Evaluating Economic Performance of Food Manufacturing Industries: An Analysis of the U.S. Pacific Northwest States

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This study develops a simple methodology of the analysis of the effectiveness of economic performance of food manufacturing industries and applies this methodology to analyze the effectiveness of economic performance of food manufacturing industries in the U.S. Pacific Northwest States (Idaho, Oregon, and Washington). The methodology is based on five ratios constructed using U.S. Economic Census data on value added, value of shipments, number of production workers, cost of materials, and capital expenditures.

A regression model is estimated to test whether the overall effectiveness of economic performance measured as the share of value added in value of shipments is a function of the effectiveness of the use of individual groups of resources (i.e. production workers, capital, and materials). The major implication of the results of econometric analysis for business decision-making is that affecting the level of the effectiveness of the use of individual groups of resources makes it possible to affect the level of the overall effectiveness of production and marketing activities.

Structural changes taking place in the food supply chain make the decision-making process of food manufacturing businesses very complex, which affects their economic performance. One key to success in this turbulent environment for a firm is to have information on its current economic performance relative to other firms in the same industry and to use this information in the strategic decision-making process. Doing this on a regular basis could be a source of a competitive advantage and may improve economic performance of food manufacturing firms and to increase the competitiveness of their respective industries at the regional, national and international levels.

In the decision-making process, firms typically use information on their economic performance over time and information on how their performance is compared to the performance of other firms in the same industry. While the depth of the intra-firm analysis depends on the firm itself as the access to the intra-firm data is unlimited, the depth of the analysis of the firm's performance relative to other firms and related industries depends on data which are publicly available.

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The first objective of this study is to develop a simple methodology of the analysis of the effectiveness of economic performance of food manufacturing industries based on a number of ratios developed using economic indicators reported by the U.S. Economic Census. These economic indicators include value added, value of shipments, number of employees, number of production workers' hours, cost of materials and capital expenditures. This methodology can also be used to analyze the effectiveness of economic performance of individual companies using their intra-firm data. Companies consisting of many establishments can compare the performance of these establishments among each other.

The second objective of the study is to apply this methodology to analyze the effectiveness of the economic performance of food manufacturing industries in the U.S. Pacific Northwest States (Idaho, Oregon, and Washington). The results of this analysis represent invaluable information for the decision-makers of food manufacturing companies located in this region. The Pacific Northwest region is a leading producer of a variety of agricultural commodities. The region provides a favorable environment for a diverse group of food manufacturing companies to establish and develop their businesses.

Problem Background and Literature Review

The number of establishments, number of employees, value of shipments, and value added are economic indicators that are usually used to measure the contribution of food manufacturing industries to the national and regional economies; these are also used to evaluate the economic performance of food manufacturing industries (Connor et al. 1985; Connor 1988; Capps, Fuller, and Nichols 1988; Christy and Connor 1988; Rogers 2001; Salin, Atkins, and Salame 2002). The choice of these economic indicators is conditional on data available to analyze the economic performance of food manufacturing industries. The U.S. Economic Census is the major source of data that reports the various economic indicators used to study the structure and economic performance of food manufacturing industries.

Food manufacturing industries are traditionally considered to be sources of employment opportunities and income in rural areas where these industries locate their establishments (Capps, Fuller, and Nichols 1988; Christy and Connor 1989; Henderson and McNamara 1997, 2000; Salin, Atkins, and Salame 2002). The number of establishments was used to analyze the location and growth patterns of food manufacturing industries (Henderson and McNamara 1997, 2000). The value of shipments and value added were used to evaluate economic performance of food manufacturing industries over time among industries and geographic areas.

While both value of shipments and value added can be used to evaluate economic performance of food manufacturing industries, value added is considered to be superior to value of shipments, as it avoids double-counting of certain resources, which is inherent to value of shipments. Therefore value added is a preferred measure to assess the performance of food manufacturing industries (Connor et al. 1985; Connor 1988). According to Economic Census, "value added is considered to be the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas" (U.S. Economic Census 2002, 2002b, 2002c, 2002d).

As it is defined by Economic Census, *value of shipments* includes the received or receivable net selling values, "Free on Board" (FOB) plant (exclusive of freight and taxes), of all products shipped as well as all miscellaneous receipts. *Value added* is the difference between the value of shipments and costs of materials, supplies, containers, fuel, plastic, purchased electricity, and contract work. The value-added indicator avoids duplication resulting from the use of products of some establishments as materials by others. For example, in the case of food manufacturing industries, the cost of agricultural materials, containers, packaging, and fuel is included in value of shipments; however, it is not included in value added generated by these industries. In other words, value added includes value of resources added to agricultural materials to produce the final product and also value that consumers attribute to a particular product, which is reflected in the level of price and profit. Therefore value added in food manufacturing typically includes wages paid to employees, depreciation of fixed assets (i.e., capital expenditures), advertising and promotion expenditures, and profit.

Classification of Industries: Consumer-Goods Industries and Producer-Goods Industries

Food manufacturing industries are classified into two groups in terms of their intensity of value-adding: industries producing consumer goods that are intended for final consumption and industries producing producer goods that are used as inputs by other industries (Connor 1988). The former group of industries tends to be more value-added oriented than the latter group. The industries producing consumer goods incur high adverting and promotion expenditures. Also, such characteristics of these goods as convenience in preparation, which allows consumers to save time while cooking at home, represent high value for consumers for which they are willing to pay higher prices. Typically, the share of agricultural raw materials in value of shipments is relatively low for these industries and the share of value added in value of shipments is relatively high.

