DETERMINANTS OF INNOVATION BEHAVIOUR: ANALYSIS OF 2004-2006 TECHNOLOGICAL INNOVATION SURVEY OF TURKEY

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MİRAY KARAKUZU

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Prof. Dr. Sencer Ayata
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Assoc. Prof. Dr. Erkan Erdil
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Assoc. Prof. Dr.
Teoman Pamukçu
Supervisor

Examining Committee Members

Assoc. Prof. Dr.
Teoman Pamukçu (METU, STPS) _____

Assoc. Prof. Dr. Erkan Erdil (METU, STPS) _____

Assoc. Prof. Dr. Serhat Çakır (METU, PHYS) _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Miray KARAKUZU

Signature :

ABSTRACT

DETERMINANTS OF INNOVATION BEHAVIOUR:
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SURVEY OF TURKEY

Karakuzu, Miray
M.S., Department of Science and Technology Policy Studies
Supervisor : Assoc. Prof. Dr. M. Teoman Pamukçu

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Main purpose of this thesis is to analyse the main determinants affecting innovation behaviour by utilizing the results of Technological Innovation Survey of Turkey for the periods 2004-2006 combined with the results of Annual Business Statistics Surveys conducted for the year 2003. The total number of the observations of the matched data of the two Surveys is 947. Main underlying reason for the time lag introduced between the two surveys is to be able to relate firm and sector characteristics to the innovation behaviour in following years.

Logit model is established with three main dependent variables as firms doing product innovation, process innovation and either one of them. According to result of the analysis, four main areas are found to be promoting the innovation behaviour in firms. Firstly, as the firm size increases, the probability of engaging in innovation is found to be affected positively. Secondly, firms having foreign share also has more tendency for innovation. This result is surprising and disproof the initial assumption related with foreign share, since foreign investment is found to be a hindering factor in some previous studies in developing countries. Thirdly having intellectual property rights is positively related with innovation

behaviour. Last positively affecting factor is engaging in R&D, which is presumable. Three factors are found to be insignificant as Export Status, Import Penetration and Tariff Rate. The relationship between foreign trade and innovation behaviour could not be justified which is mainly due to lack of data reliability.

Keywords: Innovation, Innovation Surveys, Determinants of Innovation

ÖZ

YENİLİK DAVRANIŞINI ETKİLEYEN FAKTÖRLER: 2004-2006 TEKNOLOJİK YENİKLİK ANKETİNİN ANALİZİ

Karakuzu, Miray

Yüksek Lisans, Bilim ve Teknoloji Politikası Çalışmaları Programı

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Bu tezin ana amacı, 2004-2006 yılları için yapılan Teknolojik Yenilik Anketi'nin verilerini 2003 yılı İş İstatistikleri Anketi sonuçları ile eşleştirilmiş bir şekilde kullanılarak, işletmelerin yenilik faaliyetlerine etki eden faktörlerin belirlenmesidir. Eşlenmiş bu veri setinde 947 adet gözlem bulunmaktadır. Bu anketler arasındaki zaman farkının nedeni, firmanın özellikleri ile ileriki yıllardaki yenilik faaliyetlerini ilişkilendirebilmektir.

Ürün yeniliği, süreç yeniliği ve herhangi birini yapıyor olmak bağımlı üç temel değişken olmak üzere logit modeli kullanılmıştır. Analiz sonuçlarına gore özellikle dört temel alan yeniliği olumlu olarak etkilemektedir. İlk olarak firma büyüklüğü arttıkça yenilik yapma olasılığı da artış göstermektedir. İkinci olarak firmadaki yabancı sermaye oranı da yeniliği olumlu olarak etkilemektedir. Bu sonuç öngörülmemiş olup, bu konudaki hipotez analiz sonuçlarına göre reddedilmiştir. Üçüncü olarak fikri mülkiyet haklarına sahip olmak da yenilik davranışını olumlu etkilemektedir. Son olumlu etkileyen faktör ise, Ar-Ge faaliyetlerinde bulunmaktır. Dış ticaret ile ilgili faktörlerin yenilik davranışı ile ilgili olan ilişkisi verilerin beyan usülü alınması ve güvenilirliklerinin az olması nedeniyle kurulamamıştır.

Anahtar Kelimeler: Yenilik, Yenilik Anketleri, Yenilik Etkenleri

To My Parents

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CHAPTER 1

INTRODUCTION

Innovation at firm level is one of the main research areas in recent science and technology policy studies since innovation is accepted as the main driver of economic growth and wealth creation. In today's global economy, the innovative capability of a firm determines its competitiveness and activeness in international production and trade networks. With the advancements in information and communication technologies, access to international business has become much easier and firms can easily feel the repercussions of a technological change occurring in any part of the world. They need to be more flexible to keep up with the advancements and even push the technological frontier by themselves.

Earlier studies in this area have been focused on R&D efforts of firms. The linear model of innovation has been the main underlying approach in these studies, which assumes that carrying out research and development activities would lead to innovative output and economic gains. However, it is obvious that research is a costly activity with a high level of risk and not all innovative firms are actively involved in research effort. R&D can be perceived as a process producing new information and knowledge but this knowledge can be in the form of a set of patents or new information about an organic compound but not bring about any economic income or increased competitiveness. R&D contributes to the accumulated knowledge stock of the relevant field. Innovation, on the other hand, is the process of transforming knowledge into commercial value. Innovations can utilise the information gained by R&D efforts like in the commercialization of a new drug. Or alternatively, they can be small design or organisational improvements which provide the competitive edge against other firms. For instance, the mp3 player of Apple Inc., the iPod, has not added much to the

technological development in that product group but the incremental innovation, especially in design and functions yielded huge commercial gains and dramatically affected other firms in the same sector.

Such drastic effects of innovation on international trade and markets, defined as “creative destruction” by Schumpeter, have meant that countries and international organizations are now more involved than ever in innovation studies with the aim of gaining insight into the innovation process while also striving, on the one hand, to push existing firms towards increased competitiveness through better regulations and incentives and on the other to encourage a new generation of more competitive firms. For instance, the European Union (EU) has published the Green Paper on Innovation in 1995 which aims to analyze the dynamics of innovation in Europe and lays the groundwork for proposals to increase innovative capacity of the Union. In 2000, the EU declared its Lisbon Strategy which aims to make the EU "*the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010*". This strategy is also closely related to the innovation capabilities of European firms.

The United States of America have also displayed increased interest in innovation especially in the aftermath of the recent economic crisis which has put the American economy in dire straits. President Obama announced a new strategy of innovation in September 2009: “A Strategy For American Innovation: Driving Towards Sustainable Growth And Quality Jobs” This strategy considers innovation as an essential element for sustainable growth and quality jobs and drafts action areas to this end.

The Organisation for Economic Co-operation and Development (OECD) has also been an active player in innovation studies. Numerous important documents developed by the OECD have come to be accepted as

international standards. The OSLO Manuel, Guidelines for Collecting and Interpreting Innovation Data, was first published in 1992. It defines different types of innovation and proposes methodology to collect innovation data. It has been accepted as the methodological document in conducting Community Innovation Surveys (CIS) in various European countries and others like Canada. Turkey has also been conducting this survey nation-wide since the second round which was conducted in 1999 for the period of 1995-1997. More recently, the OECD launched its Innovation Strategy at the Ministerial Council in May 2007. This strategy aims to gain better insight into innovation activities and to design proposals for promotion, measurement and assessment of innovation. The strategy is supported by sub-projects including empirical ones which utilise data gathered by CIS, as in the case of the OECD innovation microdata project. This project utilises innovation data at the European level to run various econometric analyses and to propose improvements in innovation indicators.

Having thus mentioned the recent emphasis on innovation studies, once can conclude that understanding innovation is now of paramount importance when it comes to drafting national policies. The main motivation for this thesis is to analyze innovation behaviour of Turkish firms utilising Turkish data. This study tries to find out what kinds of determinants affect the firms' innovation decisions and to what extent. The findings of this main research question can be used as an input in the formulation of national policies supporting innovation. The following quotation (Freeman and Soete 1997) explains the importance of empirical research in innovation studies at national level:

> *There are many plausible, half-tested hypothesis and many interesting conjectures in innovation theory, but insufficient firm evidence to refute or support them. … Such systematic testing of generalizations and hypothesis is essential to advance our understanding.*

Briefly, the main aim of this study is to reveal the determinants of innovation for the Turkish case, which can be utilised for further analysis and policy design. There are only a limited number of empirical studies for Turkey (Pamukçu (2003), Özçelik and Taymaz (2005)) and more such research is required to fully understand the innovation behaviour of firms in such a predominant economy as Turkey.

The main data sources of this analysis are the 2006 Technological Innovation Survey, which is carried in parallel with CIS, for the time period 2004-2006 and the Annual Business Statistics Survey for the year 2003. The innovation activity is used as dependent variables from the first survey and explanatory variables are introduced from the second survey. A time lag is introduced between the two data sources to be able to perceive the effects of firm characteristics in innovation decision for the near-future. Since most of the determinants, like firm size, are affected by innovations, time lag is supposed to hinder the endogeneity problem.

The 2006 Technological Innovation Survey contains a total of 2173 observations. However, when matched with the 2003 Annual Business Statistics Survey, the number of firms which could be brought together in a single data set for various reasons goes down to 947.

Logistic regression has been chosen as an econometric analysis method with three different dependent variables, namely product or process innovation, only product innovation and only process innovation. Main independent variables analyzed as determinants of the above three different innovation activities are firm size, export status, foreign ownership, possession of intellectual property rights, import penetration, tariff rate, R&D activity, market concentration and skill level.

In the following chapter, measuring innovation and main types of innovation are discussed. In Chapter 3, previous literature on determinants of

innovation and recent empirical studies in this area are outlined. Chapter 4 explains the history of innovation measurement in Turkey and reports the main finding of the 2006 Technological Innovation Survey. The econometrics study is explained in detail in the 5th Chapter. The reason for the selection of logistic regression, the main hypothesis, dependent and independent variables, results and discussion of these results are available in this chapter.

CHAPTER 2

INNOVATION AND MEASURING INNOVATION

2.1. Technological Innovation Survey 2004-2006

As stated in the previous chapter, 2006 Technological Innovation Survey was conducted in 2007, in line with Community Innovation Survey (CIS) – 2006. Firm level data related to innovation activities between the time period of 2004-2006 is collected by this survey. One of the main aims of the survey is to better understand the relation between innovation and economic growth in Turkey. Moreover decision makers can obtain information about the determinants affecting innovative capacity of the enterprises which is a very essential source while designing and implementing science and industry policies and general economic policies depending on them. This study aims to conduct further empirical research using the outcomes of the survey, which will serve as an input for national policy design. Questions asking whether the firm realised any innovation activity in the period of 2004-2006 have been utilised as main data input for this study. Innovation concept and different types of innovation, like product and process, has been elaborated in this chapter to give better insight for the motivation of the analysis.

2.2. What is Innovation?

Innovation is, beyond the shadow of a doubt, the main source of impetus for long-term economic growth and the principal foundation on which competitiveness in global markets rises. It can also partly remedy many social challenges. The interplay of innovation and economic change is of utmost significance. Innovation results in the creation and diffusion of new knowledge, which in turn puts the economy in a better position to develop new products and methods of operation.

The term “innovation” was first used in the 15th century and a basic description of the term would be “the introduction of something new or new idea method or device”. Economic significance of the concept, however, is “the search for, and the new discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups” as defined by Dosi (1998, p.222). A slightly different take on the definition of the term comes from Schumpeter as “carrying new combinations”. This second definition is not merely restricted to the domain of technology since it could be suggested to entail the introduction of a new good; the introduction of a new method of production; the opening of a new market; the conquest of a new source of supply; and the development of a new form of industrial organization as put forward by Cooke and Morgan (2000). OSLO manual (OECD, 2005), used as the main reference in designing and implementing of Community Innovation Surveys defines innovation as follows:

*An **innovation** is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations*.

