Concluding Remarks

This report uses gross-output and net-output approaches to measure multifactor and labor productivity indexes of the U.S. food manufacturing sector. The gross-output approach relates the adjusted value of shipments as a function of capital, labor, energy, and all intermediate materials, while the net-output approach relates the net value added as a function of labor and capital. This study finds a striking difference in the multifactor productivity indexes obtained through different approaches. The gross-output approach yields no significant changes in multifactor productivity over the sample period, while the net-output approach indicates a steady increase in the productivity index.

The cause for different multifactor productivity results may be explained below. The productivity index is calculated by subtracting the rates of change in the combined input index from the output index. In the gross-output model, materials are considered both as input and output of a production function. If the cost of materials constitutes a large portion of the value of shipments, the rate of change in the output index would be close to the combined input index, causing the measured multifactor productivity index to be small. In the net-output model, materials are not included in output or considered as input in a production function. The difference in the rates of change between the net value added and the combined capital and labor inputs—that is, the net-output multifactor productivity index—shows more degrees of freedom to vary than under the gross-output model.

In fact, the food manufacturing sector is materials-intensive, with material costs constituting about 60 percent or more of the value of gross output. The ratios for some food manufacturing industries, such as meat products and fats and oils, even reach 75 percent or higher. These two industries depend on either relatively expensive meats as raw materials for processing or heavy use of soybeans for crushing or semi-refined soybean oil for refining. Consequently, including or excluding materials as a component in a production function will substantially affect the results of measured productivity indexes. Basically, the economic meaning of the productivity measurements from the two approaches is different, and they represent different applications. There are certain advantages for applying either the gross-output or net-output approach to measure the productivity indexes of the U.S. food manufacturing sector.

Results obtained from the gross-output approach should be used for interpreting food manufacturing productivity trends. The gross-output approach measures the ability to produce higher gross output from the same level of all inputs because of technological change. Under this approach, the production function is a comprehensive representation of a production structure that includes the contribution of all factor inputs available from the data sources. Therefore, the measured gross-output productivity index may closely represent technology changes over time, while the potential change effects from unmeasured inputs can be avoided. On the other hand, a distinct drawback of applying the net-output approach is the assumption that materials inputs are separable from other inputs and cannot be the source of productivity growth. The Bureau of Labor Statistics (BLS) apparently supports using the gross-output results to explain productivity trends. Gullickson indicated that the BLS has not included net-output productivity indexes in its news release of productivity trends for all manufacturing industries since 1994.

Productivity indexes obtained from the net-output approach should be used for evaluating the contribution of food manufacturing to the growth of the Nation's GDP, mainly because the definition of net output is the same as for gross-product-originating (value-added) GDP. As a common practice to evaluate the Nation's GDP in any year, the level of GDP is frequently regarded as dependent on the input of labor measured in worker-hours multiplied by the labor productivity measure as real value added per worker-hour. Therefore, the net-output labor productivity index using the net value added as output in a production function may directly show the contribution of the food manufacturing industries to the Nation's GDP. In addition, net-output labor productivity, which depends solely on capital and labor inputs, can be easily interpreted as dependent on technological progress and the quantity of capital goods available to workers. This provides a framework for easy interpretation of the substitution relationships between capital and labor inputs. These advantages in application, however, are not available in the gross-output labor productivity measure.