete approximation to the more general Divisia index, implies a homogenous translog production function. Geometric index exacts Cobb-Douglas production function.
The computation of aggregate output and input indexes requires that technical change be neutral and that the underlying transformation function be separable in outputs and inputs. For example, output aggregation requires that each firm’s technology be separable in terms of output, such that the marginal rate of substitution between any pair of outputs must be independent of inputs.

The term ‘exact’ implies a measure of the percentage change in variable costs at time t that cannot be explained by changes in inputs or outputs or changes in variable input prices. Almost all indexes are based on cost and revenue shares within the framework of restrictive production functions in the sense of assumption of constant returns to scale, competitive equilibrium and absence of input substitutability. Indexes that are exact even for flexible unit cost function or production function are said to be superlative (Diewert, 1976).

Productivity measures that are rooted in indexes can be estimated at three important levels. These are static, dynamic and surrogate productivity measure. Static productivity ratios are concerned with what happened in a given period, such as:

\[ SPR = \frac{1998 \text{ output}}{1998 \text{ input}} \]

suggesting that 1998 is the year of consideration. The dynamic indexes compare the static productivity of one period (often called base period) with the static productivity ratios of the current period. Symbolically, it can be expressed as:

\[ DPI = \frac{\text{output 1999}}{\text{input 1999}} \frac{\text{output 1998}}{\text{input 1998}} \]
where 1998 is taken to be the base period. The resultant productivity index can be relied upon to monitor progressive changes in productivity.

In the case of surrogate indexes, they measure terms that are highly correlated with productivity such as customer satisfaction, profits, effectiveness, quality, and efficiency among others.

On the whole the strength of the index number approach to TFP measurement is that all inputs can be accounted for conceptually, while the most obvious limitation is summed up in the difficulties of disentangling technical changes from the effects of scale economies and input substitution.

**The Econometric Approach to TPF Measurement**

The standpoint of the econometric approach to productivity measurement is the estimation of explicitly specified production function (the primal function) or the dual (cost or profit) function with a view to establishing the direct linkage of productivity growth to key characteristics or parameters of either of the functions. One important benefit of this approach is that its econometric implementation yields parameter estimates of the production technology in the process of measuring productivity advancement.

The combination of developments in duality theory and flexible functional forms with econometric theory has brought about significant advance in the econometric approach to TFP measurement. This advancement has equally improved the approach’s estimation efficiency. The methodology employed in most studies followed closely the seminal paper on the translog production function by Berndt and Christensen (1973). A typical econometric methodology designed to measure productivity growth will involve specifying a function representing the technology either as a production, cost or profit function, and
estimating the derivatives. The structural equation below represents the specification of the technology function:

\[ y = f(p, z, t; B) + u \]

Where \( y \) is the dependent variable which can either be output, cost or profit; \( p \) is a vector of say variable input quantities, factor prices, or output and factor prices, \( z \) is a vector of fixed factors or outputs; \( u \) is a random error for econometric estimation; \( t \) stands for time and \( B \) is a vector of unknown parameters to be estimated.

Grosskopf (1993) enriched the literature on productivity measurement when he observed that the traditional approaches to productivity measurement generally, though implicitly, assume that observed output is frontier output. Frontier output implies that the observed output is best practice output. The implication of this assumption for productivity measurement and analysis is that observed output is technically efficient. He then bifurcated approaches to total factor productivity measurement along the line of those that ignore inefficiency, that is, approaches in the frontier framework, and those that explicitly allow for inefficiency, that is, non-frontier framework. Further classification of total factor productivity measurements is again done along nonparametric (index number) models and parametric (econometric approaches). Figure 3 below presents in form of a diagram the classification of approaches to total factor productivity based on Grosskopf (1993).

For instance, the Tornqvist index is concerned with the natural discrete approximation of productivity growth and is said to be exact for translog technology. The index is also believed to be superlative because the translog functional form is flexible. Hence, these non-parametric approaches are very
appealing in terms of ease of calculation and flexible modelling of underlying technology. These advantages are possibly responsible for their popularity.

