Studying the Effect of Knowledge Spillover on Innovative Performance of Knowledge Base Companies in the Extent of Electric Generators

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Abstract—The word knowledge spillover has been used in scientific resources to explain the increase in innovation rate in technical clusters. And it means to exchange ideas among people. The focus of knowledge base companies in one geographical zone leads to make internal relations in knowledge base companies in an especial and professional field; and due to global competition and risk space development, by specializing one zone, the governments have contributed to facilitate learning conditions, publish and transfer knowledge flows which play a significant role in social, economical and technical dimensions of each area. To promote their innovative activities, the knowledge base companies also invest in learning activities. This learning may take place in internal or external way. The knowledge flow among the main actors is one of the external learning factors. This article is going to analyze the relation between the knowledge spillover spillover mechanisms as independent variable and innovative performance of knowledge base companies as dependent variable.

The data collection tool in this research is questioner that gathered the intended data from managers and senior experts of 71 companies placed in Tehran Science and Technology Park.

The research methodology was a description of the type of correlation. To answer the questions and analyze the research hypothesis using the Smart-PLS software, we used the structural equation analysis method and analyzed the path using minor partial squares (PLS). The results show that the knowledge spillover by creating productive companies, knowledge spillover by displacement of labor force and knowledge spillover by informal interactions have a positive and significant effect on innovative performance. The results also showed that knowledge spillover have the greatest impact on innovative performance of the company by creating productive companies.

Keywords— Knowledge spillover, innovative performance, knowledge base companies.

I. INTRODUCTION

The science and technology parks are defined with geographical industry focus that have internal relations and their related institutions have formed in a professional field. Recently, with the spread of globalization and increase in risk space, regional expansion of science and technology has been paid attention. By specializing one area, providing learning environment and publishing knowledge in different dimensions, knowledge spillover may increase competition between knowledge base companies, since innovation is one of the effective factors in competitiveness. Researchers emphasis on significance of innovative relations in science and technology parks and place adjacent. But some others in addition of the mentioned items emphasis on existence of coherent communication, the collaborative internal business network and the existence of institutions related to mentioned activities like specialized curators, actors generating knowledge like research institutions and universities, mediator institutions like intermediaries, consultants and consumers of one of them in the value added production chain. Creating local economy advantages and benefits caused by aggregation of economical interconnected activities and in conclusion knowledge and technology spillover and consequently learning have been mentioned as positive consequences of formation of science and technology parks. Today knowledge is considered as one of the most significant and effective factors in production. Knowledge can be very determinant in firm innovation and finally in competitiveness and their growth. When firms in one geographical zone have linked for information, professional services, parts, human resources supply, technology and sale, they will act more learnable and innovative than separate firms. The spillover of the knowledge which takes place among the knowledge base companies in different parts of a knowledge base company by learning, is considered as the main motivators of innovation, learning and economical growth. Studies on the impact of knowledge spillover on the performance of knowledge base companies represent the positive impact of knowledge spillover on innovative performance of knowledge base companies. The knowledge spillover caused by internal relations in knowledge base companies and their personnel's interactions, is an intellectual advantage which is gained by exchange of information. The knowledge which is created under the influence of regional density in a knowledge base company may also be used in other knowledge base companies and leads to innovation and economic growth. This article did the research by quantitative analysis of evaluation of the effect of knowledge spillover on innovative performance of knowledge base companies. And also addresses the relations between different mechanisms of knowledge spillover and innovative performance.

II. A REVIEW OF RESEARCH BACKGROUND

2-1. Knowledge Spillover s

Audretsch and Lehmann evaluated the distance distribution of innovation at the state level in America. They

used the new productions presented in America market as the indicator of innovative activity. Their findings support this idea that innovation is intensive in one space due to the implicit nature of technological knowledge and indicates that personal interactions are essential to knowledge spillover.

