Innovation Success And Firm Size: An Emprical Study In The Chemistry Industry In Turkey

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Abstract Firms create competitive advantage by perceiving or discovering new and better ways to compete in an industry to bring new products and services to market. So firms should have a clear understanding of the importance of innovation. It involves changing competences and capabilities and producing qualitatively new performance outcomes. This research studies on relationship between firm size and innovation success in the chemistry industry. The survey is implemented to 52 firms and data are analyzed by SPSS programme. In the part of the methodology, dependence of innovation success to number of employees is explored and then effects of the number of employees on the innovation success is tested. This research draws a conclusion if the number of employees increases, innovation success of firms will increase.
Key words chemistry industry, firm size, innovation, number of employees.

1 Introduction

Increased competition has pushed companies to become more efficient in processing, to reorganise management, develop new products and explore new markets in order to meet the needs and wants of consumers competitively[1].

The market opportunities of firms and the development opportunities of regions depend increasingly on their capacity to contuniously generate innovative products and processes. Innovation, therefore, plays a key role in building competitiveness and sustaining economic growth[2].

Companies world wide of different size and sectors are operating in an increasingly dynamic, complex and unpredictable environment. This increase suggests that many firms seek new ways of conducting their business through some kind of innovation to make a profit and stay ahead of the competition. In particular intense global competition, rapid technology changes and product variety proliferation are part of the characteristics of the new manufacturing environment [3].

Innovation is by definition, novelty. It is the creation of something qualitatively new, via processes of learning and knowledge building. It involves changing competences and capabilities and producing qualitatively new performance outcomes [4].

According to Peter Drucker “Innovation is the effort to create purposeful focused change in an enterprise’s economic and social potential”[5].

To make a firm innovative one requires a conceptual framework for analyzing how a firm transforms productive resources into goods and services that customers want at prices they can afford. Innovation requires learning about how to transform technologies and access markets in ways that generate higher quality, lower cost products [4].

Product innovation can be seen as any good, service or idea that is perceived by someone as new [1]. “Reference [6] define product innovation as a new technology or combination of technologies introduced commercially to meet a user or a market need.”

Process innovation includes the adaptation of existing production lines as well as the installation of an entirely new infrastructure and the implementation of new technologies[1]. Process innovation can be defined as new elements introduced into an organization’s production or service operations; input materials, task specifications, work and information flow mechanisms and equipment used to produce a product or render a service with the aim of achieving lower costs and higher product quality[7].

Whilst new products are often seen as the cutting edge of innovation in the marketplace, process innovation plays just as important strategic role. Being able to make something noone else can, or to do so in ways which are beter then anyone else is a powerful source of advantage [8].

Organisational innovation deals with changes in marketing, purchases and sales, administration, management and staff policy.

Market innovation which is defined as the exploitation of new territorial markets and the penetration of new market segments within existing markets [1].

Process of innovation can be divided into three:

-The production of scientific and technological knowledge
-The translation of knowledge into working artifacts
-Responding to and influencing market demand[4].

In this research firstly importance of innovation is explored, secondly comprehensive literature review is described. After that methodology of research and analysis of innovation success related with firm size in the chemistry industry between 2003-2007 is presented. In the part of the methodology chi-square test is implemented to explore dependence of innovation success to number of employees. And to get an idea about if the number of employees increases how innnovation success of firms will change, t test is implemented. Then conclusions are described. The aim of this research is to present the effects of the number of employees in companies on the innovation success.

2 Literature Review

Since the late 1970s, industrial dynamics has emerged as a major research area for industrial economists. Within the growing interest in industrial dynamics, innovation has been recognized as a key element affecting the dynamics and evolution of industries. Again, since the late 1970s several studies have pointed to the fact that a large number of indutries follow a life cycle in which a radical innovation and the related entry of small new producers that introduce new products is followed by demand growth, a greater emphasis on process innovations and a selection process which ultimately leads to a concentrated market structure. It has also been convincingly indicated that these dynamic sequences are different from one industry to another [9].

Since the second half of the 1980s, the focus of economic research has shifted from the analysis of price and cost related factors of competitiveness to the important role played by technological change. The greater attention to technology and non-price factors of competitiveness corresponds to a shift of focus from short run patterns to long run dynamics, which has been greatly inspired by the classical contribution of Schumpeter and on the role of innovation and technology diffusion in the process of growth and structural change[10].

On the other hand, a heterogenous set of emprical studies within the evolutionary economics tradition has followed a different route and argued that the Schumpeterian view necessarily requires a disequilibrium approach to the study of innovation, structural change and growth. Evolutionary scholars have emphasised the sector-specific nature of innovation and extensively investigated its impact on the competitiveness of different systems of innovation [10].

