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An Investigation into the Effective Factors on the Intention to Commercialization of Knowledge in a University: A Case Study

Ali Biranvand
Payame Noor University, Iran, biranvand@gmail.com

Mohammad Hassan Seif
Payame Noor University, Iran, hassanseif@gmail.com

Soheila Safa
Payame Noor University, Iran, Ssafa7076@yahoo.com

Saeid Mazloumian
Payame Noor University, Iran, s.mazloumian@pnu.ac.ir

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Mohammad Hassan Seif

Associate Professor, Department of Educational Sciences, Payame Noor University, Iran.
hassanseif@gmail.com

Ali Biranvand,

Assistant Professor, Department of Knowledge and Information Science, Payame Noor University, Iran.
biranvand@gmail.com

Soheila Safa

M.A. Department of Educational Sciences, Payame Noor University, Iran.
Ssafa7076@yahoo.com

Saeid Mazloumian

Assistant Professor, Department of Educational Sciences, Payame Noor University, Iran
s.mazloumian@pnu.ac.ir

Abstract

The purpose of this study was to provide a causal model for factors affecting the commercialization of academic research. This study is an applied research in terms of purpose and a descriptive study of correlation type in terms of method. The statistical population consists of 499 graduate students at Engineering School of Shiraz University. The data gathering tool was a questionnaire. Cronbach's alpha coefficient was used to assess its reliability. In this research, the effect of following variables on attitude to commercialization of Knowledge (ACK) of knowledge is investigated: psychological empowerment (PE), self-efficacy, university policy (UP), social capital (SC), and perceived behavioral al control. The results of this study, based on the obtained correlation coefficients, show that the intention to commercialization of Knowledge (ICK) has a separate and significant relation with PE, perceived behavioral control (PBC) and ACK at the level of 0.01 and with the SC variable at the level of 0.05. Furthermore, the ICK has no significant relationship with self-efficacy and UP.

Keywords: Commercialization, Knowledge Commercialization, Intention to Commercialization of Knowledge, Attitude Commercialization of Knowledge, Shiraz University. Iran.

Introduction

Commercialization is one of the key steps in the process of economic and social development of societies, which makes research and inventions turn into marketable products. Today, universities and education departments play a role in the economic development of societies. Commercialization of the knowledge is considered to be the third mission of universities; the idea holds that universities have a general socioeconomic role and a public responsibility to carry out, especially in their local areas and to their local stakeholders(Arbo, 2007; Jongbloed, Enders, & Salerno, 2008). Furthermore, (Etzkowitz, Webster, Gebhardt, & Terra, 2000; Nelles & Vorley, 2010)), emphasizing the need for knowledge commercialization, argue that commercialization activities are important mechanisms by which universities directly influence national and regional economic development.

The need to pay attention to the commercialization of knowledge in universities and to identify the factors influencing it for strategic planning in universities has become an undeniable principle today, which leads to a shift in the role of universities from knowledge producers to producers of capital from knowledge. This role shift takes place with the aim of improving the performance of the national or regional economy as well as generating financial benefits to the university and its staff, and leads to an increase in commercialization-related activities in the last two decades (Etzkowitz et al., 2000). Today, universities are struggling to communicate with the industry and the market, so that they can pave the way for development in addition to providing for their needs. Universities produce fundamentally new knowledge that, in time, becomes a key foundation for new technologies that improve productivity, promote economic growth, create jobs and wealth, and enhance a society's quality of life (Arora, Belenzon, & Patacconi, 2018; Pisano, 2010; Zahra, Kaul, & Bolívar-Ramos, 2018).

Science and the key managerial challenges surrounding its commercialization. As a result, the literature on corporate science commercialization is sparse and fragmented, especially when compared with work on academic entrepreneurship and university technology commercialization (Link, Siegel, & Wright, 2015; Shane, 2004; Siegle & Wright, 2015; Wright, 2007). This suggests an opportunity for greater dialogue between these two areas of research (Zahra et al., 2018). In order to have a scientific and economic development, it is necessary to, along with making proper plans, identify the factors influencing the process of knowledge commercialization in universities and to eliminate obstacles.

Lack of an understanding of the factors affecting the commercialization of academic research in different sectors will impose considerable costs and lost time to the community. By identifying the factors influencing the commercialization of academic research, the complexity of this process is reduced and its success rate increases, meanwhile students, faculty members and other researchers can identify the right path for their research. Therefore, the present study seeks to understand and identify the factors affecting the commercialization of knowledge in universities.