The study of the geographical position of inventions registration with the number of assignments to patent certificates show that the relation between knowledge spillover and place adjacent of knowledge base companies is a significant relation. The Saxony analysis in the Silicon Valley also showed that the innovative performance of knowledge base companies of semiconductors in comparison with other collections, due to the available strong relations among components of this collection is higher. These relations contribute to exchange the informal ideas and the knowledge which is necessary to learning and innovation. In addition, the personnel's interactions have effects on exchanging the informal knowledge and displacement of labor force between knowledge base companies and establishing generative companies lead to intensive knowledge spillover in labor force. Zucker and coworkers addressed the existence of knowledge spillover and the location of specialists and proved the significant relations between them. Researchers showed that place adjacent contributes to accumulation of knowledge in firm level and increases innovation in collections. spillover of the knowledge that has been used as a factor to explain the increase in innovation rate in the technical clusters, takes place with free flow by interactions among knowledge base companies, or by rotation of expert work force and forming productive companies in collections. also there are other studies about the effect of geographical collection on the process of knowledge accumulation in developing countries, although these studies generally have pointed to advantages and significance of accumulation, none of them have addressed the role knowledge spillover plays clearly.

TABLE I. Empirical studies on knowledge spillover.

Results	Methodology	Writer
References to patent certificates are one of the ways to overcome knowledge.	Referral to patent certificates	Jeff and Tranenbur
spillover of knowledge in the semiconductor industry in the Silicon Valley (USA)	Comparative Case	saxenian
Manufacturing complexes in the industry tend to be innovative	New Product Innovation	Audretsch and Feldman
Knowledge localization	Birth generations	Zucker, Darby& Brewer
The shift of workforce between knowledge-based companies and the fluidity of knowledge spillover	Displacement of labor force	Almeida and Kogut
Knowledge spillover is initially located on social networks and then on local networks	social network	Breschi and Lissoni (2003)
Knowledge spillover practices have an impact on the innovative technological and organizational performance of telecommunications companies.	Identifying knowledge spillover practices	Kesidou and Romijn, 2008

Kesidou and Roseman during the research they did on the software companies located in Montevideo city in Uruguay country in 2008 analyzed the mechanisms of occurrence of knowledge spillover in developing countries and considered its effect on innovative performance of this kind of business. Finally, they mentioned that identified mechanisms which create knowledge spillover, effect on business performance positively.

2-2. Innovative Performance: Throughout the process of technological learning, knowledge-based companies increase their innovative ability. Innovative company performance, the variable output is the company's innovative capability. The innovative capability of internal activities and external resources is achieved. The acquisition capabilities of innovative abilities in Roman studies are categorized as follows:

1. The technological capability may be achieved through in-house technological activities, such as in-company research and development activities, or reverse engineering.

2. Knowledge may be obtained from external sources, or by-product of different ways of interacting with the outside world, or through active and targeted search.

3. Innovative capacity increases through the use of human capital through formal, non-formal and informal educational activities at the firm level (kesidou, 2008). The ability to innovate refers to the skill and knowledge that is needed to improve or modify the product / service. Lawson & Washamson (2005) Shows that the ability of innovation to the ability to continuously transform knowledge and ideas into products, The processes and systems are new to the benefit of the company and its shareholders (Oliver et al., 2017). In general, innovation addresses all the company's efforts to achieve technological excellence, production, or improvement of technological conditions (Kaiser, 2002). The ability to innovate assets is specific to the company (Guan & Me, 2003). This ability to quickly introduce new products and adopt new processes for the competitiveness of companies is very important. These authors have categorized the innovation capability into seven dimensions: learning ability, Research, development, production, marketing, organization, utilization of strategic resources. Studies show that companies with a higher level of innovation are averaging more than twice as much as other companies (Ming-Tien & Chung-Lin, 2010).

As a conclusion, an overview of technological learning texts is presented Which focuses on learning resources and is less relevant to the factors affecting the learning process (kotha 2010). Specialization is one of the main advantages of inter-firm and key elemental links To strengthen inter-agency links. Regional concentration of similar economic activities and the relationship between strategic enterprise Promotes the degree of specialization. (Alnsowilar et al., 2005) And this specialization increases interdependence (Stephen Roper et al., 2017).

