

Overview on Industrial Productivity

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Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker.

Paul Krugman, The Age of Diminishing Expectations (1994)

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Abstract

Productivity describes various measures of the efficiency of production. A productivity measure is expressed as the ratio of output to inputs used in a production process, i.e. output per unit of input. Productivity is a crucial factor in production performance of firms and nations. Increasing national productivity can raise living standards because more real income improves people's ability to purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs. Productivity growth also helps businesses to be more profitable. There are many different definitions of productivity and the choice among them depends on the purpose of the productivity measurement and/or data availability.

INTRODUCTION

Purposes of productivity measurement

Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input use. While there is no disagreement on this general notion, a look at the productivity literature and its various applications reveals very quickly that there is neither a unique purpose for, nor a single measure of, productivity. The objectives of productivity measurement include:

- Technology: A frequently stated objective of measuring productivity growth is to trace technical change. Technology has been described as "the currently known ways of converting resources into outputs desired by the economy" and appears either in its disembodied form (such as new blueprints, scientific results, new organizational techniques) or embodied in new products (advances in the design and quality of new vintages of capital goods and intermediate inputs). In spite of the frequent explicit or implicit association of productivity measures with technical change, the link is not straightforward.
- Efficiency: The quest for identifying changes in efficiency is conceptually different from identifying

technical change. Full efficiency in an engineering sense means that a production process has achieved the maximum amount of output that is physically achievable with current technology, and given a fixed amount of inputs. Technical efficiency gains are thus a movement towards "best practice", or the elimination of technical and organizational inefficiencies. Not every form of technical efficiency makes, however, economic sense, and this is captured by the notion of allocative efficiency, which implies profit-maximizing behavior on the side of the firm.⁵ One notes that when productivity measurement concerns the industry level, efficiency gains can either be due to improved efficiency in individual establishments that make up the industry or to a shift of production towards more efficient establishments.

- Real cost savings: A pragmatic way to describe the essence of measured productivity change. Although it is conceptually possible to isolate different types of efficiency changes, technical change and economies of scale, this remains a difficult task in practice. Productivity is typically measured residually and this residual captures not only the above-mentioned factors but also changes in capacity utilization,

learning-by-doing and measurement errors of all kinds.

- **Benchmarking production processes:** In the field of business economics, comparisons of productivity measures for specific production processes can help to identify inefficiencies. Typically, the relevant productivity measures are expressed in physical units (e.g. cars per day, passenger-miles per person) and highly specific. This fulfills the purpose of factory-to-factory comparisons, but has the disadvantage that the resulting productivity measures are difficult to combine or aggregate.

- **Living standards:** Measurement of productivity is a key element towards assessing standards of living. A simple example is per capita income, probably the most common measure of living standards: income per person in an economy varies directly with one measure of labour productivity, value added per hour worked. In this sense, measuring labour productivity helps to better understand the development of living standards. Another example is the long-term trend in multifactor productivity (MFP). This indicator is useful in assessing an economy's underlying productive capacity ("potential output"), itself an important measure of the growth possibilities of economies and of inflationary pressures.

Productivity Concepts

Productivity:

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CONCEPT

Productivity is the quantitative relation between what we produce and what we use as a resource to produce them i.e., arithmetic ratio of amount produced (output) to the amount of resources (input). Productivity can be expressed as:

$$\text{Productivity} = \text{Output/Input}$$

Productivity refers to the efficiency of the production system. It is the concept that guides the management of production system. It is an indicator of how well the factor of production (Land, Capital, labor and energy) are utilized.

European Production Agency (EPA) has defined productivity as,

"Productivity is an attitude of mind. It is the mentality of progress, of the constant improvements of that which exists. It is the certainty of being able to do better today than yesterday and continuously. It is the constant adaptation of economic and social life to changing conditions. It is the continual effort to apply new techniques and methods. It is the faith in human progress."