The distinction between the terms innovation and invention can be confusing yet the two concepts differ in a fundamental way. Invention is the first appearance of a new idea for a new product or process while innovation is the first attempt for the commercialization of this idea. Usually there is a time lag involved. Invention can be done in different places such as universities, laboratories but innovation requires a firm to combine different types of knowledge, capabilities, skills and resources. Invention may also require complementary innovation or inventions to make the realization of the invention feasible. For instance an invention may require a new material

to be developed, which is the main reason for the time lag between invention and innovation.

Innovation as a process is both social and interactive. In developing the National Innovation System NIS, Neo-Schumpeterian/evolutionary economists take stock of Schumpeter's view that innovation has a crucial role to play in economic growth. They also further elaborate this view to the extent that the innovation process should be regarded as a system of various actors' contributing economic activity. Learning, as indicated by Lundvall (1992, p.1), is a primary activity that occurs at all levels of this organic system. He goes on to further generalize this view by stating that "most fundamental resource in the modern economy (learning economy) is knowledge and, accordingly, the most important process is learning". Underlining the interactive and therefore socially embedded nature of the process of learning, Lundvall (1992) maintains that learning combined with the economic structure and the institutional framework form the adequate breeding grounds for, and dramatically affects, the process of interactive learning. This process, in turn, would result in innovations. Therefore, it becomes evident that innovation as a process is a social one that evolves around human interaction.

2.3. The Nature of Innovation

Certain aspects of the nature of innovation process strike out in modern economy as described by Dosi (1988, p.222). First among these aspects is the fact that the very notion of innovation involves a fundamental element of uncertainty. It is hardly possible to foresee or predict potential technical and commercial outcomes of innovative undertakings beforehand or even during the very process on innovation. The second significant aspect in Dosi's view (1988) is that innovations rely more and more on scientific advances which enrich knowledge in the field. Thirdly, research and innovation have become increasingly intricate processes performed in formal organizations such as private laboratories belonging to firms, government laboratories and

universities while former innovative endeavours were usually associated with reclusive scientists working within their own resources. Today, however, formal research is more and more integrated in the industry. Fourthly, a considerable portion of all innovation and improvements are achieved through “learning by doing” and “learning by using”. As underlined by Dosi (1988), “informal” activities involved in solving various “innovation” problems can provide firms with the opportunity to learn how to use/improve/produce the involved things. The fifth major point is the view that technological improvement cannot be depicted as mere flexible reactions to changes in market conditions. Instead, and quite the contrary, it is a combined outcome of already existing cutting edge technologies, the very nature of these technologies and levels of technological advancement achieved by firms, organizations and countries.

2.4. Types of Innovation

The work of Joseph Schumpeter has greatly influenced theories of innovation. He argued that economic development is driven by innovation through a dynamic process in which new technologies replace the old, a process he labelled “creative destruction”. In Schumpeter’s view, “radical” innovations create major disruptive changes, whereas “incremental” innovations continuously advance the process of change. Schumpeter (1934) proposes a list of five types of innovations:

- Introduction of new products.
- Introduction of new methods of production.
- Opening of new markets.
- Development of new sources of supply for raw materials or other inputs.
- Creation of new market structures in an industry.

Despite the five main categories proposed, the first two of have attracted the main attention in economics. The relationship between economic growth

and the product and process innovations has been the main focus of research in innovation literature.

Another point of view in classifying innovation is done through comparison with the current state of the technology (Freeman and Soete 1997). In this sense the continuous improvements are referred to as “incremental” or “marginal innovations” whereas the big improvements such as introduction of a new machine or process are called as “radical” innovations. Schumpeter underlined the importance of the radical innovations in the economic progress. However this view is challenged by some other scholars. Lundvall (1992) suggested that, continuous incremental innovations also have economic impacts as significant as radical innovation. Radical innovations also require a sequence of continuous incremental innovations in order to increase the commercialization and competitiveness of the product or process.

Henry Chesbrough (2006) suggests another classification of innovation, namely closed and open innovation. Chesbrough suggests that business community is experiencing a “paradigm shift” in commercialization of industrial knowledge. He uses the term paradigm shift as describing how professionals pursue industrial R&D and innovation, with reference to Thomas Kuhn (1962).

Closed innovation was tacit knowledge for way of doing business: In the twentieth century, German chemical industry created a central research laboratory, which was used to develop and commercialize a tremendous variety of new products. However, mobility of skilled labor turned out to be the main erosion factor for the closed innovation paradigm. Private venture capital which supported establishment of spin-off companies also accelerated this erosion.

Closed innovation refers to activities within the internal resources of the enterprise with very limited or no contribution of external know-how or resources whereas open innovation refers to extensive interaction of the enterprise in innovative process through licensing or spin-off companies.

As seen above, there are various classifications of innovation in the current literature. Since the results of the Technological Innovation Survey are utilized in this study, the classification proposed in the third edition OSLO Manuel (OECD, 2005) is central to the attention. The manual defines four main types of innovation as: product innovations, process innovations, marketing innovations and organizational innovations. In the first two editions of the manual (1992, 1997), there are two main classifications as: technological product and process. Discussion about organisational and non-technological innovation was only included as an annex. The manual explains the introduction of organisational and marketing innovation as to fulfil the need the understand how firms innovate and what types of innovations they realize, since knowing whether they are not innovative or not is not enough for researchers and policy makers.

2.4.1. Product Innovation

As stated above, the first type of innovation classified in OSLO Manuel (OECD, 2005) is product innovation. It is defined as follows:

A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. (OECD, 2005)

The term product includes goods and services. Product innovation can be introduction of new goods and services and significant improvements in the

operational or user characteristics of the existing good or services. Fist microprocessors, digital cameras or introduction of online banking for the first time can be named as the examples of new products. On the other hand, significant improvements in products can be illustrated as: using advanced fabrics enables breathing in clothing and improvement of online services radically.

Product innovations do not include insignificant changes, ordinary upgrades, and regular seasonal modifications (as in clothing) and design changes that do not bring about significant change in product's functional characteristics.

Section two of the 2006 Technological Innovation Survey includes questions related to product innovation. Question 2.1. which asks whether during the three years 2004 to 2006 the enterprise introduced any new or significantly improved goods or services, is defined as one of the main dependent variable of this study. This section of the survey also asks by whom this product innovation realised, the market for this innovations and the percentage of income generated by these innovations in the total revenue.

2.4.2. Process Innovation

The second type of innovation included in the OSLO Manuel (OECD, 2005) is process innovation, which is defined as follows:

*A **process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.* (OECD, 2005) Process innovation is as important as product innovation and in most cases it is used as a complementary improvement.

Process innovations can be in various forms as: reduction of unit production or freight costs, increasing of the quality of the product. Utilization of Computer aided Design (CAD) techniques can be an example of process

innovation in the development phase of a new product. Utilization of barcode technique is a process innovation contributes to enhancement of the quality by tracking of goods.

2006 Technological Innovation Survey investigates process innovation at section three. If firm reported that it had applied any process innovation for the time period 2004-2006 (Question 3.1.), firm is also asked the kind of process innovation. The alternatives available are as follows:

- New or significantly improved methods of manufacturing or producing goods or services
- New or significantly improved logistics, delivery or distribution methods for the firm's inputs, goods or services
- New or significantly improved supporting activities for firm's processes, such as maintenance systems or operations for purchasing, accounting, or computing

2.4.2. Organisational and Marketing Innovation

The third edition of OSLO manual adds two new innovation types, marketing and organizational innovation, to main types of innovation. *A **marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.* (OECD, 2005) Marketing innovations aim to address customer needs better, open up new markets, or reposition a firm's product on the market, with the objective of increasing the firm's sales.

*An **organizational innovation** is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations.* (OECD, 2005) Organizational innovation has principally to do with the particular manner of doing business.

Organisational innovation was discussed in the previous edition (2nd edition, 1997) of the manual, Lam (2005) states that, even economists consider

organisational change as a response to technical change; organisational innovation could be the trigger for the product or process innovation. It is obvious that organisational structures can affect firm's activities and performance and the decision to innovate
or engage in R&D activities.

The final section, section 10, is devoted to both marketing and organizational innovation. Since the introduction of these two types to the empirical studies is very recent, they are not included to the scope of this study.

2.3. Innovation Systems

The performance of an innovating firm is not limited with its own capabilities and resources. The business and legal environment where the firm operates are also very important factors affecting its performance. Therefore it is crucial to improve and design new organizational and functional paradigms in which the performance of innovators would rely on the relations and cooperation between actors in the system. Innovation systems can be defined and analyzed as three complementary layers as: national innovation system, regional innovation system and sectoral innovation system.

2.3.1. National Innovation Systems

The term "national system of innovation" (NSI) was first used by Freeman (1987). Freeman (1987) described this system as the network of public and private sector institutions whose activities and interactions trigger, import, and spread new technologies. There are two main approaches to the NSI concept by Lundvall (1992) and Nelson (1993). Nelson (1993) focuses on national systems on a case study basis rather than theory development. On the other hand, Lundvall (1992) is more theoretically oriented and develops an alternative to the neo-classical economists. Lundvall suggests that "the structure of production" and "the institutional set-up" are the two vital pillars

that “jointly define a system of innovation” Also suggested by Lundvall (2000) is the fact that innovation systems are both social and dynamic. This suggestion refers to both the institutions that make up the system and the linkages and information flows among them. The NSI approach regards the nation as the primary unit of analysis which makes sense to capture the information flows and their impact on the economic growth on the national level which governs these flows. Although capital is mobile within borders, human capital and know-how has limited mobility due to tacit knowledge.

2.3.2. Regional Innovation Systems

Regional Innovation System approach is a relatively new concept compared to NSI. The concept has its origins in the “industrial clusters” (Porter, 1990) studies in which linkages and information flows within firms having spatial proximity are analyzed. The approach is mainly used as an analytical framework for advancing the understanding of the innovation process in the regional economy. No single definition of the concept of regional innovation is universally accepted; however, it is usually recognized as a series of private and public interests, formal institutions and other organizations that are in interaction and that function in line with organizational and institutional arrangements and relationships which lead to the generation, use and dissemination of knowledge (Doloreux, 2003).

2.3.3. Sectoral Innovation Systems

The third complementary layer in the innovation systems approach is the sectoral innovation systems. Malerba’s (2002) perception of the sectoral system framework is one that focuses on the nature, structure, organization and dynamics of innovation and production in sectors with special reference to building blocks; actors, networks, institutions, demand and knowledge. With this approach information flows and linkages are analyzed with a sectoral basis.

2.4. Measuring Innovation: Innovation Surveys

The fact that innovation holds the key to economic development has meant that the importance of innovation studies is constantly increasing. Therefore, availability of relevant data obtained through innovation surveys has emerged as a vital point.

Even though governments first became interested in innovation in the 1960s, it is only in the 1980s that OECD countries started conducting innovation surveys on a regular basis. Before this came to be the norm, there were mainly two approaches for measuring innovation.

First one is measuring innovation as output. In this approach significant innovations were analyzed and sources of these innovations were studied. The first example of this approach was realized in the UK in late 1950s by Carter and Williams (1957). First institutional attempt with this approach was done by US National Science Foundation (NSF). Commercialized technological innovations that bear the characteristics of the related firms were spotted and counted. The period 1963-167 saw the first large NSF innovation study. In 1974, a second round of the innovation survey was realized utilizing the same approach.

OECD also initiated studies with output approach. Gaps in Technology (1968) report collected and analyzed innovations in order to explain the key differences between the United States and Europe. Data from OECD sector studies, national governments, published resources, experts and industrialists formed the basis for the report was based on data collected from OECD sector studies as well as national governments, published resources, experts and industrialists.

Three limitations to the output approach were set by the US Department of Commerce (1967): limited and biased sample, no assessment of the relative importance of innovations and difficulty of clearly identifying the country of origin.

The second approach in measuring innovation is activity-based. Both NSF and OECD abandoned the output approach in order to be able to collect all data relevant to innovation activities and costs. NSF conducted two consecutive innovation surveys in 1985 and 1993.