In the science and technology parks literature, intermediate goods manufacturing firms, Products for other businesses within the set for They sell more processing, while firms in the final stages of the chain, Sells the final product to external customers (Cable and others, 1999).

Direct tools for measuring knowledge spillover have recently been based on firm-level information from innovation research such as the Research Association EU Innovation

(CIS). Using the CIS questions, as a starting point in this research, we tried to provide different sources of knowledge Which may be used by the companies mentioned above. Based on previous research and current research hypotheses, the conceptual model used in this study to investigate the effect of spillover Knowledge and its mechanisms are based on the innovative performance of knowledge-based companies as shown in Fig. 1.
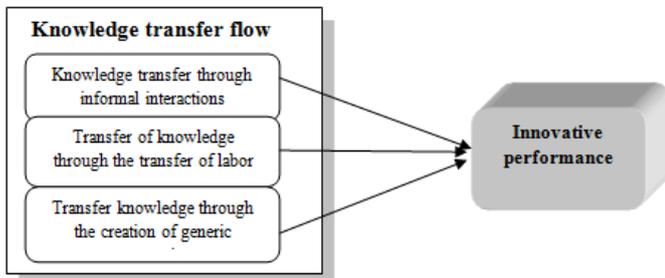

Fig. 1. Conceptual model of research.

Variables Based on the conceptual model of the research, the dependent variable is an innovative performance that the dimensions examined by this variable, according to Table III, are:

1) technological innovation and 2) organizational innovation. Indicators that measure these dimensions Table VI is shown in Table. The variable of a new product or service indicates the number of innovations Which are first introduced by the company to the market and are not imitations in any way.

This variable relates mainly to standardized products to products and services Personalization (Kesidou, 2008). The second indicator, the change in the service mix, has been the fundamental changes to the products and services that have taken place in the last five years, it shows. These changes may be needed to address the needs of customers. The difference with the previous indicator is that companies that are a whole new product Not only have they introduced a new feature and function But they have the ability to do this by making little changes in previous products.

TABLE II. Investigating dependent variables.

Definition / Measurement	Variable Name	Sub Variables	Dependent Variable
Indicates the ability to participate in creating or improving product / service in the market based on scientific and technological advancements.	Tech-inno	Technological innovation	Innovation performance
Reflects the ability to participate in improving and making changes in management practices, strategy and organizational structure.	Org-inno	Enterprise / Business Innovation	

The amount of changes in business strategy, the use of marketing management methods and the change in the organizational structure of the company is also another of the variables of the innovative performance of knowledge-based

companies (Kesidou, 2008). Also, identified mechanisms of knowledge spillover in theoretical foundations as independent variable dimensions are: 1) spillover of knowledge through the creation of productive companies; 2) spillover of knowledge through the transfer of labor and 3) spillover of knowledge through the interactions shown in Table III.

TABLE III. Independent research variables.

Definition / Measurement	Variable Name	Sub Variables	Dependent Variable
If a company is a parent company of a university or larger multinational corporation, otherwise it is zero.	LKS_S	spillover of knowledge through the creation of generating companies	Knowledge spillover
Percentage of employees who have been members of other companies based in the company in the last 5 years.	LKS_L	spillover of knowledge through the displacement of the workforce	
A Likert scale based on the importance of free sources of knowledge within a collection that arises from informal interactions between local activists.	LKS_I	Influence of knowledge through interactions	

III. METHODOLOGY OF RESEARCH

Methodologically, this research is a correlation research. The present research is based on how to get it The required data and the classification of the research according to their purpose are among descriptive research.

This research is applied in a descriptive-survey method. In this research, in order to formulate the basics, definitions and theoretical concepts of the library resources including documents, Books and scientific articles were used as well as for collecting data needed to test the research hypotheses Two design questionnaires and then a number of finalists came together.

