# THE IMPACTS OF R&D EXPENDITURES ON THE MANUFACTURING SECTORS' EXPORT PERFORMANCE IN TURKEY AND COMPARATIVE EMERGING MARKETS

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Thesis Abstract

İsmail Yıldırım, "The Impacts of R&D Expenditures on the Manufacturing Sectors' Export Performance in Turkey and Comparative Emerging Markets"

This dissertation aims to analyze the impacts of different research and development (R&D) activities on the export performance of manufacturing sector's basic divisions for Turkey and comparative emerging economies. In the light of this aim, Turkey and seven comparative emerging countries were selected to analyze impact of R&D on export performance. The Fixed Effect Model of panel data analysis has been used in the study and the model results suggest the existence of positive significant relationship between gross domestic R&D activities and export performance. The study shows that R&D activities support chemical sector, machinery sector and sector of manufactured goods classified by material exports. As these industries rely on invention and technology, the empirical results support hypotheses put forth in this dissertation. The models in the second part of the study analyze how government and business enterprise R&D activities affect export performances. These results illustrated that the different sources of R&D activities have diverse impacts on manufacturing sectors' export performances.

# Tez Özeti

İsmail Yıldırım, "Ar-Ge Harcamalarının Türkiye ve Karşılaştırmalı Gelişmekte Olan Ülkelerdeki İmalat Sektörlerinin İhracat Performansına Olan Etkisi"

Bu tez farklı araştırma geliştirme (Ar-Ge) aktivitelerinin imalat sektörlerinin ihracat performansına olan etkisini Türkiye ve karşılaştırmalı gelişmekte olan ekonomiler için analiz etmeyi amaçlamaktadır. Bu amaç ışığında Türkiye ve ilgili veriyi barındıran yedi adet karşılaştırmalı gelişmekte olan ülke seçilmiştir. Çalışmada panel veri analizi altında "Sabit Etkiler Modeli" kullanılmıştır ve model sonuçları ülke içi toplam Ar-Ge aktiviteleri ile ihracat performansı arasındaki pozitif ve anlamlı bir ilişkiye işaret etmektedir. Çalışma göstermiştir ki, Ar-Ge aktiviteleri kimya, makine ve materyale göre sınıflandırılmış imalat ürünleri sektörlerini desteklemektedir. Bu sektörler innovasyon ve teknolojiye dayandığından ampirik sonuçlar tez için konulmuş olan hipotezleri desteklemektedir. İkinci kısımdaki modeller ihracat performansını etkilemede devlet ve ticari teşebbüs Ar-Ge harcamalarının farklarını analiz etmektedir. Bu modellere ilişkin sonuçlar göstermiştir ki, farklı kaynakların Ar-Ge aktiviteleri imalat sektörlerinin ihracat performanslarını değişen anlamlılık derecelerinde etkilemektedir.

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# CHAPTER 1

## INTRODUCTION

The power of knowledge can carry nations to leading positions around the globe in any area. The role of technological advancement in economic growth of countries is an inevitable fact. Accordingly, the stock of knowledge can be increased via investing in research and development (R&D) activities or diffusion of existing technology. R&D activities are one of the main factors which enable firms, industries or countries to have more creative and productive designs. This in turn, increases the advantageous position of them in the market.

The general R&D expenditures coming from public or private sources have been increasing in the world in the last decades. For many countries higher variations are seen in R&D expenditures compared to GDPs. As the GDP falls down due to economic crises, there will higher decreases in R&D expenditures. The R&D intensity meaning that the share of R&D expenditures in GDP is around 2.3% in Organization for Economic Co-Operation and Development (OECD) average in 2007. However, the mentioning rate is 0.72% in Turkey. The business enterprise sector is the main source of R&D activities in most of the OECD countries. Accordingly, two thirds of the total R&D activities were financed by business enterprise sector in total OECD countries. For Turkey, although there has been an increasing trend of business enterprise R&D activities in the last decades, the governmentally resourced R&D activities are still in the leading position.

The aim of this study is to analyze the impacts of R&D activities on the export performance of manufacturing sectors. To do that, both the gross domestic R&D activities and its divisions such as governmental and business enterprise R&D

activities are tested. The relationship of economic growth, R&D and export performance has been argued in many studies. Although their causality relations can be differed, in general with enhanced R&D activities new technology can be produced. Creative designs and lower costs occur afterwards which enable exporters to have more shares from the international trade markets.

In the literature Schumpeterian ideas which emphasized the power of technology were not welcomed by neo-classics in the years around the half of twentieth century. Controversially, neo-classics saw the technology as exogenous factor which is assumed to be stable among countries. The convergence of economies was another basic theory of neo-classics. These theories of convergence and the technology as exogenous factor have been eliminated by many other theories such as in the study of Romer (1986). By that time period, neo-classics have also started to accept the idea that the technology is indeed an endogenous factor in economic growth (Schumpeter, 1962). Many empirical studies have been done over the issue of technology's impact on the export performance. These studies showed there is a strong positive relationship between the technology and export performance. The results show that R&D activities are crucial for the exports in many sectors which are not only R&D intensive industries but also some of the other industries. Additionally, for some sectors depending mainly on the R&D activities the size of the domestic market is also important. Moreover, in addition to direct R&D activities, the spillover effects which are called also as indirect R&D activities have crucial importance.

The main hypothesis configured in this dissertation is the gross domestic R&D expenditures have positive impact on the manufacturing sector export performance in developing countries. Secondly, it is assumed that the R&D affects

each manufacturing sector divisions' export performances on different levels. Thirdly, the study focuses on the differences between governmental and business enterprise R&D activities on the export performance of mentioning sector divisions. The Fixed Effect Model of panel data is estimated to make the analyses.

The first part of the model analyzes the impact of gross domestic R&D on export performance. In the second part of the model the differences between government and business enterprise R&D activities are tested.

As the contributions of this study to literature the following arguments can be stated; the study is one of the first studies which test the effects total R&D expenditures on the export market shares of different divisions of manufacturing sector in developing countries. Secondly, the study tests the impacts of both government and business enterprise R&D activities' on the manufacturing export performance. Thirdly, the study includes a wide range of sector based coverage among R&D and export studies which means that the study covers the whole manufacturing industry via four main divisions instead of focusing on narrowly specified single industries. The divisions analyzed are chemical sector, manufactured goods classified chiefly by material, machinery and transport equipments sector and miscellaneous manufactured articles sectors. There are also indirect results of the study related to the trade balances. Since, the results of the study are also about how to increase the export market share they indirectly favor the betterment of current account balance.

The rest of paper is organized as follows. Chapter 2 gives an overview of the concept and characteristics of R&D. Also, the chapter includes the general trends of R&D in the world and in Turkey as well as focusing on the policies and strategies. In

Chapter 3, general international trade facts of world and Turkey are given including the industrial focused analysis of Turkey. In Chapter 4, the literature on R&D has been reviewed with theoretical and empirical backgrounds and samples. In chapter 5, methodology and data are discussed briefly with main empirical findings. In the mentioned chapter, the study of Ozer and Çiftçi (2009) is extended through adding new independent and dependent variables and the Fixed Effect Model is used for estimations. The final chapter provides some concluding remarks and policy implications.

# CHAPTER 2

# RESEARCH AND DEVELOPMENT

R&D is just like a huge tree with enormous amounts of branches, leaves and roots spreading around which cause scientists to have hardships on making definition as well as collecting data about it. In 1963, experts on R&D from OECD members met together at the Villa Falcioneri in Frascati, Italy. Their study was embodied with the publication of first official version of the Proposed Standard Practice for Surveys of R&D, the so-called "Frascati Manual". The experts developed methodological manuals not only on R&D (Frascati Manual) but also on innovation (Oslo Manual), human resources (Canberra Manual), technological balance of payments and patents as science and technology. All these outcomes are known as "Frascati Family". Frascati Manual's most recent version was published in the year 2002 as sixth edition, which basically defines the concept of R&D and expresses the methodology for R&D surveys like its previous editions. Including standards for R&D surveys inside, Frascati Manual is now the most commonly used reference for R&D studies in the world (OECD Frascati Manual, 2002).

Since the crucial part of academic literature over R&D uses classifications and methodologies of Frascati Manual, the concept of R&D, definitions and the classification methods of R&D is described with respect to the Manual in this study. In order to have clear understanding about the concept of R&D, the definition, main sub-contents and functional and sector classifications will be explained with similar concepts and examples. Then, the R&D trends in the world will be examined as well as adding more detailed analysis for Turkey. The historical perspective and current R&D policies and strategies are highlighted.

## The Concept of Research and Development

On a very fundamental level R&D indicators can be divided into two parts as inputs and outputs of R&D. It should be stated that the OECD Frascati Manual (2002) covers only R&D inputs which are R&D expenditures and R&D personnel. These two inputs, including all their sub-groups, are main entries which are transformed into R&D outcomes after used effectively in countries. Outputs of R&D on the one hand, are more general and mostly consist of benefits such as the innovation and the socio-economic welfare which are even harder to measure.

In the OECD Frascati Manual (2002), Research and Experimental Development (R&D) is defined as:

> Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (p. 30)

In fact, the definition declares that an activity can be defined as R&D only with the existence of creative and systematic action which causes a value addition to the current level of knowledge.

From the perspective of activity type, R&D consists of three main groups such as, Basic Research, Applied Research and Experimental Development. In the activity of Basic Research firstly, performers proceed through formulating and testing hypotheses, theories and laws. Results of this type of research are generally published in scientific journals and not sold. According to Manual, Basic Research has two sides. Such as, a research can be defined as Pure Basic Research which is done for the sake of knowledge advancement without having a demand for long term economic or social benefits. On the one hand, Oriented Basic Research expected to

be devoted on a solution of a current or future problems or possibilities with the expectation that it will produce a broad base of knowledge. Secondly, in Applied Research, investigation efforts are primarily put on a particular practical goal and objective. It requires taking into account the available knowledge and its extensions in order to solve particular problems. It can be stated that, the sake of discovering bright results of basic research distinguishes the applied research from the basic research. The outcomes of Applied Research are generally valid for a single or limited number of notions or systems and it is often patented. In Manual thirdly, Experimental Research refers basically to practical experiences and discoveries that are guided towards producing new products and services or to advance the existing ones. (OECD Frascati Manual, 2002)

There exist enormous types of activities which are closely linked to R&D via similar information and operation processes as well as institutions and personnel. However, for survey reasons R&D should be differentiated from similar activities through accepting scientific and technological bases as references. The OECD Frascati Manual (2002) gathered together the activities that resemble to R&D activity but must be excluded from R&D activities with four headings. Such as education and training, other related scientific and technological activities, other industrial activities administration and other supporting activities.

In education and training firstly, research and teaching activities are closely embedded to each other. Experiences gathered in teaching activities can often be used as an input for research activities. Therefore, it is difficult to distinguish where teaching activity ends and R&D activity starts. Key criteria accepted here is the novelty to differentiate R&D from routine teaching and other work-related activities. In the Manual, all education and training of personnel in the natural sciences,

engineering, medicine, agriculture, the social sciences and the humanities in universities and special institutions of higher and post-secondary education are excluded from R&D activities while the research done by students at the PhD level is accepted. Related to that, for a post graduate student, course works are assumed to be education and training activities whereas, performing independent studies are counted as R&D activities. On the one hand, for the teachers, training students in laboratory work is a part of education activity, however supervising an R&D project is thought as a R&D activity. Secondly, according to Manual R&D related scientific and technological activities such as collecting, recording, classifying and analyzing done by scientific and technical personnel, patent services and etc. are excluded except the ones that are undertaken particularly for the purpose of an R&D project. For example, the activities of a research laboratory library maintained predominantly for the benefit of the research workers in the laboratory should be included in R&D (OECD Frascati Manual, 2002).

According to Manual thirdly, although they are inevitably the parts of innovation process most of the industrial activities such as patent filing, licensing, market research and redesigning for manufacturing process and etc. are excluded from R&D. Distinguishing R&D in from industrial activities is not also a simple operation due to its embedded framework. If the particular focus is on making technical improvements on the product or process, then this activity is assumed to be R&D. On the other hand, if the primary objective is to enlarge markets, the action here is not counted for R&D. Finally, administrative and other supportive activities according to Manual, either in the way of pure R&D financing activities such as management and distribution of R&D funds to performers and research agencies or

indirect supporting activities like cleaning, storage, repair, transportation and etc., are excluded from R&D (OECD Frascati Manual, 2002).

In this part of the Chapter II, a brief summary of the concept of R&D is given via defining and demonstrating some examples of R&D activities as well as the exclusions using mainly Frascati Manual which is the worldwide reference in this area. After all, it should be stated that, measuring, exhibiting and distinguishing R&D activities depends on many detailed criteria and even rule of thumbs play a crucial role for that. Generally, in order to sort out an R&D activity some basic questions asked related to the objective, innovativeness, properties of staff working on it, methods being used, way of funding and etc. about the mentioning activity help surveyors. In the following part of the chapter, the sectoral classification of R&D will be given with the aim of having more detailed information about the concept of R&D used in academic surveys.

## Sectoral Classification of R&D

In OECD Frascati Manual (2002), R&D activities are divided into sectors in order to be able to perform more accurate and detailed analysis. Fundamental division is based on the performer and funder of R&D activities. There are many benefits of sectoral classification such as, different survey methods can be applied among different sectors, enable surveyors to see the level and the direction of R&D differences between sectors and it gives an opportunity to have a framework for analyzing the flow of funds between R&D-funding and R&D-performing entities.

Five main sectors were defined for R&D classifications which are business enterprise, government, higher education, private non-profit and abroad.

Business enterprise sector, according to the OECD Frascati Manual (2002), covers all firms and organizations in the market whose primary aim is to have a market share via producing goods and services and to make sale to the general public at an economically significant price. Business enterprise sector is made up of mainly three parts such as, private enterprises, public enterprises and non-profit institutions. Private enterprises are the core part of business enterprise sector which may include some firms for which R&D is the main activity like commercial R&D institutes and laboratories. Exceptionally, private enterprises operating in higher education business should be examined in the higher education sector. Business enterprise sector also include public enterprises which are owned by government but operate in market just like other private firms do. There exist also non-profit organizations (NPO) in business enterprise sector which operate in market as well, producing goods or services. Mainly there are two versions of NPOs; first type consists of the ones operating in market in order to recover their cots like clinic hospitals. Second are typically created by business associations such as chamber of commerce and trade associations. Government sector, according to OECD Frascati Manual (2002) is composed of:

> All departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community (p. 62).

Key notion here is, government sector includes benefits which can not otherwise be provided economically such as health, education, social services, defense and regulation of public order and etc. Additionally, all non-market NPOs, except the ones administrated by higher education sector, controlled and financed by government sector are included in government sector. In Turkey, many activities of

R&D are supported by government and there are numbers of governmental subsidies in the mentioning area. Thus it can be said that Turkey is a convenient country for both foreign and domestic investors to structure R&D investments (Öner, 2006)

Higher education sector in the OECD Frascati Manual (2002) is defined as "All universities, colleges of technology and other institutions of post-secondary education, whatever their source of finance or legal status". Higher education sector includes also research institutes, experimental stations and clinics operated directly under the institutions in higher education sector. In comparison to other sectors, higher education sector classification is not defined standard ways world-wide. The above definition is produced by OECD whereas United Nations Educational, Scientific and Cultural Organization (UNESCO) do not use exactly the same one. Therefore it is difficult to have clear guidelines that ensure internationally comparable data. There are also some blurred areas such as, post-secondary education, university hospitals and clinics and research institutions which have close links with either higher education sector or other sectors. After all, the main part of the higher education sector in countries consists of universities and colleges of technology.

The figure below, demonstrates the methodology of R&D sectoral classification via asking critical decision questions. In the figure, government sector is simply summarized as the institution which is controlled and mainly financed by government. Business enterprise sector is defined in the figure as it may or may not sell its output at an economical price and controlled and mainly financed by business enterprise units. Finally, higher education sector is demonstrated in the figure as involving higher education and controlled either by government or private non-profit units.