OECD Group of National Experts on Science and Technology Indicators (NESTI) also made significant efforts to develop a methodological framework for systematic collection of innovation data. In this way, it would become possible to obtain comparable data which would in turn be available for the use of member countries. As a result of these efforts, Oslo Manual was developed and adopted in 1992, in cooperation with Eurostat. The Manual was revised twice in 1997 and 2005.

The main function of the OSLO Manual is to provide a theoretical and practical basis on which innovation surveys would be conducted. The manual covers various suggestions for obtaining data on varying sorts of innovation expenditures, innovation outcomes, innovation objectives, possible uses of diverse sources in deriving information on firms' innovation activities as well as methods which protect of thwart innovation.

The Oslo Manual does not include specific requirements for organization of an innovation survey, since national characteristics are also important in survey design. To maintain comparability between EU countries, the harmonised questionnaire of Community Innovation Survey (CIS), containing core set of questions, was developed by Eurostat in collaboration with the European Commission in 1992. The resulting survey (CIS) was conducted in 13 European countries in 1993. The second round (CIS2) and

the third round (CIS3) of the survey were realized in 1996 and 2003 respectively. The fourth round was initiated in 2004 to cover the activities conducted by firms during the time span between 2002 and 2004. With the third edition of the OSLO Manual in 2005, the set of questionnaires were revised according to the suggestions of the new edition. Questions related to marketing and organizational innovation were added. The most recent round was conducted in 2006. (CIS-2006)

Currently, CIS is conducted regularly every two years by the EU member countries. Some non-member countries like Australia, Canada, Iceland, Japan, Korea, New Zealand, Norway and Switzerland, are also conducting CIS to obtain comparable data.

CHAPTER 3

FRAMEWORK SITUATION IN THE ANALYSIS OF INNOVATION SURVEYS

3.1. Recent Literature about Different Aspects Analyzed

In the previous chapter, the definition and measurement of innovation have been discussed. As emphasized before, innovation is essential for economic growth. To be able to develop policies that support innovative firms or leads firms to become more innovative, it is vital to understand the innovation process. In other words, the following question must be answered: *What kind of firm or market characteristics affect innovation behaviour?* In this chapter, literature considering the question above is discussed. Recent econometric studies have utilized the results of innovation surveys or other various data sources to investigate different aspects of firms or sectors. The main focus of these studies, relevant to this study can be listed as follows:

- Firm Size
- Sector of Enterprise
- Technological Opportunities
- Competitive Conditions
- Foreign Ownership
- Internationalization
- Utilization of Intellectual Property Rights

3.3.1. Firm Size

The main firm characteristic analyzed among the determinants of innovation is the firm size. There are various assumptions about the correlation between the firm size and innovation. Small and Medium Sized Enterprises (SMEs), with less than 250 employees according to Turkish and EU definition (see Table 3.1 for SME definition in Turkey) are defined as small and flexible, which are important characteristics for innovation. On the other hand, some countries like South Korea are dependent on large firms. The so-called ”national champions” are responsible for the majority of economic activities and innovation. It is important to keep in mind that the firm distribution in Turkey in terms of size is not comparable with industrialised countries like Germany, the UK or France, where large companies usually have more than 1000 employees. However, 99% of the firms in Turkey are SMEs according to the below chart.

Table 1. SME definition of Turkey according to Departmental Committee Decree No: 2005/9617

	Number of Employees	Annual Turnover or Annual Balance Sheet Total
Micro Enterprise	< 10	≤ 1 million TL
Small Enterprise	< 50	≤ 5 million TL
Medium Enterprise	< 250	≤ 25 million TL

Recent studies which aim to analyze the effect of firm size on innovation activity have tended to focus on hypotheses of Schumpeter on the correlation between firm size and innovation efforts. Schumpeter (1942)

argues that innovation intensity augments proportionally with firm size and industry concentration.

In his earlier studies, Schumpeter (1934) had contradicting views related to firm size. He had claimed that innovations were realized in new and small firms which were not operating in existing production activities. He later changed his perspective when he analyzed big firms in industries like the chemical sector. He concluded that economies of scale is very important for firms which have R&D projects. They can spread the risks of R&D by undertaking multiple projects at a time; they are better placed to benefit from unforeseen innovations. Obtaining external financing to run innovation activities is also easier for large firms. As a result, he changed his opinion on firm size and "Schumpeterian Hypothesis" (which claims that large firms in concentrated markets are more likely to support innovation) became one of the main research areas in innovation literature. Various researchers realized empirical research to test this hypothesis for different countries and sectors.

For instance, Pavitt et al. (1987) examined the relationship between firm size and innovation activity based on information on more than 4000 significant innovations realized in the UK for the time period of 1945-1983. He suggested that the relationship between innovative activity and firm size is U-shaped instead of r-shaped. According to his results, over the 1956-1983 period, innovation intensity increased consistently for firms with less than 500 employees and declined for firms with more than 500 and less than 10000 employees. The very largest firms were consistently the best performers throughout the 1956-1983 period.

Innovation surveys conducted in many countries have also been analyzed to point out whether a firm's probability of undertaking innovation activities increases with the firm's size (usually illustrated with total employment). Braga and Willmore, (1991) analyzed Brazilian data for 4342 industrial

establishments surveyed in 1981. They ran a logistics regression to test different dependent variables as proxies for technological activity. According to their results, firm size has a positive and highly significant effect on all technological activities.

Henderson and Cockburn, (1996) conducted a comprehensive study for the pharmaceutical industry. Detailed internal firm data of 10 R&D performing firms were analyzed. They concluded that large firms are more productive in their research efforts, because they can benefit from economies of scale and scope.

Evengelista et al. (1998) analyzed innovative firms in various European manufacturing sectors and their firm sizes by utilising the results of the 1993 Community Innovation Survey. Their study also revealed that larger firms engage in higher levels of innovation than smaller firms.

Malerba (1993) analyzed Italian industrial composition in a historical perspective untill late 1980s and concluded that large firms play a significant role in core R&D system whereas small firms interact in a local level with limited innovation intensity.

Peeters and Van Pottelsberghe (2003) analyzed Belgian manufacturing firms' innovation capabilities and performances. Their study indicated that larger firms are more successful with regard to innovation capabilities.

Some empirical studies have mixed results when it comes to the correlation between innovation intensity and size. To illustrate, Dasgupta et. al (1980a, 1980b) put forward that size and innovation are interdependent. Lööf et al. (2001), on the other hand, found in their study spanning Nordic counties that firm size had a negative impact on innovation intensity in Finland, a positive one in Norway and a negligible one in Sweden.

Benavente (2006) found out, for his part, that bigger firms display a higher percentage of innovative sales and that the R&D intensity of firms with larger market shares is also higher. Chudnovsky et al. (2005) examined the results of the innovation surveys in Argentina from 1992 to 2001 and concluded that bigger firms are more likely to undertake innovation work and release novelties into the market.

There is also empirical evidence that (Acs et al, 1998) successful innovators grow faster than other firms and become larger than non-innovators.

There are also studies which fail to show the positive correlation of size and innovative activity. (Worley, (1961); Mansfield, (1964); Grabowski, (1968); Adams, (1970); Loeb and Lin, (1977); Acs and Audretsch, (1988)). There are even some studies (Holmstrom, B. (1989)) which suggest that there is a negative correlation.

As it is obvious from the preceding paragraphs, there is, in the literature, a great variation in empirical findings related to size. One of the main reasons of this variety is that size is closely related to the sector of enterprise. Pavitt (1987) suggested that firms operating in high technological opportunity sectors are usually either very small or very large firms. Large firms are more innovative in sectors like chemicals and electric and electronics whereas small firms are more dominant in sectors like machinery/mechanical engineering and instruments. Moreover, firm size is not comparable in developed and developing countries.

3.3.2. Sector of the Enterprise

Sector of the enterprise is also an important factor affecting firms' innovative behaviours. Technological opportunities and the competitive conditions of the sector in which the firm is operating affect the firm's innovative behaviours. Nelson and Winter (1982) introduced the term "technological regime" to define the surrounding of the firm that affects the innovative behaviour and numerous empirical studies (Pavitt, 1984; Malerba and Orsenigo, 1993, 1996; Audretsch, 1997) indicated that firms operating in the same technological regime tend to organise innovative activities in a same manner. The firms in the same sector share the sources of information and technology and face alike opportunities for innovation, they also have similar users and user demands that can trigger innovation. Levin et al. (1987) emphasized appropriability conditions which refer to the environmental factors that govern an innovators ability to capture profits generated by an innovation. These empirical studies in sectoral difference resulted in the establishment of different taxonomies for sectoral classification.

For example, Pavitt (1984) developed a classification that divides the sectors in three as: 1) supplier dominated, 2) production scale intensive– determined by the size and principal lines of activity and 3) science based. On the other hand, Scherer (1982a, 1982b) provides a two-fold sector classification as patent creating and patent using.

Robson et al. (1988) extended Scherer's classification and suggest a new division as the intensity of innovation in an industry versus the extent to which an industry diffuses products and process innovation.

On the other hand, strategic management literature emphasizes that firm differences can lead to behavioural differences in the same sector.

Technological opportunities vary across sectors because scientific progress favours some sectors over traditional sectors. For instance, biotechnology

and nanotechnology are two sectors heavily engaged in R&D activities. These two fields come up with more R&D-based product and process innovations whereas more traditional sectors like textile are not enjoying technological opportunities as intensely. Similarly, Mairesse (2004), suggests that innovation is more sensitive to R&D in technology intensive sectors than low-tech sectors.

The structure of the market is also another important factor affecting innovation. In the literature, it is generally accepted that firms operating in concentrated markets are more likely to innovate since monopoly structure is believed to make it easier for firms to invest in innovation. One of the main arguments of Schumpeter (1942) is that innovation intensity augments proportionally with industry concentration.

On the other hand, other scholars such as Arrow (1962), claim that benefits from innovation at the margin are higher in a competitive market compared to a monopolistic environment. Furthermore, absence of competitive environment can lead to bureaucratic inefficiency (Scherer, 1980).

3.3.3. Foreign Ownership

Due to its role in the development and spread of knowledge and innovation, multinationality is a key part of strategies employed by firms. Multinational companies benefit from the experiences of their various local subsidiaries and these subsidiaries can further spread innovation effects in their localities. Such an organizational structure has the potential of leading to higher innovation.

Multinational firms have various intangible assets like brand recognition, organizational structure and efficiency which can lead to organisational or marketing innovations for the local subsidiaries.

For instance, Frenz et al. (2004) analyzed the results of CIS2 and CIS3 for the UK and concluded that multinationality is positively correlated to innovation. On the other hand, the results of the study suggest that the country of origin only affects innovation propensity. Foreign ownership has no impact on other innovation-related measures (innovation outputs, innovation inputs or continuous innovation). Love and Ashcroft (1999) suggest that a positive correlation exists between foreign ownership and innovation.

Ebersberger et al. (2005) concluded that in the Nordic region - albeit with the exception of Norway - the propensity of undertaking R&D and innovation work remain the same in both foreign-owned firms and domestically-owned firms.

Sadowski et al. (2006) analyzed the CIS2 results in the Netherlands and stated that foreign subsidiaries are more innovative, that they are more prone to launching both “imitative” and “real” innovations than local firms.

There are also counter findings related to foreign ownership. This can be the case for developing countries where the MNCs have subsidiaries with limited function. Innovative activities and information flow from headquarters are limited in these countries. Bishop and Wiseman (1999) concluded that foreign capital has a detrimental effect on firms’ innovative capabilities.

Firms engaged in international activities are open to various markets and to knowledge transfer via foreign trade activities. Internalization can be linked to the enhancement of technological capabilities and further investment in innovation activity. Empirical studies indicate that there is a positive relationship between internalization and innovation activities. (Lunn and Martin (1986), Braga and Willmore (1991), Kumar and Saqib (1996))

3.3.4. Utilization of Intellectual Property Rights

The main incentive of innovation is to increase competitiveness and profitability by commercializing new products and new methods. If there is a threat perception that other firms could easily copy these innovations, the motive for innovation will decrease. Therefore, companies tend to protect their inventions either through trade secrets or via different forms of intellectual property rights, such as patents, copyrights and trademarks. Nevertheless, Mansfield (1986) and Levin et al. (1987) suggested that patents may not, after all, be so important in many sectors. According to the empirical study by Cohen, Nelson and Walsh (2000) conducted using data from the United States, different forms of intellectual property protecting measures (trade secrets, being first in the market, complex designs) are more efficient than patents.