Considering the importance and place of universities and scientific centers in addressing the needs of society and moving towards capital production from the knowledge generated in these centers, it is necessary to introduce a model fitting the structural, environmental and human conditions of these centers for commercialization of knowledge. Accordingly, in this research, we use a path analysis model in a case study of the students at Engineering School of Shiraz University to investigate the effect of PE, UP, self-efficacy and SC on PBC, ACK and ICK of knowledge. Due to the fact that the technical and engineering fields of study provide a suitable platform for capital production from the commercialization of academic research, the Engineering Schools of Shiraz University are studied. In this regard, and considering the literature, the conceptual model of the research is presented in Fig 1. This model examines the effect of the variables of PE, UP, self-efficacy, and SC on PBC, ACK and ICK.
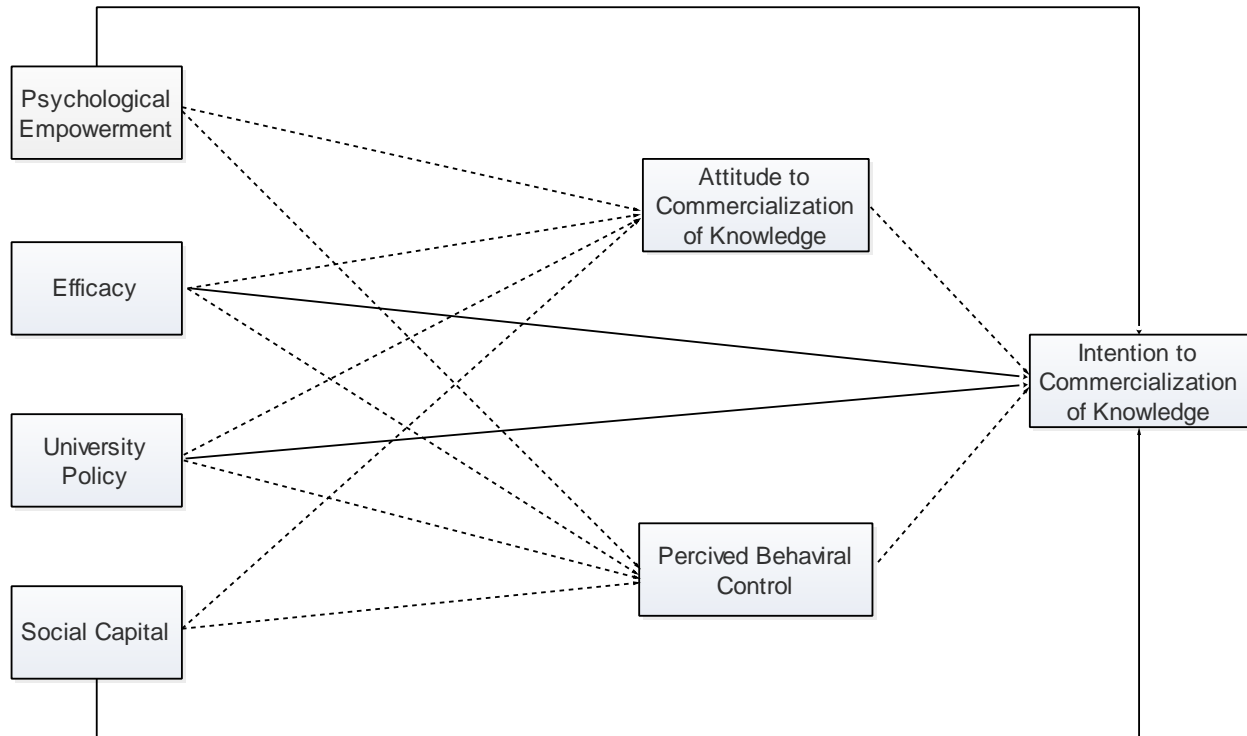
Fig1: Conceptual model of research

Research Objectives

The major purpose of the research

The major objective of the research is to investigate the factors affecting knowledge commercialization at Engineering Schools of Shiraz University (ESSU).

The minor purposes of the research

- Investigating the direct and indirect effects of PE on the ICK at ESSU.
- Investigating the direct and indirect effects of self-efficacy on the ICK at ESSU.
- Investigating the direct and indirect effects of UP on the ICK at ESSU.
- Investigating the direct and indirect effects of SC on the ICK at ESSU.
- Investigating the effect of PBC on the ICK of ESSU
- Investigating the effect of ACK on the ICK at ESSU.