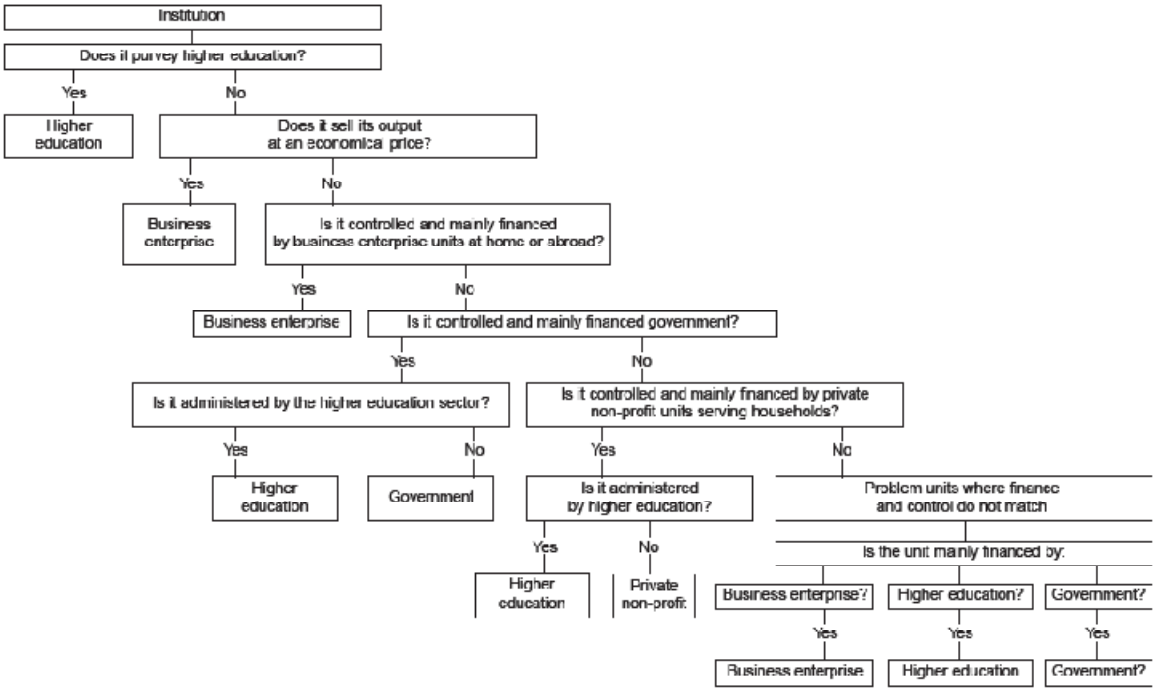



Figure 1: Decision tree for sectoring R&D units

Source: OECD Frascati Manual (2002)

In this part of the Chapter II, the sector based classification of the R&D is defined via explaining business enterprise, government and higher education sectors in order to have clear understanding about the notion of R&D and its sub components. Private non-profit sector and abroad sector are not defined due to the fact that they are not in the scope of this dissertation.

## Latest Developments in R&D over the World

Innovativeness is directly related to new designs, new products as well as new technologies. For OECD area higher variations are seen in R&D expenditures compared to gross domestic products (GDP). That is, as the existence of a drop in GDP due to economic crises will cause higher decreases in R&D expenditures. In 2007, R&D expenditures in the OECD area reached approximately to 886 billion

dollars which also refer to 2.29% of the overall GDP. The figure below represents the R&D intensities of the countries (OECD, 2009).

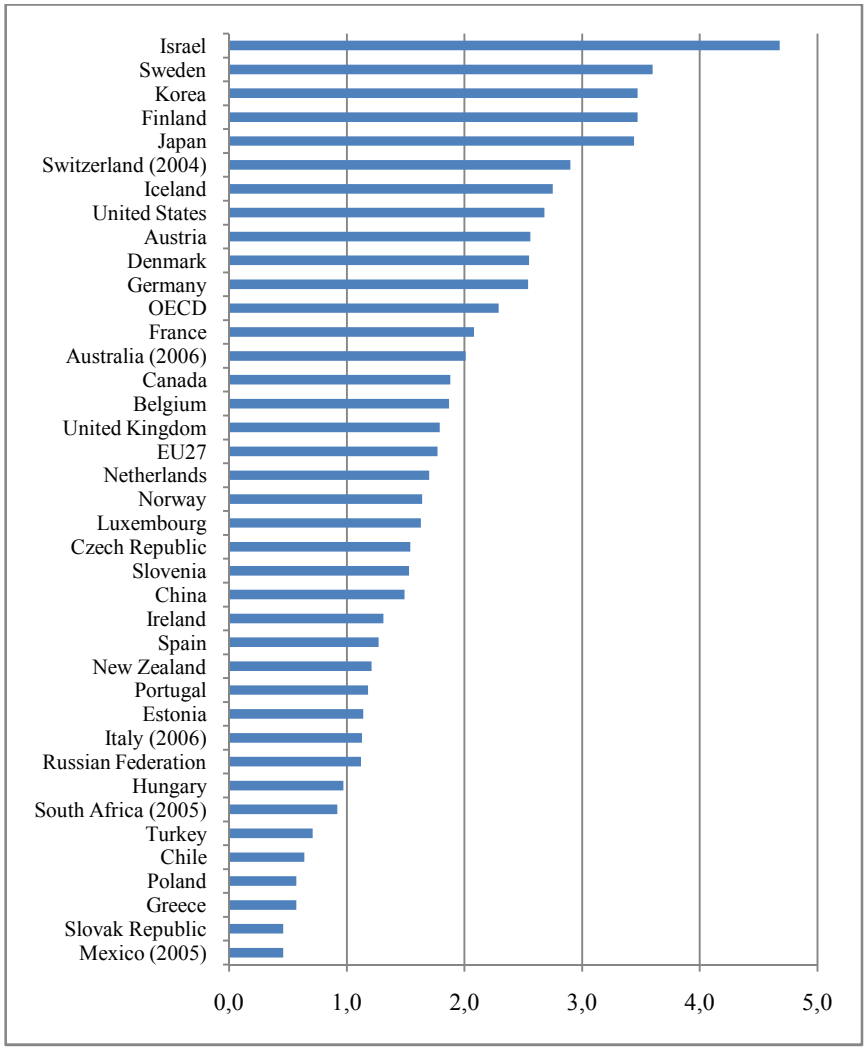



Figure 2: Gross domestic R&D expenditures in the world in 2007 (% of GDP)

Source: OECD Science Technology and Industry Scoreboard 2009

R&D intensity is higher than 3% in four OECD countries Finland, Japan, Korea and Sweden. The OECD average is around 2.3%. In the last two years crucial growth in R&D intensity was reported for Portugal and Australia (0.4 and 0.2 percentage points respectively). As it can be seen from the figure some non-OECD economies also have crucial rates in R&D intensity. Share of gross domestic R&D expenditures in GDP (GERD) of China is around 11.5% total OECD. Additionally, R&D intensity in

Israel is 4.7% which is higher than that of any OECD country. The elasticity of R&D to GDP differs in countries. The figure below demonstrates the responsiveness of R&D expenditures to GDP. For some countries like Hungary, Slovak Republic, Poland and Spain the variations of R&D expenditures has been three times greater than the GDP changes (OECD, 2009).

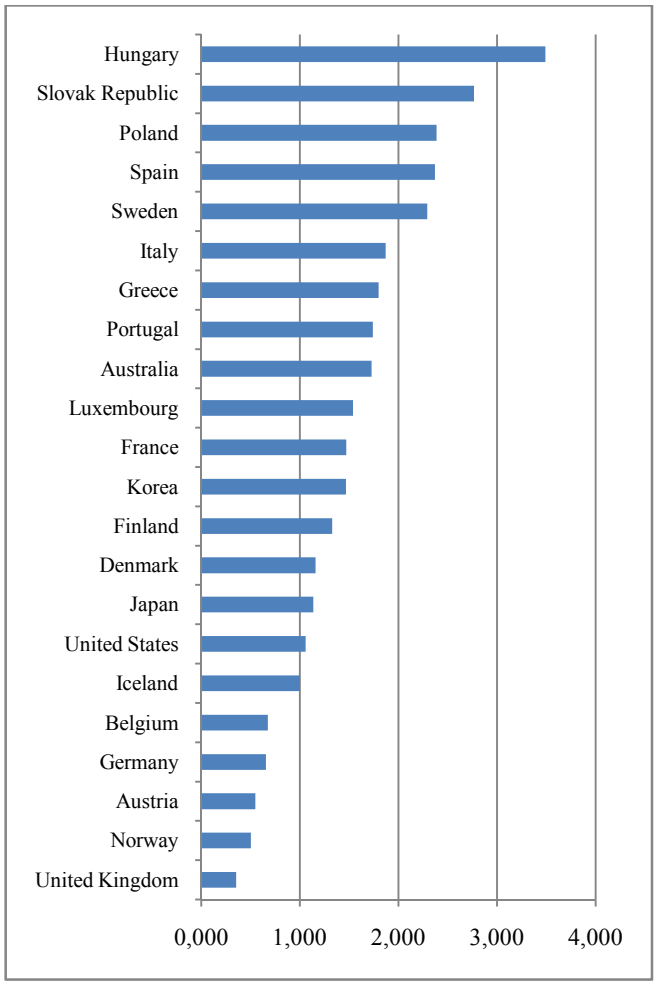



Figure 3: Responsiveness of R&D expenditures to GDP (1981-2007)
Source: OECD Science Technology and Industry Scoreboard 2009

Source of R&D financing differs in countries. The business enterprise sector is the major source of R&D activities in most of the OECD countries. Two thirds of the total R&D activities were financed by business enterprise sector. The figure below represents the source of R&D financing in countries and regions. In the OECD

countries, business funding of R&D has been growing on average at a faster speed than government-financed R&D over the last 25 years (OECD, 2009).

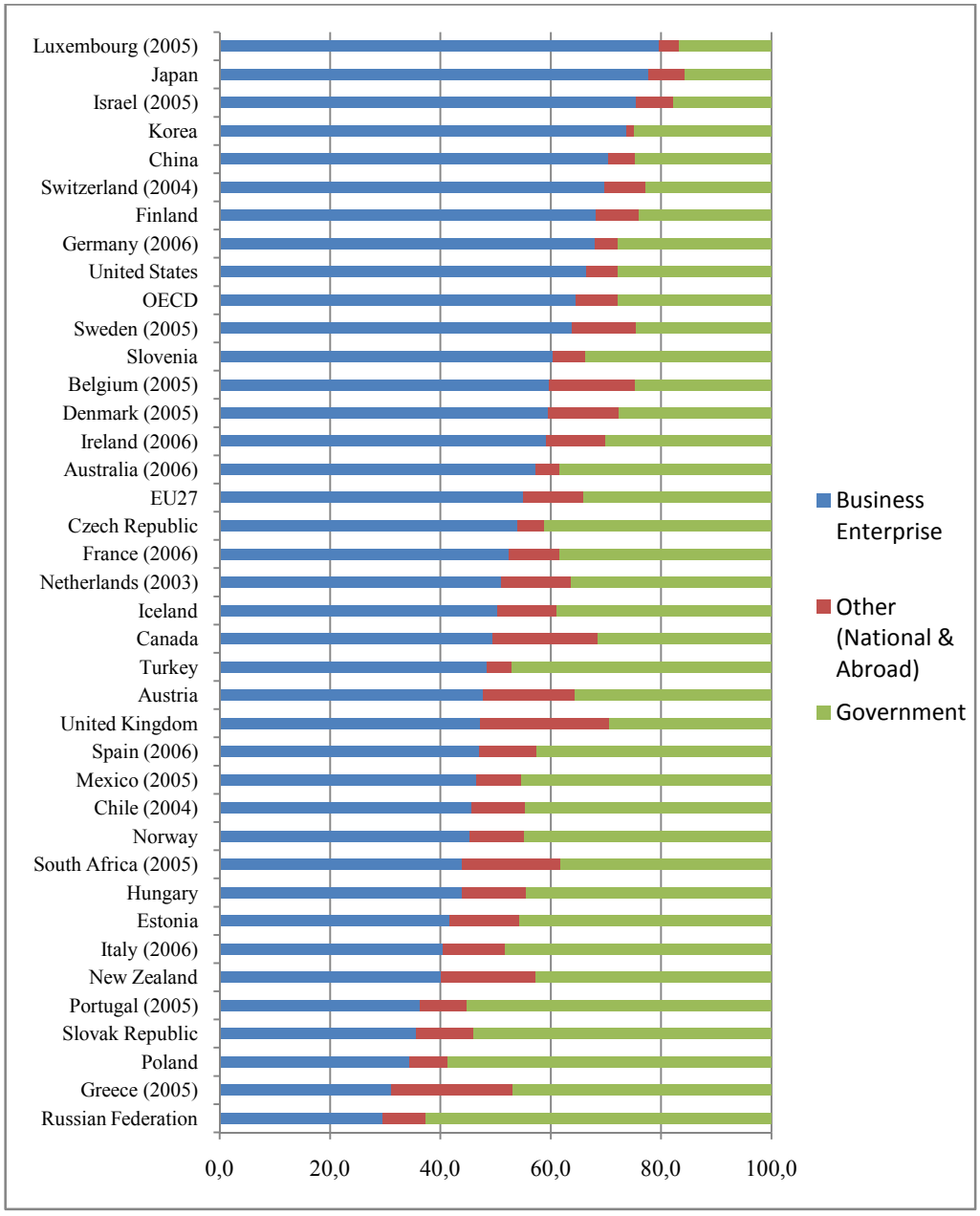



Figure 4: R&D by source of financing (2007, % of national total)

Source: OECD Science Technology and Industry Scoreboard 2009

Iceland, Portugal and Turkey experienced a strong growth of business R&D during the last decade, which is higher than 10%. The figure below represents the last decade business enterprise R&D expenditures' growth rates. Outside the OECD area,

China and Estonia had growth rates above 20% a year in real terms. The Slovak Republic is the only country among surveyed ones having experienced a decline in real terms during the period (OECD, 2009).

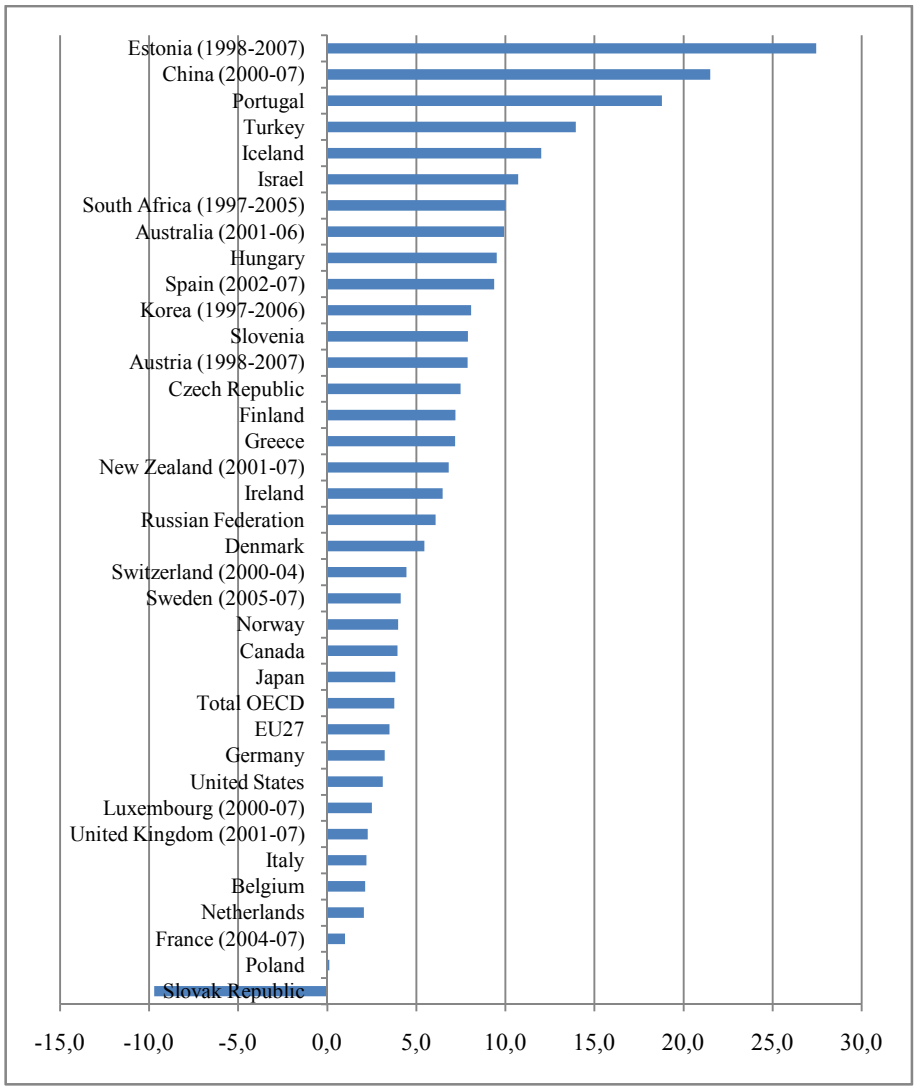



Figure 5: Average annual growth rate of business enterprise R&D (1997-2007, %)
Source: OECD Science Technology and Industry Scoreboard 2009

Additionally, Table 1 includes the gross domestic R&D expenditures (as percentage of GDP) of different countries. According to 2008 results Sweden have the highest GERD with 3.8%. Finland, Japan and Korea come after with the rates of 3.7%, 3.4% and 3.4% respectively. Slovak Republic, Poland and Turkey have the lowest rates 0.5%, 0.6% and 0.7% respectively.