The first questionnaire consists of 19 questions and the second questionnaire contains 6 questions. The questionnaires of this research are subject to the judgment of several experts and management professors He worked at the universities and after making some amendments and obtaining the approval of those professors For higher reliability and acceptability of narrative Formal, about 30 questionnaires were distributed to the statistical community And at first, it was not possible to understand a number of questions for respondents, and after several times the text was streamlined And eliminating some of the questions, the questionnaire was sufficiently formal and finally, two agreed questionnaires were used as a tool for data collection. The statistical population of the research is considered to be senior executives and experts in companies based on knowledge based companies.

According to available statistics, the number of companies based in the active science and technology park In the field of electrical generators, 78 units were estimated. According to the Morgan table in a community of 78 At least 71 samples should be evaluated. Stratified sampling It is done by random

appointment. The distribution of the statistical community is presented in Table IV.

TABLE IV. Sample size of knowledge companies based on universities located in Tehran Science and Technology Park in the field of electric power generation.

Total	Consultation	Software Production	Hardware Manufacturing	Electric Generator Design	Field of Activity / Technology Park
16	3	5	6	2	University (A)
12	2	4	3	3	University (B)
14	2	3	5	4	University (C)
7	-	2	3	2	University (D)
10	2	3	2	3	University (E)
12	3	3	2	4	University (F)
71	12	20	21	18	total

In this research, the data collected from a variety of statistical indicators including frequency, Frequency percentage, types of tables and charts. In the inferential statistics section, to investigate the research hypotheses, the method of structural equation analysis and path analysis using partial least squares (PLS) will be used. In the descriptive statistics section, software such as Excel and SPSS software were used in the inferential statistics section of Smart-PLS software.

IV. FINDINGS

In this study, structural equation modeling using partial least squares method and PLS software, to test the assumptions and validity of the model. The PLS is based on variance which requires less constraints in comparison with similar techniques of structural equations such as Laserl and Amos (Liljander et al., 2009).

The main advantage is that this kind of modeling requires less number of samples than lasers (Wixom and Watson, 2001). It is also a powerful method in cases where the number of samples and measurement items is limited and the distribution of variables can be indeterminate (Hair et al., 2010). The PLS modeling is done in two steps. In the first stage, the model of measurement should be through the validity and reliability analysis and confirmatory factor analysis. In the second stage, the structural model is investigated by estimating the path between variables and determining the fitting indexes of the model.

4.1.1. Step One: Measurement Model The measurement of the model is related to the validity and reliability of the measuring instruments.

Validity: To assess convergent validity, the AVE criterion (average extracted variance) and CR (Composite Reliability) was used to measure the results of this criterion for the dimensions of the six research variables Is shown in Table I. Composite reliability higher than 0.7 and higher mean of variance From 0.5 is two prerequisites for convergent validity and structural correlation (Qing Lin and Qi Huang, 2009). As shown in Table V, all composite reliability values are higher than 0.7 and the mean values of the higher variance From 0.5 and this confirms that the convergent validity of the questionnaire is acceptable.

In the divergent narrative, the difference between the indices of a structure and the indexes of other structures is compared in the model. This is calculated by comparing the

root AVE of each structure with the values of the correlation coefficients between the structures. To do this, we must construct a matrix with the values of the original diameter, the root of the matrix of the coefficients of the AVE of each structure. And the lower values of the main diameter are the coefficients of correlation between each structure with other structures. This matrix is shown in Table VI. As can be seen from Table VI, Rectangular AVE of each structure has increased the correlation coefficients of that structure with other structures, which indicates the acceptability of the divergent validity of the structures

TABLE V. Average results of variance extracted from research structures.

Variable / Benchmark	Informal Interactions	Handling Staff	Natal Firms	Innovative Performance
AVE	0/6340	0/6008	0/6556	0/5535
CR	0/8443	0/8658	0/8374	0/8821

TABLE VI. AVE ratio matrix with structural correlation coefficients (Divergent Validity).

