Human Capital and Labor Productivity in Food Industries of Iran

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Abstract

One of the most important factors that affect labour productivity is human capital. Due to the importance of Food Industries of Iran this paper examines the role of human capital on labour productivity in food industries of Iran over the 1995-2006 period. The study used the ratio of educated workers to total workers and the ratio of skilled workers to total workers as a proxy for human capital and applied the Cobb–Douglas production function of industry. The results showed that educated workers and skilled workers have a significant effect on labour productivity. The measurements of these effects were 0.14 and 0.42 for educated and skilled workers respectively. It can be concluded that education, skills and capital per worker (k=K/L) have a positive and significant effect on labour productivity in food industries of Iran.

Keywords: Labor Productivity, Human Capital, Educated Worker, Skilled Worker, Food Industry

1. Introduction

In the past 40 years, human capital theory (Schultz, 1961; Becker, 1964; Mincer, 1974) has attracted much attention by confirming the causal relationship between education and economic growth. This is because the human capital theory maintains that economic development can be achieved and sustained by an educated and productive workforce. The relationship between human capital and labour productivity has always been the focus in all economy's sectors (agriculture, industry and service) of each country. Regarding the importance of food industries in Iran and its role in Iran's economy, this study investigated the role of human capital on labour productivity in Iranian food industry.

2. Food Industry in Iran

Food industry is widely recognized as a 'sunrise industry' in Iran, with huge potential in the enlistment of the agricultural economy, the creation of large scale processed food manufacturing, the food chain facilities and the generation of employment and export earnings. As a result, this industry is one of the largest industries in Iran. Based on the recent reports (2006) by the Statistical Centre of Iran (SCI), the sector is ranked first in terms of employment (18 percent). Moreover, in terms of value-added, it is ranked third (16 percent).

Furthermore, the development of these industries would increase the demand for agricultural products in food processing and reduce the level of waste**.** The importance equally lies in identifying the strength and the weakness of the food industry in presenting scientific solutions to researchers. It will also assist economic policymakers to reach their program goals quickly. In brief, the importance of food industries is due to three important factors; 1) Priority of the Non-oil Exports in Foreign Trade, 2) Respond to Nutrition of population, and 3) Prevention of Wastage.

In spite of the importance of this industry, there are several problems with the food industry. In The Ministry of Cooperatives report, it has indexed the problems related to the industry which accounted for about 30 cases, among others, poor management, lack of innovations, high interest rates, inflation, frazzle machinery, specialist shortage, etc (Jamshidi, 2004). A majority of these problems affect the productivity and efficiency in the industry. Inefficiency and low productivity are the main dilemmas of the industry. Table and Figure (1) show labour productivity in food industries in comparison to total industries (Afrooz, Khalid, Zaleha, & Chin, 2011). As illustrated in the past decade, labour productivity in food industries was less than the average of labour productivity in total industries of Iran. Now the main question is why? And what are the main factors affecting labour productivity and how much is the impact of each? Regarding these questions this study attempted to investigate the human capital components that affect labour productivity in food industries of Iran.

3. Human capital in Literature

The term "Human Capital Theory" first appeared in the writings of Theodore Schultz

"*I propose to treat education as an investment in man. Since education becomes a part of a person receiving it, I shall refer to it as human capital*" (Schultz, 1960). In this view, an individual's stock of human capital may be

regarded as an asset on which an income or 'return' comparable to rent or interest is earned. In this respect human capital becomes a factor separable from and to an extent substitutable for the other factors in the production function namely undifferentiated labour and physical capital. Human capital theory also suggests that education or training raises the productivity of workers by imparting useful knowledge and skills, hence raising workers' future income by increasing their lifetime earnings (Becker, 1964). Becker (1964) and Mincer (1974) provided explanations that link investment with the training of workers and wages. In particular, the theory draws a crucial distinction between general education and firm-specific training. More skilled or better educated workers can increase their training provided their technical efficiency is increased. Such workers contribute effectively to the acquisition and combination of productive resources that are more receptive to new approaches in production and management.

In the past 20 years there have been several attempts to investigate the role of human capital on labour productivity. McMahon (1984) considered the relation of education and of scientific and technical knowledge developed through R&D with labour 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 a group sample of large French and Swedish firms. They applied the Cobb–Douglas function, and used the data from two panels of large French and Swedish firms for the same period (1987–1993). The 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. 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 (ISIC) industries. The key point with the mentioned studies was that they focused on micro determinants of productivity especially human capital and R&D. Briefly, the literatures showed that human capital and R&D were given more attention than other factors. Moreover the literatures showed that most of the researchers were interested to use parametric approach and utilized production functions. Due to the importance of micro determinants of productivity especially human capital, this study explains the human capital's effect on labor productivity in food industries of Iran.