Table 1: Gross Domestic R&D Expenditures as Percentage of GDP (GERD) in Countries

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | 1,2 | .. | 1,4 | .. | 1,5 | .. | 1,6 | .. | 1,4 | .. | 1,5 | .. | 1,6 | .. | 1,7 | .. | 2,0 | .. | .. |
| Austria | 1,4 | 1,4 | 1,4 | 1,4 | 1,5 | 1,5 | 1,6 | 1,7 | 1,8 | 1,9 | 1,9 | 2,1 | 2,1 | 2,3 | 2,3 | 2,5 | 2,5 | 2,5 | 2,7 |
| Belgium | .. | 1,6 | .. | 1,7 | 1,6 | 1,7 | 1,8 | 1,8 | 1,9 | 1,9 | 2,0 | 2,1 | 1,9 | 1,9 | 1,9 | 1,8 | 1,9 | 1,9 | 1,9 |
| Canada | 1,5 | 1,6 | 1,6 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,8 | 1,8 | 1,9 | 2,1 | 2,0 | 2,0 | 2,1 | 2,0 | 2,0 | 1,9 | 1,8 |
| China | .. | 0,7 | 0,7 | 0,7 | 0,6 | 0,6 | 0,6 | 0,6 | 0,7 | 0,8 | 0,9 | 1,0 | 1,1 | 1,1 | 1,2 | 1,3, | 1,4, | 1,4, | 1,5 |
| Czech Republic | .. | .. | .. | .. | .. | 1,0 | 1,0 | 1,1 | 1,1 | 1,1 | 1,2 | 1,2 | 1,2 | 1,3 | 1,2 | 1,4 | 1,5 | 1,5 | 1,5 |
| Denmark | 1,5 | 1,6 | 1,6 | 1,7 | .. | 1,8 | 1,8 | 1,9 | 2,0 | 2,2 | .. | 2,4 | 2,5 | 2,6 | 2,5 | 2,5 | 2,5 | 2,6 | 2,7 |
| Finland | 1,8 | 2,0 | 2,1 | 2,1 | 2,3 | 2,3 | 2,5 | 2,7 | 2,9 | 3,2 | 3,3 | 3,3 | 3,4 | 3,4 | 3,5 | 3,5 | 3,5 | 3,5 | 3,7 |
| France | 2,3 | 2,3 | 2,3 | 2,4 | 2,3 | 2,3 | 2,3 | 2,2 | 2,1 | 2,2 | 2,1 | 2,2 | 2,2 | 2,2 | 2,2 | 2,1 | 2,1 | 2,0 | 2,0 |
| Germany | 2,6 | 2,5 | 2,4 | 2,3 | 2,2 | 2,2 | 2,2 | 2,2 | 2,3 | 2,4 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,6 |
| Greece | .. | 0,3 | .. | 0,4 | .. | 0,4 | .. | 0,5 | .. | 0,6 | .. | 0,6 | .. | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | .. |
| Hungary | 1,5 | 1,0 | 1,0 | 1,0 | 0,9 | 0,7 | 0,6 | 0,7 | 0,7 | 0,7 | 0,8 | 0,9 | 1,0 | 0,9 | 0,9 | 0,9 | 1,0 | 1,0 | 1,0 |
| Iceland | 1,0 | 1,2 | 1,3 | 1,3 | 1,4 | 1,5 | .. | 1,8 | 2,0 | 2,3 | 2,7 | 3,0 | 3,0 | 2,8 | .. | 2,8 | 3,0 | 2,7 | 2,7 |
| Ireland | 0,8 | 0,9 | 1,0 | 1,2 | 1,3 | 1,3 | 1,3 | 1,3 | 1,2 | 1,2 | 1,1 | 1,1 | 1,1 | 1,2 | 1,2 | 1,3 | 1,3 | 1,3 | 1,4 |
| Italy | 1,3 | 1,2 | 1,2 | 1,1 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,2 | 1,2 |
| Japan | 3,0 | 3,0 | 2,9 | 2,9 | 2,8 | 2,9 | 2,8 | 2,9 | 3,0 | 3,0 | 3,0 | 3,1 | 3,2 | 3,2 | 3,2 | 3,3 | 3,4 | 3,4 | 3,4 |
| Korea | .. | 1,8 | 1,9 | 2,0 | 2,2 | 2,3 | 2,3 | 2,4 | 2,2 | 2,2 | 2,3 | 2,5 | 2,4 | 2,5 | 2,7 | 2,8 | 3,0 | 3,2 | 3,4 |
| Luxembourg | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1,7 | .. | .. | 1,6 | 1,6 | 1,6 | 1,7 | 1,6 | 1,6 |
| Mexico | .. | .. | .. | 0,2 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,4 | 0,3 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | .. |
| Netherlands | 2,1 | 2,0 | 1,9 | 1,9 | 2,0 | 2,0 | 2,0 | 2,0 | 1,9 | 2,0 | 1,8 | 1,8 | 1,7 | 1,8 | 1,8 | 1,8 | 1,8 | 1,8 | 1,8 |
| New Zealand | 1,0 | 1,0 | 1,0 | 1,0 | .. | 1,0 | .. | 1,1 | .. | 1,0 | .. | 1,1 | .. | 1,2 | .. | 1,2 | .. | 1,2 | .. |
| Norway | .. | 1,6 | .. | 1,7 | .. | 1,7 | .. | 1,6 | .. | 1,6 | .. | 1,6 | 1,7 | 1,7 | 1,6 | 1,5 | 1,5 | 1,6 | 1,6 |
| Poland | 0,9 | 0,7 | 0,8 | 0,8 | 0,7 | 0,6 | 0,7 | 0,7 | 0,7 | 0,7 | 0,6 | 0,6 | 0,6 | 0,5 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 |
| Portugal | 0,5 | 0,5 | 0,6 | 0,6 | 0,6 | 0,5 | 0,6 | 0,6 | 0,7 | 0,7 | 0,8 | 0,8 | 0,8 | 0,7 | 0,8 | 0,8 | 1,0 | 1,2 | 1,5 |
| Slovak Republic | 1,6 | 2,1 | 1,8 | 1,4 | 0,9 | 0,9 | 0,9 | 1,1 | 0,8 | 0,7 | 0,6 | 0,6 | 0,6 | 0,6 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 |
| Slovenia | .. | .. | .. | 1,6 | 1,8 | 1,5 | 1,3 | 1,3 | 1,3 | 1,4 | 1,4 | 1,5 | 1,5 | 1,3 | 1,4 | 1,4 | 1,6 | 1,4 | 1,7 |
| Spain | 0,8 | 0,8 | 0,9 | 0,9 | 0,8 | 0,8 | 0,8 | 0,8 | 0,9 | 0,9 | 0,9 | 0,9 | 1,0 | 1,0 | 1,1 | 1,1 | 1,2 | 1,3 | 1,4 |
| Sweden | .. | 2,7 | .. | 3,1 | .. | 3,3 | .. | 3,5 | .. | 3,6 | .. | 4,2 | .. | 3,8 | 3,6 | 3,6 | 3,7 | 3,6 | 3,8 |
| Switzerland | .. | .. | 2,6 | .. | .. | .. | 2,7 | .. | .. | .. | 2,5 | .. | .. | .. | 2,9 | .. | .. | .. | 3,0 |
| Turkey | 0,2 | 0,4 | 0,4 | 0,3 | 0,3 | 0,3 | 0,3 | 0,4 | 0,4 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,6 | 0,6 | 0,7 | 0,7 |
| United Kingdom | 2,1 | 2,0 | 2,0 | 2,0 | 2,0 | 1,9 | 1,8 | 1,8 | 1,8 | 1,8 | 1,8 | 1,8 | 1,8 | 1,7 | 1,7 | 1,7 | 1,8 | 1,8 | 1,8 |
| United States | 2,6 | 2,7 | 2,6 | 2,5 | 2,4 | 2,5 | 2,5 | 2,6 | 2,6 | 2,6 | 2,7 | 2,7 | 2,6 | 2,6 | 2,5 | 2,6 | 2,6 | 2,7 | 2,8 |

Source: OECD MSTI database

## R&D in Turkey

In order to have a wide range of information about R&D progress in Turkey, the development of R&D including historical and current situation will be explained without skipping future plans and strategies. In order to have an understanding about historical evolution of R&D and its policies in Turkey, the five-year development plans will be examined briefly. Then, crucial pillars of science and technology related issues will be defined in order to reflect the structure of R&D in today's Turkey. Finally, in this area Turkey's strategic targets and policies regarding the future will be projected in order to enlighten what is going to happen in tomorrow's Turkey.

### Historical Perspectives of R&D Policies in Turkey

In Turkey, first try of planned economy related policies were implemented in 1930s but particularly due to the II. World War environment these policies were not applied healthy. After military intervention in 1960, the planned economy came into play once again with more dynamic frameworks which lasted about twenty years from that time on. In planned economy period the governmental policies produced were usually mandatory for public sectors and directive for the private sector (Arslan, 2007). Related to this, it was decided that the economic policies will be determined with respect to development plans which were going to be prepared in a five year base. In 1960 The State Planning Organization (SPO) was founded with the primary aim of constructing those five-year plans (State Planning Organization, 1963).

The first of five-year development plans covers the years from 1963 to 1967 and they have been continued until today. In the first plan, although it was not in a detailed way the issue of strengthening technical and scientific knowledge was

talked. In this period, The Scientific and Technical Research Council of Turkey (TUBITAK) were founded as it was planned in the first five-year development plan. Although at the beginning it was not functioning as expected, TUBITAK was a clear output proving the government had willingness about having systematic policies in the area of science and technology. Detailed structure of TUBITAK will be examined in the following parts of the chapter.

In the second five year plan, the issue of "Science and Research" was taken into account which was one of the main differences of second plan from first one. In the mentioning area, aims, current situation of the country and general trends in terms of science and technology were cleared. Some statistical facts were expressed in order to show the level of Turkey in comparison to other countries. For example, in the plan it was stated that, Turkey's R&D expenditures are equal to % 0.4 of her GDP whereas in some countries this rate reaches around to %4. Additionally, rate of R&D personnel to the population reaches % 0.6 in some countries whereas, it was only % 0.012 for Turkey in the year 1964 (State Planning Organization, 1968). Thus, in the plan Turkey's current situation in terms of R&D indicators was stated and targets, policies and strategies were determined accordingly. However, some of the basic aims were not actually practical, such as the target of R&D expenditures' rate to GDP was set as % 0.6 whereas it actually reached that rate in the beginning of 2000 (Arslan, 2007).

In the third five-year plan of SPO (1974), covering the years from 1973 to 1977, the concept of "Technology Transfer" was emphasized which itself enables to build a bridge so that technological advancements can be linked to industry. Lack of sufficient institutional mechanisms was one of the main reasons preventing technology transfers to improve. One of the crucial issues took place in the plan was

producing national technology. Accordingly, policies argued and determined in order to develop and maintain national technology infrastructure. Another significant content of the plan which is worth to mention, is a consciousness about need for industrialization which can be established via advanced technologies. (Kiper and Demir, 2009). As a new structural settlement, Department of Science and Technology was founded in this period, under the Ministry of Industry and Technology but it had not worked efficiently.

Like in the previous plan, the issue of technology transfer and related problems were underlined even more detailed concerns in the fourth five-year plan of SPO (1974). The emphasis was put on the problem of high costs of technology transfers, lack of organic links between R&D institutions and industries and insufficient environment for the national knowhow leakage (Kiper and Demir, 2009). It is underlined in the plan that the technology transfer is established in Turkey via licensing, know how agreements, foreign direct investments, machinery and hardware etc. The suffering point is know-how was leaked to developing countries as a package and self development would happen merely via opening this package for which at that time in Turkey there had not enough infrastructures. All these elements were the factors increasing the cost of technology transfer.

The importance of national technology production and limiting character of law is also underlined stating that the laws regulating the patent rights serve for the interests of the technologically improved foreign sellers. However, it should instead be supportive for the domestic technology producers. In this plan period, Turkish Science Policy (1983-2003) was declared which was prepared for establishing policies to deal with the mentioning problems. However, the goals related to R&D budget, uncertainty of national science and technology policies, non-establishment of

mutual relationships between R&D institutions and industry were not realized as expected (State Planning Organization, 1974).

The key difference of the fifth five-year plan of SPO (1984) compared to previous plans is the underlining issues of targeted sectors and areas. Given the fact that, in the planned economy period imports had been done without knowing detailed technological know-how, thus it is planned to increase the efficiency of Techno-parks and strengthen the incentive mechanisms towards R&D institutions and universities in order to enrich the general information level about the technology.

In the sixth five-year plan of SPO (1989) which covers the years 1990-1994, the major novelty is the existing of more concrete targets. Targets were given in the plan at the very beginning of the "Science and Technology" part such as, "… in order to have complete R&D infrastructure, number of R&D personnel will be doubled which is 33.000, number of R&D personnel as 15 per 10 thousand people and the proportion of GDP which is reserved for R&D expenditures will tried to be increased up to 1%." As it stated in the previous plan, subventions for Techno-parks' diffusions and support for universities and R&D institutions had continued increasingly in this period. The primarily focused sectors for support were also determined which are technology intensive such as bio-technology, information technology, communication, satellite and nuclear technologies and etc.

In the seventh five-year plan of SPO (1989) the science and technology related policies and goals pointed out with the heading of "Progress Project in Science and Technology". Current situation, policies and targets including regulations were settled with giving a lot of details. Although the targets were not going to be reached properly later on, at the planning degree there had been a

comprehensive “to do” list in the policies and aims section of the plan. Highlighted policies and targets were such as, revision in the support mechanisms in R&D, rise of the share of business enterprise sector in R&D expenditures, increasing budget from scarce financial resources for science and technology, establishment of international science and technology cooperation and etc. Although previous targets were far from realization proportion of R&D expenditure in GDP and R&D personnel per 10 thousand people were aimed to reach %1.5 and 15 respectively.

In the eighth five-year plan of SPO (2000) which covers the years of 2001-2005, science and technology based structure; strategies and targets were explained briefly as follows: strengthening of physical, legal and human structure, put emphasis on the industry competitiveness in international level, ongoing support for R&D activities in a university-industry cooperation, more focus on some priority sectors such as aerospace, nuclear technologies, energy technologies and etc. The mentioning part of the plan is headed as “Developing the Science and Technology Skills” which reflects first the present situation in the area, then expresses related policies and targets. New targets determined such as, proportion of R&D expenditure in GDP stays same at the %1.5 whereas R&D personnel per 10 thousand people was planned to increase 20. Some of the attention getting policies existed such as, encouragement of foreign direct investments which can affect domestic technologies positively, raising more qualified engineers and intermediate staff, restoring the principals of governmental R&D support and preparing action plans for the needs of information society and economy (State Planning Organization, 2000). Additionally, in the late 2000 The Supreme Council for Science and Technology was tasked TUBITAK with establishing science and technology strategies for the years 2003-

2023. The so-called project “Vision 2023” will be pointed out in the following parts of the chapter in detail (Arslan, 2007).

