An investigation on the effect of technology on total factor productivity improvement of insurance firms

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CHRONICLE	ABSTRACT
	This paper presents an empirical investigation to study the impact of the implementations of the recent advances on technology on total factor productivity improvement (TFP) of some Iranian insurance firms over the period 2008-2012. The study considers the number of information and communication technology (ICT) employees, insurance treaty and the number of computers used together with online users as technology advancement. Using generalized least square technique, the study has determined a positive and meaningful impact of the number of research and development employees as well as the number of personal computers together with online users on TFP improvement. However, the numbers of ICT employees and insurance treaty have no significant impact on TFP improvement.

1. Introduction

During the past few years, there have been tremendous changes on business organizations and there have been many giant organizations, which are solely built based on the magic of information and communication technology (Daly et al., 1985; Falk, 2005; Chambers & Davies, 2001). Google, for instance, started its model in 1999 with only one million dollars but in less than 10 years, it became one of the biggest firms in terms of capital (Atzeni & Carboni, 2006). Traditional business models such as banks, insurance firms, etc. have also tried to use the idea of information and communication technology to expand their businesses (Van Ark et al., 2003). There are also various studies on learning the effects of information and communication technology (ICT) on total factor productivity. Colombo et al. (2013) investigated the effect of the adoption of broadband Internet technology on the productivity performance of small and medium enterprises (SMEs). They reported that the effect of the adoption by SMEs of basic broadband applications was negligible (or even negative). Conversely,

SMEs were detected to benefit from adopting selected advanced broadband applications depending on various contingent factors.

Hollenstein (2004) tried to explain timing and intensity of a firm's adoption of ICT using a large sample of firms. The analysis was based on the rank and the epidemic framework of technology adoption. The explanatory variables included various dimensions of anticipated advantages from and expenses of technology adoption, what provides to capture the effect of uncertainty and adjustment costs. They described the role of "New Workplace Organization" as a determinant of the adoption of ICT, as well as the reverse relationship. Jalava and Pohjola (2007) analyzed the effects of ICT on output and labor productivity growth in Finland over the period 1995–2005. They reported that ICT could be accounted for 1.87 percentage points of the observed labor productivity growth at the average rate of 2.87 per cent.

Neirotti and Paolucci (2007) investigated the insurance industry in the US and Europe through case studies and an analysis of 30 Italian insurance companies. Twenty case studies executed between 1998 and 2003 helped us conclude that technological and business path dependencies, along with time compression diseconomies, could result in diversities in IT adoption dynamics because of their differences in IT governance and management practice. The analysis also indicated that most of the insurance companies increased their productivity through IT regardless of their IT management capabilities. They also explained that competitive advantages were not associated with IT spending levels as well as with the type of IT investments that made general productivity growth in the industry possible.

2. The proposed study

This paper presents an empirical investigation to study the impact of the implementations of the recent advances on technology on productivity improvement of some Iranian insurance firms over the period 2008-2012.
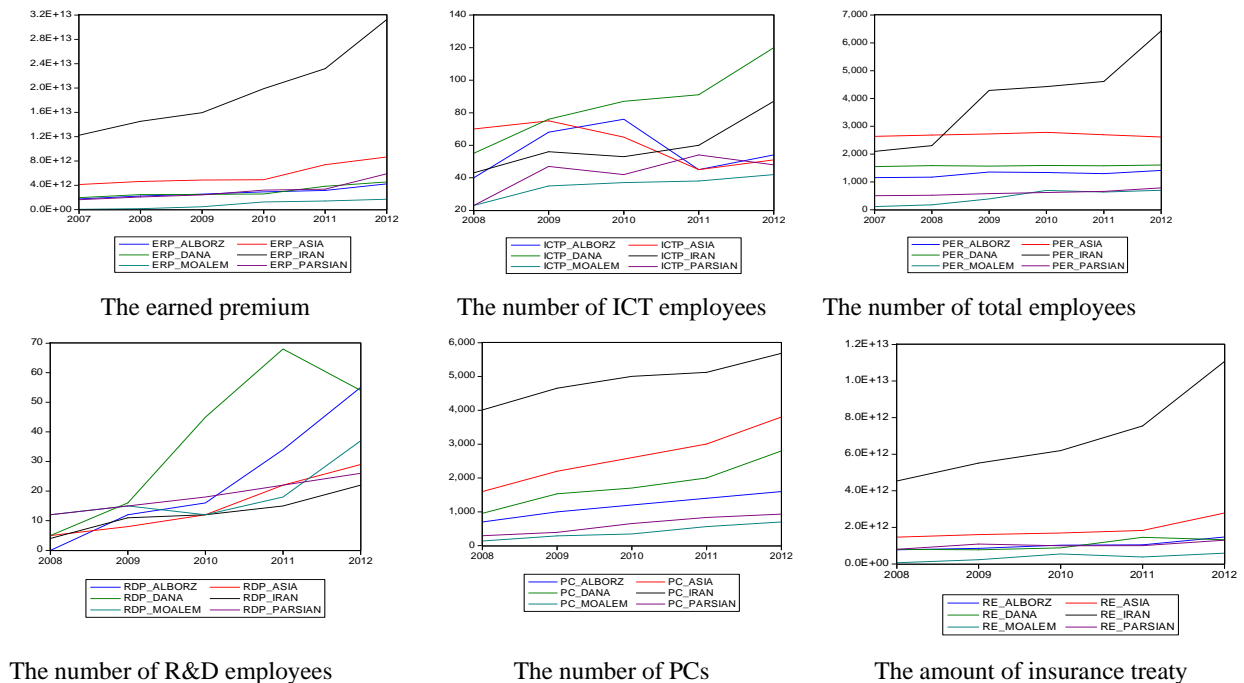
Fig. 1. The trend of some basic statistics for six Iranian selected insurance firms

As we can observe from the results of Fig. 1, there is an increasing trend on the number of employees who were hired in this industry over the period 2008-2012.