Although innovation has been studied extensively, there is no generally accepted way of measuring innovation. Some research is based on published R&D expenditures and patent data while other research relies on measurements derived from detailed surveys among companies. Innovation itself is a very broad concept and, as a result, various classifications of innovation have been developed and applied in the economic literature [1].

In recent years there has been a good deal of discussion concerning the relationships among market structure, research and development, and the rate of technical change. Much of this discussion has focussed on the question of whether large firm size is a necessary condition before firms will engage in research and whether research and development is likely to grow more or less than in proportion to increases in firm size. A further set of questions deals with the relationship between and the rate of technical change experienced by the firm [11].

While large manufacturing companies can often invest in new technologies and equipment, providing world class skills, training to their work force and winning new markets this is hardly the case for small companies [3]. For an organization to develop the capacity for sustained innovation, it must have three elements: available resources, collobarative structures and processes to solve problems and innovation in the business strategy[12].

The study of the relationship between firm size and innovation also goes back to Schumpeter. Schumpeter claimed that large firms are more likely to innovate than small firms. With their accumulated stock of knowledge in specific technological areas, their advanced competence in large scale R&D projects, production and distribution and their access to resources, large firms create barriers to entry for new entrepreneurs.

The relationship between company size and innovation has been extensively studied. Emprical studies have reached apparently contradictory conclusions. These are mainly due to the different measurements of innovation used but also to different sampling methods, with many studies taking data across industries to try to reach generalised conclusions rather than looking at industry specific patterns of innovation [1].

Schmookler (1972) reviewing the broad evidence, found that beyond a modest level, efficiency of inventive activity tends to be intensively with firm size. Large firms spent more on R&D per patent than did smaller ones. Scherer (1965) through regressions found that patent intensity varied inversely with firm size and increased with R&D intensity. A.C. Cooper (1965) interviewed in either the electronics or chemical industry. He found large firms seem to become enmeshed in bureaucracy and red tape, resulting in a less hospitable atmosphere for creative contributions by operating personel. Superior technical personel tend to be attracted to smaller companies where greater latitude may be afforded them. The larger the firm, the more difficult it may be to recognize the problems needing solution. Pawitt and Wald (1971) concluded that both large and small firms play essential, complementary and interdependent roles in the process of innovation. Larger firms have tended to contribute most to innovation in areas requiring large scale R&D, production or marketing. Smaller firms tend to concentrate on specialized but sophisticated components and equipment. They have often made very major innovations when large firms let the oppurtunity slip by [13]. Galbraith (1952) emphasizes current innovative activity requires vast sums of money for technical personel, engineers, scientists and their equipment. The needed resources are available only to large firms possessing a substantial degree of monopoly power. Nutter (1956) indicates large firms can hedge against the technical uncertainties associated with innovation by undertaking several projects simultaneously [13]. According to reference [14] in general a positive effect of size on innovation output is expected, since larger firms tend to be less financially constrained. However, it may also happen that larger firms view themselves as less threatened by competition and lower the rate of innovation. Reference [15] expects market returns to technological innovations be higher for larger firms for two reasons. First, large firms also have more opportunity and resources for developing and introducing technological innovations. Second, large resources allow firms to benefit more from these technological innovations through faster product development, higher sales etc.

3 Methodology

This paper investigates the relationship between innovation and firm size in the chemistry industry during the period of 2003-2007. Reason of choosing chemistry as a sector is one of the most dynamic sectors. Size of the firm is measured by the number of employees.

The data for the anlaysis come from the UK innovation survey. The survey was implemented in 2001 and is based on the core Eurostat Community Innovation Survey (CIS) of innovation [16]. The method and the types of questions in CIS are described in the OECD's Oslo Manual. It allows investigation of patterns of innovation across a large number of industrial firms. It also enables researchers to explore the relationship between indicators of performance and different innovation strategies [17][18].

This survey is implemented to 52 chemistry firms. Innovation success of firms is evaluated according to thier responses about product innovation, process innovation, innovation activities, financial sports, knowledge sources and advantages of innovation. Dependent variable is product and process innovation, independent variable is number of employees. All data are tested by SPSS programme.

Firstly to analyze effects of the number of employees in firms on the innovation success these hypothesis are formulated

H_1: Product innovation success of firms and number of employees are independent.