The ninth five year development plan of SPO (2006) covering the years 2007-2013 has prepared for seven years instead of five. R&D is examined under the title of “Increasing Competitive Power” in the mentioning plan. Innovation improvement and spreading information and communication technologies were two main frameworks explaining the R&D strategies and plans. Innovation which gives the opportunity of having high value added products is a significant factor increasing competitive advantage of countries. In today’s world with highly competitive international markets, exporting high value added products is a way to become economically powerful actor. In the ninth five year development plan of State Planning Organization (2006) it is stated that: “Innovation is one of the crucial elements of competitive economic structure and a high proportion of innovations are caused by operations of science and technology producing R&D activities.” In Turkey R&D activities are done mainly in universities and public research institutions. Key point is the need for strong links between those R&D producing institutions and the corporations using this R&D (Kiper and Demir, 2009).

The proportion of R&D expenditures in GDP was %0.67 in 2002 which is quite low in comparison to the rates of technologically improved countries. The Table 1 in the following parts of the chapter demonstrates the mentioning rates for OECD countries. In this period, governmental support for R&D activities has continued such as the tax reductions in technology improvement areas for the firms and the researchers as well. By 2005, TUBITAK has started support programs for in the areas of academic, industry and publics (State Planning Organization, 2006).

## R&D Implementations in Turkey

In Turkey, R&D activities are empowered by mainly three sectors such as, government sector, business enterprise sector and higher education sector. As it explained in the early parts of the chapter, a complete differentiation of an R&D activity in terms of the sectors is usually not possible due to its embedded structure. Thus, most of the time roots of an R&D activity can be included more than one sector. For example, universities have autonomous structure whereas they are owned either by government or private sector. Similarly, some public institutions like KOSGEB and TUBITAK can organize R&D activities with private sector and universities, which are called techno-parks. Eventually, R&D activities, although it is hard to differentiate sometimes, are nourished by public or private resources including also higher education (Adak, 2007).

Table 2: Sources and Change of R&D in Turkey (% of GDP, %)

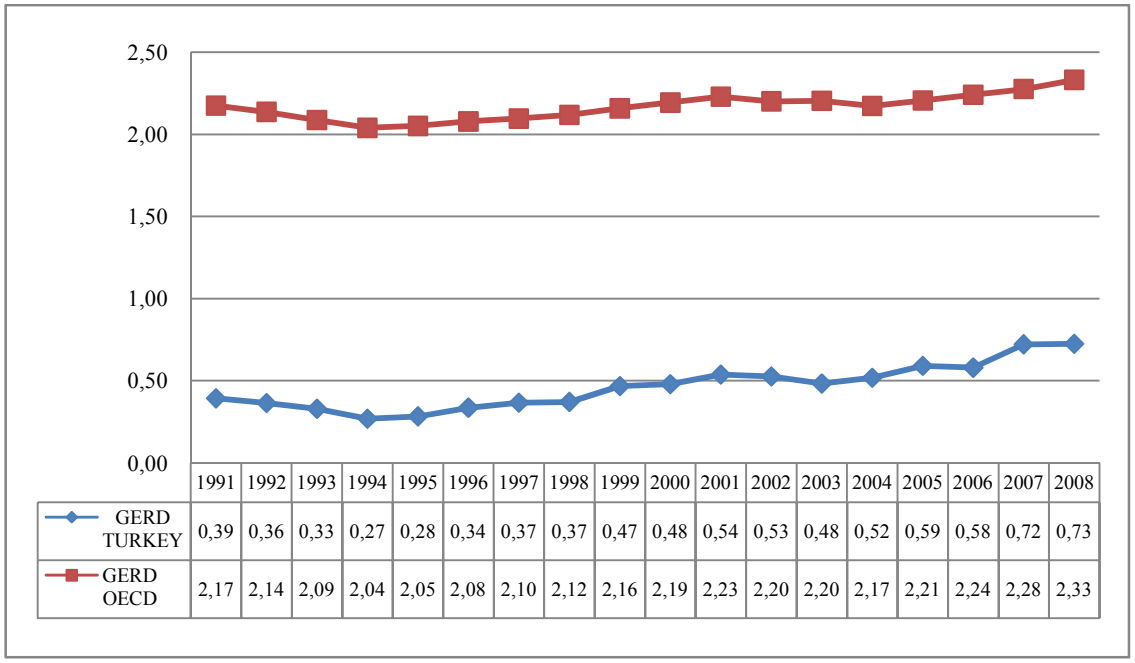
| Source of R&D | 2006 | 2007 | Change |
|---|---|---|---|
| Goverd | 0.07 | 0.08 | 14 |
| Berd | 0.22 | 0.30 | 36 |
| Herd | 0.30 | 0.34 | 13 |

Source: OECD MSTI database

The main three pillars of R&D sources in Turkey are government (GERD), business enterprise sector (BERD) and the higher education (HERD). It should be noted that, financing of higher education R&D activities is done by mainly government. The percentage of HERD in Turkey is the highest among all as it seen in the figure above. The general trend in the world favors the business enterprise sector R&D activities more than other sources. For Turkey, although the BERD is getting increased in the last decades HERD is still higher. This is about the less developed R&D environment

in the country which leads government to be the first in the area both initiating GOVERD and HERD.

Thus basically there exist two sources of funding for R&D activities such as public funding and private funding. A country's general R&D expenditure which is called "GERD" has two main funding sources. GERD of a country is usually compared with her GDP to make international comparisons. Figure 6 includes the GERD of Turkey and total OECD countries. As it can be seen from the figure, GERD in Turkey is less than 1 percent in all periods. However, the rates in total OECD members have always been more than 2 percent. This gives a clear idea about the situation of Turkey in terms of the level of R&D expenditures.



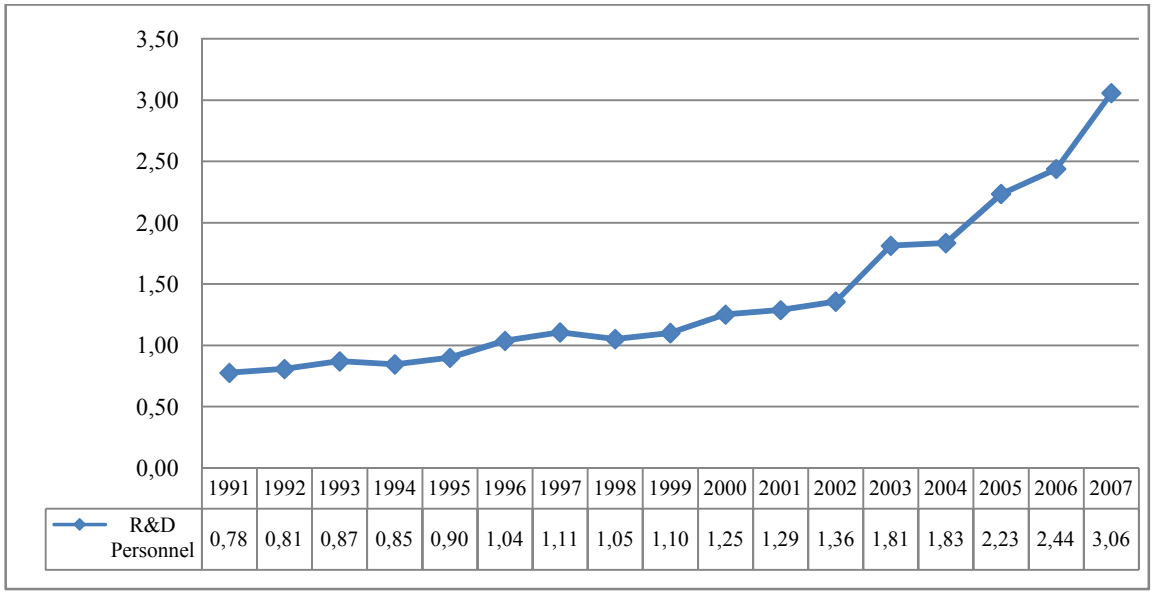

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GERD TURKEY | 0,39 | 0,36 | 0,33 | 0,27 | 0,28 | 0,34 | 0,37 | 0,37 | 0,47 | 0,48 | 0,54 | 0,53 | 0,48 | 0,52 | 0,59 | 0,58 | 0,72 | 0,73 |
| GERD OECD | 2,17 | 2,14 | 2,09 | 2,04 | 2,05 | 2,08 | 2,10 | 2,12 | 2,16 | 2,19 | 2,23 | 2,20 | 2,20 | 2,17 | 2,21 | 2,24 | 2,28 | 2,33 |

Figure 6: The share of R&D expenditures in GDP (Turkey, OECD total)

Source: OECD MSTI database

Number of scientific and technical personnel gives a concrete idea to understand the resources devoted to R&D. Figure 7 demonstrates the R&D human resources per

10.000 total employment in Turkey. As it can be seen in the figure, there exists a clear rising trend in the number of R&D personnel in years.

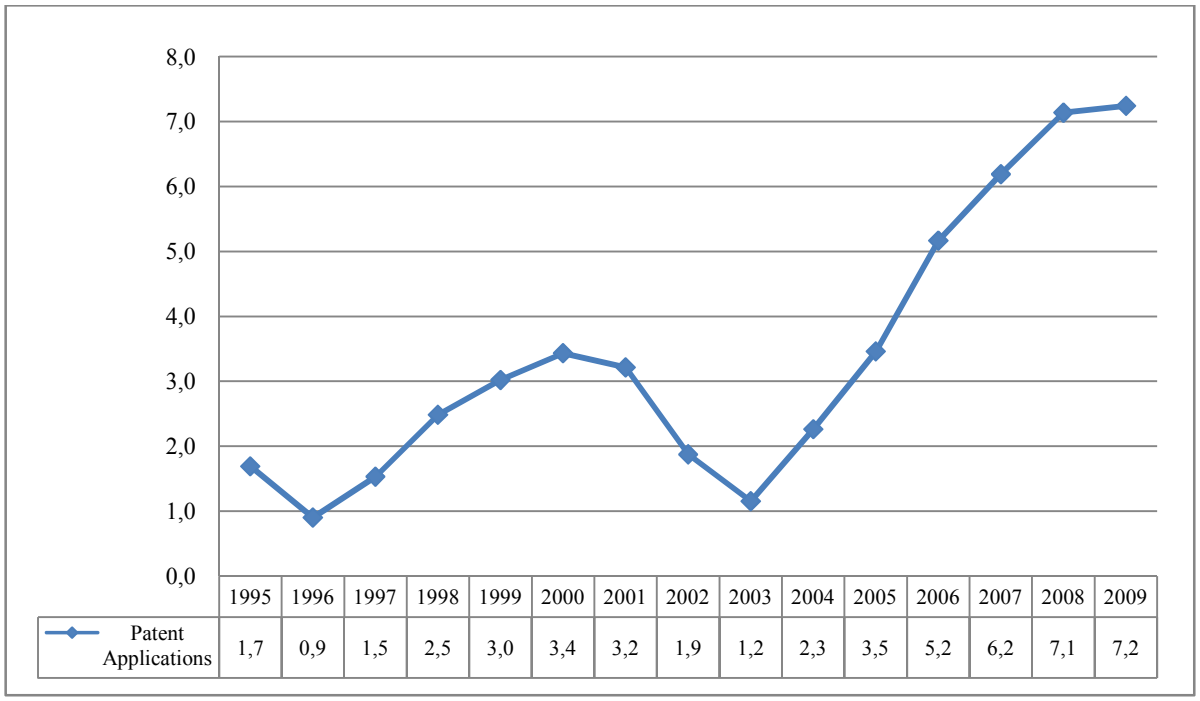



| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R&D Personnel | 0,78 | 0,81 | 0,87 | 0,85 | 0,90 | 1,04 | 1,11 | 1,05 | 1,10 | 1,25 | 1,29 | 1,36 | 1,81 | 1,83 | 2,23 | 2,44 | 3,06 |

Figure 7: Total R&D personnel per thousand employments in Turkey

Source: OECD MSTI database

Patent is an output indicator for R&D expenditures which is crucial to learn the level and the effectiveness of R&D activities. Thus, number of patent applications, which is seen in the Figure 8, gives an idea about the output trend of R&D activities in Turkey. As it can be seen in the figure there has been an increasing trend in the first years which is turned down in the crisis period of 2002. Starting from 2003, increasing trend appeared again.




| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Patent Applications | 1,7 | 0,9 | 1,5 | 2,5 | 3,0 | 3,4 | 3,2 | 1,9 | 1,2 | 2,3 | 3,5 | 5,2 | 6,2 | 7,1 | 7,2 |

Figure 8: Total patent applications in Turkey (Thousand)

Source: Turkish Patent Institute web site

## R&D Institutions

As it stated earlier, due to its embedded structure it is usually hard to differentiate perfectly between the R&D activities of business enterprise and public sectors. Business sector R&D activities in Turkey started to develop by the years of 1990s. Before that, it is hard to mention about distinct R&D policies and activities unfortunately. Public sector activities have been played the role of pioneer for industrial R&D activities. In this sense, public powers initiated business enterprise R&D activities through providing financial and infrastructural needs. In order to serve for the mentioning aims there exist some public institutions such as The State Planning Organization (DPT), Supreme Council for Science and Technology (BTYK), The Scientific and Technological Research Council of Turkey (TUBITAK) and Small and Medium Enterprises Development Organizations (KOSGEB) (TUBITAK, 2010).

## Supreme Council for Science and Technology (BTYK)

Supreme Council for Science and Technology (BTYK) was founded in 1983 with the missions of carrying out and managing Turkish Science Policies, assisting government in determining long term R&D policies, assigning to public institutions about R&D related concerns, establishing research centers and coordinating the related institutions. It is the highest ranking authority in determining science, technology and innovation policies. To sum up, the council builds long terms goals, assign tasks provide the environment needed and follows-up developments (TUBITAK, 2010).

The BTYK is chaired by the Prime Minister and related ministers including undersecretaries of some related public corporations. Additionally, heads of some institutions such as president of TUBITAK and Undersecretary of State Planning Organization also participate in the meetings. With the twenty permanent members chaired by Prime Minister, including more than one hundred different governmental actors BTYK meetings by law have to be arranged at least twice a year (TUBITAK, 2010).

## The State Planning Organization (DPT)

The State Planning Organization is a governmental organ responsible for preparing and executing the development plans as well as directing science and technology policies in the mentioning plans. The latest development plan issued by DPT covers the years from 2007 to 2013 which is mentioned in the early parts of the chapter. Another significant mission of DPT is to determine and redistribute the budget of R&D investments. This budget is the fundamental source of public funding of R&D

which is allocated to TUBITAK, universities, governmental R&D institutions and other related projects (TUBITAK, 2010).

The Small and Medium Enterprises Development Organization (KOSGEB)

Most of the industrial production of Turkey is provided by small and medium size enterprises (SME). In this sense, it is crucial for the governmental authorities to serve those firms in terms of science, technology and innovation infrastructures. Small and Medium Enterprises Development Organization was established with the aim of taking SMEs to a comparatively advantageous position in highly competitive global market arena. The organization which is founded under the Ministry of Industry and Trade gives assistance and supports in the areas such as R&D activities, innovation advancement projects and industrial application supports (Adak, 2007).

