

Test of Efficiency- Wage Model for Iran's Economy

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Abstract

According to efficiency- wage model, the firms instead of paying the market clearing wages will pay the real wages which enhance the productivity of their workers. In this approach wage is an independent variable which will influence the performance of the firms. On the other hand, one can say that when productivity and efficiency increase the firms will be induced to pay higher wages to their workers. In this study we have investigated the relationship between the wages and the productivity for the period 1984-2004. The results show that the causality is from wages to efficiency and productivity. Among the variables which are expected to have influence on productivity and efficiency, oil revenue is the dominant factor. Real wages also had a positive and significant effect which is consistent with efficiency- wage theory; even though its effect is very small.

Key words: Efficiency wages, Productivity, Efficiency, Shirking.

1- Introduction

There have been different tests on the relationship between wages and productivities. It has been assumed that markets are competitive; thus wages are determined in a competitive labor market, and the firms try to maximize their profits subject to the market wages. Firms have no role in determining the wages and only reacting to them.

On the other hand, in efficiency- wage theories the firms usually set the wage rates which are higher than competitive wages. Hence, as the markets moves away from the competitive conditions it is conceivable that wages have

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influence on efficiency and productivity. In this article we have studied the relationship between wages and productivity based on efficiency wage theories. In part two we survey the wage efficiency models and in part three we test the model for Iran's economy during the period 1984-2004.

2- Efficiency wage theory

For a firm in a competitive labor market, wages are given and it tries to maximize its profit by setting $w=MP_L$ (1). The reaction of the firm when w changes is by hiring or firing the labors accordingly. Efficiency wage theory explains the situation when the firm is not paying the competitive wages. This typical firm sets the wage; and the number of needed labor is determined by (1).

The logic behind efficiency wage model is that the labors effort and thus productivity is a function of the level of wages. That is

$$e=e(w) \tag{2}$$

Where e is labor's effort and we expect that $e' > 0$ and $e'' < 0$.

Solow has developed a model in which the level of production is a function of effective labor. Assuming the capital to be fixed, the production function would be:

$$q = f(e(w)L) \tag{3}$$

where L is the labor input and $e(w)L$ shows the effective labor. Again assuming the output price is equal to 1($P=1$), the firm's profit is

$$\pi = f(e(w)L) - wL \tag{4}$$

The firm's aim is to maximize its profit (π). That would be achieved by following conditions:

$$\frac{\partial \pi}{\partial w} = 0 \qquad \frac{\partial \pi}{\partial L} = 0 \tag{5}$$

It can be shown that the profit is maximized when the offered efficiency wage w^* satisfies two conditions. The first condition is that the elasticity of effort with respect to the wage is unity. This means that the firm should set a wage which will minimize labor costs for efficiency unit of labor. The second

condition for profit maximization is that the firm should hire labor up to the point where its marginal product is equal to the efficiency wage. With the effort curve described by (2), the higher the real wage the greater the effort of workers. Initially there is a region of increasing returns where increases in the real wage elicit a more than proportionate increase in the labor effort. Effort per wage $\frac{e}{w}$ is maximized at a point where the ray from the origin is tangential to the effort function. On the other hand $\frac{e}{w}$ is the inverse of wage costs per efficiency unit $(\frac{w}{e})$.

At w^* the effort elasticity with respect to wage is one, i.e. if efficiency wage increase by one percent, the effort will increase by one percent too. After (before) this point, if the efficiency wage increases by one percent the effort increases by less (more) than one percent. Thus paying higher or lower than W^* which maximizes efficiency is not to the benefit of the firm. Another logical for paying efficiency wages is to prevent shirking. Since the collection of information relating to the productivity of labor and continual monitoring of them is very costly to the firm, the payment of an efficiency wage in excess of the market-clearing wage can act as an incentive which will deter the workers from shirking.

The threat of dismissal is not an effective deterrent in a labor market where workers can quickly find a new Job at the same wage rate. However, if a firm pays a wage in excess of what is available. Else where, or if there is unemployment, workers have an incentive not to shirk. Shapiro and Stiglitz 1984 have developed a model in which the payment of an efficiency wage acts as a disincentive to shirking. But as Shapiro and Stiglitz note, if it pays one firm to raise its wage it will pay all firms to raise their wages.

3- Wages and Productivity in Iran

Different factors are expected to influence productivity and efficiency. Some of them are economic factors and we believe that social and cultural factors are very important as well. However in this study we have concentrated on the relationship between wages and productivity and efficiency. In doing so,

first we get an estimate of productivity and efficiency and then we look at the causality between wages and productivity and efficiencies.