Whether intellectual property rights promotes innovation is not clear. In order to have this kind of stimulation, a firm must utilize the intellectual property for further improvement or realization of new products and methods.

CHAPTER 4

INNOVATION SURVEYS IN TURKEY

4.1. Historical Development

Innovation surveys in Turkey were initiated parallel to CIS2 by the State Institute of Statistics (currently named as Turkish Statistical Institute (TURKSTAT)). In its first experience, two separate questionnaires were designed for manufacturing and service sectors for the activities covering 1995-1997. The survey was conducted in 1999. According to the results of these surveys, 24.6% of the firms in the manufacturing sector and 48.2% of the firms in the service sector declared that they had realized technological innovations.

The second round for Turkey in innovation surveys was the CIS3. This time, an integrated questionnaire was used both for the manufacturing and the service sector. The field study was realized in 2002 and the firms were asked about their activities for the period of 1998 - 2000. The results were announced in 2004. 29.4% of the firms in the manufacturing sector and 38.5% of the firms in the service sector declared that they had realized technological innovation during that time span.

CIS4 was the third round for the Turkey in innovation surveys. The survey was conducted for the innovation activities in the time span of 2002-2004. According to the results of the survey 34.6% of the firms in manufacturing sector and 24.6% of the firms in service sector engaged in innovation activities.

The most recent round of the innovation surveys, entitled 2006 Technological Innovation Survey, was conducted in 2007. It was realized in line with CIS-2006 and data was collected for the time period of 2004-2006.

In regards to the type of innovation that most characterizes the activities of innovating firms in the manufacturing and service sectors, innovating firms mostly undertake product and/or process innovation as technological innovation (Table 4.1).

Table 2. Technological Innovation Activities of Turkish Firms (%)
Source: TurkStat

CIS	Manufacturing Sector	Service Sector
1995-1997	24.6	48.2
1998-2000	29.4	38.5
2002-2004	34.6	25.9
2004-2006	35.3	24.6

According to CIS 2004-2006, almost all of the innovating firms in Turkey cooperated with other domestic firms, which corresponded to 85.1% and 90.4% of innovating firms in the manufacturing and services sectors, respectively (Table 4.2).

Table 3. Inovating Firms Cooperating for Technological Innovation Activities(%)
Source: TurkStat

CIS		Country			
		Domestic	**EU**	**US**	**Others**
2002-2004	Manufacturing Sector	86.1	31.3	5.2	7.9
	Service Sector	85.4	24.6	9.8	13.6
		Domestic	**EU**	**US and Others**	
2004-2006	Manufacturing Sector	85.1	11.9	3.0	
	Service Sector	90.4	8.7	0.9	

In comparison to CIS 2002-2004, the results of CIS CIS 2004-2006, indicate that innovating firms in the service sector have more actively been engaged in other enterprises within their enterprise group (64.3%) while firms in the manufacturing sector have more actively been engaged with the suppliers of equipment, materials, components, or software (77.4%) as provided in Table 4.3.

Table 4. Characteristics of the Cooperation Partners of Innovating Firms (%)
Source: TurkStat

CIS		Type of Partner						
		Other enterprises within your enterprise group	Suppliers of equipment, materials, components, or software	Clients or customers	Competitors and other enterprises in your sector	Consultants, commercial labs or Private R&D institutions	Universities or other higher education institutions	Government or public R&D institutions
2002-2004	Manufacturing Sec.	53.8	76.5	66.5	45.4	46.8	31.8	21.5
	Service Sec.	62.0	76.7	64.3	54.8	48.5	29.1	31.0
2004-2006	Manufacturing Sec.	47.4	70.1	58.6	37.3	43.0	34.2	23.6
	Service Sec.	64.3	77.4	61.0	38.0	62.3	38.0	26.3

Since the results 2006 Technological Innovation Survey, CIS 2004-2006 are utilized for this study, the main descriptive findings of the survey are elaborated in the following section.

4.2. Descriptive Statistics for CIS-2006

Questionnaire of the 2006 Technological Innovation Survey (Annex A.) was developed according to the EUROSTAT CIS-2006 and the recommendations of the 3rd edition of the OSLO Manual. In the first section of the survey, the general characteristics of the firm like the legal title, foreign share, turnover, number of employees and the markets where the firm is operating, were asked. The second section is devoted to questions related to product innovation. Types of process innovations realized and the actor mainly responsible for this process innovation are asked in section 3.

Sections 5, 6 and 7 are devoted to the firms which allegedly make product or process innovations. Information about innovation expenditures, knowledge resources utilized, collaborations and the impact of the innovation activity are collected in these sections. In section 8, failed or abandoned innovation activities and hampering factors are asked to firms. Section 9 is devoted to intellectual property rights. Finally, the last section is related to organizational and marketing innovations. This section was not available in previous rounds of the innovation surveys and was integrated to the survey according to the suggestions of the 3rd edition of the OSLO Manual.

4.2.1. General Information about the Firms

There are a total of 2173 observations obtained via 2006 Technological Innovation Survey. Only 397 (18%) of these firms belong to an enterprise group. Most of the firms do not have any foreign share in their capital structure. Only 200 (9% of the total sample) firms declared having foreign share. The distribution of firms according to their foreign share ratio is available in Figure 4.1. According to figure almost half of the firms (45%) having foreign share has no domestic shares. 78% of the total of 200 firms have a majority of foreign share, only 44 firms have foreign share majority of the shares are domestic.

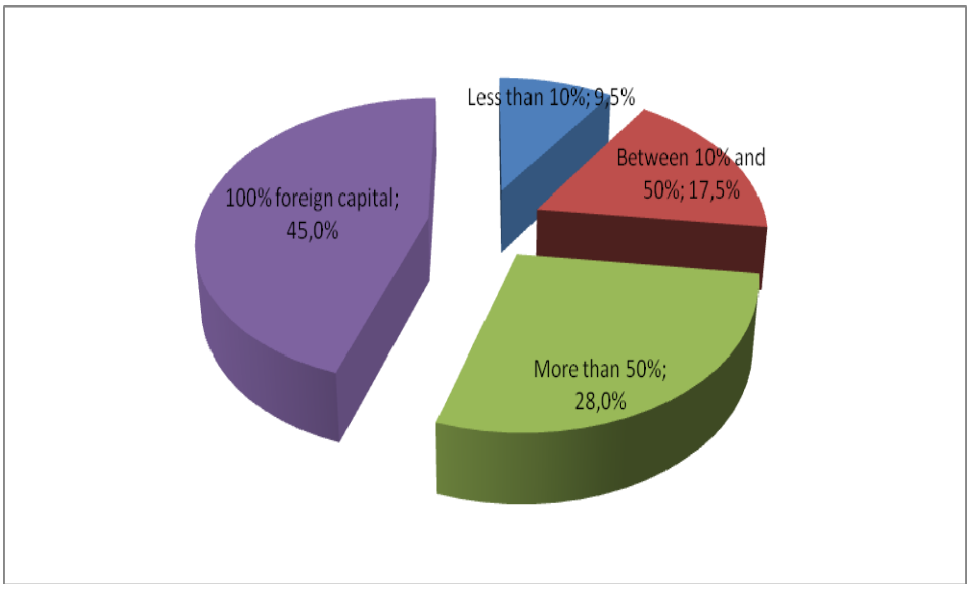

Figure 1. Distribution of firms according to foreign share ratio

Source: TURSTAT 2006 Technological Innovation Survey

For the determination of size class of the firms, the total number of employees, owners/partner, unpaid workers, were asked for the months of February, May, August and November 2006 and the average number of these four months was calculated. The size distribution below is based on that average number. Small and Medium Enterprises (SMEs) constitute the majority of the observations with 78%.

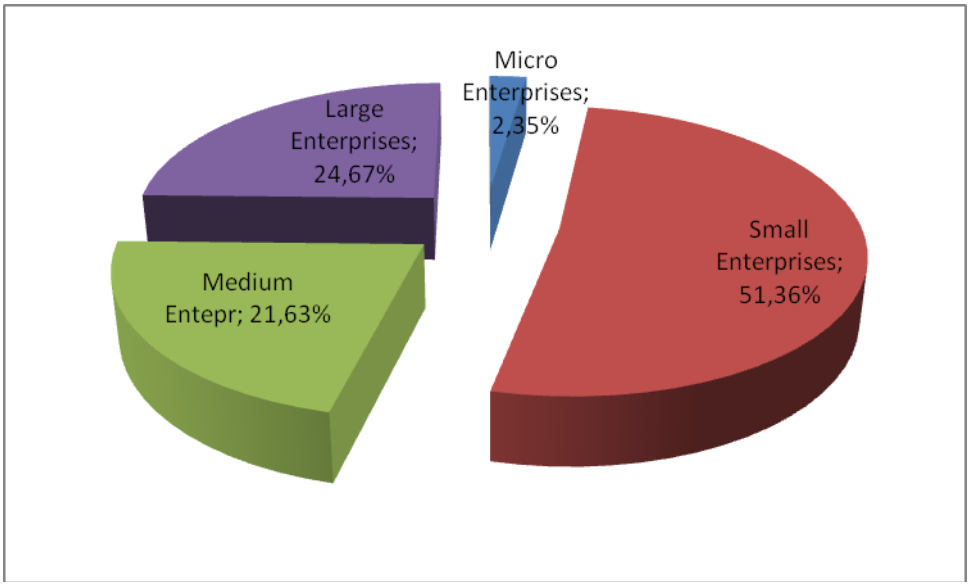

Figure 2. Size Classification of the firms
Source: TURSTAT 2006 Technological Innovation Survey

4.2.2. Product Innovation

The second section of the survey is devoted to product innovations. As it is seen in the figure below only 26% of the firms realized a product innovation.

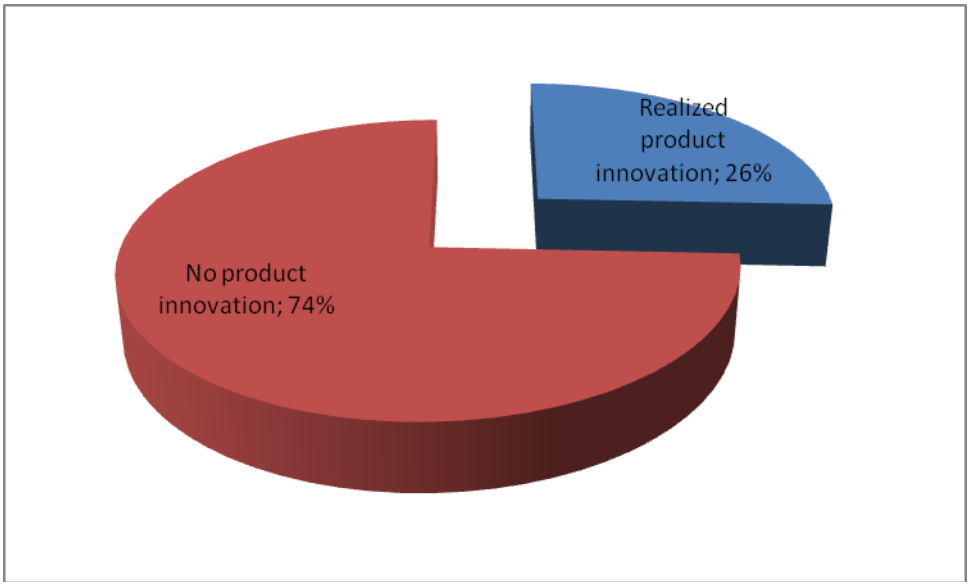

Figure 3. Ratio of Firms performed product innovation
Source: TURSTAT 2006 Technological Innovation Survey

The majority of the product innovation is related to goods. As available in Figure 4.4. only 37% of the product innovations is related to services.