Some examples of this group of industries are fruit and vegetable canning, dried and dehydrated food manufacturing, bread and bakery product manufacturing, and seasoning and dressing manufacturing. Canned vegetables and soups, dehydrated potatoes, bakery products, mayonnaises, and dressings are examples of the products manufactured by these industries. The major components of value added for this group of industries are wages paid to employees, capital expenditures, advertising and promotion expenditures, and profit.

The industries manufacturing producer goods tend to generate less value added compared to industries producing consumer goods. The share of agricultural raw materials in value of shipments is typically large and the share of value added in value of shipments is relatively small in these industries. They do not incur significant advertising and promotion expenditures. Some examples of food manufacturing industries producing producer goods are animal-food manufacturing and grain and oilseed milling. The major components of value added of these industries are wages paid to employees, capital expenditures and profit.

Some industries produce a mix of products consisting of both producer goods and consumer goods; animal product manufacturing is an example. The output of this industry is sold in grocery stores and is also used to produce various meat and meat-based products such as sausages, cold cuts, hot dogs, soups, etc.

Approaches Used to Analyze Economic Performance of Food Manufacturing

One of the approaches to evaluate economic performance of food manufacturing industries is to analyze changes in value of shipments, value added, and other economic indicators over time among different industries and across geographic regions. Another approach is to analyze ratios constructed using value added, value of shipments, and other economic indicators reported by Economic Census. The ratio of value added to value of shipments is the most frequently analyzed ratio. It was used to compare economic performance of food manufacturing industries among each other across regions and over time (Capps, Fuller, and Nichols 1988; Connor et al. 1985; Connor 1988; Rogers 2001; Salin, Atkins, and Salame 2002). This ratio is more meaningful in characterizing the intensity of value-adding activities than is value added alone, as it indicates the proportion of value added in the total value of shipments (Connor 1988). For example, an industry can generate a relatively low level of value added as measured by dollars; however, the industry can be highly value-added oriented as measured by the share of value added in value of shipments.

A number of ratios reported in the previous literature were constructed using either value added or value of shipments in conjunction with economic indicators characterizing various resources (inputs) used in food manufacturing: labor, material resources, and capital. The value added and value of shipments characterize the output produced and labor, material resources, and capital are inputs used to produce this output. Therefore these ratios characterize productivity of the resources (i.e., inputs) used, or in other words, they characterize the effectiveness of the use of these resources, as it is referred to in this study. A few ratios were developed to measure labor productivity: a ratio of value added to the number of employees (Capps, Fuller, and Nichols 1988; Connor 1988; Christy and Connor 1989), the average number of employees per plant (Christy and Connor 1989), and the ratio of employee payroll to value of shipments (Connor et al. 1985). Labor is the resource most frequently used in this type of analysis. The ratio of cost of materials to value of shipments appeared in Connor et al. (1985) and Connor (1988). The same sources presented a number of ratios characterizing capital intensity: ratios of capital expenditures to the number of employees, production hours worked, and value added (Connor et al. 1985), and a ratio of capital expenditures to value of shipments (Connor 1988).

There are different approaches to analyze these ratios. First, economic development trends of food manufacturing industries can be analyzed over time (Connor et al. 1985; Capps, Fuller, and Nichols 1988; Connor 1988; Christy and Connor 1989). Second, economic performance of industries can be compared across different regions (Christy and Connor 1989; Salin, Atkins, and Salame 2002). Third, the comparison can be conducted among industries (Connor et al. 1985; Connor 1988). Finally, the ratios can be used to analyze economic performance of individual business entities and establishments within these entities. For example, Mauget and Declerck (1996) used a number of ratios to analyze economic performance of a group of agricultural cooperatives in Europe. Some of the analyzed ratios were the ratio of value added to turnover, the ratio of labor costs to turnover, and the ratio of sales to the number of employees. Rogers (2001) used the share of value added in value of shipments to compare performance of the U.S. food manufacturing companies of different sizes.

Although a variety of ratios of economic performance appear in the literature, there is no study that systemizes a procedure of ratio analysis. Furthermore, very limited attention was paid to exploring the relationships among these ratios. Connor et al. (1985) and Connor (1988) presented a simple comparison of some of these ratios for food manufacturing industries. An important issue that has not been addressed in the empirical literature is whether the level of the intensity of the individual resources' use (i.e. input productivity or effectiveness of input use) affects the overall economic performance of food manufacturing industries. This study provides empirical evidence that can help answer these questions.

Data and Definitions

The U.S. Economic Census is the source of information used to analyze the structure, economic development trends and economic performance of food manufacturing industries. The Census Bureau conducts Economic Census surveys every five years, covering years ending in "2" and "7". Economic Census data are widely used in the decision-making of agencies involved in policy development, state and local government, individual businesses, and trade organizations.

The Economic Census surveys are conducted on an establishment basis. All economic indicators are reported per establishment and then aggregated over all establishments comprising a particular product class and industry. An establishment is a single physical location at which business is conducted (i.e., plant, warehouse, shop). It may or may not be identical with a company (i.e., firm or enterprise). A firm may have only one establishment; in this case, establishment and firm are identical. However, in many cases a firm consists of more than one establishment. For example, many food processing companies operate more than one plant, often located in different geographic areas. Each establishment is included in a separate industry classification conditional on its main activity, which may be different from its company's main activity.