Research Hypotheses

- PE has a direct effect on the ICK.
- PE has an indirect effect on the IC through the PBC.
- PE has an indirect effect on the ICK through ACK.
- Self-efficacy has a direct effect on the ICK.
- Self-efficacy has an indirect effect on the ICK through the PBC.
- Self-efficacy has an indirect effect on the ICK through ACK.
- UP has a direct effect on the ICK.

- UP has an indirect effect on the ICK through PBC.
- UP has an indirect effect on the ICK through ACK.
- SC has a direct effect on the ICK.
- SC has an indirect effect on the ICK through the PBC.
- SC has an indirect effect on the ICK through ACK.

Research Method

This research is an applied study in terms of the purpose, a library study in terms of the method of literature review, and a field study in terms of the method of collecting data for confirming or rejecting research hypotheses. Due to the fact that the present research investigates the effective factors and their effect on the ICK of knowledge, the descriptive-survey method is used in this research. The approach of this research is quantitative. The statistical population of the study includes all graduate and Ph.D. students at ESSU. 153 out of 499 Ph.D. and graduate students of Engineering School were selected by availability sampling method. A questionnaire was used to collect information and quantitative data. The data were analyzed using SPSS and LISREL.

Findings

Calculation of the correlation coefficient between the research variables shows that the relationships defined in the conceptual model of the research have changed and need to be fundamentally modified. The correlation coefficient between the variables is presented in Table 1.

**Table1:** The Correlation Coefficient of the Research Variables

Variables	Mean	SD	Correlation Coefficient						
			PE	SE	UP	SC	PBC	ACK	ICK
PE	54.92	7.36	1						
SE	46.79	6.57	-0.07	1					
UP	36.95	7.29	0.27**	0.14	1				
SC	64.03	13.08	0.28**	0.07	0.56**	1			
PBC	11.20	2.32	0.37**	-0.10	0.10	0.22**	1		
ACK	26.86	3.72	0.23**	0.04	0.15	0.11	0.52**	1	
ICK	28.95	6.26	0.34**	-0.01	0.10	0.20*	0.70**	0.37**	1

*: significant at 0.05   **: significant at 0.01

Before discussing the relationships between variables, we must evaluate the consistency of the conceptual model and the data collected. To do this, we first fit the conceptual model into data through a path analysis method. The results of this fitting are given in Table 3 and Fig 2. T-values that are greater than 1.96 or smaller than -1.96 represent significance of the relationships between variables. As you can see, the relationships of the UP with PBC, the ACK and the ICK are not significant. This is important in providing a modified conceptual model.

Table2: Regression Coefficients and T Coefficients Related to the Research Variables**.**