4. Methodology

As mentioned before, there are several factors that affect productivity. Education, experience, skills, training, age and gender affect the labour productivity directly (Mahadevan, 2002). On the other hand, factors such as innovation, investment, R&D, trade, firm size, government policy and inflation affect total productivity (Khan, 2006). Due to the importance of human capital in food industries productions this paper investigates the effects of human capital on labor productivity. To examine the role of human capital in food industry's productivity, the study adopted Cobb–Douglas production function of industry as specified below:

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

Where:

Y = represents the 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, Eqn (1) becomes:

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

y=Y/L labor productivity, k=K/L capital per Worker, α+β-1 return-to-scale assumption. If α+β=1 then return to scale is constant.

If we assume that α+β=1 then we have:

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

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

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

Where: θ is the time effects including the changes in technology (Ballot et. al., 2001), xi= factors that affect productivity. By replacing Eqn (4) in (3) we have:

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

After taking natural logarithm from (5) we write:

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

ln y is natural logarithm of labour productivity that is shown with the symbol $\bar{y}$, ln A as a constant fix of technology is shown with symbol (α_0) and ln$k$ is natural logarithm of capital per worker that is shown with the symbol $\bar{k}$, and then we have:

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

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

As discussed earlier, the level of technology represented by TFP was influenced by the level of human capital, inflation, firm size, rate of trade, innovation, and research cost and government policy. In this study, the empirical approach used by Ballot et. al. (2001) and Sderbom and Teal (2004) was employed.

5. 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 a price index of each group on the base year 1997 that was published by the Central Bank of Iran.

6. Empirical Model and results

Owing to the importance of education, skill as a proxy for human capital and capital per worker, the study estimated the effect of these variables on labour productivity. The empirical model used for the study is written as:

$$y_{it} = \beta_0 + \beta_1 ED_{it} + \beta_2 SK_{it} + \beta_4 k_{it} + \theta_t + \varepsilon_{it} \quad (8)$$

Where: i= (1, 2…22) sub-sector of food industry and t=1995-2005

$y_i=(Y_i/L_i)$ value –added per worker in $_i$th sub-sector.

ED = ratio of educated workers to uneducated workers in $_i$th sub-sector.

SK = ratio of skilled workers to unskilled workers in $_i$th sub-sector.

k = (K /L) ratio of capital to worker in $_i$th sub-sector.

ε = error term in $_i$th sub-sector.

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

This study used two–way error components of fixed effect model to estimate the equation (8). The results of the estimation are brought in Table (2). Coefficients of variables show that educated workers and skilled workers had significant effect on labour productivity. As Table (2) illustrates the parameter of educated workers is 0.14, which means that when the ratio of educated workers to uneducated workers increases by one unit (1 percent) labor productivity increases by 0.14 units (0.14 percent). The parameter of skilled workers is 0.41, which means that when the ratio of skilled workers to unskilled workers increases by one unit (1 percent) labor productivity increases by 0.41 unit (0.41 percent). Also the comparison coefficients show that skilled workers have more effect on labour productivity in food industries of Iran.

On the other hand the time effect of this model is showed in Table (3). The coefficients of time in 1995-2006 period show the technical changes in the food industries of Iran. In other words, Table (3) shows that the trend of technical changes was in an increasing rate, that experienced a change from -0.1 to +0.11 during that period. In general all results show that, education, skill (as a proxy for human capital) and capital per worker (k=K/L) have a positive and significant effect on labour productivity in food industries of Iran. The key point of this result is that the effects of human capital (educated workers and skilled workers) are more than the effect of the ratio of capital to worker in food industries. Therefore, more investments in human capital in food industries may cause improvement in labour productivity.

7. Conclusion

In conclusion, with regards to the importance of food industries (Priority of the Non-oil Exports in Foreign Trade, Respond to Nutrition of population and Prevention of Wastage) and lack of research related to the examination of factors affecting labour productivity in food industry of Iran, this study investigated the role of human capital (ratio of educated workers to total workers as a proxy for human capital) on labour productivity in food industry of Iran. The empirical results showed that the educated workers and skilled workers have a significant effect on labour productivity. The measurements of this effect were 0.14 and 0.42 for educated and skilled workers respectively. In other words, if the ratio of educated workers increases by one percent, labour productivity increases by 0.14 percent and if the ratio of skilled workers increases by one percent, labour productivity increases by 0.42 percent. The key point of this result is that the effects of human capital (educated workers and skilled workers) are more than the effect of the ratio of capital

to worker in food industries of Iran. Therefore, more investments in human capital in food industries may cause a promotion in labour productivity.