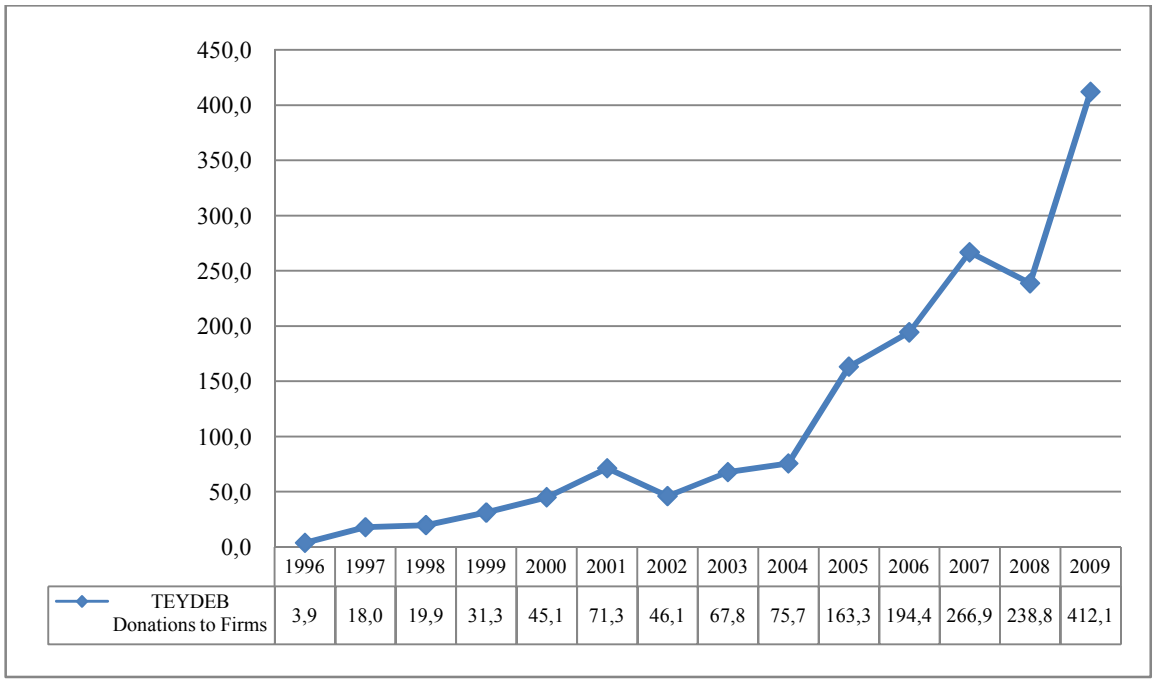
The Scientific and Technological Research Council of Turkey (TUBITAK)

TUBITAK is one of the leading agencies in Turkey for sustaining and funding R&D activities. The Council was founded at the year of 1963 with the aim of upgrading the science, technology and supporting related activities. It has an autonomous structure which is governed by "Scientific Board". It is responsible for managing the R&D activities in line with the national targets and concerns. The Council has a consultative role for the Turkish Government about the issues of R&D. Besides, it represents the secretariat of Supreme Council for Science and Technology (BTYK). As a part of its supportive mechanism the Council has many subsidy programs which are related to industry projects, academic supports, public researches, European Union and etc. The best way of seeing contributions of TUBITAK to R&D activities must be through evaluating the supports both to industry and academics. The Figure

9, 10, 11 and 12 demonstrate the main framework of the Council's supportive mechanism (TUBITAK, 2010).

"Technology and Innovation Funding Programs Directorate" (TEYDEB) is one of the support programs of TUBITAK focusing on Turkish companies. The program aims to develop R&D activities and establish innovation culture in the firms so that the companies' competitive advantage can increase around the world. TEYDEB provides funding and assists to firms in the issues of designing and implementing Research, Technology and development as well as facilitating the industry-academia co-operations. There are some priority sectors in TEYDEB's support mechanism such as, machinery, manufacturing, electronics, metallurgy, information technologies and biotechnology and etc. (TUBITAK, 2010). Figure 9 demonstrates the support of TEYDEB to firms. The amount of mentioning funding has increased tremendously in years. In 1996 the support amount was less than 4 million TL whereas in 2009 it reached 412 million TL.

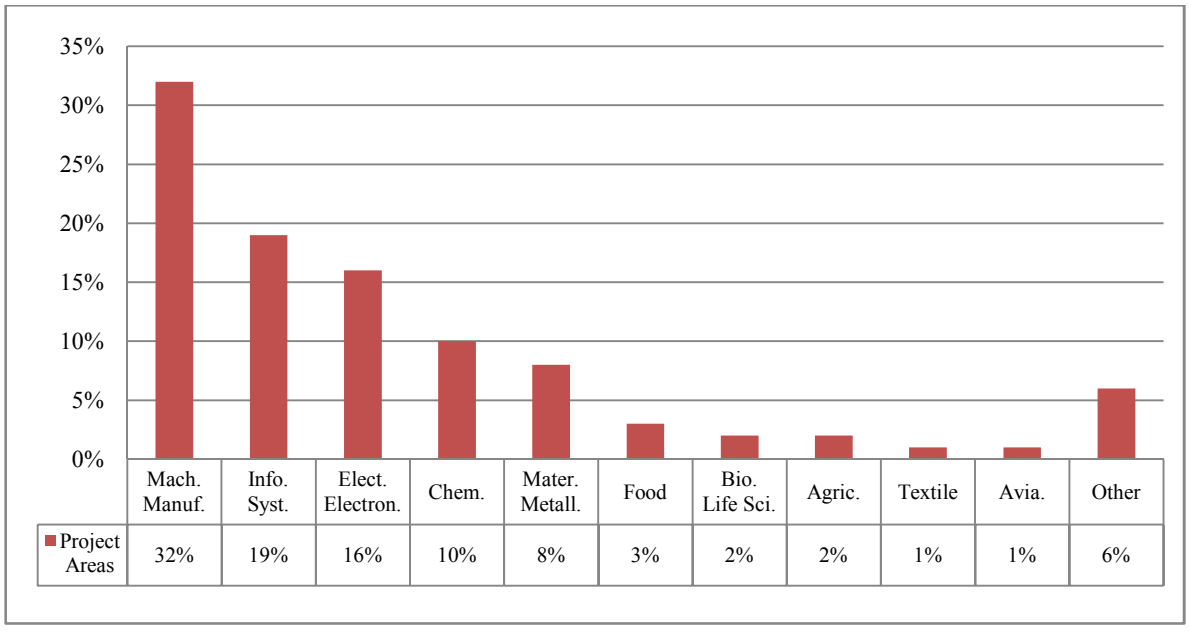
Figure 10 connotes the weights of suggested project application areas subject to the support of TEYDEB cumulated from the years between 1995 and 2009. Projects in the areas of machinery and manufacturing took the lead via forming %32 of total projects. Information systems and electric-electronics come after that with the rates of %19 and %16 respectively. Indeed, the areas seen in the mentioning figure reflect the priority sectors in the general governmental R&D policies of Turkey.




| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEYDEB Donations to Firms | 3,9 | 18,0 | 19,9 | 31,3 | 45,1 | 71,3 | 46,1 | 67,8 | 75,7 | 163,3 | 194,4 | 266,9 | 238,8 | 412,1 |

Figure 9: Donation to firms under the TEYDEB support program (Million TL)

Source: TUBITAK web site



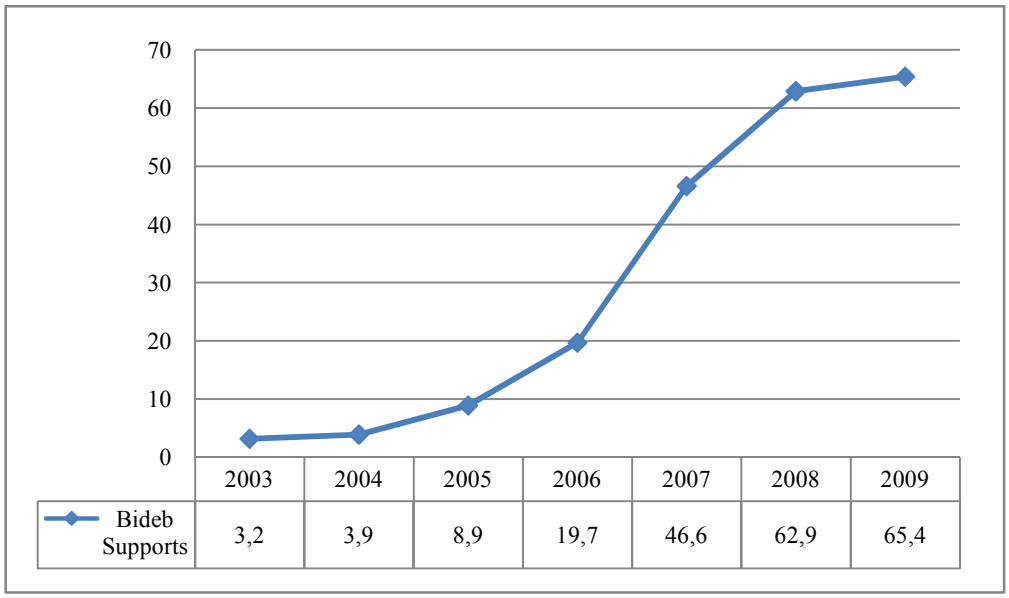

| | Mach. Manuf. | Info. Syst. | Elect. Electron. | Chem. | Mater. Metall. | Food | Bio. Life Sci. | Agric. | Textile | Avia. | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Areas | 32% | 19% | 16% | 10% | 8% | 3% | 2% | 2% | 1% | 1% | 6% |

Figure 10: Suggested project application areas subject to TEYDEB supports (1995-2009 Cumulative, %)

Source: TUBITAK web site

In addition to the Industry funding, TUBITAK has also supportive mechanisms for academics via funding projects. “Scientists Funding Programs Directorate” (BIDEB)

is responsible for providing support to the scientists so that they can produce science and technology and convert it to economic benefits. Establishing proper environment for scientists and researchers to enhance their capabilities, giving presents and providing funds with the aim of encouragement are the main functions of BIDEB. Figure 11 shows the BIDEB supports in years. As it stated in the mentioning figure there has been a distinct increase in the BIDEB supports. In the year 2003 expenditure made under BIDEB mechanism was 3.2 million TL whereas it has reached to the point of 65.4 million TL in 2009.




| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| Bideb Supports | 3,2 | 3,9 | 8,9 | 19,7 | 46,6 | 62,9 | 65,4 |

Figure 11: Support of BIDEB (Million TL)

Source: TUBITAK web site

## Current R&D Policies and Strategies

It can be clearly seen from the history that the fundamental technological innovations caused radical changes in socio-economic systems. Even starting from the first ages, thinking the discovery of wheel for example, technological advancements have upgraded the life style of human being. Industrial revolution with steam power,

discovery of piston engine and electric motor are the samples which explains the mentioning situation successfully (Tubitak, 2004).

Technological innovations are discovered each day with the help of R&D activities. Converting those innovations into economic benefit is the key point helping firms or countries in general for having competitive advantage in the market. In today's highly competitive international markets it is crucial to produce and export high value added products to become economically powerful. In order to have high value added products, actors should increase their innovative capabilities through R&D activities.

As it stated in the early parts of the chapter, Turkey has started to develop policies in technological development since the beginning five year plans. There has been a considerable amount of progresses in the competitive power with the light of these policies. However, the goals in the policy documents have not been achieved most of the time. In the meeting of December 2000, The Supreme Council for Science and Technology (BTYK) assigned the responsibility of preparing the strategy and policies of science, technology and innovation for the next 20 year until 2023 to TUBITAK. The so-called "Vision 2023 Project" started in 2002 by TUBITAK and completed more than 2 years.

The road map for technological strategies is established with the "Technological Foresight Study". In 2002 the mentioning vision 2023 study started which includes 192 meetings and 36 panels lasted more than one year organized by the participation of 250 experts from public and private institutions and universities. Additionally, a two phased Delphi survey was applied and with the attendance of 2400 experts. Finally, Strategic Technology Groups were formed in the 8 main study

fields determined in the panel studies. The panels concluded their studies in 2003 and prepared reports and road maps about 94 technological activity topics. These topics were consolidated with 8 main groups. In 2004, for each group the "Strategic Technology Groups" were composed in order to determine critical technology areas, related targets and policies (TUBITAK, 2004).

The technological foresight study summarizes the current and future vision of technological developments through targets and policies. An important part of the Turkey vision for 2023 is to become technologically matured with innovativeness and capable of increasing its net value added via own resources. To have competitive advantage in manufacturing and owning more shares from international trade pie is one of the main targets supporting the vision. A notable conclusion of the study is the list of 8 strategic areas to be focused primarily to enhancement. These 8 issues are information and communication technologies, biotechnology and gene technologies, nanotechnology, mechatronics, production process and technologies, materials technologies, energy and environment technologies and finally the design technologies (TUBITAK, 2004).

Through the attendance of experts with enormous amounts, detailed definitions about strategies are placed in the document. These descriptions are expected to direct actors in developing their competitive power. Focusing was used as a keyword referring that allocating scarce resources to focused areas which have primary importance in strategic development. An important notion underlined in the document is the "National R&D procurement" especially in defense sector due to its high share from GDP. Related to that, another main concern is the establishment of "Turkish Research Area" (TARAL) as the main framework including public and private actors in R&D activities. Under the TARAL studies gross domestic

expenditure on R&D is targeted to reach 2% by 2010 whereas it is %0.73 in 2008 (TUBITAK, 2004).

## University and Industry Linkages in Turkey

Developing countries in most of the cases, purchase technology and know-how from developed countries. In this type of technology transfer mechanism it is not possible to gain the implicit knowledge of technological developments thus, without that basic level of know-how it is not possible to produce new technologies as well. According to this view, it is significant to establish effective-working knowledge and technology production areas. A strong linkage between universities and industry is crucial to become a knowledge based economy. Historically, there has been generally weak co-operation between university and industry which is mentioned in the five year plans in the early parts of the chapter. More concrete efforts were seen by the foundation of TUBITAK in 1990s. The most common ways of bringing together universities and the industry in takes the form of summer industrial practice of students from universities, contract base projects for firms, providing laboratory and some special design services via university centers etc. (Kiper and Demir, 2009).

In a report evaluating Turkish university-industry relationship, the main cooperation and support mechanisms are separated into 5 main categories such as project oriented, publicly supported co-operative programs, institutional co-operative structures oriented with public program, contract based projects and training programs in universities, institutional bodies owned or dominated by university and informal networks and other initiatives (Adak, 2007).

Project oriented, publicly supported co-operative programs are project based supportive for industry and public institution based R&D activities. TUBITAK-

TEYDEB is a sample of support mechanism for industrial firms and public institutions. TEYDEB focuses on supportive mechanisms for the industrial companies which operate with a university or with a research institute. Donations to firms under TEYDEB program can be seen in the Figure 9. There are also some other programs namely "Industrial Thesis Supporting Program (San-Tez)", "The Support Program for Scientific and Technological Research Projects" and etc. which have supportive mechanisms for university and industry linkage mechanisms (Kiper and Demir, 2009).

Institutional co-operative structures oriented with public program are another type of classification which helps to explain university industry relationships in Turkey. Techno parks are the main actors which enable to convert R&D activities into industrial innovations. The Technology Development Zones (TDZs) Law numbered 4691 was issued in 2000 which is being conducted by Ministry of Industry and Trade. It is regulating establishment of techno parks in co-operation with the universities and research centers to provide the infrastructure required for facilitating technological innovation. There are some incentives for the participant firms in techno parks such as value added tax exemptions for the software development activities, income tax exemptions for the researchers' salaries, software engineers, land provision for the firms and construction of infrastructure and management building (Arslan, 2007).

Contract based projects and training programs in universities is another zooming in universities with industrial activities. However, Higher Education Council (YOK) Law includes constraints which are unfavorable for the academicians. According to the mentioning law, researchers providing services to firms not located in techno parks must transfer 70 percent of project income to their

universities and cannot start their own businesses. Thus, the current mechanism has some powerful discouragements for the academicians (Kiper and Demir, 2009).

This chapter is devoted to have a general understanding about R&D. To do that, first the concept of R&D has explained in a detailed way. Secondly, the general R&D trends of the world and Turkey has highlighted as well as the historical developments. Additionally, R&D implementations, institutions and policies were analyzed. Finally, the university and industry linkages have demonstrated.