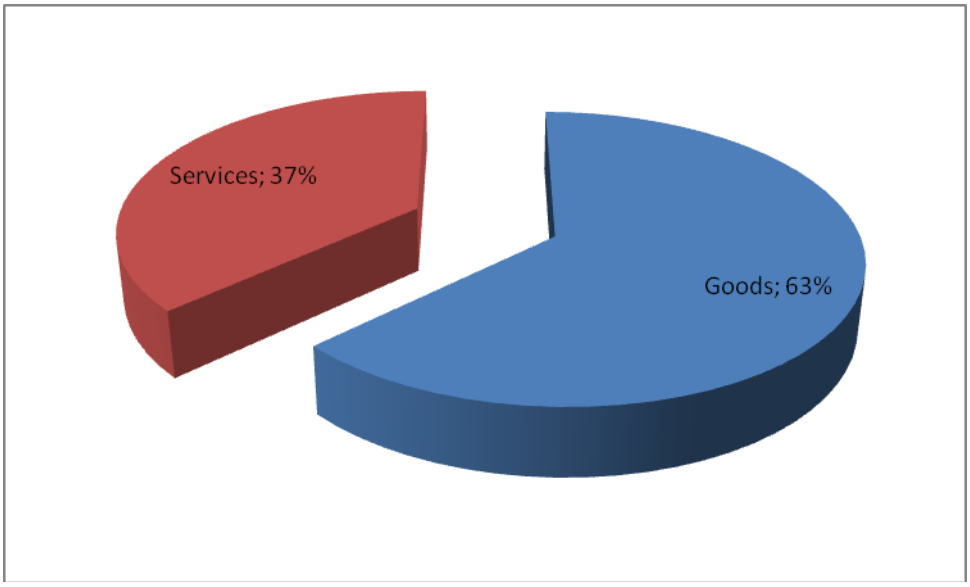

Figure 4. Distribution of product innovation types
Source: TURSTAT 2006 Technological Innovation Survey

The results of the survey reveal that, collaboration with other partners are weak while performing product innovation. Majority of the firms engage in innovation activities in isolation. Statistical information about the degree of novelty is available in Figure 4.6.

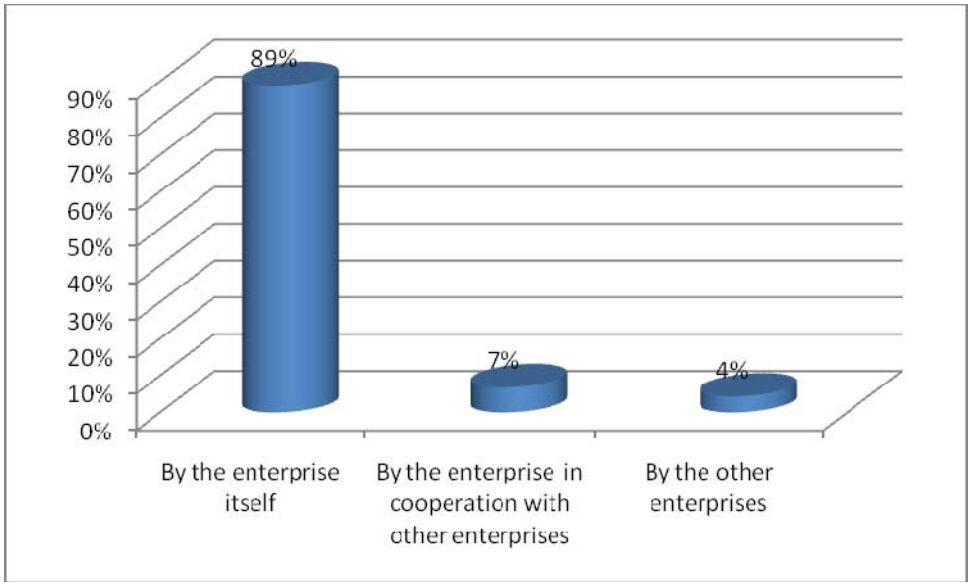

Figure 5. Type of collaborations related to product innovation
Source: TURSTAT 2006 Technological Innovation Survey

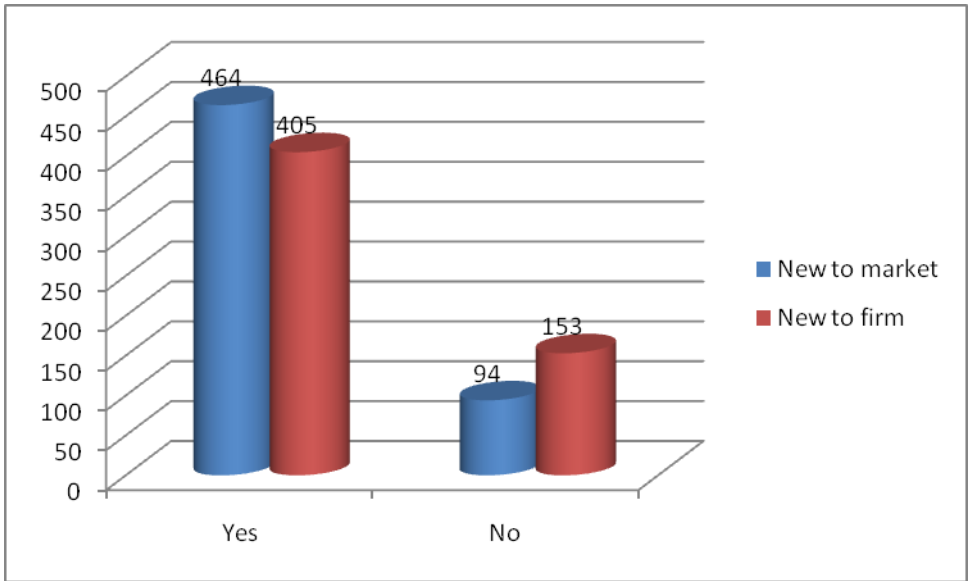

Figure 6. Degree of novelty of the product innovations
Source: TURSTAT 2006 Technological Innovation Survey

4.2.2. Process Innovation

The third section of the questionnaire is devoted to process innovations. As available in Figure 4.7. 27% of the firms declared that they realized process innovation for the reporting period. There is also a question investigating the type of this process innovation. According to the results of this question 44% of the process innovations are related with the new/improved methodologies for the production. Whereas 36% of the process innovation is devoted to the new/improved logistics for production and the rest of the process innovations are related with supporting activities.

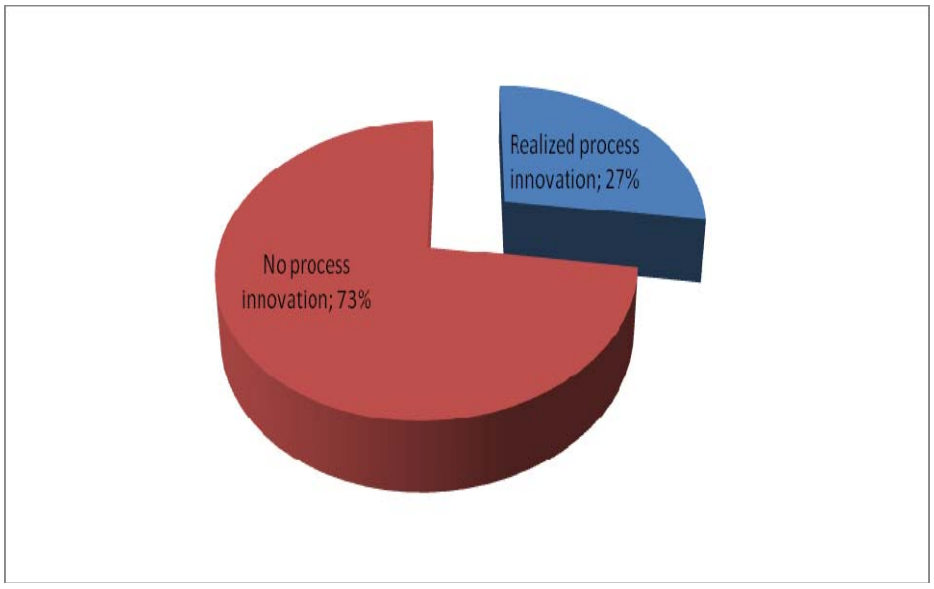

Figure 7. Ratio of Firms performed process innovation
Source: TURSTAT 2006 Technological Innovation Survey

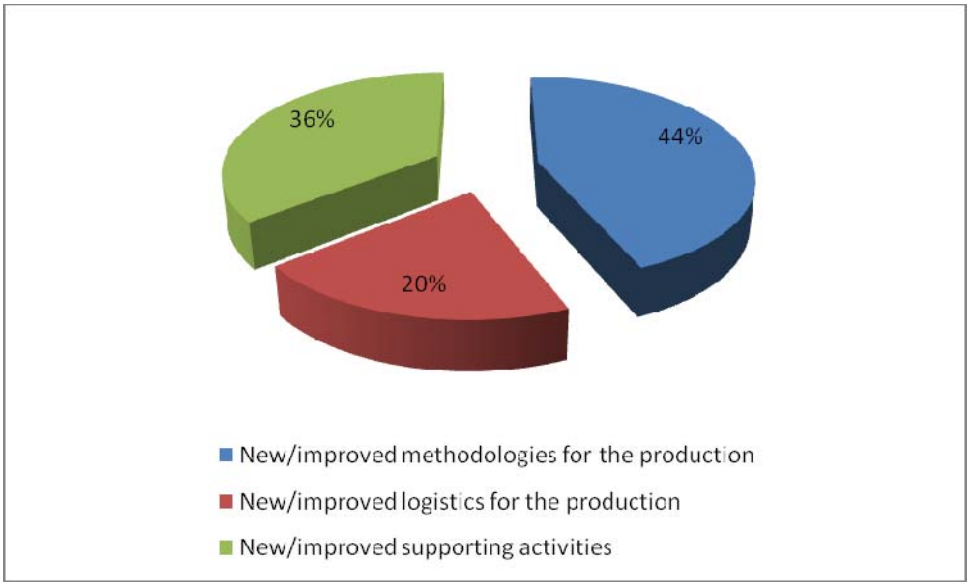

Figure 8. Types of Process Innovations
Source: TURSTAT 2006 Technological Innovation Survey

As in the case of the product innovation, majority of the process innovations are performed by the enterprise itself. However relative to product innovation more firms realised process innovation in cooperation with other enterprises.

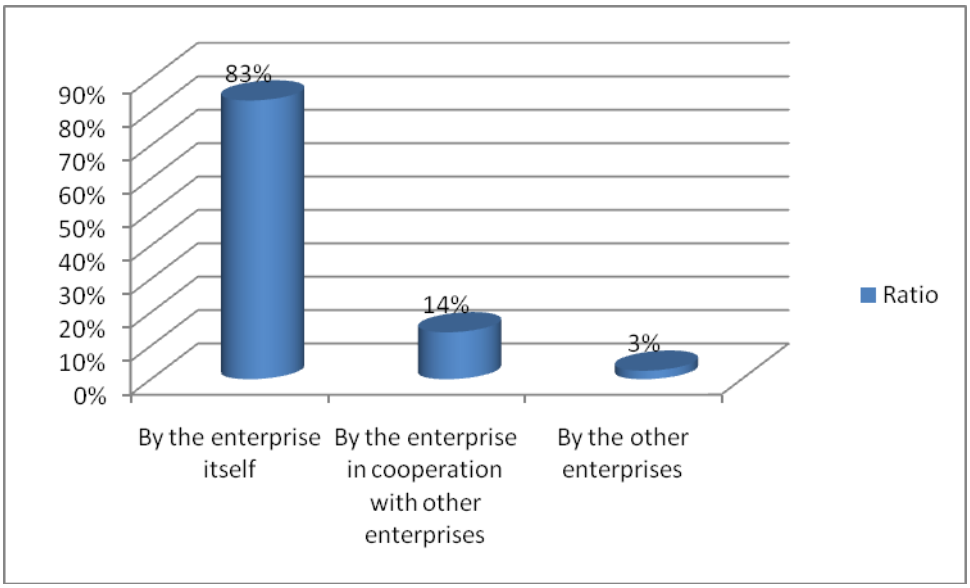

Figure 9. Type of collaborations related to process innovation
Source: TURSTAT 2006 Technological Innovation Survey

CHAPTER 5

ECONOMETRIC STUDY

As it is stated before, the core objective of this study is to investigate the main determinants of innovative behaviour for firms. In this chapter, the econometric analysis will be described in detail. The binary variable of doing innovation, (1 for realized innovation and 0 for not realized) for the period of 2004-2006 is the dependent variable for the models.