3-1- Estimation of Productivity and efficiency

In order to estimate the productivity we use the Cobb-Doglas production function for the period under investigation:

$$\begin{aligned} \ln(y) = & -6.029 + 0.331\ln(k) + 0.845\ln(L) + 0.4108D & (6) \\ & (-5.0) \quad (2.3) \quad (6.4) \quad (6.6) \\ \bar{R}^2 = & 0.89 \end{aligned}$$

Where \ln is the natural log, Y is G D P calculated on the base of constant prices of 1997, L is level of employment and K is the capital stock again calculated at 1997 prices. Thus the growth of total factor productivity would be:

$$\dot{TFP} = \dot{Y} - 0.331\dot{K} - 0.845\dot{L} \quad (7)$$

In order to estimate the efficiency index we have used the K.J. Sengupta's model (1990); Efficiency index in year t is equal to the ratio of real output (Y_t) to the efficient output (Y_t^*). Efficient output is the maximum output which can be produced with the available inputs. In order to find the efficient output we define the following LP model:

$$\begin{aligned} \text{Min } & \alpha L_i + \beta K_i \\ \text{S.t. } & \alpha L_i + \beta K_i \geq Y_i & i=1, 2, \dots, n & (8) \\ & \alpha, \beta \geq 0 \end{aligned}$$

By solving (8) for each of years $t=1, \dots, n$ we can find Y_t^* . The result is shown in Fig.1 in which \dot{TFP} is rate of growth of total factor productivity and \dot{TE} the rate of growth of efficiency. As can be seen from Fig 1, rate of growth of TFP and TE are very much close to each other; even though they have been calculated on two different techniques.

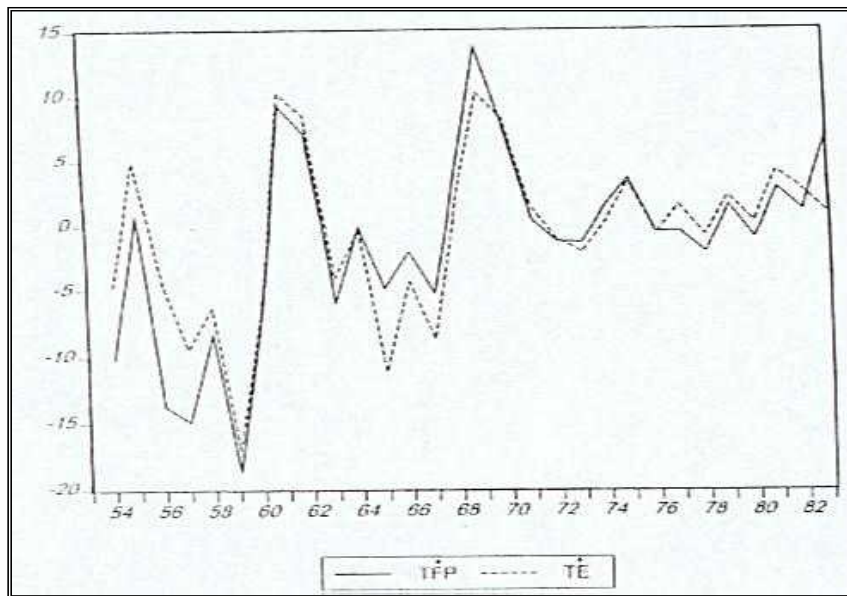


Fig1: The Growth of total Factor Productivity (TFP) and Efficiency (TE)

3-2- Causality Test

As it was explained in section2, efficiency wage theory emphasizes that firms can use the wages to enhance the workers' effort and prevent their shirking. Thus, one expects that productivity and efficiency be influenced by the wages. On the other hand, we expect that when productivity and efficiency increases the firms will be induced to pay higher wages to their workers.

In this section we are using the Granger test to find the causality between productivity and wages. As can be seen from table1, the causality goes from wages to productivity, and hence it is consistent with the efficiency wage model.

Table 1: The causality test between growth of productivity, efficiency and Wages

Hypothesis	F	Probability	Results
1) growth rate of TFP is not the cause of growth rate of wages	0.77	0.48	not rejected
2) growth rate of wages is not the cause of growth rate of TFP	7.44	0.003	rejected
1) efficiency growth is not the cause of growth of wages	0.31	0.74	not rejected
2) growth rate of wages is not the cause of efficiency growth	3.56	0.04	rejected

3-3- Estimating the effects of wages on productivity and efficiency

In order to see the effects of wages on productivity and efficiency we have estimated some equations, in which other factors such as variation in oil revenues, level of education of labor force, government employees and social environment are also included. We expect that the oil revenue which is the main source of economic activities in Iran's economy have major impact on productivity and efficiency. The level of education of labor force is estimated by the years of education of the employed workers. Since the government has the dominant role in Iran's economy, government's employee could be an important factor in determining productivity. Social factor in developing economies usually are important factors determining productivity and efficiency. While human capital indicates personal characteristics, social factors explain the environment in which factors of production are used. There are a long list which enters the social factors, among them we can find, respecting the law, respecting others, confidence between citizens, Lack of these factors, would increase crimes and transaction costs in an economy. For our study we have used the number of per capita cases investigated in the counts.