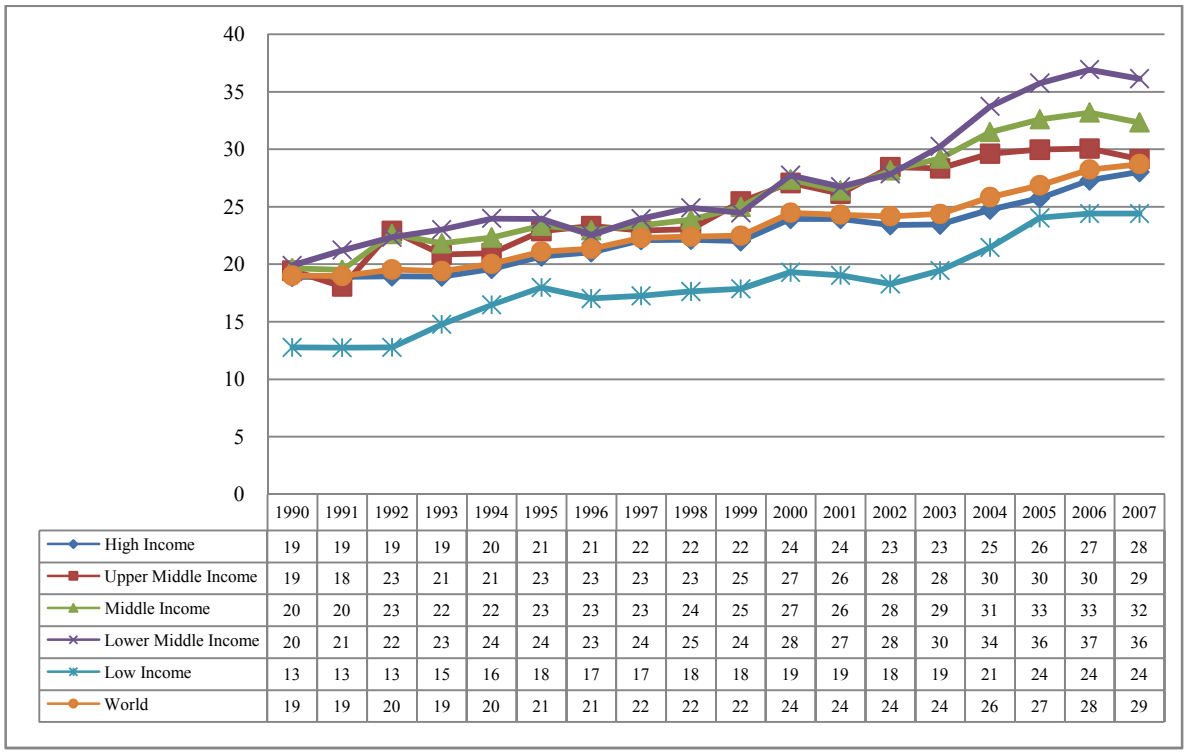
# CHAPTER 3

## INTERNATIONAL TRADE AND SECTORS

In this chapter, general international trade facts in the world and in the Turkey as well will be given in order to see the big picture. There will be also sectoral analyses regarding mostly the Turkey's international trade in order to see the composition of exports and imports from the sector based perspective. Standard International Trade Classification (SITC) will be used which is one of the most commonly used methods of commodity classification.

### International Trade in the World

Figure 12 and 13 below indicate the ratio of exports and imports to GDP in income based differentiated countries of the world.

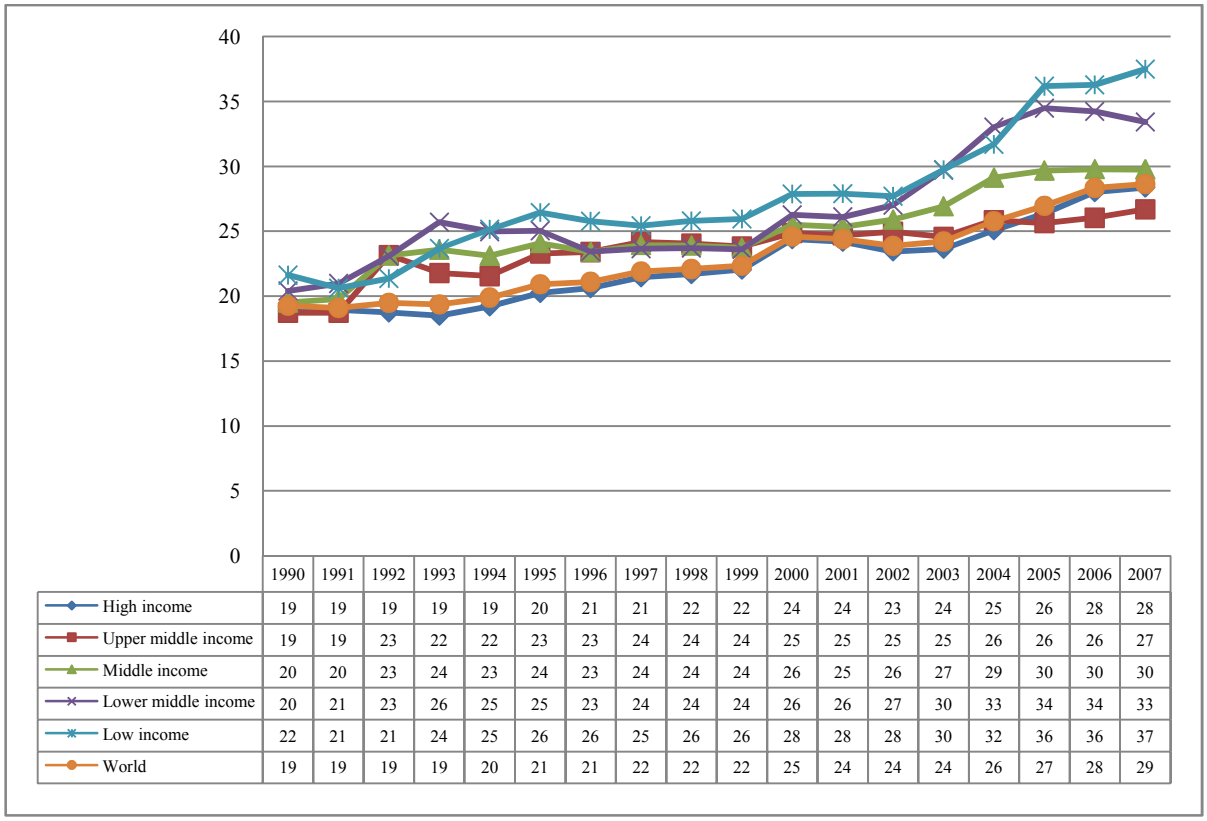



| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Income | 19 | 19 | 19 | 19 | 20 | 21 | 21 | 22 | 22 | 22 | 24 | 24 | 23 | 23 | 25 | 26 | 27 | 28 |
| Upper Middle Income | 19 | 18 | 23 | 21 | 21 | 23 | 23 | 23 | 23 | 25 | 27 | 26 | 28 | 28 | 30 | 30 | 30 | 29 |
| Middle Income | 20 | 20 | 23 | 22 | 22 | 23 | 23 | 23 | 24 | 25 | 27 | 26 | 28 | 29 | 31 | 33 | 33 | 32 |
| Lower Middle Income | 20 | 21 | 22 | 23 | 24 | 24 | 23 | 24 | 25 | 24 | 28 | 27 | 28 | 30 | 34 | 36 | 37 | 36 |
| Low Income | 13 | 13 | 13 | 15 | 16 | 18 | 17 | 17 | 18 | 18 | 19 | 19 | 18 | 19 | 21 | 24 | 24 | 24 |
| World | 19 | 19 | 20 | 19 | 20 | 21 | 21 | 22 | 22 | 22 | 24 | 24 | 24 | 24 | 26 | 27 | 28 | 29 |

Figure 12: Ratio of total exports over GDP in income based aggregated countries (%)
Source: World Bank database.

The ratio of exports and imports to GDP usually refers to the level of openness of an economy. However, this should not be taken as a concrete fact. Service oriented and larger economies tend to show relatively small ratio despite their openness to trade such as United Stated. Another counter sample is a change in the value of trade. The value of trade does not necessarily increase as the openness of trade rises. For example, an increase in oil prices depresses the importing county's economy whereas leading to higher trade to GDP ratio.

As it seen in the Figure 12 and 13, the increasing trend in the ratio of exports and imports to GDP is in progress. It roughly reflects that the general level of openness to trade has a rising trend in the world.




| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High income | 19 | 19 | 19 | 19 | 19 | 20 | 21 | 21 | 22 | 22 | 24 | 24 | 23 | 24 | 25 | 26 | 28 | 28 |
| Upper middle income | 19 | 19 | 23 | 22 | 22 | 23 | 23 | 24 | 24 | 24 | 25 | 25 | 25 | 25 | 26 | 26 | 26 | 27 |
| Middle income | 20 | 20 | 23 | 24 | 23 | 24 | 23 | 24 | 24 | 24 | 26 | 25 | 26 | 27 | 29 | 30 | 30 | 30 |
| Lower middle income | 20 | 21 | 23 | 26 | 25 | 25 | 23 | 24 | 24 | 24 | 26 | 26 | 27 | 30 | 33 | 34 | 34 | 33 |
| Low income | 22 | 21 | 21 | 24 | 25 | 26 | 26 | 25 | 26 | 26 | 28 | 28 | 28 | 30 | 32 | 36 | 36 | 37 |
| World | 19 | 19 | 19 | 19 | 20 | 21 | 21 | 22 | 22 | 22 | 25 | 24 | 24 | 24 | 26 | 27 | 28 | 29 |

Figure 13: Ratio of total imports to GDP in income based aggregated countries (%)
Source: World Bank database

The existence of gains from international trade for both exporting and importing country is an inevitable fact. Thus, international trade is in favor of both sides which enable the exporter to sell its products at reasonable prices. Importers on the other hand enjoy the cheaper prices. Countries desiring to empower their economies have strong willingness to enlarge their exporting capabilities which also result in the rises of general importing level.

In Figure 12, it can be seen that the exports to GDP ratio in lower middle income countries are higher than the ratio of others. Lower middle income countries in the figure refer to the per capita income level approximately between one and four thousand which have relatively higher desire for exports. High income countries which have more than approximately 11 thousand per capita income has relatively smaller ratio mainly due to their high levels of GDP.

There is a growing tendency in international trade to GDP ratio. Given the fact that there exist an expansion in the GDP many countries, the level of international trade is said to be growing faster. There must be many reasons for that but the fundamental ones are the increasing trend in removing the borders, more need to have higher exports and the results of globalization. Technological advancements for example, are improving each day as one of the crucial factors enabling more productive production styles and better communication and logistics opportunities.

European area is a main exporter of the world. According to WTO statistics 43% of the total world exports came from Europe while Asia is the second having the ratio of 25%, in the year 2008. All around the world, fuels are the mostly exported goods with having share of 18.2% from all exports. Machinery and chemicals come after having the shares of 12.4% and 8.1% respectively.

Table 3: Leading Exporting Countries in 2009 (Billion $, %)

| Merchandise Trade | | | | Commercial Trade | | | |
|---|---|---|---|---|---|---|---|
| Rank | Exporter | Value | Share | Rank | Exporter | Value | Share |
| 1 | China | 1.201,5 | 2,1 | 1 | United States | 947,8 | 2,6 |
| 2 | Germany | 1.126,4 | 2,0 | 2 | United Kingdom | 466,6 | 1,3 |
| 3 | United States | 1.056,0 | 1,9 | 3 | Germany | 453,3 | 1,2 |
| 4 | Japan | 580,7 | 1,0 | 4 | France | 285,0 | 0,8 |
| 5 | Netherlands | 498,3 | 0,9 | 5 | China | 257,2 | 0,7 |
| 6 | France | 484,7 | 0,9 | 6 | Japan | 251,7 | 0,7 |
| 7 | Italy | 405,8 | 0,7 | 7 | Spain | 244,3 | 0,7 |
| 8 | Belgium | 369,9 | 0,7 | 8 | Italy | 202,5 | 0,6 |
| 9 | Korea, Republic of | 363,5 | 0,6 | 9 | Ireland | 193,5 | 0,5 |
| 10 | United Kingdom | 352,5 | 0,6 | 10 | Netherlands | 181,8 | 0,5 |
| 11 | Hong Kong, China | 329,4 | 0,6 | 11 | Singapore | 175,6 | 0,5 |
| 12 | Canada | 316,7 | 0,6 | 12 | India | 174,9 | 0,5 |
| 13 | Russian Federation | 303,4 | 0,5 | 13 | Hong Kong, China | 172,6 | 0,5 |
| 14 | Singapore | 269,8 | 0,5 | 14 | Belgium | 157,6 | 0,4 |
| 15 | Mexico | 229,6 | 0,4 | 15 | Switzerland | 137,6 | 0,4 |
| 23 | Turkey | 102,1 | 0,2 | 26 | Turkey | 65,5 | 0,2 |

Source: World Trade Organization database

Table 3 above indicates the major exporters in the world with their rankings including Turkey as well. China took the lead in merchandise exports around the globe with the export values exceeding 1.200 billion dollars which is although declined 16% compared to previous year. In the recent years, China has become a production center of the world mainly due to its cheaper labor costs. From the sector based perspective, nearly half of the China exports in 2009 resulted from the machinery and transport equipment which refers to SITC Section 7. Other major export sectors of China are miscellaneous manufactured articles and manufactured goods classified chiefly by material referring to SITC section 8 and 6 respectively. Major export partner of the China is the United States which purchased 18.4% of the total China exports in 2009. Hong Kong and Japan come after the United States.

Germany ranked as the second after China while having 2% share from world merchandise exports in 2009. Like many other countries, Germany's value of exports also declined in 2009 with a high rate of 23.1%. Parallel to that, the trade surplus of Germany decreased 27.7% in 2009. Like China, 44.5% of Germany exports consist of machinery and transport equipment. Other major commodity groups included chemicals with related products and manufactured goods classified chiefly by material respectively with 15.3% and 12.8% of exports. Additionally, France, Netherlands and Unites States are the top destinations for Germany exports.

United States had the third ranking in the world's total merchandise exports in 2009. The value of United States exports is around 1.056 billion dollars having the share of 1.9% from total world merchandise exports. Machinery and transport equipments have the biggest share from United States exports having the rate of 34.7%. Second ranking belongs to chemicals and related products which took 15.1% share from the total United States merchandise exports. On the one hand, United States took the lead in commercial exports approaching to 950 billion in 2009. United Kingdom which is her closest follower has the export value of 466 billion dollars that is even less the half of United States' result. United States with these results made the 2.6% of total world's merchandise exports.

Table 4 below shows the leading importing countries in the world. Unites States have the first ranking in the world's merchandise import in terms of values. Reaching around 1.600 billion dollars United States merchandise imports took the 2.8% of the total world's merchandise imports. From the sectoral perspective, roughly half of the United State imports consisted of machinery, transport equipments and miscellaneous manufactured articles referring to SITC section 7 and 8. Another remarkable result is that the important share, which is 17.4%, of the

United States imports are in the SITC section 3, namely minerals fuels, lubricants and related materials.