	Informal Interactions	Handling Staff	Natal Firms	Innovative Performance
Informal interactions	0/7962			
Handling Staff	0/5520	0/7751		
Natal firms	0/4511	0/6014	0/8096	
Innovative performance	0/6267	0/6144	0/6001	0/7439

4-1-2- Reliability To examine the reliability of the questionnaire, in addition to the Cronbach's alpha coefficient, which is presented in Table VII And confirms the reliability of the questionnaire, the PLS method is also used. The PLS method uses index reliability (Rivard & Huff, 1988).

Indicator reliability is also calculated by measuring the factor loads by calculating the correlation between the indices of a structure with that structure. If this value is equal to or greater than 0.6 (Hulland, 1999), this is confirmed The reliability of that model is acceptable. But if the factor load between a question and the corresponding dimension is less than 0.6, It is possible to exclude that question from the model and subsequent analyzes.

As shown in figure 2, All values of factor loads among structures and questions are greater than 0.6, which shows a high correlation.

TABLE VII. Cronbach alpha coefficient.

Research Structures	Informal Interactions	Handling Staff	Natal Firms	Innovative Performance
Cronbach's alpha coefficients	0/8468	0/8115	0/8667	0/8543

4-2 Second Step: Structural Model and Hypothesis Test: A structural pattern test that examines the hypothesis of research and the effect of hidden variables on each other. To confirm the research hypotheses, the Bootstrapping command of the Smart PLS software was used The output is the result of the coefficients t (Fig. 3). When the values of t are greater than +/- 96/1 and less than -96.9, Indicates the significance of the relevant parameter and subsequently confirms the research hypotheses.
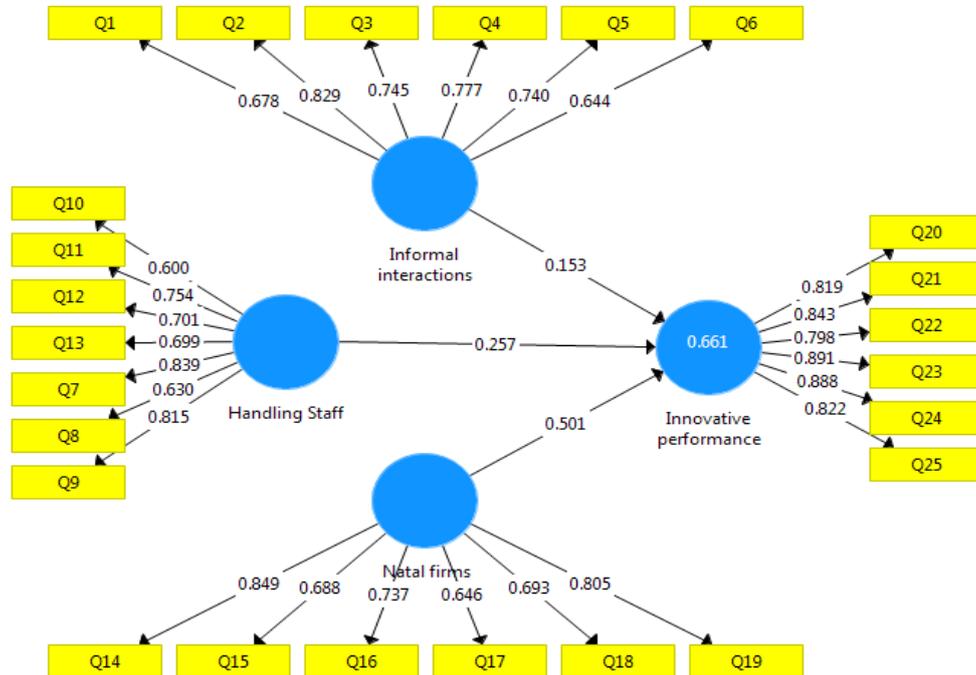