Independent variable	Dependent variable	Regression	Standardized regression	Coefficients T
PE	Intention to Commercialization of Knowledge	0.08	0.09	1.36
SE		0.05	0.06	0.93
UP		-0.02	-0.02	0.31
SC		0.02	0.08	0.51
PBC		1.82	0.67	10.66*
ACK		-0.01	-0.01	-0.09
PE	Perceived Behavioral Control	-0.11	0.24	4/26*
SE		-0.03	-0.07	-0.97
UP		-0.02	0.09	-0.83
SC		0.03	0.17	1.89
PE	Attitude to Commercialization of Knowledge	0.11	0.34	4.26*
SE		-0.03	-0.07	-0.97
UP		-0.02	-0.08	-0.83
SC		0.03	0.17	1.89
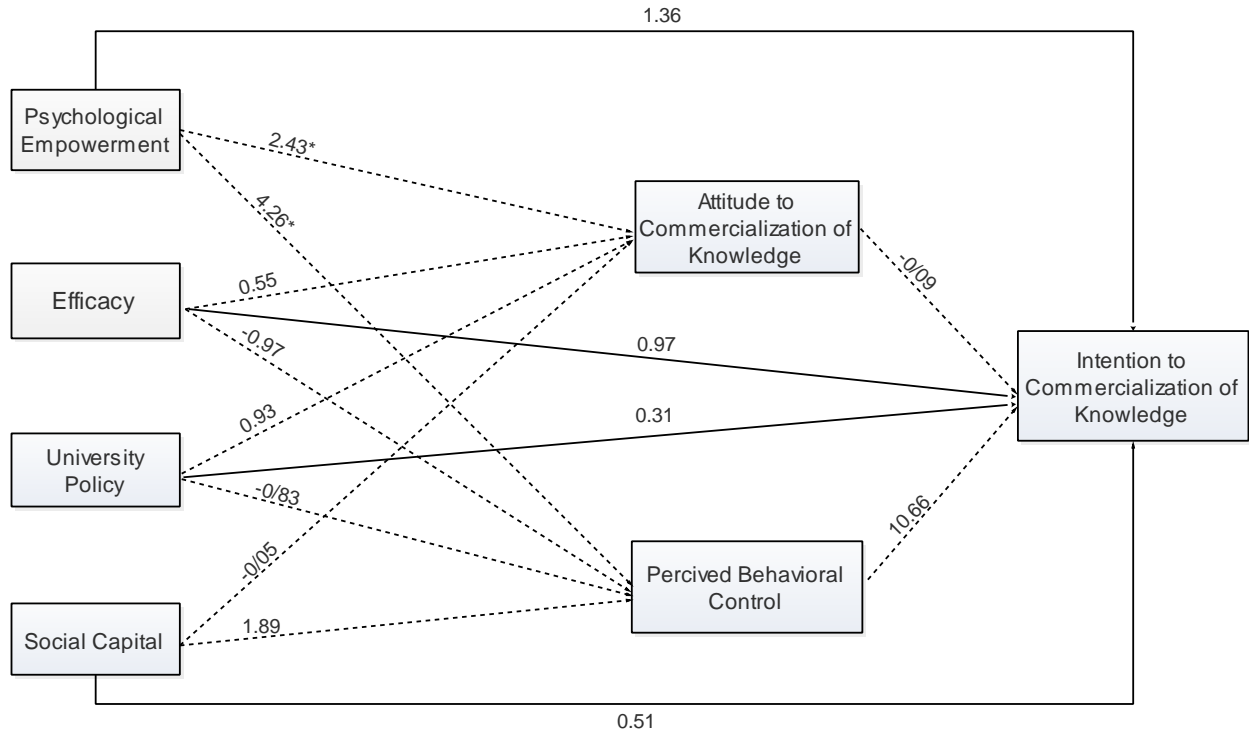
**Fig2**: The Coefficients of the Effect of Variables on the IC in the Conceptual Model of the Research

Considering that some model fit indicators such as the ratio of chi-square of degree of freedom and root mean square error of approximation are not in acceptable range, the fitted model needs to be modified. Therefore, some of the hypotheses based on which the model is formed do not match the data, and thus, some changes are needed to be made in the hypotheses to achieve a modified conceptual model consistent with the data. This can be due to the high correlation of UP with SC, as well as the high correlation of the PBC with the ACK, which is mentioned in the descriptive statistics section.

So considering: 1) the strong correlation of UP with SC, 2) the significant correlation of UP with self-efficacy and PE, 3) the lack of significant relationship of UP with variables of PBC, intentions to commercialization and ACK, 4) the strong correlation of perceived behavior control and ACK, in addition to the suggestions made by the software, modifications are proposed to be made in the conceptual model. By making the necessary changes, the modified conceptual model is presented in Fig3.

Table3: Indicators of Conceptual Model Suitability Using Path Analysis Method.