Table 4: Leading Importing Countries in 2009, (Billion $, %)

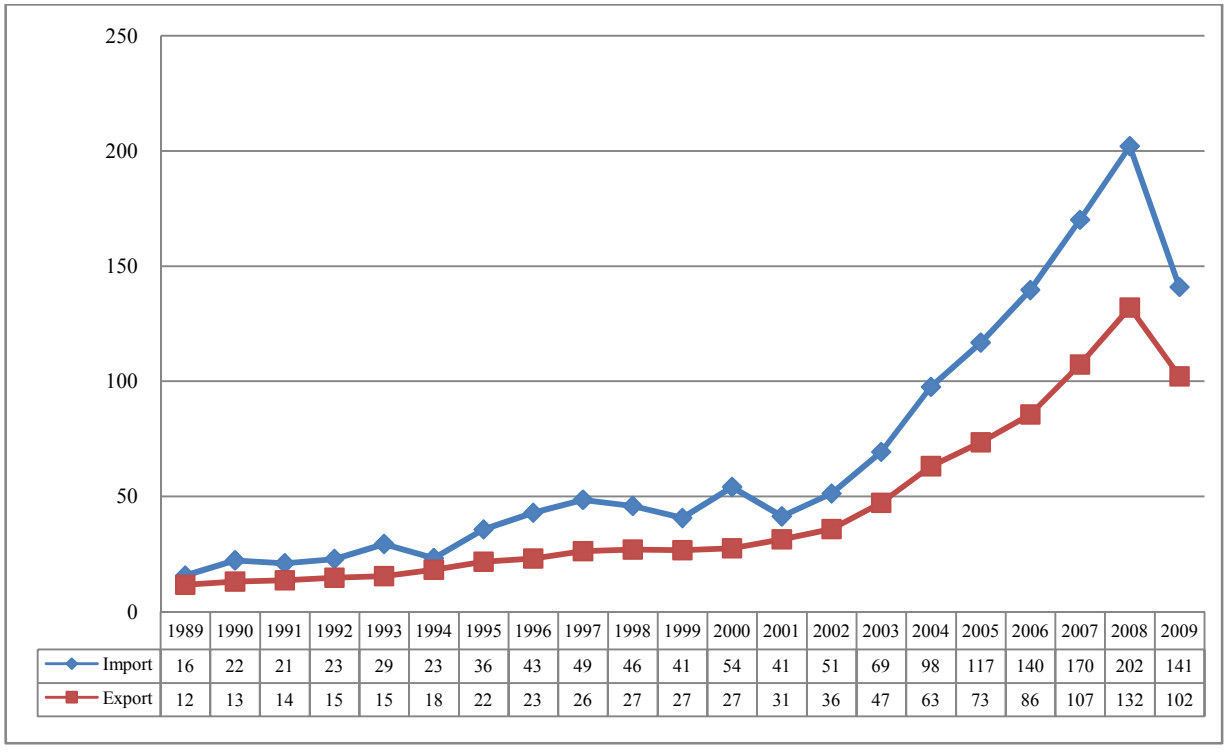
| Merchandise Trade | | | | Commercial Trade | | | |
|---|---|---|---|---|---|---|---|
| Rank | Importer | Value | Share | Rank | Importer | Value | Share |
| 1 | United States | 1.605,3 | 2,8 | 1 | United States | 661,2 | 2,0 |
| 2 | China | 1.005,7 | 1,7 | 2 | Germany | 506,2 | 1,5 |
| 3 | Germany | 938,3 | 1,6 | 3 | United Kingdom | 321,7 | 1,0 |
| 4 | France | 559,8 | 1,0 | 4 | China | 316,4 | 0,9 |
| 5 | Japan | 552,0 | 1,0 | 5 | Japan | 293,8 | 0,9 |
| 6 | United Kingdom | 481,7 | 0,8 | 6 | France | 252,9 | 0,8 |
| 7 | Netherlands | 445,5 | 0,8 | 7 | Italy | 229,2 | 0,7 |
| 8 | Italy | 412,7 | 0,7 | 8 | Ireland | 206,9 | 0,6 |
| 9 | Hong Kong, China | 352,2 | 0,6 | 9 | Spain | 172,9 | 0,5 |
| 10 | Belgium | 351,9 | 0,6 | 10 | Netherlands | 169,4 | 0,5 |
| 11 | Canada | 329,9 | 0,6 | 11 | Singapore | 162,7 | 0,5 |
| 12 | Korea, Republic of | 323,1 | 0,6 | 12 | India | 159,5 | 0,5 |
| 13 | Spain | 287,6 | 0,5 | 13 | Canada | 155,2 | 0,5 |
| 14 | India | 249,6 | 0,4 | 14 | Korea, Republic of | 150,0 | 0,4 |
| 15 | Singapore | 245,8 | 0,4 | 15 | Belgium | 148,2 | 0,4 |
| 23 | Turkey | 140,9 | 0,2 | 39 | Turkey* | 31,2 | 0,1 |

Source: World Trade Organization database

China and Germany came after United States which took the 1.7% and 1.6% shares from total merchandise exports around the globe. Resembling to its exports, %40.6 of China's imports also consist of machinery and transport equipment. Sectors of crude materials, inedible, mineral, lubricants and related materials have also importance in China's imports having 14.8% share from total China imports. Germany on the one hand, is one of the significant buyers of world exports. Resembling to other major actors, Germany's major import commodities are under the SITC section 7, namely machinery and transport equipments. Another portion of the imports, having rates from 9% to 13%, are said to be homogenously distributed among the sections of 3, 5, 6, 8, and 9 which are mainly manufactured goods.

International Trade in Turkey

In 2009, the import value of Turkey is around 140 billion dollars, with 30.2% decline in comparison to previous year. From the sectoral point of view, declines in the SITC section 3 and 9, namely mineral fuels with related products and commodities and transaction no classified elsewhere in the SITC respectively, had crucial effects on the downfall of general import level. The export value of Turkey also declined by 22.6% in 2009 and amounted approximately to 102 billion dollars which is also below the level of 2007. About two thirds of the decline was caused by the export level decreases in the sectors of SITC 6 and 7, so-called manufactured goods classified chiefly by material and machinery with transport equipments. The details of sectoral changes will be examined in the following part of the chapter. Figure 14 below illustrates the export and import trends of Turkey at the mentioning years.




| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Import | 16 | 22 | 21 | 23 | 29 | 23 | 36 | 43 | 49 | 46 | 41 | 54 | 41 | 51 | 69 | 98 | 117 | 140 | 170 | 202 | 141 |
| Export | 12 | 13 | 14 | 15 | 15 | 18 | 22 | 23 | 26 | 27 | 27 | 27 | 31 | 36 | 47 | 63 | 73 | 86 | 107 | 132 | 102 |

Figure 14: International trade trend in Turkey (billion $)

Source: UN Comtrade database

The trade deficit, parallel to world including the effects of economic crises, declined from 70 billion dollars in 2008 to 39 billion dollars in 2009 which also shows that the rate of decrease in the imports is higher than that of exports. Exports coverage ratio to imports was %65.4 in 2008 whereas the rate increased to 72.3% in 2009.

Table 5 indicates the major international trade partners of Turkey in the year of 2009. Significant share of the Turkey's trade volume consists of European Union countries such as Germany, France, United Kingdom Italy and etc.

Table 5: Major International Trade partners of Turkey in 2009, (Billion $, %)

| Rank | Export | Value | Share | Rank | Import | Value | Share |
|---|---|---|---|---|---|---|---|
| 1 | Germany | 9,79 | 9,6 | 1 | Russian Fedearation | 19,72 | 14,0 |
| 2 | France | 6,21 | 6,1 | 2 | Germany | 14,10 | 10,0 |
| 3 | United Kingdom | 5,92 | 5,8 | 3 | China | 12,66 | 9,0 |
| 4 | Italy | 5,89 | 5,8 | 4 | USA | 8,57 | 6,1 |
| 5 | Iraq | 5,13 | 5,0 | 5 | Italy | 7,67 | 5,4 |
| 6 | Switzerland | 3,94 | 3,9 | 6 | France | 7,09 | 5,0 |
| 7 | USA | 3,23 | 3,2 | 7 | Spain | 3,78 | 2,7 |
| 8 | Russian Fedearation | 3,20 | 3,1 | 8 | United Kingdom | 3,47 | 2,5 |
| 9 | United Arab Emirates | 2,90 | 2,8 | 9 | Iran | 3,41 | 2,4 |
| 10 | Spain | 2,82 | 2,8 | 10 | Ukraine | 3,16 | 2,2 |
| 11 | Egypt | 2,62 | 2,6 | 11 | Republic of Korea | 3,12 | 2,2 |
| 12 | Romania | 2,22 | 2,2 | 12 | Japan | 2,78 | 2,0 |
| 13 | Netherlands | 2,12 | 2,1 | 13 | Netherlands | 2,54 | 1,8 |
| 14 | Iran | 2,02 | 2,0 | 14 | Belgium | 2,37 | 1,7 |
| 15 | Free Zones | 1,96 | 1,9 | 15 | Romania | 2,26 | 1,6 |

Source: UN Comtrade database

A gripping result which is worth to mention is about the changes of export partners. The composition of Turkey's trade partners have been differing in the recent years in favor of the eastern countries. For example, Iraq took the 5.0% of total exports in 2009 whereas it was 1.8% in 2003. Besides, Iran having 2.0% shares of Turkey exports in 2009 whereas the mentioning rate was only 0.6% in 1999. According to Undersecretariat of the Prim Ministry for Foreign Trade statistics, regional trade

surplus of Turkey is the highest in near and middle east area, having the surplus rate of 7.8 billion dollars in 2008, increased from the 2007 rate of 2.4 billion dollars (Undersecreteriat of the Prim Ministry for Foreign Trade, 2009).

## International Trade Sectors in Turkey

In this part of the chapter sector based analysis of exports and imports in Turkey will be highlighted. To do that, the SITC (Revision 3) method will be used as reference method to differentiate sectors. The mentioning classification system is maintained by United Nations. Table 6 below represents the percentage shares of exports and imports among the sectors.

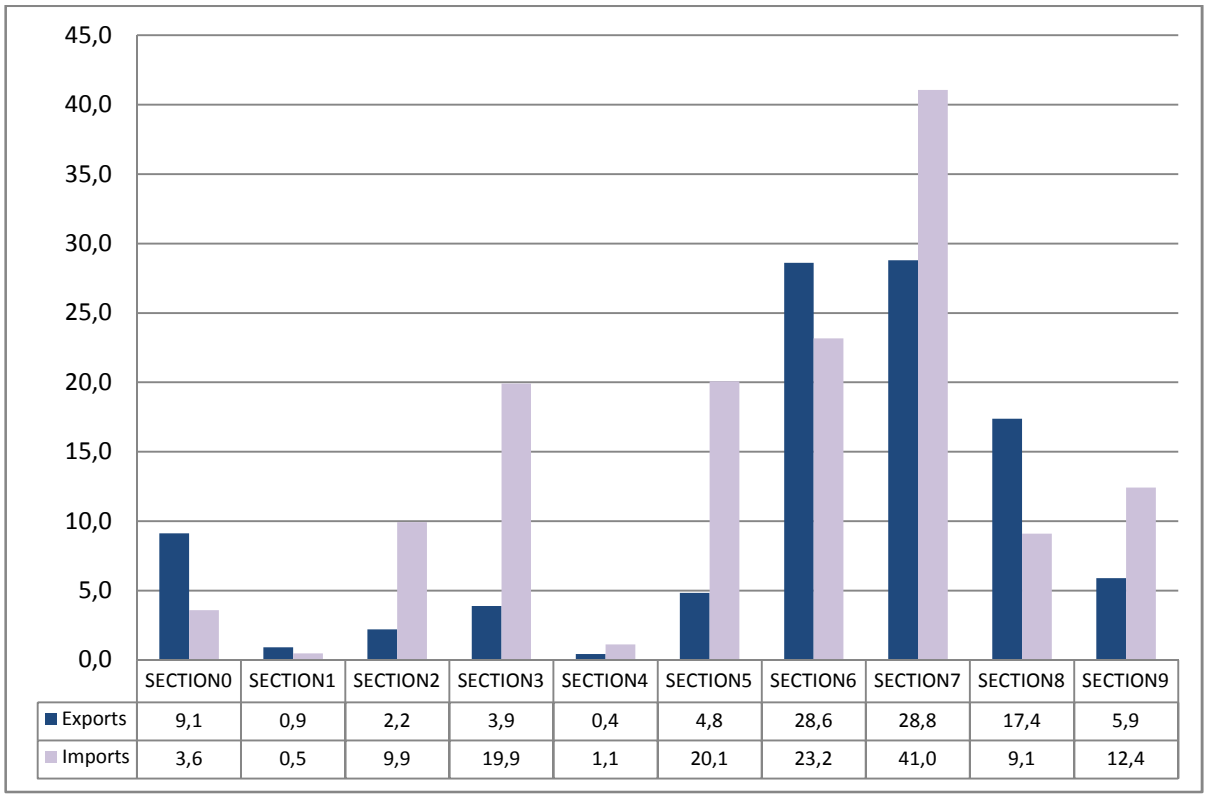
Table 6: Sector Based Percentages of Exports and Imports of Turkey According to SITC in 2009 (%)

| Section Number | Section Definition | Export | Import |
|---|---|---|---|
| 0 | Food and Live Animals | 8,9 | 2,5 |
| 1 | Beverages and Tobacco | 0,9 | 0,3 |
| 2 | Crude Materials, Inedible, Except Fuels | 2,2 | 7,1 |
| 3 | Mineral Fuels, Lubricants and Related Materials | 3,8 | 14,1 |
| 4 | Animal and Vegetable Oils, Fats and Waxes | 0,4 | 0,8 |
| 5 | Chemicals and Related Products, N.E.S. | 4,7 | 14,2 |
| 6 | Manufactured Goods Classified Chiefly by Material | 28,0 | 16,4 |
| 7 | Machinery and Transport Equipment | 28,2 | 29,1 |
| 8 | Miscellaneous Manufactured Articles | 17,0 | 6,5 |
| 9 | Commodities and Transactions not Classified Elsewhere in the SITC | 5,8 | 8,8 |

Source: UN Comtrade database

The sections 5, 6, 7, and 8 refer to the manufacturing sector. Turkey's manufacturing exports and imports have the major share from its trade volume. Manufacturing exports and imports took respectively 77.9% and 66.2% shares from total exports and imports of the country. Having approximately the same share around 28%, sectors of SITC section 6 and 7 together exceeds half of the total exports. In the import side, SITC sections of 3, 5, 6 and 7 are the main sectors having the shares

from 14.1% to 29.1%. Figure 11 below demonstrates the export and import values of different sectors. The figure gives also an idea about the coverage ratios of export to import and sector based trade balances. In manufacturing sector the trade deficits are seen in the Section 5 and 7. However, there exist trade surpluses in Section 6 and 8.




| | SECTION0 | SECTION1 | SECTION2 | SECTION3 | SECTION4 | SECTION5 | SECTION6 | SECTION7 | SECTION8 | SECTION9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Exports | 9,1 | 0,9 | 2,2 | 3,9 | 0,4 | 4,8 | 28,6 | 28,8 | 17,4 | 5,9 |
| Imports | 3,6 | 0,5 | 9,9 | 19,9 | 1,1 | 20,1 | 23,2 | 41,0 | 9,1 | 12,4 |

Figure 15: Sector based export and import values with SITC3 classification in 2009 in Turkey (billion $)

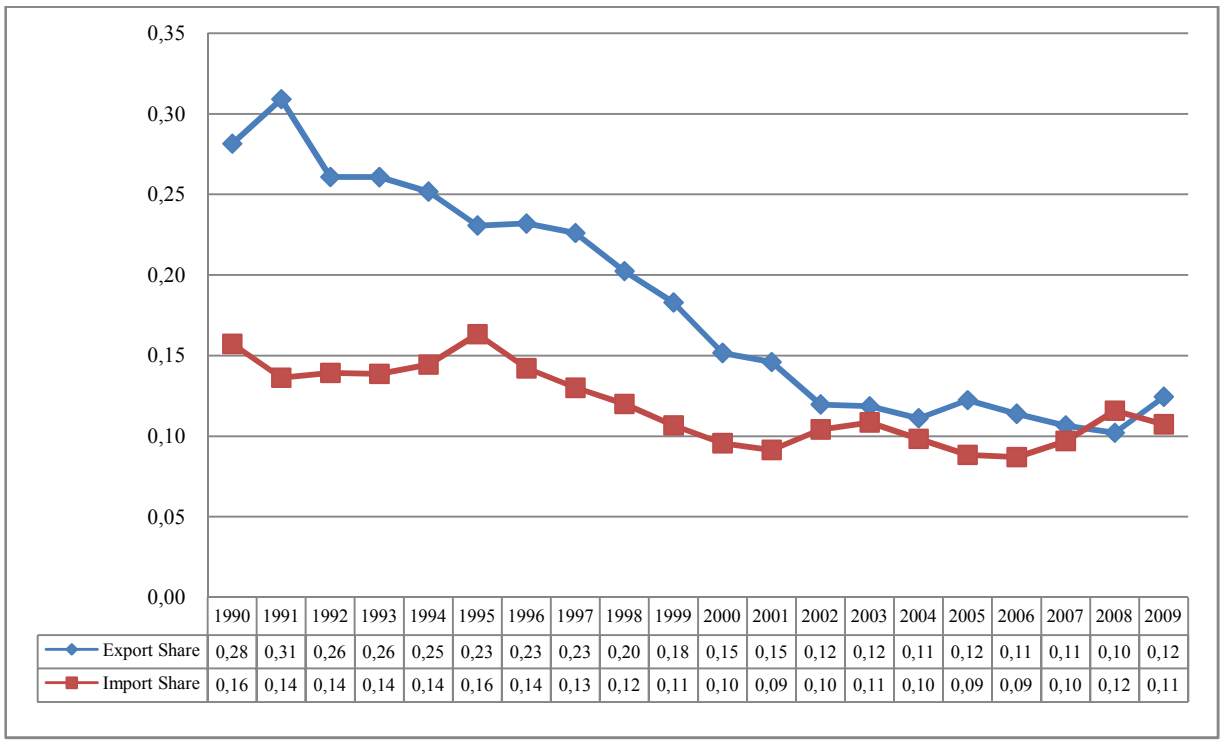
Source: UN Comtrade database

According to World Trade Organization (WTO) data sets, SITC sections are divided into three main categories such as primary products, manufactures and the other products. Following part of the chapter is devoted to indicate international trade analysis of main sectors from those categories in Turkey.