Table 1 Product Innovation- Real Frequencies

	Number Of Employees				
Product Innovation	1-9	10-49	50-249	250 and upper	Total
Yes	1	10	14	4	29
No	4	15	3	1	23
Total	5	25	17	5	52

Table 2 Product Innovation- Expected Frequencies

	Number Of Employees				
Product Innovation	1-9	10-49	50-249	250 and upper	Total
Yes	2.79	13.94	9.48	2.79	29
No	2.21	11.06	7.52	2.21	23
Total	5	25	17	5	52

$$X^2 = \underline{\Sigma \text{ (Real frequency-Expected frequency)}^2}$$

Expected frequency

Chi-square (X^2) test is implemented and found that X^2=11,170. The curve for the chi-square distribution with 3 degrees of freedom and 5% value of $X^2_{.05}$= 7,815. According to acceptance and rejection regions H_1 hypothesis is rejected. Thus, product innovation success of firms and number of employees are not independent.

Chi-square (X^2) test is also implemented for process innovation.

H_2: Process innovation success of firms and number of employees are independent.

Table 3 Process Innovation- Real Frequencies

	Number Of Employees				
Process Innovation	1-9	10-49	50-249	250 and upper	Total
Yes	1	13	14	4	32
No	4	12	3	1	20
Total	5	25	17	5	52

Table 4 Process Innovation- Expected Frequencies

	Number Of Employees				
Process Innovation	1-9	10-49	50-249	250 and upper	Total
Yes	3.08	15.38	10.46	3.08	32
No	1.92	9.62	6.54	1.92	20
Total	5	25	17	5	52

According to test X^2=8,441. The curve for the chi-square distribution with 3 degrees of freedom and 5% value of $X^2_{.05}$= 7,815. Thus X^2=8,441 falls in the rejection region. The H_2 hypothesis must be rejected. Conclusion is process innovation success of firms depends on the number of employees.

Secondly we need to answer if the number of employees increases, how innovation success of firms will change. These hypothesis are formulated to test;

H_3: If the number of employees increases, product innovation success of firms changes.

Table 5 T Test- Group Statistics Of Product Innovation

	Product Innovation	N	Mean	Std Deviation	Std. Error Mean
Number Of Employees	Yes	29	2.7241	.75103	.13946
	No	23	2.0435	.70571	.14715

Table 6 Independent Samples Test- Product Innovation

		Levene's Test For Equality Of Variances		
		F	Sig	t
Number Of Employees	Equal Variances Assumed	2.180	.146	3.333
	Equal Variances Not Assumed			3.357

According to t test for product innovation α = 0.05 and Sig= 0,146. Thus 0,146> 0,05 and H_3 hypothesis must be accepted.

Hypothesis for process innovations are;

H_4: If the number of employees increases, process innovation success of firms changes.

Table 7 T Test- Group Statistics Of Process Innovation

	Process Innovation	N	Mean	Std Deviation	Std. Error Mean
Number Of Employees	Yes	32	2.6563	.74528	.13175
	No	20	2.0500	.75915	.16975

Table 8 Independent Samples Test- Process Innovation

		Levene's Test For Equality Of Variances		
		F	Sig	t
Number Of Employees	Equal Variances Assumed Equal Variances Not Assumed	1.428	.238	2.834 2.821

According to t test for process innovation $\alpha = 0,05$ and Sig= 0,238. Thus 0,238> 0,05 and H_4 hypothesis must be accepted.

4 Results

Our findings after analyzing the data,relationship between innovation success and number of employees is not coincidence. It is tested by analyzes. The results clearly shows if the number of employees increases, innovation success of firms will increase. The firm size is getting bigger and bigger, product innovation success increases from %20 to %40 and %82,35. And process innovation success increases from %20 to %52 and %82,35.

Table 9 Number of Employees And Innovation Success

Number Of Employees	Product Innovation	Process Innovation
1-9	%20	%20
10-49	%40	%52
50-249	%82,35	%82,35
250 and upper	%80	%80

5 Conclusions

In today's highly competitive markets firms evaluate all opportunities and possibilities to gain competitive advantage. This is getting more and more difficult by day by. To make it easier understanding technological innovaiton is vital for firms for several reasons. First innovation is perhaps the most powerful engine of growth. Second, technological change creates new growth markets through radical innovations. Third innovation often transforms small outsiders into market leaders replacing leading firms.

Small firms which want to increase innovation success, firstly they need to evaluate effects of innovation on quality of product and service, new markets, cost of labour, cost of energy and raw material, capacity of production and elasticity of production. They should investigate all financial supports for innovation and they should try to reach all knowledge sources to be innovative firm.

For any organization, innovation represents not only the oppurtunity to grow and survive but also the opportunity to significantly influence the direction of the industry .

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