Indicator	Acceptable range	Amount calculated
Chi-Square/df	<3	36.73
RMSEA	<0.08	0.49
NFI	>0.90	0.85
NNFI	>0.95	-2.33
GFI	>0.90	0.94
AGFI	>0.90	-0.81
CFI	>0.90	0.84
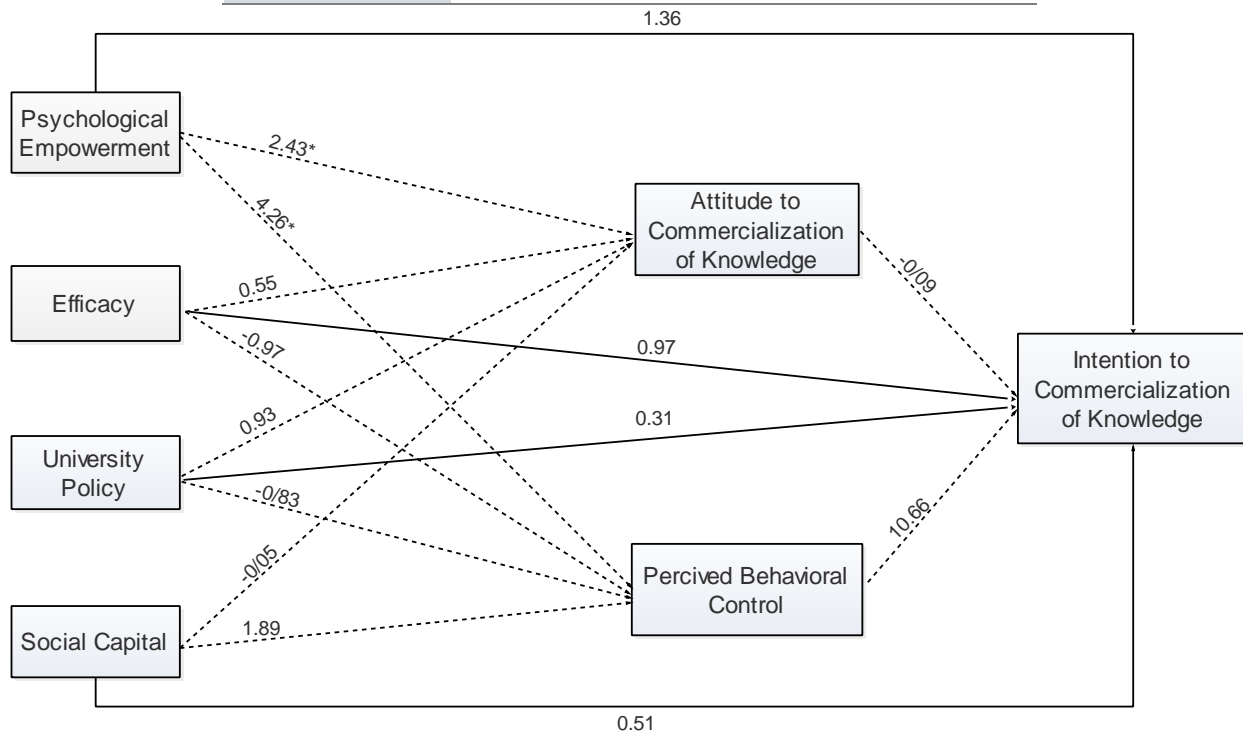
Fig3: Modified conceptual model

We re-fitted the conceptual model to data using path analysis method. The results of fitting the conceptual model to the data are shown in Table 4. As can be seen, in Table 4, all indicators are within acceptable range and the modified model is well fitted to the data. Lack of change in the presented model compared to the model previous to fitting of the data indicates that the model is very well fitted.

Table4: Regression and T Coefficients Related to the Research Variables in the Modified Model.

Independent variable	Dependent variable	Regression	Standardized regression	Coefficients T
PE		0.07	0.09	1.35

SE	Attitude to Commercialization of Knowledge	0.05	0.06	0.95
SC		0.01	0.02	0.41
PBC		1.83	0.68	9.42*
ICK		-0.01	-0.01	-0.12
PE	Perceived Behavioral Control	0.10	0.23	4.18*
SE		-0.03	-0.08	-1.09
UP		0.7	0.43	1.71
SC		0.02	0.13	1.71
PE	Intention to Commercialization of Knowledge	0.02	0.05	0.63
SE		-0.06	-0.10	1.38
UP		-0.03	-0.10	-0.93
SC		-0.01	0.03	-0.37
PE	Social capital	0.26	0.25	2.07*
SE		0.02	0.20	0.17
UP		0.93	1.03	7.31*

Table5: Indicators of the Suitability of the Modified Conceptual Model Using the Path Analysis Method

Indicator	Acceptable range	Amount calculated
Chi-Square/df	<3	1.06
RMSEA	<0.08	0.02
NFI	>0.90	0.99
NNFI	>0.95	0.99
GFI	>0.90	0.99
AGFI	>0.90	0.94
CFI	>0.90	1.00

Table6: Direct, Indirect and Total Effects Obtained from the Modified Conceptual Model.

Independent variable	Direct Effect	Indirect Effect			Whole Effect
		PBC	AC	SC	
PE	0.07	0.08	0.00	0.03	0.18
SE	0.05	0.02	0.01	0.00	0.08
PU	--	--	--	0.01	0.01
PBC	0.83	--	0.01	--	0.84
ICK	0.01	--	--	--	0.01
SC	0.01	0.02	0.00	--	0.03

The Results of Research Hypotheses Examination

- PE has a direct effect on the IC of knowledge.