References

Afrooz, A., Khalid, A. R., Zaleha, M. N. & Chin, L. (2011). Total Factor Productivity in Food Industries of Iran. *International Journal of Economics and Finance, 3*(1).

Ballot, G., Fakhfakh, F. & Taymaz, E. (2001). Firms' human capital, R&D and performance: a study on French and Swedish firms. *Labour Economics, 8*(4), 443-462.

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. New York: National Bureau of Economic Research.

Belorgey, N., Lecat, R. & Maury, T.-P. (2006). Determinants of productivity per employee: An empirical estimation using panel data. *Economics Letters, 91*(2), 153-157.

Chang, C.-L. & Oxley, L. (2009). Industrial agglomeration, geographic innovation and total factor productivity: The case of Taiwan. *Mathematics and Computers in Simulation, 79*(9), 2787-2796.

Hall, B. H. & Mairesse, J. (1995). Exploring the relationship between R&D and productivity in French manufacturing firms. *Journal of Econometrics, 65*(1), 263-293.

Jamshidi, H. *Cooperatives in the process of globalization (To increase competitiveness in the economy). Ministry of Cooperatives. 2004*. Retrieved. from.

Khan, S. U. (2006). Macro Determinants of Total Factor Productivity in Pakistan. *SBP Research Bulletin, Volume.2, Number. 2*.

Lorraine, D., Reed, H., & Reenen, J. V. (2006). The Impact of Training on Productivity and Wages: Evidence from British Panel Data. *Oxford Bulletin of Economics and Statistics, 68(4)*.

Mahadevan, R. (2002). *New Currents in Productivity Analysis: Where To Now?* : APO

McMahon, W. W. (1984). The relation of education and R&D to productivity growth. *Economics of Education Review, 3*(4), 299-313.

Mincer, J. (1974). *Schooling, Experience and Earnings*. New York: National Bureau of Economic Research.

Sderbom, M., & Teal, F. (2004). Size and efficiency in African manufacturing firms: evidence from firm-level panel data. *Journal of Development Economics, 73*(1), 369-394.

Schultz, T. W. (1960). Capital formation by education. *Journal of Political Economy 68*, 571–582.

Stephan, J., & Szalai, K. (2003). Firm-Specific Determinants of Productivity Gaps between East and West German Industrial Branches (Publication.: http://ideas.repec.org/p/wpa/wuwpdc/0403002.html

Table (1). labor productivity in food and total industries of Iran

year	Food industry	Total industry
1996	0.315638	0.370592
1997	0.352647	0.428602
1998	0.368705	0.414514
1999	0.379319	0.455628
2000	0.353902	0.49906
2001	0.350024	0.543125
2002	0.405686	0.546085
2003	0.389732	0.622189
2004	0.378778	0.695975
2005	0.440355	0.740551
2006	0.466378	0.891648

Table (2). The estimated coefficients of variables

Variables	Coefficient	Prob.
C	1.070853	0.0000
LN(K/L)	0.121670	0.0531
Educated workers	0.143487	0.0812
Skilled workers	0.416750	0.0259
F-statistic		26
0.000		
R-squared		0.80

Table (3). Time effect in food industries

	DATEID	Effect
1	1/1/1995	-0.100608
2	1/1/1996	-0.053128
3	1/1/1997	-0.014945
4	1/1/1998	-0.075707
5	1/1/1999	-0.022647
6	1/1/2000	-0.026682
7	1/1/2001	0.015609
8	1/1/2002	0.045999
9	1/1/2003	0.025367
10	1/1/2004	0.015951
11	1/1/2005	0.074741
12	1/1/2006	0.116051

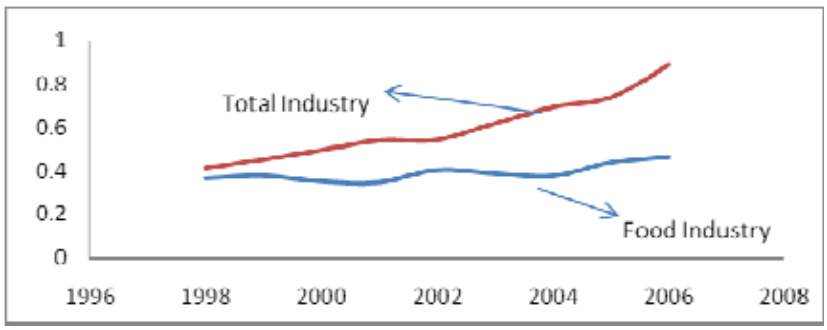

Figure (1). labor productivity in food and total industries of Iran