The Economic Census classifies industries according to the North American Industry Classification System (NAICS), which was adopted in the U.S., Canada, and Mexico in 1997. NAICS replaced the Standard Industrial Classification (SIC) system that had been used in the U.S. before. According to the NAICS, food manufacturing (311)[1] includes nine groups of industries: animal food manufacturing (3111), grain and oilseed milling (3112), sugar and confectionary product manufacturing (3113), fruit and vegetable preserving and specialty food manufacturing (3114), dairy product manufacturing (3115), animal slaughtering and processing (3116), seafood product preparation and packaging (3117), bakeries and tortilla manufacturing (3118), and other food manufacturing (3119). This classification is referred to as a four-digit classification level. Each of these groups of industries includes a number of sub-groups or product classes, up to the six-digit classification level. For example, dairy product manufacturing includes dairy product (except frozen) manufacturing (31151) and ice cream and frozen dessert manufacturing (31152). Dairy product (except frozen) manufacturing (31151) includes fluid milk manufacturing (311511) and cheese manufacturing (311513), among other product classes.

A typical set of economic indicators reported for various industries and product classes includes: number of establishments; number of employees and employees' payroll; number of production workers, number of production workers' hours, and production workers' wages; and value added, cost of materials, value of shipments, and capital expenditures. The economic indicators used in this study are the number of employees, number of production workers, number of production workers' hours, value of shipments, value added, cost of materials and capital expenditures. Following approaches used in previous studies, these economic indicators are used to construct and analyze a number of ratios. This study refers to these ratios as economic-effectiveness ratios. In previous literature similar ratios were referred to as the performance ratios, productivity ratios, and capital intensity.

The definitions of value of shipments and value added are presented in the previous section, and the rest of the economic indicators used in this study are discussed in this section. *The number of employees* includes all full-time and part-time employees on the payrolls. *The number of production workers* includes workers engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, maintenance, repair, recordkeeping, and other services closely associated with these production operations. *The number of production workers' hours* includes all hours worked or paid for at the manufacturing plant. *The annual*

[1] NAICS codes are in parentheses.

payroll includes the gross earnings of all employees on the payroll paid in the calendar year.

Cost of materials refers to direct charges actually paid or payable for items consumed or put into production during the year; in particular, it includes the cost of materials or fuel consumed. In the case of food manufacturing industries, the cost of materials typically include the cost of agricultural materials, semiprocessed foodstuffs, other ingredients, packaging and containers, fuels and energy, and contract work. *Capital expenditures* represent the total new and used capital expenditures reported by establishments in operation; these are the expenditures related to new and used machinery and equipment as well as permanent additions and major alterations to manufacturing establishments.

This study analyzes the effectiveness of economic performance of food manufacturing industries in the U.S. Pacific Northwest States: Idaho, Oregon, and Washington. The U.S. level ratios for the analyzed industries are also calculated. The analysis is conducted using Economic Census data (geographic series reports) for the years of 1997 and 2002 at a four-digit classification level. All nine food manufacturing industries mentioned earlier are present in the analyzed states; however, a complete set of data needed for the analysis is available for only seven industries, excluding sugar and confectionary product manufacturing and seafood product preparation and packaging. Because of a small number of establishments composing these industries, some of the data are not reported due to confidentiality issues.

Methodology

Ratios

The ratios developed and analyzed in this study are presented in Table 1.[2] Four of the analyzed ratios include value added relative to the value of shipments, number of production workers' hours, capital expenditures, and cost of materials. The fifth ratio is the share of the number of production workers in the total number of employees.

The share of value added in value of shipments characterizes the intensity of value-adding and is preferred to using value added alone to characterize the performance of food manufacturing industries. This study refers to this ratio as the overall effectiveness of production and marketing processes. The ratios of value added to the number of production

[2] For a more convenient interpretation, some of the ratios are multiplied by 100 and are interpreted as percentage shares.

Table 1. Economic Effectiveness Ratios.

Ratio Characterizing the Overall Effectiveness

$$\frac{\text{Value added}}{\text{Value of shipments}} *100$$

The ratio (share) characterizes the overall effectiveness of production and marketing processes.

Ratios Characterizing the Effectiveness of Production Workers Use

$$\frac{\text{Number of production workers}}{\text{Number of employees}} *100 \qquad \frac{\text{Value added}}{\text{Number of production workers hours}} \text{ (\$/hour)}$$

Ratios Characterizing the Effectiveness of Capital and Material Resources Use

$$\frac{\text{Value added}}{\text{Capital expenditures}} \qquad \frac{\text{Value added}}{\text{Cost of materials}}$$

workers' hours, to cost of materials, and to capital expenditures and the share of production workers in the total number of employees characterize how effectively the individual groups of resources are used.

The ratio of value added to the number of production workers' hours and the share of production workers in the total number of employees characterize the effectiveness of the use of production workers (i.e., labor productivity). The ratio of value added to cost of materials characterizes the effectiveness of the use of material resources (i.e., material intensity or material productivity). Similarly, the ratio of value added to capital expenditures characterizes the effectiveness of the use of capital resources (i.e., capital intensity or capital productivity).

There are two approaches to analyzing these ratios: they can be analyzed over time, or across geographic regions with similar food manufacturing industries. If changes in the ratios are analyzed over time, an increase in any of these ratios would be a positive trend characterizing a more effective use of economic resources (production workers, materials, and capital) or a more effective overall economic performance of the industry.

Empirical Model and Hypotheses

A regression analysis is used to explore the relationships among the ratios, in particular,whether the effectiveness of the use of individual groups of resources affects the overall effectiveness. It is hypothesized that the overall effectiveness of economic performance is a function of the effectiveness of the use of individual groups of resources (i.e., production workers, capital, and materials).[3] The analysis of ratios presented in the following section suggests that the industries characterized by larger shares of value added in value of shipments are the industries that have more value added produced per unit of major inputs used, which supports the hypothesis tested.