PE refers to a change in the beliefs, motives and goals of individuals. According to Table 4, the beta coefficient between PE and the ICK is 0.09 with a T-value of 1.35, which is not significant at 5% level. Therefore, PE has no direct effect on the ICK. This is consistent with the results of the (Ghanadan & Andishmand, 2009).

- PE has an indirect effect on the ICK through the PBC.

According to Table 4, beta coefficient between PE and PBC is 0.33 with a T-value of 4.18, which is significant at 5%. Therefore, PE has a direct effect on the PBC. Moreover, the non-standardized regression coefficient between PE and PBC is 0.10 (with standard deviation of 0.025) and it is 1.83 (with standard deviation of 0.19) between PBC and ICK. Therefore, PE has an indirect effect on the ICK through the PBC. This is consistent with the investigations of (Jahed, 2011; O'Grady, 2002; Ranganathan & Rosenkopf, 2013).

- PE has an indirect effect on the ICK through the ACK.

According to Table 4, beta coefficient between PE and ACK is 0.05 with a T-value of 0.63, which is not significant at 5%. Therefore, PE has a direct effect on the ACK. Besides, the non-standardized regression coefficient between the PE and the ACK is 0.02 (with a standard deviation of 0.039) and it is -0.01 (with a standard deviation of 0.11) between the ACK and the ICK of knowledge. Therefore, PE does not have an indirect effect on the ICK through the ACK. This is consistent with the research by (O'Shea, Allen, Morse, O'Gorman, & Roche, 2007; Seif & Fathi, 2015).

- Self-efficacy has a direct effect on the ICK.

According to Table 4, the beta coefficient between self-efficacy and the ICK is 0.06 with a T-value of 0.95, which is not significant at 5%. Therefore, self-efficacy does not directly affect the ICK. This is consistent with the research by (Jahed, 2011; Seif & Fathi, 2015).

- Self-efficacy has an indirect effect on the ICK through the PBC.

According to Table 4, the beta coefficient between self-efficacy and PBC is -0.08 with a T-value of -1.09, which is not significant at 5%. Therefore, self-efficacy has no direct effect on PBC. In addition, the non-standardized regression coefficient between self-efficacy and PBC is -0.03 (with a standard deviation of 0.027) and it is 1.83 (with a standard deviation of 0.19) between PBC and IC of knowledge. By placing these values in the Sobel method, the T-value of -1.10 was obtained which is not significant at 5% level. Therefore, self-efficacy does not have an indirect effect on

the IC of knowledge through the PBC. This is consistent with the research by (Liñán & Chen, 2009; Seif & Fathi, 2015), who conclude in their study that SC affects intention to set up an entrepreneurial business.

- Self-efficacy has an indirect effect on the IC of knowledge through the AC.
According to Table 4, beta coefficient between self-efficacy and ICK is 0.10 with a T-value of 1.38, which is not significant at 5%. Therefore, self-efficacy does not directly affect the ICK. The beta coefficient between the ACK and the ICK is -0.01 with a T-value of -0.12, which is not significant at the 5%. Therefore, the ACK does not directly affect the ICK. There is no significant relationship between self-efficacy and ICK and between ACK and the ICK at the level of 5%. Therefore, self-efficacy does not have an indirect effect on the ICK through the ICK. This is consistent with the research of (Jahed, 2011) and inconsistent with the research of (Seif & Fathi, 2015).

- UP has an indirect effect on the ICK through SC.
According to Table 4, beta coefficient between UP and SC is 0.52 with a T-value of 7.31, which is significant at 5%. Therefore, UP has a direct effect on SC. There is also no significant relationship between SC and the ICK at the level of 5%. Therefore, UP does not have an indirect effect on the ICK through SC. Of course, the T-value was calculated based on the Sobel statistic to be 0.41, which is another proof for rejection of this relationship.

- UP has an indirect effect on the ICK through the ACK.
According to Table 4, the beta coefficient between SC and the ICK is 0.02 with a T-value of 0.41, which is not significant at the alpha level of 5%. Therefore, the UP does not have an indirect effect on the ICK through SC.

- PBC has a direct effect on the ICK.
For Engineering School, beta coefficient between PBC and the ICK is 0.68 with a T-value of 9.42, which is significant at 5%. Therefore, the hypothesis of the direct effect of PBC on the ICK of knowledge among the students of the Engineering School is accepted. This hypothesis is consistent with the research by (Jahed, 2011; O'Grady, 2002; Ranganathan & Rosenkopf, 2013).