Fig. 2. Software output - Research sample model (path coefficients and factor load).
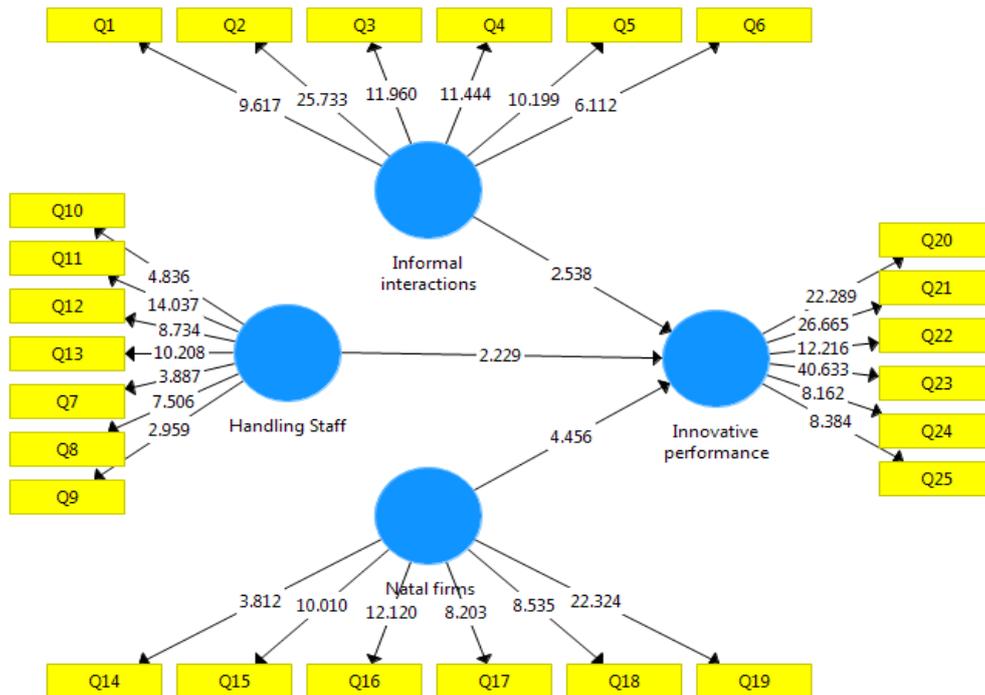

Fig. 3. Software output - coefficients t.

4-3-Methods for assessing modeling models One of the ways of evaluating modeling models is the determination coefficient (R2). The coefficient of determination (R2) examines how many percent of the variance of a dependent variable is explained and explained by the independent variable (s) (Fig. 2).

It is therefore natural that this value is equal to zero for an independent variable and for a dependent variable it is greater than zero. The higher the rate, the greater the impact factor of independent variables. According to the coefficient of model determination, we can say that the overwhelming dimensions of knowledge through the creation of productive companies, spillover of knowledge through the displacement of labor force and knowledge spillover through informal interactions have been able to explain 0.661 of variance of the variable of innovative performance; The researchers have identified three values of 0.19, 0.33 and 0.67 as the criterion value for weak, moderate and strong R2 values.

On this basis, it can be concluded that the model has a relatively predictive capability Strong is the amount of residual error associated with prediction and can include other factors affecting innovative performance.
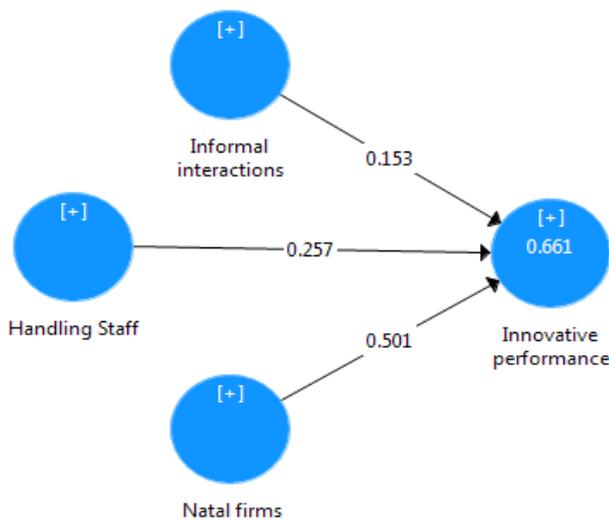

Fig. 4. Evaluation of shaping modeling models.

