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Determinants of productivity in food industries of Iran

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ABSTRACT

Considering to Importance of Food Industries related to generate employment, more so than many other manufacturing sector and also it's vital role in Iran's economy. This paper examines the determinants of labour productivity in food industries of Iran over the 1995-2006 period. The study applied the Cobb–Douglas production function of industry. The results showed that total factor productivity is 17.8 percent. The determinants like education, skilled, specialist, capital per worker and wages have affected on productivity's differences in Iranian food industries. The most important factor was employee's specialization in this industry.

Introduction

Any product that requires some degree of processing is referred to as a processed product, regardless of whether the amount of processing is minor, such as for canned fruit and snack foods. Processed foods are "value-added" products. This refers to the raw commodity transformed into processed product through the use of materials, labor, and technology. Food processing can be defined as the transformation of agricultural commodities as part of their preparation for human consumption. This definition encompasses relatively simple activities such as cleaning, grading and storage as well as transformation such as milling, canning and freezing.

Moreover, the food manufacturing sector is best understood as one link in the marketing channel between the farmer (or fisherman) and the ultimate consumer. Food processing covers a wide range of products from these sub-sectors – agriculture, horticulture, plantation, animal husbandry and fisheries. Food processing industry is of enormous significance for Iran's development because of the vital linkages and synergies. On the other hand Based on a recent report (2008) from the Statistical Centre of Iran (SCI), this industry is ranked first in terms of employment (18 percent). However, in terms of value-added incentive, it is ranked third (16 percent).

In spite of the importance of this industry, there are several problems with the food industry. Poor management, lack of innovations, high interest rates, inflation, frazzle machinery, specialist shortage, and so on have been the main problems related to the industry (Jamshidi). Majority of these problems affect productivity and efficiency in the industry. Inefficiency and low productivity are the main dilemma of the industry. Table and Figure (1) show labor productivity in food industries in compare to total industries. As it is illustrated in the past decade, labor productivity in food industries was less than labor productivity in average total industries of Iran(Afrooz, Khalid, Zaleha, & Chin, In publishing). Now the main question is why? And what are the main factors affecting labor productivity and how much is the impact of each? Regarding these questions this study attempted to investigate the factors that affect labor productivity in food industries of Iran.

Factors Affecting Productivity and Literature Review

The term productivity has been a key concept for national development strategy due to its impact on economic and social development. Today, the concept is not only known by economists and managers, but by all involved in economic activity. Productivity is a notion that has profound importance in our lives. It can have major effects at the national, industrial and individual levels. The concept productivity can be affected by several factors. The identification and Investigation of these factors have been of great importance to policymakers, enterprises and owners of industries.

There are two types of factors that affect productivity. These are measurable factors and immeasurable factors. Measurable factors can be listed as follows: Ratio of capital to labor, education, training, experience, firm size, gender, type of firm ownership, innovation, information technology, macroeconomics policies, number of firms or companies, foreign investment, trade and competition, energy, demography, labor market unrest, regulation, investment in machinery and equipment, R&D(Khan, 2006; Mahadevan, 2001). The important point is that some factors are uncontrollable by firms, despite being measurable (e.g. macroeconomics policies, innovation, foreign investment, regulation and etc). Immeasurable factors are the factors that can be controlled by firms but not quantifiable such as quality of the workplace, nutrition of workers, management and so forth.

Several studies attempt to establish the macro determinants of total factor productivity (TFP). In particular, these determinants are inflation, foreign direct investment, financial sector depth, private credit, budget deficit, population growth, investment, employment, and government consumption openness of trade. For example;Kohpaiboon(2006) examined technology spillover from foreign direct investment (FDI) based on a cross-industry analysis of Thai manufacturing. Macro determinants of total factor in Pakistan was examined by Khan

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(2006). Liu et al (2001) investigated the impact of foreign direct investment on labor productivity in the Chinese electronics industry. Miller and Upadhyay(2000) studied the effects of openness, trade orientation and human capital on total factor productivity for a pooled sample of developed and developing countries