- SC has a direct effect on the ICK.
According to Table 4, beta coefficient between SC and the ICK is 0.02 with a T-value of 0.41, which is not significant at 5%. Therefore, SC does not directly affect the IC. This hypothesis is consistent with the research by (Seif & Fathi, 2015).

- SC indirectly affects the ICK through the PBC.

According to Table 4, beta coefficient between SC and PBC is 0.13 with a T-value of 1.71, which is not significant at 5%. Therefore, SC does not directly affect the PBC. Moreover, the beta coefficient between PBC and the ICK is 1.83 (with a standard deviation of 0.19). By placing these values in the Sobel method, the T-value is calculated based on Sobel statistics to be 1.69, which indicates that the SC does not affect the ICK through the PBC.

- SC has an indirect effect on the ICK through the ACK.
According to Table 4, beta coefficient between SC and ACK is -0.03 with T-value of -0.37, which is not significant at 5%. Therefore, SC does not directly affect the ACK.

- SC has direct influence on the PBC.
Regarding the relationship between the two variables of SC and the PBC, it should be said that SC is obtained from a group of individuals, and individuals need to have some abilities to realize it. In this context, the PBC refers to the level of effective and beneficial use of mental capacity, and in fact it refers to each capital of an individual. According to Table 4, beta coefficient between SC and PBC is 0.13 with a T-value of 1.71, which is not significant at 5%. Therefore, SC does not have a significant effect on the PBC. This hypothesis is consistent with the research by (Liñán & Chen, 2006; O'Grady, 2002; Seif & Fathi, 2015).

Discussion and Conclusion
PE, as a concept, has many applications in various fields. In this study, PE refers to students' beliefs, motivations and subjectivities to the concept of knowledge commercialization. Some experts such as Cook and Hansaker extend the notion of empowerment and apply it to any situation that gives individuals the sense of being worthy and being in control of affairs, provides them with the necessary power for innovation, and makes them persistent in meaningful works. From this perspective, empowerment is a highly personal and multifaceted motivational force that can be stimulated from within the individual or by colleagues or managers. In this regard, the university can play a fundamental role. The university can make this important mentality in the minds of the students that their research can be a breakthrough. PE ultimately leads to an understanding of their self-behavior and the ability to control it. The results of the research show that from the viewpoint of the students of Engineering School, PE has no direct effect on the ICK and this is an indirect effect through the ACK and PBC.

Self-efficacy refers to the belief in having the ability to do things, and the PBC refers to guiding behavior and organizing them in mind, which itself leads to self-efficacy. Beliefs and behaviors

are part of the process of self-efficacy. Self-efficacy by using PBC can lead to changes in people's interests and beliefs towards knowledge commercialization.

An attitude is a set of beliefs, feelings and emotions that determine the behavior of the individual. People's attitude is affected by factors such as the environment which directly affects them. People's attitude can show their interests and mentality. As there is a relationship between people's attitude and self-efficacy, attitude can then show people's interests and intention. Regarding the two concepts of the ACK and the IC of knowledge, students have presented different views.

SC, which refers to the creation of creative, skillful and productive people, cannot be achieved except through the university and right policies. In this hypothesis, the effect of UPs on the SC has been directly investigated.

SC is directly related to what is called "civic virtue", because SC is used as a source of both malicious and good deeds; for example, to monopolize the employment opportunities for insiders or to fight against fictitious or real enemies. Then, SC is not in fact a single entity, but is a set of different entities with two common elements: first, they all include an aspect of social structures, and second, certain acts of activists such as social acts including other forms of capital are productive; that is, it makes it possible to realize certain goals that are not realizable otherwise.

SC, as a new category, is closely related to self-efficacy. Self-efficacy is the ability to do things and to believe in doing. These beliefs are very important in the community, and even collective self-efficacy can be introduced, in which society actually comes to believe that it can work for all aspects of its life. This belief is a great generator which can serve as a great stimulus for guiding the society.

SC is a vast and broad circle that manifests all the capacities of society. Individual beliefs and capacities can determine the capital of a society. According to Coleman, SC refers to the relationships and interactions between the individuals in a society, which can be either useful or not. Therefore, people's attitude can be one of the elements effective regarding the ICK.

The general result of this research demonstrates that PBC has the highest effect on the ICK directly. Regarding the indirect part, the highest effect relates to the PBC.

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