$$d \log(TFP) = -0.0023 - 0.0625DOILL + 0.0721DOILU + 0.304dLog(W)$$

(-0.1)
(-2.3)
(2.7)
(1.96)

$$- 0.527d \log(EDU) + 0.105d \log(CR) + 0.0146d \log(NG) + 0.223d \log(TFP_{-1}) \quad (9)$$

(-0.9)
(0.5)
(0.2)
(1.7)

$$R^2 = 0.727 \quad DW = 1.81 \quad F = 6.8$$

$$dLog(TE) = 0.0043 - 0.062DOILL + 0.059DOILU + 0.324dLog(w) \quad (10)$$

(0.2)
(-2.8)
(2.6)
(2.4)

$$- 0.509Log(EDU) + 0.073dLog(CR) + 0.018dLog(NG) + 0.297dLog(TE)$$

(-1.0)
(0.4)
(0.3)
(2.5)

$$R^2 = 0.778 \quad DW = 1.7 \quad F = 9.03$$

The factors in equation (9) and (10) are:

TFP, total factor productivity; TE efficiency index; DOILL a dummy for those years in which the reduction in oil revenues were more than 10 percent; DOILU a dummy variable for those years in which the increase in oil revenues were more than 10 percent ; w average wages with 1997 prices ; EDU human capital measured with the years of education for employed workers ; CR the number of per capita cases investigated in the courts ; NG number of government employees .

Equation (9) and (10) show that in explaining the productivity and efficiency oil revenues and wages are two major factors which have had the dominant role. Since oil sector is the main source of providing hard currencies for the country, we expect that its variations have major impact on productivity and efficiency. Imports of raw material and intermediate goods are very much dependent on the oil revenues, thus as more hard currencies become available from this sector, the factories can utilize more of their production capacities. In turn productivity and efficiency are very much dependent on the use of capacity

by the firms. The correlation coefficient between use of capacity (measured by the ratio of output to capital) and oil revenues is equal to 0.936. On the other hand the correlation coefficient between capacity use and productivity and efficiency are 0.910 and 0.896 respectively.

Another important variable which had a positive meaningful sign on productivity and efficiency is the level of wages. This finding is consistent with the causality test, which shows the direction from wages to productivity and efficiency; and also with the efficiency wage theories. If the productivity equation is regressed in logarithmic form, the coefficient of wage is equal to 0.324. This figure shows the elasticity of total factor productivity with respect to wage. Hence, although the wages have had positive and meaningful effect on productivity its effectiveness were relatively small.

4- Summary and conclusion

Efficiency wage theories explaining the situation where the firms and manufacturing sector are not paying the market wage to their workers, rather they are paying the wages which maximizes their profit. In doing so, they can influence their workers by increasing their efforts and preventing the shirking. Thus, according to these theories, wages act as a variable which can enhance the performance of the firms, i.e. productivity and efficiency. Our study shows that causality goes from wages to productivity and efficiency. Also the estimated regressions show that among the explanatory variables only oil revenues and wages had a meaningful effect on productivity and efficiency. Finally, the effect of wage variable on productivity and efficiency is relatively small.

References

- 1- Bulow, J. and L. Summers (1986), A Theory of Dual Labor Markets with Application to Industrial Policy, Discrimination and Keynesian Unemployment, *Journal of Labor Economics*, Vol. 4, No. 3, PP. 376-414.
- 2- Central Bank of I.R. Iran, National accounts, years 1959-2004
- 3- Dickens, W. (1986), Wages, Employment and the Threat of Collective Action by Workers NBER Working Paper No. 1856.

4-Dunlop, J.(1985), The task of Contemporary Wage Theory, in J. Dunlop(ed.) The Theory of Wage Determination, London : Macmillan.

5- Iran Statistical Center, Annual Statistics, different years

6- Jones, S.R.G. (1985), Dual Labor Markets, Productivity and Unemployment, Mimeo, University of British Columbia, April.

7- Nily, M. and Nafisi, S.(2005);" Estimation of human capital based On average years of education of labor force of Iran "; Journal of Economic Research, No. 25

8- Shapiro, C. and J. Stiglitz (1984), Equilibrium Unemployment as a Worker Discipline Device, American Economic Review, June, Vol. 74, pp. 433-44

9- Senupta, J.K, “ Estimation of efficiency with multiple outputs “; Journal of Quantitative Economics , Vol.6 No.1 Jan. 1990 PP.85-103.

10- Solow, R. (1979), Another Possible Source of Wage Stickness, Journal of Macroeconomics, Vol.1, No. 1, Winter, 79-82.