For that kind of analysis, there are mainly three approaches for constructing a probability model as: Linear Probability Model, Logistic Regression (or alternatively Logit) and Probit Model. In Linear Probability Model (LPM) error terms are correlated with the size of independent variables and not normally distributed.

Logistic Regression or Probit are better alternatives where the independent variables can be non-continuing and the relationship between dependent and independent variables are not required to be linear. The logistic equation projects the probability of belonging to an entity, which has a class or group. In our case, it is the probability of realizing innovation activities, explained by various determinants. Logistic regression provides the opportunity to explain the variables both quantitative and qualitative nature.

Probit model has the same approach as logit model, while the cumulative distribution function (CDF) differs. In some analysis, the normal CDF distribution has better results, which is the situation for probit. Cumulative logistic function is preferred for this particular study, so logit model is constructed to be able to explain the innovation behaviour. Logistic regression is elaborated in the following section.

5.1. Logistic Regression

For a single dependent variable, which is our case, a logistic regression can be implemented, if there are more than two dependent variables, a multinomial logistic regression would be needed.

Let Y be the binary variable (yes/no) and X the independent variable partially explaining Y. There will be two different probabilities as $P(Y=1|X)$ and $(1-P(Y=1|X))$ with two different values of Y. Then the model is defined as below:

$$P(Y=1|X)=\pi(X)=\frac{e^{\beta_0+\beta_1x_1+\beta_2x_2+...+\beta_nx_n}}{1+e^{\beta_0+\beta_1x_1+\beta_2x_2+...+\beta_nx_n}}$$

Since $\pi(x)$ reflects a probability, its value must be in the in the interval [0,1].

$$g(p)=\ln(\frac{p}{1-p})$$

If the logit function above is applied to π(X), then the expression becomes as below:

$$g(\pi(X))=\beta_0+\beta_1x_1+\beta_2x_2+...+\beta_nx_n$$

By transforming like that, while π (X) varies between 0 and 1; g (π (X)) varies between - and +.

5.2. Data

The data utilized as dependent variables are obtained from the 2006 Technological Innovation Survey. In order to be able to investigate the innovative behavior, mainly the results of Annual Business Statistics Survey are integrated to the models as independent variables. Using at least one year time lag is assumed to make the analysis more realistic. The data from Annual Business Statistics Survey is collected for the years of 2003 and 2004. The main discussion of the results will be analysis based on the 2003 data since year 2004 is also in the time frame of the 2006 Technological Innovation Survey.

In order to be able to obtain a single data set for the analysis with the inputs from both surveys, the data had to be matched. A key variable, enterprise number, is used for this matching by the experts of TURKSTAT. However, all the observations could not be matched because of framework incompatibility. Therefore, this situation had a drastic impact on the sample size used for the models. 2006 Technological Innovation Survey contains a total of 2173 observations. But only 947 of the observations can be matched with the data from 2003 Annual Business Statistics Survey and 1150 of the observations for 2004 Annual Business Statistics Survey. As a result this study is conducted with the 44% of the enterprises that responded to 2006 Technological Innovation Survey for 2003 data matching. For the matching with the 2004 Annual Business Statistics Survey, the ratio of observations in 2006 Technological Innovation Survey that can be matched was 53%.

5.3. Research Questions

Hence this study aims to make contribution to understand innovation behaviour with empirical findings; with the dependent variable of making innovation, various explaining variables are analyzed for their relation with this dependent variable. To perceive the differences between product and

process innovation mechanisms, three main dependent variables are used: product or process innovation, only product innovation and only process innovation.

Table 5. Main Hypotheses for the Determinants of Innovation

	Hyphothesis	**Sign of Relationship**
1	Firm Size	+
2	Export Status	+
3	Foreign Ownership	-
4	Intellectual Property	+
5	Import Penetration	+
6	Tariff Rate	-
7	R&D Activity	+
8	Market Concentration	-
9	Skill Level	+

In Table 5.1. each hypothesis for the explanatory variables is summarized. As discussed in section 3.3.1. Schumpeter (1942) argues that innovation increases with firm size. As shown in the previous sector, the majority of the firms in the population of 2006 Technological Innovation Survey are in the manufacturing sector (48%), the economies of scale are more important and as the firm size increases, it is expected that the innovative activities are also increased.

Exporting and Import Penetration are used to test the relationship between international activities and innovative behaviour. International activities are

recognized as important activities for learning from outside of the firm and gives room for any possible spillovers. So these variables are also expected to be a contributing factor to innovation. Tariff rate is a hindering factor for international activities, so it is expected to have negative effect on innovative behaviour.

Foreign ownership is a variable that has different empirical findings in different countries. The kind of the relationship between the main international firm and its affiliates in the country determines the sign of the correlation between innovative behaviour and foreign ownership. In undeveloped and developing countries, foreign firms tend to keep their R&D activities in main offices and transfer low value added activities to the other country. For instance OEM (Original Equipment Manufacturing) type manufacturing is prevalent in some sector in Turkey. In that kind of activity, the domestic firm mainly performs the assembly work and have little chance to learn new information and develop some innovative capabilities. So for Turkish case, foreign ownership is expected to be a hindering factor for innovation activities.

Intellectual property variable shows whether the firm has any licenses. Even patents are not utilised as commercial gains in most of the case, it shows the capability of firm in utilization of knowledge. So it is logical to expect that firms having intellectual property will be more innovative.

One of the simplest descriptions of innovation is the transfer of knowledge to income and competitiveness, so engaging to R&D activities is expected to have positive impact on innovation.

Innovation is mainly dependent to new information or ideas, so human resources are more important than physical infrastructure. Since, skill level is used as the quality of human resources, it is expected to be a positive contributing factor to innovative behaviour.

5.2.1. Dependent Variables

In this section, the data sources for dependent and independent variables and the kinds of proxy roles these data are playing will be explained. The main challenges and constraints which limited the intended scope of this study are also introduced.

Three different dependent variables are used: product and process innovations, only product innovations and only process innovations. As stated in previous section, the source of the dependent variables is the 2006 Technological Innovation Survey, namely the sections II and III. Question 2.1. asks whether the firm realised any product innovation and Question 3.1. investigates process innovation for the time period 2004-2006. The results of these questions are used as the fist two dependent variables. As the third dependent variable, these two innovation activities are combined with a dummy variable, it takes value of 1 if one of the innovations were realized and takes value of 0, if neither product innovation nor process innovation were performed.

Since the 2006 Technological Innovation Survey conducted according to latest edition of the OSLO Manuel (3rd edition), it also includes a section related to organization and marketing innovations (Section 10). Nevertheless, these two new categories are excluded from the scope of this study due to the limited nature of the existing literature and relevant empirical studies.

5.2.2. Firm Size

For the purposes of the first hypothesis, the size of the firm refers to the number of employees. In order to overcome the big variations of the number of employees, logarithms of the values are used. The logarithm of the

number of employees measures the relationship between the innovative behavior and firm size. To perceive the relationship fully, the square of this number could also be included in the model so as to test the rate of increase or decrease. Unfortunately, including these two independent variables in the regression models yields no conclusions because of the multicollinearity issue. As a result, the independent variable, as a proxy for firm size, measures only the linear relationship.

5.2.3. Export Status

Annual Business Statistics Survey contains information about the export volume of firms. Due to the data reliability problem, most of the emprical studies use the binary variable instead of the export value. During the first inspection of the data, it was observed that some of the export values are not consistent with the production and export values. Consequently, in order to overcome this problem, dummy variable is used instead of the total export value.

5.2.4. Foreign Ownership

The foreign ownership data is also taken from Annual Business Statistics Survey. In the primitive iterations of the models, the foreign ownership is introduced to model in different forms: the foreign ownership ratio, dummy variables according to the foreign share ratios (up to 10%, between 10% and 50% and more than 50%). However, the results according to these independent variables were not significant. Therefore, the dummy variable for foreign ownership is utilized.

5.2.5. Technology Transfer

The usage of external knowledge is measured with the total value of intellectual property rights acquired divided by the total income of the firm, in order to normalize the effect of varying firm sizes. Both the intellectual property right and income data used come from the results of Business Statistics Survey.

5.2.6. Import Penetration

Import penetration represents the importing intensity and is calculated for the NACE classification 4 digit level as below:

$$Import\ Penetration = \frac{Import}{Production + Import - Export}$$

The data of total volumes of import and export values are available classified according to ISIC Rev. 2. On the other hand total production volume data is available with the NACE Rev. 3. Some of the sectors in the ISIC Rev. 1 are the consolidated versions of two or more NACE Rev. 3. sectors. Therefore related export and import volumes are added up to find the NACE Rev. 3. version of the data.

5.2.7. Tariff Rate

Tariff rate measures the main restrictions to foreign trade. It is included in the model to see the effect of this kind barrier. Both the independent variables of import penetration and tariff rate are investigating the relationship between foreign trade and innovative behavior with a different relationship sign. The source of the data is the TRAINS (Trade Analysis and Information System) database of UNCTAD. Only data for 2003 was available and it was used both for 2003 and 2004.

5.2.8. R&D Activity

Engagement of R&D Activity is represented as the binary variable whether the firm made any R&D expenditure and the data source is the Business Statistics Survey. With this independent variable the effect of R&D activity on innovation behavior is indented to be measured.

5.2.9. Market Concentration

The structure of the market is also an important area of investigation in the innovation literature. To measure the market concentration, there exists two main indexes: Herfindahl index and CR4. Herfindahl index is calculated as the sum of the squares of the market shares of each individual firm in that sector. On the other hand, CR4 is calculated as the sum of market shares of the 4 firms having the highest market share. Both of these two indexes were requested from TURKSTAT. Due to data confidentiality they could not be utilized.

5.2.10. Skill Level

The structure of human resources can also be related to the innovative behavior of the firm. Two different independent variables were introduced in the models initially: wage intensity and share of R&D personnel. But the independent variables of export and foreign share were affected by skill level variables and results were not significant for any of these independent variables. As a result, skill level variables could not be introduced into the model.

5.3. Introduction of the Variables and the Model

The dependent variables are listed in table 5.1. The description of the independent variables is available in table 5.2. The correlation matrix of the variables used in the models exists in table 5.3.

To exhibit the relationship between the dependent and the independent variables, logistics model is used.