Therefore the overall effectiveness of economic performance (the share of value added in value of shipments) is the dependent variable and the ratios of the effectiveness of the use of individual groups of resources are the independent variables in the regression model to be estimated. A positive relationship between the overall effectiveness and each of the ratios measuring the effectiveness of the use of individual groups of resources is expected. An increase in the amount of value added produced per unit of labor, capital, and materials is expected to lead to an increase in the share of value added in value of shipments. The model is estimated using standard Ordinary Least Squares (OLS) estimation procedure.

Three effects are controlled by introducing a set of binary (i.e., dummy) variables in the regression model: differences among three states (i.e. Idaho, Oregon, and Washington),[4] differences over time (i.e. between 1997 and 2002),[5] and differences between the consumer-goods industries and producer-goods industries.[6] As discussed earlier, the former industries are characterized by a higher level of value-added intensity; the binary variable is expected to capture this effect.

Results

Ratio Analysis

<u>The share of value added in value of shipments (Table 2):</u> The industries characterized by the largest share of value added in value of shipments (i.e. the most value-added-oriented industries) are bakeries and tortilla manufacturing, other food manufacturing, and fruit and vegetable preserving and specialty food manufacturing. The shares of value added in

[3] To analyze the productivity of the U.S. food manufacturing, Huang (2003) estimated a model where value added was a function of individual groups of inputs used in food manufacturing. This study models the intensity of value added activities (i.e. effectiveness of economic performance) as a function of the intensity (i.e., productivity) of the input use.

[4] The model includes a dummy variable for Idaho and a dummy variable for Washington. Oregon is the omitted category, which is captured in the intercept (constant).

[5] The model includes a dummy variable for 2002; 1997 is the omitted category.

[6] The model includes a dummy variable for consumer-goods industries; producer-goods industries represent the omitted category. The consumer-goods industries are fruit and vegetable preserving and specialty food manufacturing (3114), bakeries and tortilla manufacturing (3118), and other food manufacturing (3119). The producer-goods industries are animal food manufacturing (3111), grain and oilseed milling (3112), dairy product manufacturing (3115), and animal slaughtering and processing (3116).

Table 2. Share of Value Added in Value of Shipments, 2002 (%).

NAICS code	Industry	U.S.	Idaho	Oregon	Washington
311	*Food manufacturing*	*44.4 (14.4)*	*37.1 (2.9)*	*55.8 (27.8)*	*43.1 (10.6)*
3111	Animal food mfg	37.7 (19.2)^{4}	39.7 (55.8)^{4}	43.2^{h} (5.5)^{6}	37.0^{l} (-12.5)^{4}
3112	Grain & oilseed milling	37.4 (22.8)^{5}	25.5^{l} (-15.4)^{6}	51.4^{h} (95.1)^{4}	31.0 (3.7)^{6}
3114	Fruit & vegetable preserving & specialty food mfg	55.2 (10.2)^{3}	54.0 (-3.9)^{3}	63.5^{h} (29.5)^{2}	49.0^{l} (5.8)^{3}
3115	Dairy product mfg	33.7 (12.2)^{6}	27.0^{l} (66.8)^{5}	31.4 (14.6)^{7}	36.0^{h} (47.4)^{5}
3116	Meat product mfg	33.0 (23.7)^{7}	13.0^{l} (2.4)^{7}	44.3^{h} (39.2)^{5}	21.2 (4.2)^{7}
3118	Bakeries & tortilla mfg	65.4 (5.3)^{1}	78.0^{h} (na)^{1}	70.1 (31.7)^{1}	62.1^{l} (12.0)^{1}
3119	Other food mfg	59.2 (10)^{2}	60.0^{h} (na)^{2}	59.6 (6.9)^{3}	56.8^{l} (9.0)^{2}

^{h} Highest share among the three states.
^{l} Lowest share among the three states.
1997–2002 percentage changes are in parentheses.
Numerical superscripts indicate ranking among the food manufacturing industries within the state.
Source: U.S. Census Bureau 1997a, 1997b, 1997c, 1997d, 2002a, 2002b, 2002c, 2002d.

value of shipments characterizing these industries in the analyzed states and U.S. are typically above 50 percent. Therefore approximately 50 percent of the total value of shipments in these industries is contributed by employee payroll, capital expenditures, advertising and promotion expenditures, and profit.

In bakeries and tortilla manufacturing, the share of value added in value of shipments is in the range of 62 percent (Washington) to 78 percent (Idaho) and the U.S. level share is 65 percent. In other food manufacturing, this share is in the range of 57 percent (Washington) to 60 percent (Idaho and Oregon) and the U.S. level share is 59 percent. The share of value added in value of shipments falls in the range of 49 percent (Washington) to 64 percent (Oregon) for fruit and vegetable preserving and specialty food manufacturing; the U.S.-level share is 55 percent.

The smallest shares of value added in value of shipments are in meat product manufacturing, dairy product manufacturing, and grain and oilseed milling. The shares of value added in value of shipments are typically below 50 percent in these industries in the analyzed region and U.S. In meat product manufacturing the share of value added in value of shipments is in the range of 13 percent (Idaho) to 44 percent (Oregon) and the U.S. level share is 33 percent. In dairy product manufacturing this share is in the range of 27 percent (Idaho) to 36 percent (Washington) and the U.S.-level share is 34 percent.