The study considers the number of information and communication technology (ICT) employees, insurance treaty and the number of computers used for online users as technology advancement. The study uses Cobb-Douglas method to measure the productivity using the following regression analysis,

$$Y = A\,L^{\alpha}\,K^{\beta} \tag{1}$$

where L and K represent labor, capital, respectively. In addition, Y demonstrates value added and A, α and β are coefficients, which are estimated using regression analysis. The proposed study uses the following form of Cobb-Douglas function,

$$ERP_{it} = A_i * INLOS_{it}^{\alpha} * PER_{it}^{\beta} * BRA_{it}^{\gamma} * AGE_{it}^{\lambda} \tag{2}$$

Taking the natural logarithm on Eq. (2) yields,

$$LERP_{it} = \alpha LINLOS_{it} + \beta LPER_{it} + \gamma LBRA_{it} + \lambda LAGE_{it} + \varepsilon_{it} \tag{3}$$

where *ERP* represents earned premium of insurance, *INLOS* is incoming losses, *PER,* stands for the number employees, *BRA* states the number of branches and finally, *AGE* shows total number of agents. In order to find out whether we have to use fixed effect or random effect as well as learning Pooled Least Squares we use F-test, which is equal to F= 7.6032 with P-value = 0.0002. Therefore, we use fixed effect for the proposed study of this paper. We have also used Hausman Test and the Chi-Square value is equal to 33.950 with P-value = 0.000. In addition, the study uses Generalize Least Square(GLS) instead of Pooled least square technique.

We present details of our findings by applying GLS technique on two regression models. The results of the first mode is as follows,

Table 1
The summary of regression analysis of LERP as a function of LINLOS, LPER, LAGE and LBRA

Variable	Coefficient	t-value	P-value
C	13.98	13.075	0.000
LINLOS	0.199	2.97	0.0064
LPER	0.8108	4.22	0.0003
LAGE	0.261	1.926	0.0651
LBRA	0.387	2.58	0.0158

$R^2 = 0.987$ $\overline{R^2} = 0.983$ D.W = 1.398

According to the results of Table 1, we may summarize the results in Eq. (2) as follows,

$$LERP = 13.98 + 0.199 LINLOS + 0.810 LPER + 0.261 LAGE + 0.387 LBRA \tag{2}$$

Based on the results of Table 1, we can understand that employees influence on earning premium more than other variables do. In addition, the number of branches is the second most efficient factors on ERP. We now present details of our findings on total factor productivity (TFP) in Eq. (3) as follows,

$$\text{TFP} = \beta_0 + \beta_1 LICTP_{it} + \beta_2 LRDP_{it} + \beta_3 LRE_{it} + \beta_4 LOG(PC_{it} * ONLIN_{it}) + U_{it} \tag{3}$$

where *LICTP* represents natural logarithm of the number of ICT employees, *LRDP* demonstrates the amount of investment on research and development, *LRE* represents the logarithm of the amount of insurance treaty, *PC* represents the number of personal computer and *ONLIN* states the number of online users. Similarly, In order to find out whether we have to use fixed effect or random effect as well as learning Pooled Least Squares we use F-test, which is equal to F= 1.552 with P-value = 0.221. Therefore, we have used fixed effect for the proposed study of this paper. Table 2 shows the summary of regression analysis on Eq. (3) as follows,

Table 2
The summary of regression analysis of LERP as a function of LINLOS, LPER, LAGE and LBRA

Variable	Coefficient	t-value	P-value
C	1.167	2.413	0.0238
LICTP	-0.278	-4.821	0.0001
LRDP	0.1006	3.668	0.0012
LRE	-0.044	-2.425	0.0232
LOG(PC×ONLIN)	0.101	3.928	0.0006

$R^2 = 0.656$ $\overline{R^2} = 0.599$ D.W $= 2.018$

According to the results of Table 2, the number of online users together with number of personal computers has the highest impact on total factor productivity followed by the amount of research and development spent on development of business units. In addition, all statistical observations such as t-student values and Durbin-Watson value are within acceptable limits. The result of R-Square indicates that the independent variables could approximately describe 60% of the changes on TFP.

3. Conclusion

During the last few years, there have been tremendous changes on development of technology and most organizations take advantage of the recent advances on information technology, personal computers, etc. to increase the productivity of their organizations. In this survey, we have presented an empirical investigation to examine the effects of different factors on productively improvement in insurance firms. The results of our studies have confirmed that the number of online users together with the number of personal computers has the highest impact on total factor productivity followed by the amount of research and development spent on development of business units.

Acknowledgement

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