4-4. Response to research hypotheses

Hypothesis 1: Influence of knowledge through informal interactions has a significant effect on the innovative performance of the company. According to the results obtained from the path coefficient and the t-statistic in figures 2 and 3 and table VIII, Then, spillover of knowledge through informal interactions has a significant effect on the company's innovative performance (T statistics outside the negative range of 96/1 to positive 1.96).

With regard to the path coefficient, we can say the effect of the spillover of knowledge through informal interactions, the company's innovative performance is positive and significant, Because the path coefficient obtained is positive. Therefore, with the increase of informal interactions, Innovative performance of the company increases, and with its decline in the organization, the innovative performance of the company is reduced.

Hypothesis 2: knowledge spillover has a significant effect on the company's innovative performance through the shift of labor force. According to the results obtained from the path coefficient and the t-statistic in figures 2 and 3 and table VIII, Then, the spillover of knowledge through the transfer of workforce has a significant effect on the company's innovative performance (T statistics outside the negative range of 96/1 to positive 1.96. Regarding the path coefficient, it can be said that the effect of the spillover of knowledge through positive displacement of the workforce on the innovative performance of the company is positive and significant, Because the path coefficient obtained is positive. So, with the increase in labor turnover, Innovative performance of the company increases, and with its decline in the organization, the innovative performance of the company is reduced.

Hypothesis 3: spillover of knowledge through birth creating companies has a significant effect on the company's innovative performance. According to the results obtained from the path coefficient and the t-statistic in figures 2 and 3 and table VIII, Then, the spillover of knowledge through the creation of birth companies has a significant effect on the company's innovative performance (T statistics outside the negative range of 96/1 to positive 1.96). Regarding the path coefficient, it can be said that the effect of the spillover of knowledge through the creation of generative companies on the innovative performance of the company is positive and significant, Because the path coefficient obtained is positive. Thus, by creating birth generations, the company's innovative performance increases.

TABLE VIII. Direct effects, t statistic and outcome of research hypotheses.

Accept or Reject the Hypothesis	Meaningful	Statistics t	Standardized Path Coefficient β	Hypothesis
Accept	Sig<0.05	2/538	0/153	spillover of knowledge through unofficial interactions → Innovative company performance
Accept	Sig<0.05	2/229	0/257	Influence of Knowledge through the Moving of the Labor Force → Innovative Company Performance
Accept	Sig<0.05	4/456	0/501	spillover of knowledge through the creation of productive companies → Innovative performance of the company

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V. DISCUSSION AND CONCLUSION

This paper examines the concept of knowledge spillover and the mechanisms that trigger this phenomenon As well as its impact on the innovative performance of companies. Due to different results about the relationship between unwanted flow Knowledge and innovative performance of companies in different countries have been observed, the relationship between these two phenomena is quantitatively analyzed through multivariate regression analysis In 71 companies, knowledge base was studied. The results of linear and multivariate regression analysis indicate that knowledge spillover And its mechanisms have a positive effect on the innovative performance of the sample. The results of the research indicate the hypothesis of the research Through the transfer of skilled and experienced workforce between partner companies as well as the informal interactions of knowledge-based companies An unwanted knowledge flows with each other, affecting their innovative organizational and technological performance. Which is also consistent with the research results of Coget (2002) (Fritsch, 2004). Establishing a reproductive company is one of the ways in which the unwanted flow of knowledge in a region and in the collections is referred to in the research by Saxony (2004) and Zucker (1999).

Suggestions The results of the research showed that knowledge spillover has a positive effect on the innovative performance of the companies studiedThis research showed that the most spillover of knowledge occurs through the establishment of generative companies. In addition, the displacement of the workforce leads to the spillover of knowledge from the acquired knowledge of the previous companies that it occupies. At the same time, the adjacent companies of knowledge base in a geographical location spill over knowledge unwittingly. Given the overwhelming knowledge of knowledge-based companies in the field of electrical generators, it is suggested There are other studies in other technical areas. In addition, companies are encouraged to focus on attracting more experienced and experienced staff.

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