Table 6. Dependent Variables

Abbreviation	**Explanation of the Variable**
prod_proc_inn	Realized product or process innovation
prod_inov	Realized product innovation
proc_inov	Realized process innovation

Table 7. Description of the variables utilized in the logit models

Name of the Variable		Explanation of the Variable	Unit of Measurement	Firm/Sector Specific
Lsize	Logarithm of employees	Indicator of Firm Size -Logarithm of the total number of employees	Number of employees	Firm Specific
Sek1	Dummy Sektor1	Sektor status - Dummy variable for the firms in Mining and Quarrying sector	Dummy variable	Sector Specific
Sek2	Dummy Sektor2	Sektor status - Dummy variable for the firms in Manufacturing sector	Dummy variable	Sector Specific
Sek3	Dummy Sektor3	Sektor status - Dummy variable for the firms in Electricity Gas and Water Supply sector	Dummy variable	Sector Specific
Sek456	Dummy Sektor456	Sektor status - Dummy variable for the firms in Wholesale Trade; Transport Storage and Communication; and Financial Intermediation sectors	Dummy variable	Sector Specific
Dexport	Export Status	Internationalization - Whether the firm engaged in exporting	Dummy variable	Firm Specific
Fdi1	Foreign Ownership	Foreign ownership - Whether the firm has any foreign share	Dummy variable	Firm Specific
Ipr_int	Intellectual Property	Technology Transfer - Total value of ipr/income	%	Firm Specific
Imp_pen	Import Penetration	Total volume of import/(Total volumes of production+import-export)	%	Sector Specific
mtax	Tariff Rate	Barier to import-tariif rate ratio	%	Sector Specific
dumrd_actv	R&D Activity	Dummy variable for R&D Activities	Dummy variable	Firm Specific

The illustration of model is as follows. Three main dependent variables are binary variables and gets 1 if innovation realized and 0 otherwise.

$$Y_1 = prod\_proc\_inn \begin{cases} = 1 \\ = 0 \end{cases}$$

$$Y_2 = prod\_inov \begin{cases} = 1 \\ = 0 \end{cases}$$

$$Y_3 = proc\_inov \begin{cases} = 1 \\ = 0 \end{cases}$$

The innovation behaviour can be represented as follows:

$$Y_i = \beta_0 + \beta_1 Lsize + \beta_2 Sek1 + \beta_3 Sek2 + \beta_4 Sek456 + \beta_5 D\exp ort + \beta_6 Fdi1 + \beta_7 Ipr\_\text{int} + \beta_8 \text{Im}\, p\_pen + \beta_9 mtax + \beta_{10} dumrd\_actv$$

where i=1,2,3

Any possible relationship between independent variables must be examined before performing the regression. If any of the independent variables are highly correlated, the results of the regression are affected. The correlation matrix of the variables are available in Table 5.3.

Table 8. Correlation matrix for the variables

	prod_proc_inn	prod_inov	proc_inov	Lsize	Sek1	Sek2	Sek3	Sek456	Dexport	Fdi1	Ipr_int	Imp_pen	mtax	dumrd_actv
prod_proc_inn	1.00													
prod_inov	-	1.00												
proc_inov	-	-	1.00											
Lsize	0.1809	0.2366	0.1509	1.00										
Sek1	-0.0488	-0.2109	-0.2109	-0.0955	1.00									
Sek2	0.1240	0.1069	0.1069	0.2509	-0.4549	1.00								
Sek3	-0.0497	-0.0834	-0.0834	0.1609	-0.0524	-0.2348	1.00							
Sek456	-0.2466	-0.1770	-0.1770	0.1621	-0.0845	-0.3790	-0.0436	1.00						
Dexport	0.2698	0.2750	0.2434	0.4125	-0.0263	-0.5012	-0.2847	-0.2145	1.00					
Fdi1	-0.0019	0.0180	-0.0930	0.0854	-0.0340	0.1160	-0.0781	0.1477	0.0392	1.00				
Ipr_int	0.0127	0.0592	0.0585	-0.0525	-0.0841	-0.2216	-0.0428	0.0881	0.0650	-0.0772	1.00			
Imp_pen	0.1814	0.1292	0.0974	0.0852	0.5158	0.0046	0.1051	0.1697	0.2162	0.1173	-0.0844	1.00		
mtax	0.1367	0.2033	0.0884	0.2273	-0.0426	0.4145	-0.1267	-0.2045	0.3535	0.3036	-0.1362	0.2118	1.00	
dumrd_actv	0.2093	0.2193	0.2855	0.2153	-0.0308	0.1419	-0.0401	-0.1193	0.1095	0.1636	0.0689	0.0803	0.1131	1.00

5.4. Result of the Analysis

The results of the regressions are available in the Tables 5.5, 5.6 and 5.7. Table 5.5. exhibits the regression result for the dependent variable of product and process innovation. Table 5.6. is devoted to the regression run with the dependent variable of product innovation and 5.7. exhibits results for process innovation.

To be able to see the sign relationship between the dependent and independent variables, Table 5.4. is constructed. If any independent variable is positively correlated with the dependent variable of performing product or process innovation, it is indicated as “+” in the results column. If any of the relationship is statistically insignificant it is denoted as “not significant”. Since the last two variables could not be introduced to the model it is written “not tested”.

For the first hypothesis related to the firm size, all of the regression results are positive indicating a linear relationship between the size and the innovative behaviour. This specific empirical study concludes that firm size has a positive effect on firm’s innovation behaviour for the consecutive years. This conclusion is inline with the Schumpeter (1942) arguing that innovation intensity augments proportionally with firm size and industry concentration. Considering the size classification of Turkish firms, policies and instruments should be targeted to SMEs to become more innovative, since they constitute 99% of the total firms.

The second hypothesis could not be tested because of regression results do not yield to any significant results. This result does not necessary conclude that exporting is not related with innovation behaviour. The data set is not sufficient to show the relationship. In order to get more concrete results, other data sources could have been utilised since firms do not tend to declare real foreign trade values in such surveys or the representative filling the survey do not have the related information.

Regression results related with foreign share is significant only for product or process innovations and only product innovations. There is no significant result for process innovations. But the sign of relationship is positive, indicating a positive relationship between foreign share and innovation behaviour. This result is just the opposite of the hypothesis. This result must be interpreted carefully. It is an indication that foreign ownership increases the firms' innovation intensity especially for product innovations. The two other types of innovation, namely marketing and organisational innovation are not in the scope of this analysis. Hence multinational firms transfer some intangible assets to the local subsidiaries like brand recognition and organisational efficiency, they could also lead positive relation to innovation behaviour.

Intellectual property also affects innovative behaviour in a positive way, as the results indicate. So the hypothesis related to this independent variable is also proved to be true. This result shows that, technology transfer as in the form of licenses increases their innovation capability in the following days. This result can be utilised in developing policies and mechanisms for the enhancement of innovation capacities of local firms. It can be concluded that, developing interfaces for effective technology transfer and developing support schemes for small enterprises, which can not cover the cost of licenses will be an option to increase innovative behaviour of firms.

The results related to import penetration and tariff rate are insignificant and no relationship could be shown between the innovative behavior. The values of these independent variables were calculated for the sector level. This can be the main reason for the failure of the analysis.

Table 9. Results of the Analysis

		Hyphothesis	**Results**
1	Firm Size	+	+
2	Export Status	+	not significant
3	Foreign Ownership	-	+
4	Intellectual Property	+	+
5	Import Penetration	+	not significant
6	Tariff Rate	-	not significant
7	R&D Activity	+	+
8	Market Concentration	-	not tested
9	Skill Level	+	not tested

Table 10. Regression results of the models for product or process innovations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lsize	0.204	0.215	0.187	0.169	0.164	0.165	0.125
	(5.30)***	(5.35)***	(4.26)***	(3.79)***	(3.66)***	(3.68)***	(2.69)***
Sek1		-0.935	-0.898	-0.849	-0.754	-0.875	-0.857
		(2.79)***	(2.68)***	(2.52)**	(2.22)**	(2.45)**	(2.39)**
Sek2		0.112	0.051	0.098	0.186	0.136	0.136
		(0.46)	(0.20)	(0.39)	(0.73)	(0.51)	(0.51)
Sek3		-1.104	-0.983	-0.922	-0.846	-0.854	-0.780
		(2.85)***	(2.50)**	(2.34)**	(2.13)**	(2.15)**	(1.96)**
Sek456		-0.534	-0.532	-0.484	-0.431	-0.432	-0.342
		(2.01)**	(2.00)**	(1.81)*	(1.59)	(1.59)	(1.26)
Dexport			0.260	0.231	0.217	0.196	0.163
			(1.60)	(1.41)	(1.32)	(1.19)	(0.98)
Fdi1				0.490	0.482	0.469	0.376
				(2.09)**	(2.05)**	(2.00)**	(1.56)
Ipr_int					0.068	0.068	0.063
					(1.93)*	(1.93)*	(1.76)*
Imp_pen						0.377	0.416
						(1.13)	(1.20)
mtax						0.040	0.018
						(0.10)	(0.04)
dumrd_actv							0.841
							(3.41)***
Cst	-1.459	-1.298	-1.257	-1.252	-1.319	-1.317	-1.212
	(7.19)***	(4.85)***	(4.67)***	(4.63)***	(4.82)***	(4.81)***	(4.38)***
Obser	947	947	947	947	947	947	947

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 11. Regression results of the models for product innovations

	(1)	(2)	(3)	(4)	(5)	(6)	(8)
Lsize	0.239	0.253	0.209	0.191	0.185	0.187	0.133
	(5.83)***	(5.86)***	(4.43)***	(3.97)***	(3.84)***	(3.87)***	(2.62)***
Sek1		-0.797	-0.737	-0.686	-0.582	-0.706	-0.672
		(2.17)**	(2.00)**	(1.86)*	(1.55)	(1.81)*	(1.71)*
Sek2		0.174	0.080	0.126	0.224	0.129	0.134
		(0.66)	(0.30)	(0.46)	(0.80)	(0.44)	(0.46)
Sek3		-1.689	-1.489	-1.422	-1.337	-1.345	-1.244
		(3.34)***	(2.91)***	(2.78)***	(2.60)***	(2.61)***	(2.41)**
Sek456		-0.605	-0.601	-0.553	-0.494	-0.498	-0.371
		(2.05)**	(2.03)**	(1.86)*	(1.64)	(1.65)*	(1.22)
Dexport			0.396	0.370	0.357	0.336	0.294
			(2.25)**	(2.10)**	(2.02)**	(1.89)*	(1.63)
Fdi1				0.437	0.434	0.418	0.304
				(1.83)*	(1.82)*	(1.74)*	(1.23)
Ipr_int					0.065	0.066	0.059
					(1.93)*	(1.96)*	(1.70)*
Imp_pen						0.174	0.207
						(0.59)	(0.67)
mtax						0.363	0.348
						(0.89)	(0.83)
dumrd_actv							1.014
							(4.14)***
Cst	-2.092	-1.963	-1.903	-1.895	-1.970	-1.969	-1.823
	(9.36)***	(6.71)***	(6.46)***	(6.41)***	(6.55)***	(6.55)***	(5.98)***
Obser	947	947	947	947	947	947	947

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 12. Regression results of the models for process innovations

	(1) S3_1	(2) S3_1	(3) S3_1	(4) S3_1	(5) S3_1	(6) S3_1	(7) S3_1
Lsize	0.232	0.246	0.218	0.204	0.199	0.199	0.155
	(5.78)***	(5.88)***	(4.77)***	(4.38)***	(4.26)***	(4.26)***	(3.18)***
Sek1		-1.216	-1.176	-1.137	-1.049	-1.076	-1.055
		(3.29)***	(3.18)***	(3.07)***	(2.80)***	(2.75)***	(2.68)***
Sek2		-0.052	-0.115	-0.081	0.002	0.036	0.038
		(0.20)	(0.45)	(0.31)	(0.01)	(0.13)	(0.14)
Sek3		-1.117	-0.993	-0.944	-0.871	-0.873	-0.788
		(2.74)***	(2.40)**	(2.27)**	(2.08)**	(2.09)**	(1.88)*
Sek456		-0.556	-0.553	-0.517	-0.466	-0.465	-0.363
		(2.00)**	(1.99)**	(1.85)*	(1.65)*	(1.65)*	(1.28)
Dexport			0.261	0.239	0.226	0.223	0.186
			(1.52)	(1.39)	(1.31)	(1.29)	(1.06)
Fdi1				0.353	0.349	0.350	0.245
				(1.51)	(1.48)	(1.49)	(1.01)
Ipr_int					0.058	0.057	0.051
					(1.74)*	(1.72)*	(1.50)
Imp_pen						0.267	0.310
						(0.78)	(0.87)
mtax						-0.316	-0.364
						(0.74)	(0.83)
dumrd_actv							0.872
							(3.61)***
Cst	-1.917	-1.665	-1.625	-1.619	-1.682	-1.680	-1.560
	(8.86)***	(5.97)***	(5.80)***	(5.76)***	(5.90)***	(5.89)***	(5.41)***
Obser	947	947	947	947	947	947	947

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

CHAPTER 6

CONCLUSION

6.1. Proposed Further Research

In order to understand firm-level innovative behaviour of Turkish firms, this study is limited in various ways. It focuses only some of the firm characteristics. For instance proxies for market concentration and skill level can be included to model to understand the effect of market and human resources of the firm.