This pattern of results suggests that industries producing goods for final consumption tend to be more value-added-oriented than are industries producing goods to be used as inputs by other industries. Bakery and tortilla manufacturing, other food manufacturing, and fruit and vegetable preserving and specialty food manufacturing are examples of the industries manufacturing consumer goods. Meat product manufacturing and dairy product manufacturing are examples of the industries manufacturing producer goods. Of the seven food manufacturing industries analyzed in Idaho, Oregon, and Washington, four of the industries characterized by the largest share of value added in value of shipments are in Oregon.

The ratio of value added to cost of materials (Table 3): As suggested by the previous literature

Table 3. Ratio of Value Added to Cost of Materials, 2002.

NAICS code	Industry	U.S.	Idaho	Oregon	Washington
311	*Food manufacturing*	*0.8 (25.7)*	*0.6 (4.7)*	*1.2 (60.2)*	*0.8 (18.6)*
3111	Animal food mfg	0.6 (30.2)^{4}	0.7 (96.2)^{4}	0.8^{h} (10.5)^{5}	0.6^{l} (-19.3)^{4}
3112	Grain & oilseed milling	0.6 (35.5)^{4}	0.3^{l} (-24.2)^{6}	1.0^{h} (191.1)^{4}	0.4 (7.3)^{6}
3114	Fruit & vegetable preserving & specialty food mfg	1.2 (22.4)^{3}	1.2 (-6.7)^{3}	1.7^{h} (70.9)^{2}	1.0^{l} (11.5)^{3}
3115	Dairy product mfg	0.5 (18.0)^{5}	0.4^{l} (88.1)^{5}	0.5^{h} (22.3)^{6}	0.5^{h} (55.9)^{5}
3116	Meat product mfg	0.5 (35.2)^{5}	0.1^{l} (5.2)^{7}	0.8^{h} (71.3)^{5}	0.3 (8.0)^{7}
3118	Bakeries & tortilla mfg	1.9 (14.8)^{1}	3.4^{h} (na)^{1}	2.4 (106.2)^{1}	1.7^{l} (32.6)^{1}
3119	Other food mfg	1.5 (25.8)^{2}	1.5^{h} (na)^{2}	1.5^{h} (20.0)^{3}	1.3^{l} (25.7)^{2}

^{h} Highest share among the three states.
^{l} Lowest share among the three states.
1997–2002 percentage changes are in parentheses.
Numerical superscripts indicate ranking among the food manufacturing industries within the state.
Source: U.S. Census Bureau 1997a, 1997b, 1997c, 1997d, 2002a, 2002b, 2002c, 2002d.

(Connor 1998), more value-added-oriented industries—those producing consumer goods—tend to have smaller shares of raw materials in value of shipments compared to industries manufacturing producer goods. A similar pattern is observed in the analyzed sample of food manufacturing industries. The ratio of value added to cost of materials is higher for consumer-goods industries than for producer-goods industries. The industries with the highest ratio of value added to cost of materials are bakeries and tortilla manufacturing, fruit and vegetable preserving and specialty food manufacturing, and other food manufacturing.[7] The value of this ratio is typically higher than 1, which means that the value added to cost of materials is at least the same as or higher than the cost of materials. For example, for fruit and vegetable preserving and specialty food manufacturing, this ratio is in the range of 1 (Washington) to 1.7 (Oregon); the U.S.-level ratio is 1.2.

The industries with the lowest ratios of value added to cost of materials are meat product manufacturing, dairy product manufacturing, and grain and oilseed milling.[8] The value of this ratio is lower than 1 in these industries, which means that the value added to cost of materials is less than the cost of materials. For example, for dairy product manufacturing this ratio is in the range of 0.4 (Idaho) to 0.5 (Oregon and Washington); the U.S.-level ratio is 0.5.

According to the ratio of value added to cost of materials, food manufacturing industries as a group are more effective in Oregon, where six out of seven industries have the highest ratio among the three analyzed states.

The ratio of value added to the number of production workers' hours (Table 4) and the share of the number of production workers in the total number of employees (Table 5): The largest ratios of value added to the number of production workers' hours are associated with the animal food manufacturing, grain and oilseed milling, and dairy product manufacturing industries. These ratios are typically

[7] These industries have the largest shares of value added in value of shipments.

[8] The meat product manufacturing and dairy product manufacturing industries are characterized by the smallest shares of value added in value of shipments.

Table 4. Ratio of Value Added to the Number of Production Workers Hours, 2002 ($/hour).

NAICS code	Industry	U.S.	Idaho	Oregon	Washington
311	*Food manufacturing*	*89.1 (21.7)*	*65.0 (15.7)*	*106.6 (62.3)*	*71.6 (15.0)*
3111	Animal food mfg	164.6 (17.4)[2]	156.1 (159.0)[1]	132.7[l] (-17.1)[4]	163.5[h] (-34.8)[2]
3112	Grain & oilseed milling	201.8 (23.7)[1]	148.2 (18.8)[2]	207.4[h] (107.5)[1]	107.4[l] (2.1)[4]
3114	Fruit & vegetable preserving & specialty food mfg	99.7 (34.9)[5]	62.4[l] (13.4)[6]	97.7[h] (59.5)[6]	63.8 (9.2)[6]
3115	Dairy product mfg	124.3 (26.2)[4]	118.1[l] (80.1)[3]	120.3 (50.9)[5]	170.0[h] (72.2)[1]
3116	Meat product mfg	44.9 (21.9)[7]	25.0[l] (-16.4)[7]	47.0[h] (28.1)[7]	40.0 (-13.7)[7]
3118	Bakeries & tortilla mfg	94.3 (20.0)[6]	99.0[l] (na)[4]	159.3[h] (131.1)[2]	105.0 (43.4)[5]
3119	Other food mfg	150.6 (23.4)[3]	69.1[l] (na)[5]	144.7[h] (1.6)[3]	112.9 (-6.4)[3]

[h] Highest share among the three states.
[l] Lowest share among the three states.
1997–2002 percentage changes are in parentheses.
Numerical superscripts indicate ranking among the food manufacturing industries within the state.
Source: U.S. Census Bureau 1997a, 1997b, 1997c, 1997d, 2002a, 2002b, 2002c, 2002d.