A major problem with productivity is that it means many things to many people. Economists determine it from Gross National Product (GNP), Managers view it as cost cutting and speed up, engineers think of it in terms of more output per hour. But generally accepted meaning is that it is the relationship between goods and services produced and the resources employed in their production.

Partial productivity

Productivity measures that use one class of inputs or factors, but not multiple factors, are called partial productivities. In practice, measurement in production means measures of partial productivity. Interpreted correctly, these components are indicative of productivity development, and approximate the efficiency with which inputs are used in an economy to produce goods and services. However, productivity is only measured partially – or approximately. In a way, the measurements are defective because they do not measure everything, but it is possible to interpret correctly the results of partial productivity and to benefit from them in practical situations. At the company level, typical partial productivity measures are such things as worker hours, materials or energy used per unit of production.

Before widespread use of computer networks, partial productivity was tracked in tabular form and with hand-drawn graphs. Tabulating machines for data processing began being widely used in the 1920s and 1930s and remained in use until mainframe computers became widespread in the late 1960s through the 1970s. By the late 1970s inexpensive

computers allowed industrial operations to perform process control and track productivity. Today data collection is largely computerized and almost any variable can be viewed graphically in real time or retrieved for selected time periods.

Labour productivity

In macroeconomics, a common partial productivity measure is labour productivity. Labour productivity is a revealing indicator of several economic indicators as it offers a dynamic measure of economic growth, competitiveness, and living standards within an economy. It is the measure of labour productivity (and all that this measure takes into account) which helps explain the principal economic foundations that are necessary for both economic growth and social development. In general labour productivity is equal to the ratio between a measure of output volume (gross domestic product or gross value added) and a measure of input use (the total number of hours worked or total employment).

The output measure is typically net output, more specifically the value added by the process under consideration, i.e. the value of outputs minus the value of intermediate inputs. This is done in order to avoid double-counting when an output of one firm is used as an input by another in the same measurement.^[3] In macroeconomics the most well-known and used measure of value-added is the Gross Domestic Product or GDP. It is widely used as a measure of the economic growth of nations and industries. GDP is the income available for paying capital costs, labour compensation, taxes and profits.(OECD 2008,11) Some economists instead use gross value added (GVA); there is normally a strong correlation between GDP and GVA. (Freeman 2008,5)

The measure of input use reflects the time, effort and skills of the workforce. Denominator of the ratio of labour productivity, the input measure is the most important factor that influences the measure of labour productivity. Labour input is measured either by the total number of hours worked of all persons

employed or total employment (head count). (Freeman 2008,5) There are both advantages and disadvantages associated with the different input measures that are used in the calculation of labour productivity. It is generally accepted that the total number of hours worked is the most appropriate measure of labour input because a simple headcount of employed persons can hide changes in average hours worked and has difficulties accounting for variations in work such as a part-time contract, leave of absence, overtime, or shifts in normal hours. However, the quality of hours-worked estimates is not always clear. In particular, statistical establishment and household surveys are difficult to use because of their varying quality of hours-worked estimates and their varying degree of international comparability.

GDP per capita is a rough measure of average living standards or economic well-being and is one of the core indicators of economic performance. (OECD 2008, 14) GDP is, for this purpose, only a very rough measure. Maximizing GDP, in principle, also allows maximizing capital usage. For this reason GDP is systematically biased in favour of capital intensive production at the expense of knowledge and labour-intensive production. The use of capital in the GDP-measure is considered to be as valuable as the production's ability to pay taxes, profits and labour compensation. The bias of the GDP is actually the difference between the GDP and the producer income. (Saari 2011, 10, 16)

Another labour productivity measure, output per worker, is often seen as a proper measure of labour productivity, as here: "Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."^[4] This measure (output per worker) is, however, more problematic than the GDP or even invalid because this measure allows maximizing all supplied inputs, i.e. materials, services, energy and capital at the expense of producer income.