An other follow-up study can be related with considering the effects of weighting TURKSTAT uses while constructing the sample for the survey. By this weighting methodology each firm represents a sample in the relevant sector or size classification. This aspect is not included in the current model of this study.

Since this study is only limited with the results of the survey, some of the firm characteristics could not be captured, like organisational structure, vision, leadership. These kinds of variables are very subjective and can be collected via firm level interviews. This approach will be very time consuming and costly, especially for such a huge sample size.

This study is limited with the determinants of innovation behaviour. However in order to fully understand the innovation at firm level, more comprehensive models must be constructed including the firm performance for the consecutive years of realization of the innovation. For this specific study, firm level data from Annual Business Survey of 2007-2008 can also be

matched, to perceive the difference of the performance of the firm. Innovating and non-innovating firms can also be compared.

6.2. Main Conclusions

Innovation studies are relatively a recent field in science policy research. Although, innovation is referred as crucial in economic growth, competitiveness, we have very limited empirical studies modelling innovative behaviour at firm level. The more we understand why firms innovate, which determinants are affecting this behaviour in a positive way, the better policies and regulations can be developed.

This study aims to interpret 2006 Technological Innovation Survey results, related with the determinants of innovation. For the Turkish case, there are only a limited number of empirical studies (Pamukçu (2003), Özçelik and Taymaz (2005)), which is an indication there is a big gap for research.

2006 Technological Innovation Survey and the Annual Business Statistics Survey for the year 2003 are the main data sources of the study. The innovation activity is used as dependent variables from the first survey and explanatory variables are introduced from the second survey. To perceive the effects of firm characteristics in innovation decision for the near-future, a time lag is introduced between the two data sources to be able. Matched data-set includes 947 observations.

As an econometric analysis method, logistic regression is utilised with three different dependent variables, namely product or process innovation, only product innovation and only process innovation. Main independent variables analyzed as determinants of the above three different innovation activities are firm size, export status, foreign ownership, possession of intellectual property rights, import penetration, tariff rate, R&D activity, market concentration and skill level.

The first hypothesis related to the firm size, regression results indicated a positive relationship between firm size and innovation for all three dependent variables.

The hypothesis related with foreign trade did not yield to any significant results, which does not necessary conclude that exporting is not related with innovation behaviour. In order to get more concrete results, other data sources can be utilised as an option for further research.

According to regression results, foreign share is effecting innovation behaviour for the dependent variables, product or process innovations and only product innovations. This result can be interpreted as foreign ownership increases the firms' innovation intensity especially for product innovations.

The regression results also suggest that, licenses increase their innovation capability in the following days. Developing supporting mechanisms and interfaces for the technology transfer can be an efficient way to stimulate innovative behaviour of the firms.

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APPENDIX

APPENDIX A: 2006 TECHNOLOGICAL INNOVATION SURVEY QUESTIONNAIRE

Part 1. General Information about the Enterprise

1.1. Name of enterprise:

1.2. Is your enterprise part of an enterprise group?

- o Yes – Specify the name of the enterprise group and in which country the head office of your group is located?
- o No

1.3. Source of capital: Domestic capital (%):

Foreign capital (%):

1.4. Total turnover of the enterprise in 2006:

1.5. Number of employees of your enterprise in 2006: (February/ May/ August/ November)

1.6. In which geographic markets did your enterprise sell goods or services during the three years 2004 to 2006?

- o Local / regional within Turkey
- o National
- o Europe
- o All other countries

Part 2. Product (good or service) innovation

2.1. During the three years 2004 to 2006, did your enterprise introduce:

- o New or significantly improved goods
- o New or significantly improved services

2.2. Who developed these product innovations?

- o Mainly your enterprise or enterprise group
- o Your enterprise together with other enterprises or institutions
- o Mainly other enterprises or institutions

2.3. Were any of your goods and service innovations during the three years 2002 to 2004:

- o New to your market? (Your enterprise introduced a new or significantly improved good or service onto your market before your competitors (it may have already been available in other markets))

- Only new to your firm? (Your enterprise introduced a new or significantly improved good or service that was already available from your competitors in your market)

2.4. Using the definitions above, please give the percentage of your total turnover in 2006 from:

- Goods and service innovations introduced during 2004 to 2006 that were **new to your market**
- Goods and service innovations introduced during 2004 to 2006 that were **only new to your firm**
- Goods and services that were **unchanged or only marginally modified** during 2004 to 2006 (include the resale of new goods or services purchased from other enterprises)

Part 3. Process innovation

3.1. During the three years 2004 to 2006, did your enterprise introduce:

- New or significantly improved methods of manufacturing or producing goods or services
- New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services
- New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing

3.2. Who developed these process innovations?

- Mainly your enterprise or enterprise group
- Your enterprise together with other enterprises or institutions
- Mainly other enterprises or institutions

Part 4. Ongoing or abandoned innovation activities:

4.1. Did your enterprise have any innovation activities to develop product or process innovations still ongoing by the end of 2006? (Yes/No)

4.2. Did your enterprise have any innovation activities to develop product or process innovations that were abandoned during 2004 to 2006? (Yes/No)

Part 5. Innovation activities and expenditures

During the three years 2004 to 2006, did your enterprise engage in the following innovation activities:

5.1.1. Intramural (in-house) R&D (Yes/No)

5.1.1.1. If yes, did your firm perform R&D during 2004 to 2006:

- Continuously?
- Occasionally?

5.1.2. Extramural R&D (Yes/No)

5.1.3. Acquisition of machinery, equipment and software (Yes/No)

5.1.4. Acquisition of other external knowledge (Yes/No)

5.1.5. Training (Yes/No)

5.1.6. Market introduction of innovations (Yes/No)

5.1.7. Other preparations (Yes/No)

5.2. Please estimate the amount of expenditure for each of the following four innovation activities in 2006 only. (Include personnel and related costs)

- Intramural (in-house) R&D:
- Acquisition of R&D (extramural R&D):
- Acquisition of machinery, equipment and software:
- Acquisition of other external knowledge:

5.3. During the three years 2004 to 2006, did your enterprise receive any public financial support for innovation activities from the following levels of government? (Include financial support via tax credits or deductions, grants, subsidized loans, and loan guarantees.)

5.3.1. Local or regional authorities (TÜBİTAK, KOSGEB, TTGV and etc.) (Yes/No)

5.3.2. Central or regional government institutes (municipality etc.) (Yes/No)

5.3.3. The European Union (EU) (Yes/No)

5.3.3.1. If yes, did your firm participate in the EU 6th Framework Programme for Research and Technical Development (2003-2006) (Yes/No)

5.3.4. Other international institutions (Yes/No)

Part 6. Sources of information and co-operation for innovation activities

6.1. During the three years 2004 to 2006, how important to your enterprise's innovation activities were each of the following information sources?

Information Source	Degree of importance			Not used
	High	Medium	Low	
Internal 6.1.1. Within your enterprise or enterprise group	O	O	O	O
Market Sources 6.1.2. Suppliers of equipment, materials, components, or software 6.1.3. Clients or customers 6.1.4. Competitors or other enterprises in your sector 6.1.5. Consultants, commercial labs, or private R&D institutes	O O O O O	O O O O O	O O O O O	O O O O O
Institutional Sources 6.1.6.Universities or other higher education institutions 6.1.7. Government or public research institutes	O O	O O	O O	O O
Other Sources 6.1.8. Conferences, trade fairs, exhibitions 6.1.9. Scientific journals and trade/technical publications 6.1.10. Professional and industry associations	O O O	O O O	O O O	O O O

6.2. During the three years 2004 to 2006, did your enterprise co-operate on any of your innovation activities with other enterprises or institutions? (Yes/No)

6.3. Please indicate the type of co-operation partner and location

Type of co-operation partner	Turkey	Europe	USA	Other	No Cooperation
6.3.1. Other enterprises within your enterprise group	O	O	O	O	O
6.3.2. Suppliers of equipment, materials, components, or software	O	O	O	O	O
6.3.3. Clients or customers	O	O	O	O	O
6.3.4. Competitors or other enterprises in your sector	O	O	O	O	O
6.3.5. Consultants, commercial labs, or private R&D institutes	O	O	O	O	O
6.3.6. Universities or other higher education institutions	O	O	O	O	O
6.3.7. Government or public research institutes	O	O	O	O	O

6.4. Which type of co-operation partner did you find the most valuable for your enterprise's innovation activities? (Give corresponding letter)

Part 7. Effects of innovation during 2004-2006

7.1. How important were each of the following effects of your product (good or service) and process innovations introduced during three years 2004-2006?

Effects	Degree of observed effect	Not

	High	Medium	Low	relev ant
Product oriented effects 7.1.1. Increased range of goods or services 7.1.2. Entered new markets or increased market in Turkey 7.1.3. Entered new markets or increased market abroad 7.1.4. Improved quality of goods or services	O O O O	O O O O	O O O O	O O O O
Product oriented effects 7.1.5. Improved flexibility of production or service provision 7.1.6. Increased capacity of production or service provision 7.1.7. Reduced labour costs per unit output 7.1.8. Reduced materials and energy per unit output	O O O O	O O O O	O O O O	O O O O
Other Effects 7.1.9. Reduced environmental impacts or improved health and safety 7.1.10. Met regulatory requirements	O O	O O	O O	O O

Part 8. Factors hampering innovation activities

8.1. During the three years 2004 to 2006 were any of your innovation activities or projects:

8.1.1. Abandoned in the concept stage (Yes/No)

8.1.2. Abandoned after the activity or project was begun (Yes/No)

8.1.3. Seriously delayed (Yes/No)

8.2. During the three years 2004 to 2006, how important were the following factors for hampering your innovation activities or projects or influencing a decision not to innovate?

Factors	Degree of importance			No effect
	High	Medium	Low	
Cost factors				
8.2.1. Lack of funds within your enterprise or group	O	O	O	O
8.2.2. Lack of finance from sources outside your enterprise	O	O	O	O
8.2.3. Innovation costs too high	O	O	O	O
Knowledge factors				
8.2.4. Lack of qualified personnel	O	O	O	O
8.2.5. Lack of information on technology	O	O	O	O
8.2.6. Lack of information on markets	O	O	O	O
8.2.7. Difficulty in finding cooperation partners for innovation	O	O	O	O
Market factors				
8.2.8. Market dominated by established enterprises	O	O	O	O
8.2.9. Uncertain demand for innovative goods or services	O	O	O	O
8.2.10. Economic uncertainty in the country	O	O	O	O
Reasons not to innovate				
8.2.11. No need due to prior innovations	O	O	O	O
8.2.12. No need because of no demand for innovations	O	O	O	O

Part 9. Intellectual property rights

9.1. During the three years 2004 to 2006, did your enterprise:

9.1.1. Apply for a patent (Yes/No)

9.1.2. Register an industrial design (Yes/No)

9.1.3. Register a trademark (Yes/No)

9.1.4. Claim copyright (Yes/No)

Part 10. Organizational and marketing innovations

10.1. During the three years 2004 to 2006, did your enterprise introduce:

10.1.1. New knowledge management systems to better use or exchange information, knowledge and skills within your enterprise or to collect and interpret information from outside your enterprise (Yes/No)

10.1.2. New methods of workplace organization for distributing responsibilities and decision making *(i.e. first use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, etc)* (Yes/No)

10.1.3. New methods of organizing external relations with other firms or public institutions *(i.e. first use of alliances, partnerships, outsourcing or subcontracting, etc.)* (Yes/No)

10.2. How important were each of the following effects of your enterprise's organizational innovations introduced during the three years 2004 to 2006?

Factors	Degree of effect			No effect
	High	Medium	Low	
Reduced time to respond to customer or supplier needs	O	O	O	O
Improved quality of your goods	O	O	O	O
Reduced costs per unit output	O	O	O	O
Improved employee satisfaction and/or lower employee work load	O	O	O	O