Table 5. Share of Number of Production Workers in the Number of Employees, 2002 (%).

NAICS code	Industry	U.S.	Idaho	Oregon	Washington
311	*Food manufacturing*	*75.7 (-0.2)*	*85.3 (1.3)*	*74.4 (-4.1)*	*78.4 (1.1)*
3111	Animal food mfg	66.2 (2.5)[6]	72.0[h] (7.3)[6]	53.3[l] (-7.3)[7]	60.3 (-1.5)[6]
3112	Grain & oilseed milling	74.2 (-0.4)[3]	82.0 (5.0)[4]	82.8[h] (5.3)[3]	63.0[l] (3.1)[4]
3114	Fruit & vegetable preserving & specialty food mfg	83.0 (-0.9)[2]	90.0[h] (4.2)[1]	85.5[l] (-1.2)[2]	88.4 (-0.1)[1]
3115	Dairy product mfg	67.7 (5.5)[5]	83.0[h] (5.1)[3]	64.3 (5.7)[4]	60.7[l] (-5.0)[5]
3116	Meat product mfg	86.1 (0.6)[1]	87.2 (-1.4)[2]	87.6[h] (7.5)[1]	87.0[l] (3.8)[2]
3118	Bakeries & tortilla mfg	60.2 (-3.0)[7]	49.1[l] (na)[7]	54.5 (-18.1)[6]	55.1[h] (2.6)[7]
3119	Other food mfg	72.2 (-1.7)[4]	77.3[h] (na)[5]	62.2[l] (-8.0)[5]	72.8 (-4.4)[3]

[h] Highest share among the three states.
[l] Lowest share among the three states.
1997–2002 percentage changes are in parentheses.
Numerical superscripts indicate ranking among the food manufacturing industries within the state.
Source: U.S. Census Bureau 1997a, 1997b, 1997c, 1997d, 2002a, 2002b, 2002c, 2002d.

higher than 120, which means that more than $120 is generated per production worker hour in these industries. For example, in animal food manufacturing this ratio is in the range of $133 per hour (Oregon) to $164 per hour (Washington); the U.S.-level ratio is $165 per hour. In grain and oilseed milling, the ratio is in the range of $107 per hour (Washington) to $207 per hour (Oregon); the U.S.-level ratio is $202 per hour.

The lowest ratios of value added to the number of production workers' hours are in meat product manufacturing and fruit and vegetable preserving and specialty food manufacturing. These ratios are lower then $100 per one production worker hour. For example, in meat product manufacturing the ratio is in the range of $25 per hour (Idaho) to $47 per hour (Oregon); the U.S.-level ratio is $45 per hour. In fruit and vegetable preserving and specialty food manufacturing this ratio falls in the range of $62 per hour (Idaho) to $98 per hour (Oregon); the U.S.-level ratio is $100 per hour. If these ratios are compared across the analyzed states, the food manufacturing industries in Oregon seem to be the most effective; in Oregon this ratio is the highest in five out of seven analyzed industries. Idaho has five out of seven industries characterized by the lowest ratios.

The industries with lower ratios of value added to the number of production workers' hours tend to have larger shares of production workers in the total number of employees as compared to the industries with higher ratios of value added to the number of production workers' hours. The share of the number of production workers in the total number of employees is in the range of 80 percent to 90 percent in meat product manufacturing and fruit and vegetable preserving and specialty food manufacturing. This means that employees other than production workers (i.e., management and employees involved in distribution) constitute approximately 10–20 percent of all employees of these establishments.

The lowest shares of the number of production workers in the total number of employees are in bakeries and tortilla manufacturing and animal food manufacturing. For example, in bakeries and tortilla manufacturing the share of the number of production workers in the total number of employees is in the range of 49 percent (Idaho) to 55 percent (Oregon and Washington), while the U.S.-level share is 60 percent. This suggests that approximately 50 percent of all employees in this industry in the analyzed region are those involved in management, marketing, and distribution activities. If the shares of production workers in the total number of employees are compared across the analyzed states, Idaho has four out of seven industries characterized by highest shares.

<u>The ratio of value added to capital expenditures (Table 6):</u> The highest ratios of value added to capital expenditures are in animal food manufacturing and bakeries and tortilla manufacturing. This ratio is typically higher than 30, which means that at least $30 of value added is produced per dollar of capital expenditures. For example, in animal food manufacturing the ratio of value added to capital expenditures is in the range of 25 (Oregon) to 32 (Idaho and Washington), while the U.S.-level ratio is 18. In bakeries and tortilla manufacturing, the ratio falls in the range of 30 (Idaho) to 36 (Washington); the U.S.-level ratio is 23.

The lowest ratios are associated with dairy product manufacturing and other food manufacturing; these ratios are typically lower than 20. For example, in dairy product manufacturing the ratio is in the range of 7 (Idaho) to 13 (Oregon), while the U.S.-level ratio is 13. In other food manufacturing, this ratio ranges from 10 (Idaho) to 18 (Oregon), and the U.S.-level ratio is 24.