**Figure 3: Approaches to Total Factor Productivity Measurements**

- **Non-Frontier Approaches**
  - Non-Parametric Index Number
    - Growth Accounting Equation
    - Divisia Index
    - Exact Index
    - Tornqvist Index
  - Parametric

- **Frontier Approaches**
  - Non-Parametric
    - Programming
    - Econometric Approaches
  - Parametric
    - Malmquist Productivity Index
    - Stochastic and Deterministic Models e.g. Econometric Models

**Source:** Author’s Construction based on Grosskopf, 1993

Notable shortcomings of the non-parametric non-frontier approaches include biased estimates of productivity growth because of the prevalence of inefficiency. Also, by using input shares to aggregate inputs, it is likely that input prices are not correct, thereby leading to allocative inefficiency. Again, the resulting measures of productivity growth have no precision with which productivity growth is measured. In general, in the case of non-parametric approaches to total factor productivity measurement, the task is to calculate productivity growth (no parameters to be estimated), which is believed to be observable.
5. Concluding Remarks: How can Productivity be improved?

As argued earlier on, it cannot be said that defining and/or measuring productivity constitutes an end in itself. Foley (1962) hinted that productivity measurement must produce effective control, which in turn will produce corrective action and which finally, results in increased productivity. NECA (1991) categorized factors that can influence productivity into three namely: general factors, organization and technical factors, and human factors. (see appendix 1 for the list of the factors under each categorization).

These factors raise a number of interesting issues relating to productivity. Notable ones include population growth and technological development, the role of government in productivity growth, productivity growth and wages, and the linkages between financial rewards and productivity, which Klitgaard (1989) observed to have become so weak particularly in the developing countries that they have actually eliminated economic incentives. In the case of government-productivity nexus, government is to provide the necessary infrastructure and to create opportunities for growth where infrastructure covers education and training, health, housing, power, water, transport, research and development, communications, and the availability of technology.

For productivity as a concept and its measurement, it seems reasonable to believe that a clearer perspective and understanding of productivity resides in a conceptualization of productivity that is all embracing. Perhaps a comprehensive definition of productivity that will make it a dependent variable of the following will suffice to know what productivity is and what is it not:

- cost saving resulting from the introduction of new technologies
- management improvement measured by attendance at management training courses and seminars
- improved methods of accomplishing certain work tasks
- increased morale and satisfaction on the part of the employees
- more and better products and services
- focus on quantitative and qualitative indicators of productivity
- unit of analysis in terms of people, work group, programmes, organizations and society at large using a combination of the above including performance indicators and standards for measuring efficiency, effectiveness, human resources planning, productivity analysis, work measurement among others.

For productivity measurement, whether imaginary or real, the main indicator of improved productivity becomes a decreasing ratio of input to output at constant or improved quality. Hitherto, existing approaches for measuring productivity are confronted by aggregation problem. Yet, productivity growth must be measured if only to look for opportunities to improve and show how well efforts are faring. It is likely that the magnitude of aggregation problem will be reduced if the right kind of choice is made between applying parametric and non-parametric productivity measurement.
References


Wen, G.J. (1993) “Total Factor Productivity Change in China’s


Appendix 1: Productivity Factors

(i) **General Factors:**
Climate
Geographical distribution of raw materials
Fiscal and credit policies
Adequacy of public utilities and infrastructural facilities
General organization of the labour market
Proportion of the labour force to the total population, degree of unemployment, of labour shortage and of labour turnover
Technical centres and information concerning new techniques
Commercial organization and size of market
General scientific and technical research
Variations in the composition of the output
Influence of low-efficiency plants and their varying proportion in total output.

(ii) **Organization and Technical Factors:**
Degree of integration
Percentage of capacity utilization
Size and stability of production
Adequate and even flow of materials
Sub-division of operations
Balancing of equipment.

(iii) **Human Factors:**
Labour-management relations
Social and psychological conditions of work
Wage incentives
Adaptability to, and liking for, the job
Physical fatigue
Composition (age, sex, skill and training) of the labour force
Organization of the spirit of emulation in production
Trade union practices.

Source: NECA (1991), P.78