On the other hand, there have been several studies that focused on micro determinants of productivity especially human capital and R&D. McMahon(1984) considered the relation of education and of scientific and technical knowledge developed through R&D to labor productivity growth within the medium term. Hall and Mairesse(1995) investigated R&D investment of individual French manufacturing firms for the 1980s. Ballot, Fakhfakh et al(2001) studied the effects of human and technological capital on productivity in sample of large French and Swedish firms. They applied Cobb–Douglas function, and used data from two panels of large French and Swedish firms for the same period (1987–1993). Results of the study revealed that training and R&D are significant in the two countries. Stephan and Szalai (2003)assessed the reasons for lower production at the firm level and found that the quality of human capital plays an important role in all three industrial branches assessed. Lorraine, Reed et al.(2006) examined the effects of work-related training on direct measures of productivity. Chang and Oxley (2009) applied Translog production function to analyze the impact of geographic innovation and R&D on total factor production (*TFP*) in Taiwan by using 242 four-digit standard industrial classification (SIC) industries.

Although extensive researches have been carried out on productivity , no single study exists which adequately covers determinants of productivity in industries of Iran. A few studies have been made to determinants of productivity .Most the studies have only focussed on one determinant of productivity ; Mehrara and Mohseni (2004) applied production function to illustrate the impacts of trade on level and growth of productivity in 1983-2000 period. The authors found that export had a positive and significant effect on productivity level. Karimi and Pirasteh (2004) investigated the impacts of exports on industrial goods, experience and skills on labor productivity. The study found a relationship between skill and experience with labor productivity.

Nili and Nafisi (2003) used production function to study the relationship between human capital and economic growth. The study found that human capital had a significant effect on economic growth .Essentially, the results of the study revealed that primary and intermediate education effects was more than other education.

Furthermore, Hosseni and Ghochi (2007) used parametric methods and Kendrik index to account for productivity and investigate the impact of trade on productive growth in the manufacturing sector of Iran .The authors found that trade had an effect on productivity growth. Moreover, the scholars showed that tariff rates have had negative effects on productivity.

However, given the volume of works done in other countries on the concept of productivity, much work still needs to be done within the Iranian context. So far these studies have only been applied to investigate productivity in total industries. On the other hand, lack of research related to productivity in food industry of Iran has existed as a problem for many years. To fill the existing gap discovered within the Iranian context, this paper examines the determinants of productivity in food industry of Iran.

Methodology

As mentioned, there are several factors that affect productivity. Education, experience, training, age and gender affect labor productivity directly. On the other hand, factors such as innovation, investment, R&D, trade, firm size, government policy and inflation affect total productivity. Due to the importance of education, skilled, specialist, research costs, gende and size of food industries this paper applied Miller and Upadhyay (2000), Ballot et al (2001), Sderbom and Teal (2004) , Chang and Oxley (2009), approach to Investigate the above factors that affect productivity. To examine factors determining industry productivity, the study adopted Cobb–Douglas production function of industry as specified below:

$$Y = AK^{\alpha}L^{\beta}e^{\varepsilon} \qquad (1)$$

Where:

Y =represents output (value added), L= number of workers, K= capital stock, A= total factor of productivity (TFP) and e = random disturbance term.

When the above equation is expressed in per capita terms, Eq. 1 becomes:

$$y = Ak^{\alpha}L^{(\alpha+\beta-1)}e^{\varepsilon} \qquad (2)$$

$y = Y/L$ labor productivity, $k = K/L$ capital per Worker, $\alpha + \beta$ -1 return-to-scale assumption. If $\alpha+\beta = 1$ then return to scale in constant.

If assume that $\alpha+\beta = 1$ then we have:

$$y = Ak^{\alpha}e^{\varepsilon} \qquad (3)$$

A represents total factor productivity (TFP) then we have:

$$A = A_0 e^{\theta+\lambda_i(x_i)} \qquad (4)$$

Where: θ is time effects including changes in technology (Ballot et al., 2001), x_i= factors that affect productivity. Replacing Eq.4 in 3 we have:

$$y = A_0 e^{\theta+\lambda_i(x_i)}k^{\alpha}e^{\varepsilon} \qquad (5)$$

After taking natural logarithm from (5) we wrote:

$$\ln y = \ln A_0 + \alpha \ln k + \theta + \lambda_i(x_i) + \varepsilon \qquad (6)$$

ln y is natural logarithm of labor productivity that will be shown with symbol $\bar{y}$, ln$A$ as a constant fix of technology will be shown with symbol (α_0) and lnk is natural logarithm of capital per worker that will be shown with symbol $\bar{k}$, then we can wrote :

$$\bar{y} = \alpha_0 + \alpha_1\bar{k} + \theta + \lambda_1 x_1 + \lambda_2 x_2 + ... + \lambda_m x_m + \varepsilon \qquad (7)$$

Where: $x_1 + x_2 + \cdots + x_m$ are factors that affect productivity.