In terms of the ratio of value added to capital expenditures, the food manufacturing industries as a group are more effective in Oregon than in Idaho and Washington; five out of seven industries in Oregon have the highest ratios among the three states. The least effective food manufacturing industries are in Idaho, where six out of seven industries are characterized by the lowest ratios, the exception being animal food manufacturing.

<u>Changes in the ratios over time and among the analyzed states:</u> If changes in the ratios are compared over time (between 1997 and 2002), the majority of the ratios of value added to value of shipments, cost of materials, capital expenditures, and the number of production workers' hours increased, which is a positive trend. An increase in the share of value added in the total value of shipments suggests that an industry has become more value-added oriented. An increase in the ratio of value added to cost of materials, the ratio of value added to capital expenditures, or the ratio of value added

Table 6. Ratio of Value Added to Capital Expenditures, 2002.

NAICS code	Industry	U.S.	Idaho	Oregon	Washington
311	*Food manufacturing*	*18.6 (22.7)*	*9.8 (6.9)*	*21.8 (47.7)*	*15.4 (12.0)*
3111	Animal food mfg	18.3 (14.5)[4]	32.4[h] (139.2)[1]	25.4[l] (-37.0)[3]	32.4[h] (52.1)[2]
3112	Grain & oilseed milling	17.2 (69.5)[5]	0.7[l] (na)[7]	27.9[h] (8.2)[2]	19.0 (453.3)[3]
3114	Fruit & vegetable preserving & specialty food mfg	16.2 (14.5)[6]	15.1[l] (49.0)[3]	22.3[h] (38.7)[5]	19.0 (48.8)[3]
3115	Dairy product mfg	12.8 (-2.6)[7]	7.1[l] (105.0)[6]	13.1[h] (60.9)[7]	11.1 (31.9)[6]
3116	Meat product mfg	19.9 (18.7)[3]	13.0[l] (101.1)[4]	25.3[h] (36.2)[4]	18.0 (17.0)[4]
3118	Bakeries & tortilla mfg	23.4 (24.3)[2]	30.3[l] (na)[2]	31.0 (130.0)[1]	36.1[h] (116.8)[1]
3119	Other food mfg	23.7 (31.0)[1]	10.4[l] (na)[5]	17.5[h] (20.7)[6]	16 (-38.2)[5]

[h] Highest share among the three states.
[l] Lowest share among the three states.
1997–2002 percentage changes are in parentheses.
Numerical superscripts indicate ranking among the food manufacturing industries within the state.
Source: U.S. Census Bureau 1997a, 1997b, 1997c, 1997d, 2002a, 2002b, 2002c, 2002d.

to the number of production workers' hours over time indicates that the same industry now produces more value added per one dollar of cost of materials, per dollar of capital expenditures, and per production worker hour. The results on changes over time of the share of the number of production workers in the total number of employees of this share are mixed. Between 1997 and 2002, some industries experienced an increase and some industries experienced a decrease in this share.

The majority of ratios calculated for food manufacturing industries in the analyzed states are of a similar magnitude to the ratios calculated for the U.S. level. However, there is evidence suggesting that food manufacturing industries in Oregon are more value-added oriented than are similar industries considered at the U.S. level. While the share of value added in value of shipments for all food manufacturing industries as a group was 44 percent for the U.S. in 2002, this share for Oregon was 56 percent. Five out of seven analyzed food manufacturing industries in Oregon have the shares of value added in value of shipments that are larger than the U.S.-level shares. The shares of value added in value of shipments are below the U.S. level for three out of seven analyzed industries in Idaho and in Washington.

The differences in ratios between the individual state level and the U.S. level as well as among the analyzed states are explained by several factors. First, the product mix characterizing a particular group of food manufacturing industries is different for each individual state and for the nation as a whole. For example, fruit and vegetable preserving and specialty product manufacturing is likely to have different product mixes in different geographic regions. In some regions it can be more vegetable-processing oriented and in some regions it can be more fruit-processing oriented. The differences in the product mix lead to differences in the level of value of shipments, cost of materials and, therefore, in the level of value added among geographic regions.

Second, differences in the effectiveness of economic performance can explain the observed differences in ratios among the analyzed states and the U.S. level. Food manufacturing industries in some geographic regions are more effective in using resources and generating more value added than are food manufacturing industries in other geographic regions. This study finds that food manufacturing industries in Oregon are more effective than food manufacturing industries in Idaho and Washington, and the factors influencing these differences are explored further.

The descriptive analysis of ratios suggests that the overall effectiveness of economic performance (i.e., the share of value added in value of shipments) is positively related to the effectiveness of the use of individual groups of resources (e.g., production workers, capital, and materials). In particular, food manufacturing industries in Oregon tend to have larger shares of value added in value of shipments and higher ratios of the effectiveness of the use of individual resources compared to the performance of similar industries in Idaho and Washington. The food manufacturing industries in Idaho tend to have smaller shares of value added in value of shipments and lower ratios of the effectiveness of the use of individual groups of resources. This pattern supports the hypothesis tested in this study and provides intuition for the empirical model.

Econometric Analysis Results

The OLS estimation results are presented in Table 7. The estimated model has a high degree of explanatory power. The explanatory variables included in the model explain 95 percent of variation in the dependent variable, the share of value added in value of shipments. All the estimated coefficients have the expected signs and the majority of them are statistically significant. Three of the four ratios included in the model as explanatory variables have a statistically significant effect on the overall effectiveness of economic performance. These are the ratios of value added to the number of production workers' hours, to capital expenditures, and to cost of materials. Therefore there is empirical support to the hypothesis that the overall effectiveness of economic performance is a function of the effectiveness of the use of individual groups of resources.