The level of technology represented by TFP was influenced by the level of human capital, innovation, and research cost .In this study, the empirical approach used by Miller and Upadhyay (2000), Ballot et al (2001), Sderbom and Teal (2004) , Chang and Oxley (2009), was employed.

Data sources

In this study we use twenty-two *4-digit* food manufacturing sub-sectors between 1995 and 2006 according to International Standard Industrial Classification (ISIC) from the *Annual Survey of Manufacturing Industries* published by the Statistical Centre of Iran. The variables were deflated by using price index of each group on the base year 1997 that published by Central Bank of Iran.

Empirical Model and results

Owing to the importance of education, skilled, gender, and capital per worker this study estimated the effect of these

variables on productivity. The empirical model used for the study was written as:

$$y_{it} = \beta_0 + \beta_1 ED_{it} + \beta_2 SK_{it} + \beta_3 SP_{it} + \beta_4 GE_{it} + \beta_5 FS_{it} + \beta_6 K_{it} + \theta_{it} + \varepsilon_{it} \quad (8)$$

Where: i= (1, 2…22) sub-sector of food industry and t =1995-2006

$y_i = (Y_i/L_i)$ value –added per workers . .

ED= ratio of educated workers to uneducated workers.

SK = ratio of skilled workers to unskilled workers.

SP = specialization or ratio of engineers to total workers.

GN = ratio of women workers to men workers.

FS = ratio of number of workers each sub-sector to total number of food industries as proxy for firm size.

k = (K /L) ratio of capital to worker.

ε = error term in ith sub-sector.

θ = is a time effect (Belorgey, Lecat, & Maury, 2006).

After using LM and Hausman tests, the Random effect model was chosen as a proper model. The results of estimation are brought in table (2).

Coefficients of variables show that educated workers, skilled workers, specialization, firm size and capital per worker (K /L) had significant and positive effect on labour productivity. Gender variable (ratio of women workers to men workers) had negative effect on labour productivity.

The specialization (*SP)* of the employees' has the most effect on labor productivity. As the table (2) illustrates the parameter of specialization (*SP)* is 1.80 followed by ratio of skilled workers to unskilled workers.

On the other hand time effect of this model is showed in table (3). The coefficients of time in 1995-2006 periods show the technical changes in the food industries of Iran. The trend of technical changes has a fluctuation during the time period. It shows the progress of technology has not have any effect on labour productivity in food industries of Iran.

Conclusion

In spite of the importance of this industry, there are several problems with the food industry that affect productivity and efficiency. Inefficiency and low productivity are the main dilemma of the industry.

The empirical studies have been illustrated in the past decade; labor productivity in food industries was less than labor productivity in average total industries of Iran. Regarding to this dilemma and importance of food industries this study investigated the factors that affect labor productivity in food industries of Iran.

The empirical results showed that specialization of the employees' has the most effect on labor productivity. As shown the parameter of specialization is 1.80 followed by ratio of skilled workers to unskilled workers. Also, the trend of technical changes has a fluctuation during the time period. It shows the progress of technology has not have any effect on labour productivity in food industries of Iran.

The key point of this result is that more investments in human capital (educated workers, skilled workers) and specialization in food industries may cause a promotion in labour productivity.

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Table 1 : The estimated coefficients of variables

Variables	Coefficient
C	0.826***
LN(K/L)	0.178***
Educated workers	0.0007*
Skilled workers	0.336**
Engineers	1.803***
Firm size	0.053***
Women workers	-0.054**
F-statistic (p-value) = 13.21 (0.000) R-squared = 0.60	

Table (2) Time effect in food industries

	DATEID	Effect
1	1/1/1995	0.026
2	1/1/1996	-0.082
3	1/1/1997	0.046
4	1/1/1998	-0.047
5	1/1/1999	0.028
6	1/1/2000	0.041
7	1/1/2001	0.0002
8	1/1/2002	0.0021
9	1/1/2003	-0.011
10	1/1/2004	-0.034
11	1/1/2005	0.032
12	1/1/2006	0.0007