The estimated coefficient for the ratio of value added to the number of production workers' hours is 0.06. If the value added per one production worker

Table 7. Overall Effectiveness of Economic Performance of Food Manufacturing Industries in the U.S. Pacific Northwest: OLS Estimation Results.

Variable	Expected Sign	Estimated Coefficient	Z-ratio
Production workers/number of employees	+	0.03	0.37
Value added/number of production workers hours	+	0.06*	3.67
Value added/capital expenditures	+	0.15**	1.60
Value added/cost of materials	+	12.29*	5.12
Idaho	?	–4.17*	–2.19
Washington	?	–2.71*	–1.64
Year (2002)	?	1.48	0.97
Consumer-goods industries	+	15.42*	5.70
Constant		15.03*	2.27
R^2 (R^2 adj.)		0.95 (0.94)	

Note: Overall effectiveness is measured as the share of value added in value of shipments (percent).
* indicates statistical significance at a ten-percent significance level using a two-sided Z-test (cut-off value of Z-statistic is |1.64|).
** indicates statistical significance at a ten-percent significance level using a one-sided Z-test (cut-off value of Z-statistic is |1.28|).
Null hypothesis Idaho = Washington fails to be rejected (Z-test p-value = 0.4698).

hour increases by $1, the share of value added in value of shipments increases by 0.06 percent. Alternatively, if the value added produced per one production worker hour increases by $10, the share of value added in value of shipments increases by 0.6 percent. The estimated coefficient for the share of production workers in the total number of employees is 0.03. Although the sign is as expected, the estimated coefficient is not statistically significant. The magnitude of this coefficient indicates that if the share of production workers in the total number of employees increases by one percent, the share of value added in value of shipments increases by 0.03 percent.

The estimated coefficient for the ratio of value added to capital expenditures is 0.15, suggesting that if the value added per dollar of capital expenditures increases by $1, then the share of value added in value of shipments increases by 0.15 percent. The estimated coefficient for the ratio of value added to cost of materials is 12.29. If this ratio increases by 0.5, the share of value added in value of shipments increases by approximately six percent.

The estimated coefficients of the binary variables for Idaho and Washington are negative and are statistically significant. This suggests that the overall effectiveness of economic performance of food manufacturing industries is lower in Idaho and Washington than in Oregon. There is no statistically significant difference in the level of the effectiveness of economic performance of food manufacturing industries in Idaho and Washington.

The estimated coefficient for 2002 is positive but not statistically significant. Although the overall effectiveness of economic performance of the analyzed industries as a group increased between 1997 and 2002, this increase was not statistically significant. As expected, consumer-goods industries tend to have larger shares of value added in value of shipments than do producer-goods industries. The estimated coefficient for a binary variable corresponding to consumer-goods industries is 15.42 and is statistically significant. The share of value added in value of shipments for consumer-goods industries is on average 15 percent larger than the share of value added in value of shipments for producer-goods industries.

Conclusion

The results of the analysis of the effectiveness of economic performance of food manufacturing industries presented in this paper can be used in a number of ways. First, food manufacturing companies with establishments located in the Pacific Northwest region (Idaho, Oregon, and Washington) can compare the economic performance of these establishments with the economic performance of their respective industries at the state, regional, and national level. Furthermore, if a company consists of more than one establishment, it can evaluate the performance of its establishments among each other and relative to the average industry performance.

The reported results are benchmarks with which the individual company's performance should be compared. To conduct this comparison, the company, using the methodology presented in the paper, should calculate similar ratios at the establishments and/or company level. As the Economic Census data are compiled using data reported by the companies, the internal documentation of the companies should have information on the same economic indicators as those reported by the Economic Census. In addition to comparing the company's economic performance with the average industry performance, it can be compared over time to analyze whether the economic performance of the company has improved over time.

The regression analysis results suggest that the overall effectiveness of economic performance is affected by the effectiveness of the use of individual groups of resources (labor, materials, and capital). The major implication of this finding for business decision-making is that by affecting the level of the effectiveness of the use of individual groups of resources it is possible to affect the level of the overall effectiveness of production and marketing activities. In particular, to increase the overall effectiveness of economic performance, food manufacturing companies should increase the effectiveness of the use of production workers, capital, and material resources.

For example, increasing the share of production workers in the total number of employees and producing more value added per production worker hour, per dollar of capital expenditures, and per dollar of cost of materials would lead to an increase in the share of value added in the total value of shipments (i.e., overall effectiveness). To develop a particular set of strategies, a detailed analysis of the use of these resources over time by the same company should be conducted. For example, if a company observes that over time less value added is produced per unit of resources used, then it is likely that there are problems in the effectiveness of the current production and/or marketing activities. The methodology presented in this paper and the benchmark results can help companies evaluate their current position in the industry and, if necessary, modify production and marketing strategies to improve their economic performance and to increase their competitiveness.

The results of a type of analysis presented in the paper are useful to take into account when making decisions on whether to expand existing food manufacturing businesses in a particular geographic area. Also, this information can be used by decision makers considering becoming involved in food manufacturing businesses or considering alternative geographic areas. Finally, the methodology can be extended to provide a more detailed and comprehensive analysis of the economic performance of food manufacturing industries and companies, as information for a more detailed analysis is available. Future studies in this area should focus on analyzing economic performance of food manufacturing industries in other geographic regions and on performance of individual industries.

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