## Primary Products

Primary products consist of two basic sectors such as agricultural products and fuels with mining products.

Agricultural products indeed refer to the SITC sections 0, 1, 2, and 4 namely Food and Live Animals, Beverages and Tobacco, Crude Materials with Inedible except Fuels and Animal and Vegetable Oils including Fats and Waxes respectively. In general, the share of agricultural product exports in total exports increased 2.2 points and reached to 12.4% in 2009. On the other hand, the share of agricultural product imports in total imports declined by 0.9 points and stayed at 10.7%. The figure below represents the trend of mentioning rate in years.



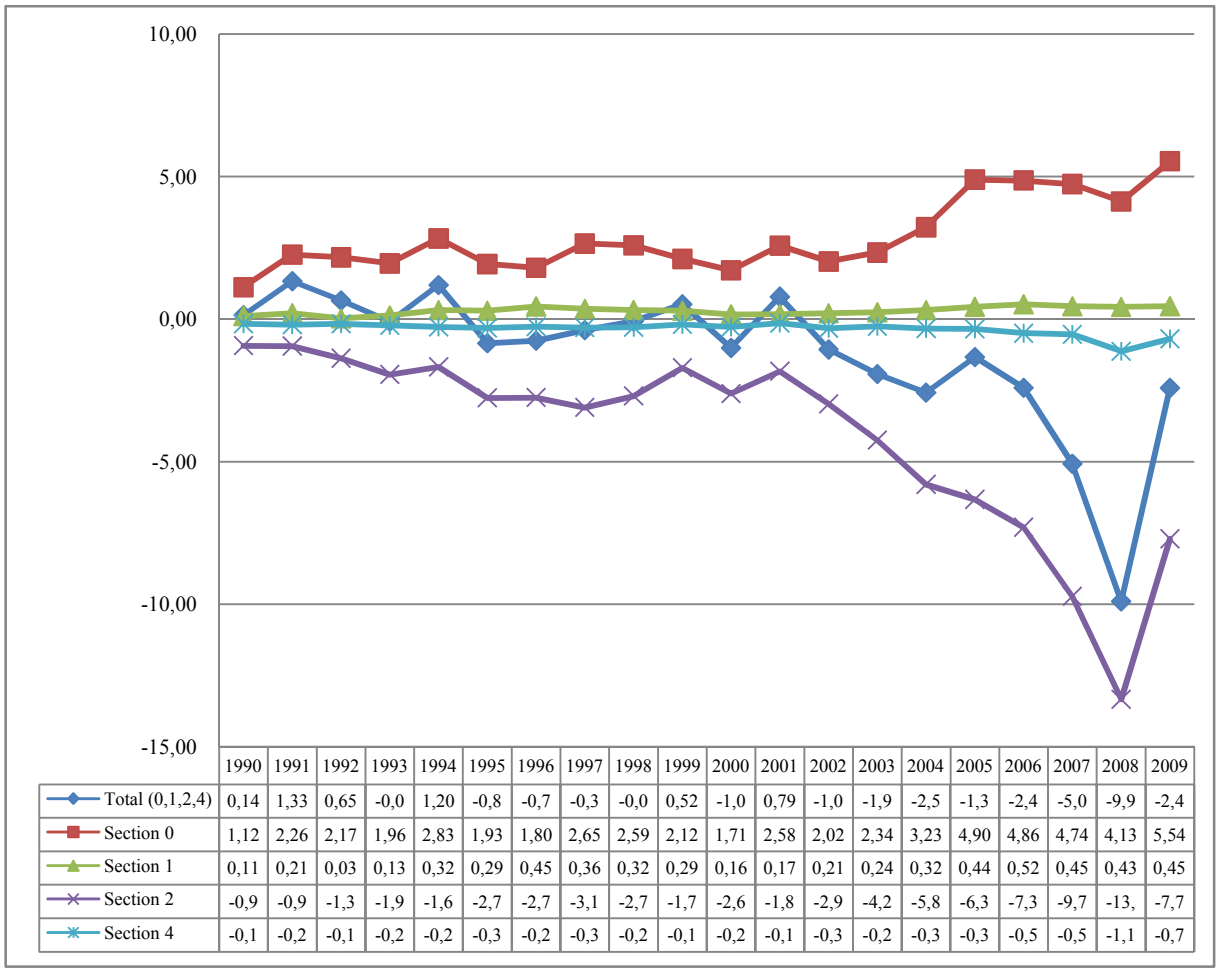

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Export Share | 0,28 | 0,31 | 0,26 | 0,26 | 0,25 | 0,23 | 0,23 | 0,23 | 0,20 | 0,18 | 0,15 | 0,15 | 0,12 | 0,12 | 0,11 | 0,12 | 0,11 | 0,11 | 0,10 | 0,12 |
| Import Share | 0,16 | 0,14 | 0,14 | 0,14 | 0,14 | 0,16 | 0,14 | 0,13 | 0,12 | 0,11 | 0,10 | 0,09 | 0,10 | 0,11 | 0,10 | 0,09 | 0,09 | 0,10 | 0,12 | 0,11 |

Figure 16: The share of agricultural product (SITC Section 0, 1, 2, 4) exports and imports in total exports and imports respectively (%)

Source: UN Comtrade database

As it demonstrated in the figure the share of agricultural exports in total exports have a clear decreasing trend in years. That is, agricultural exports were 28% of total exports in 1990 whereas it decreased to 12% in 2009. Even though it does not have similar sharpness, agricultural imports also have a decreasing trend.

Sector based trade balance of Turkey in agricultural products (SITC section 0, 1, 2, 4) has been negative, in other words in deficit, over the last 8 years. The Figure 17 indicates the trade balances of agricultural products with the breakdown of SITCs.




| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total (0,1,2,4) | 0,14 | 1,33 | 0,65 | -0,0 | 1,20 | -0,8 | -0,7 | -0,3 | -0,0 | 0,52 | -1,0 | 0,79 | -1,0 | -1,9 | -2,5 | -1,3 | -2,4 | -5,0 | -9,9 | -2,4 |
| Section 0 | 1,12 | 2,26 | 2,17 | 1,96 | 2,83 | 1,93 | 1,80 | 2,65 | 2,59 | 2,12 | 1,71 | 2,58 | 2,02 | 2,34 | 3,23 | 4,90 | 4,86 | 4,74 | 4,13 | 5,54 |
| Section 1 | 0,11 | 0,21 | 0,03 | 0,13 | 0,32 | 0,29 | 0,45 | 0,36 | 0,32 | 0,29 | 0,16 | 0,17 | 0,21 | 0,24 | 0,32 | 0,44 | 0,52 | 0,45 | 0,43 | 0,45 |
| Section 2 | -0,9 | -0,9 | -1,3 | -1,9 | -1,6 | -2,7 | -2,7 | -3,1 | -2,7 | -1,7 | -2,6 | -1,8 | -2,9 | -4,2 | -5,8 | -6,3 | -7,3 | -9,7 | -13, | -7,7 |
| Section 4 | -0,1 | -0,2 | -0,1 | -0,2 | -0,2 | -0,3 | -0,2 | -0,3 | -0,2 | -0,1 | -0,2 | -0,1 | -0,3 | -0,2 | -0,3 | -0,3 | -0,5 | -0,5 | -1,1 | -0,7 |

Figure 17: Trade balances of agricultural product (SITC Section 0, 1, 2, 4) (billion $)
Soruce: UN Comtrade database

As it can be seen from the figure, total sector based trade deficit is in the lowest value in the year of 2008 with the major effects of economic crises. SITC section 0

namely “Food and Live Animals” includes the products such as, meat and meat preparations, fish, live animals, cereals, sugar, coffee, tea, cocoa and etc. For the SITC section 0 export values has always been higher than the import values in the years after 1990. When it comes to the SITC section 1 that is “Beverages and Tobacco”, the result is in the trade surplus’s side as well, having the values changing approximately from 25 to 525 million dollars. SITC section 2 namely “Crude Materials, Inedible, Except Fuels” includes the products such as hides, skins, oil-seeds, cork and wood, textile fibers, crude animal and vegetable materials and etc. For the SITC section 2, import values have always been higher than the export values which indicate the trade deficit. For the SITC section 4 which is called “Animal and Vegetable Oils, Fats and Waxes” trade balance situation resembles to section 2, as having trade deficits in all examined years.

SITC section 3 which is called “Mineral Fuels, Lubricants and Related Materials” includes the products of coal, coke, petroleum and related products, manufactured and natural gas, current electric and etc. Since these are mainly the energy products, like many other countries around the world, Turkey is also a dependent actor in most of these commodities. Thus, import values are much higher in comparison to export values in years.

As it stated on the Table 8 in the following parts of the chapter, Petroleum and related products have the biggest share from in trade volume of SITC section 3. Like many other commodities the import values of petroleum and related products declined by 44% in 2009 and stayed at around 15 billion dollars. Russian Federation is the main import partner of Turkey in petroleum and related products. 49% of the Turkey’s petroleum and related products import came from Russian Federation in the year 2009. Iran, Saudi Arabia and Iraq are the followers of Russian Federation with

the mentioning shares of 9.3%, 6.9% and 6.1% respectively. In coal, coke and briquettes Russian Federation is again major import partner of Turkey having the share of 36.8% of total imports in the same division.

## Manufacturing Sector

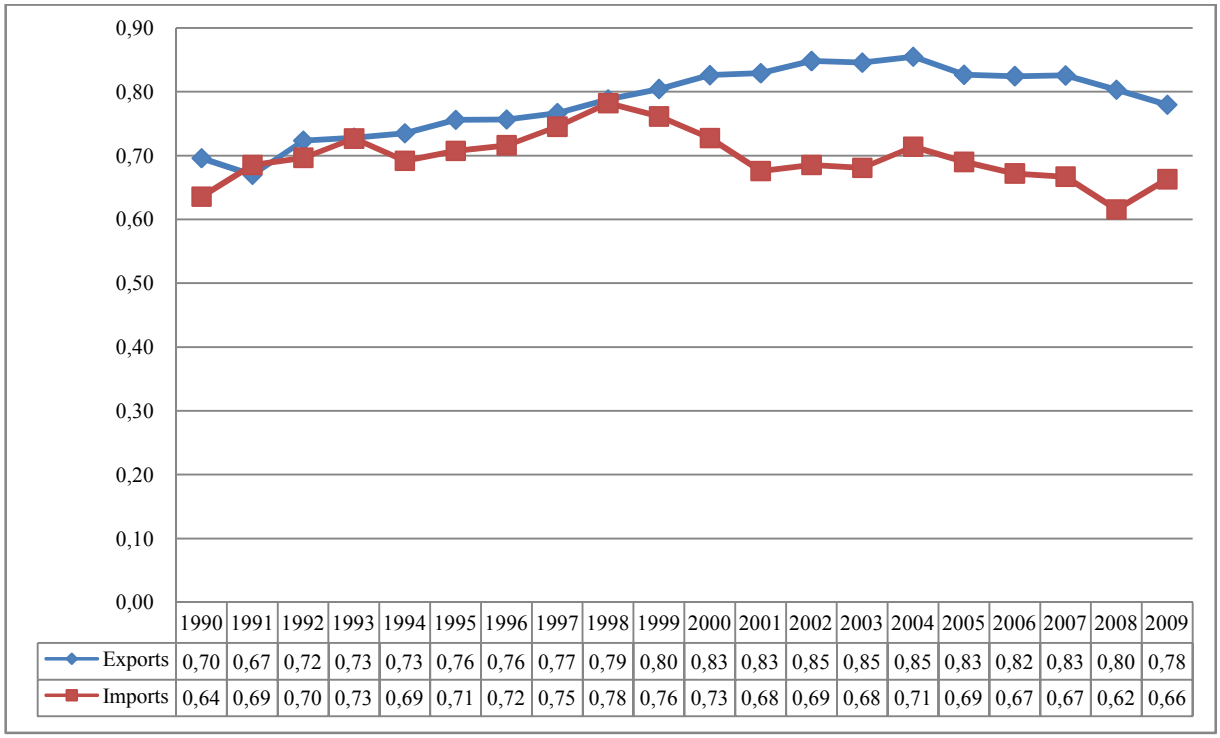
In order to have a general understanding about the historical developments of Turkish manufacturing industry following few paragraphs are presented.

Turkey implemented an import substitution industrialization strategy in the years around 1970. This process caused a rapid but unsustainable economic growth in the country. Then, in the late 1970s the structural adjustment and stabilization programs were applied in order to cope with balance of payments difficulties. In 1980s the export led strategy was implemented then. High level of export incentives and real currency devaluations were seen in this period. The result was the export booms which however affected negatively real wages with the help of devaluations (Ozcelik, 2002).

The real wage deteriorations was followed by non-rising gross fixed capital formation in manufacturing sector which was a reversing result due to the fact that it was the manufacturing industry causing also other sectors to experience export boom. Thus, instead of focusing technological developments Turkey implemented cumulative exchange rate depreciations in those periods. It is seen in many studies and real life events like Asian Tigers sample, international competitiveness depends more on innovativeness and less on cost reductions via devaluations. To sum up, Turkey with a weak national innovation system and small share of R&D expenditures in GDP is a surprising case in the area since the existence of relatively successful and productive manufacturing sector. The results could be much more

beneficial in case of well established innovation and R&D investments systems (Ozcelik, 2002).

Manufactures sector indeed refers mainly to the SITC section 5, 6, 7 and 8. The mentioning sections are chemicals, manufactured goods classified chiefly by material, machinery and transport equipment and miscellaneous manufactured articles.




| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exports | 0,70 | 0,67 | 0,72 | 0,73 | 0,73 | 0,76 | 0,76 | 0,77 | 0,79 | 0,80 | 0,83 | 0,83 | 0,85 | 0,85 | 0,85 | 0,83 | 0,82 | 0,83 | 0,80 | 0,78 |
| Imports | 0,64 | 0,69 | 0,70 | 0,73 | 0,69 | 0,71 | 0,72 | 0,75 | 0,78 | 0,76 | 0,73 | 0,68 | 0,69 | 0,68 | 0,71 | 0,69 | 0,67 | 0,67 | 0,62 | 0,66 |

Figure 18: The share of manufactures (SITC Section 5, 6, 7, 8) exports and imports in total exports and imports respectively (%)

Source: UN Comtrade database

The Figure 18 above represents the share of manufactures' exports and imports in total export and import values respectively. The major part of both exports and imports consist of manufactures the rates differ from 60% to 85%. In general, sector based trade balance in manufactures have a negative sign reflecting the trade deficit. In 2009, the sector based trade deficit of manufactures is around 13 billion dollars. Trade balance of SITC section 5 and 7 which are "Chemicals and Related Products"

and “Machinery and Transport Equipments” are always negative in the examined years whereas the trade balance of SITC section 8 is positive in the years examined. Trade balance of SITC 6 on the other hand, is shifting which indicates positive sign in some years and negative signs in others.

“Iron and Steel Sector” is one of the main divisions in SITC section 6. As it stated in the Table 8, the sector took 8.89% share from total exports and 5.44% share from total imports.

Due to the existence of global financial crisis, world steel production amount declined at a rate of %8.1 and stayed around 1.2 billion tons in 2009. All the countries around the world decreased their iron and steel production except China and India having the growth rates of 7.5%. Iron and steel sector of Turkey has also affected negatively by the economic crises decreasing the production 5.6% in 2009 compared to previous year (Ministry of Industry and Trade, 2010).

Iron and steel sector is one of the crucial sectors in Turkey increasing production rate from 14.3 million tons to 25.3 million tons in the years between 2000 and 2009. Turkey is the 10$^{th}$ biggest iron and steel producer around the world and second in Europe after Germany which also indicates that it is a crucial sector to be focused on. Following figure represents the crude steel production trend in Turkey (Association of Iron and Steel Producers, 2010).

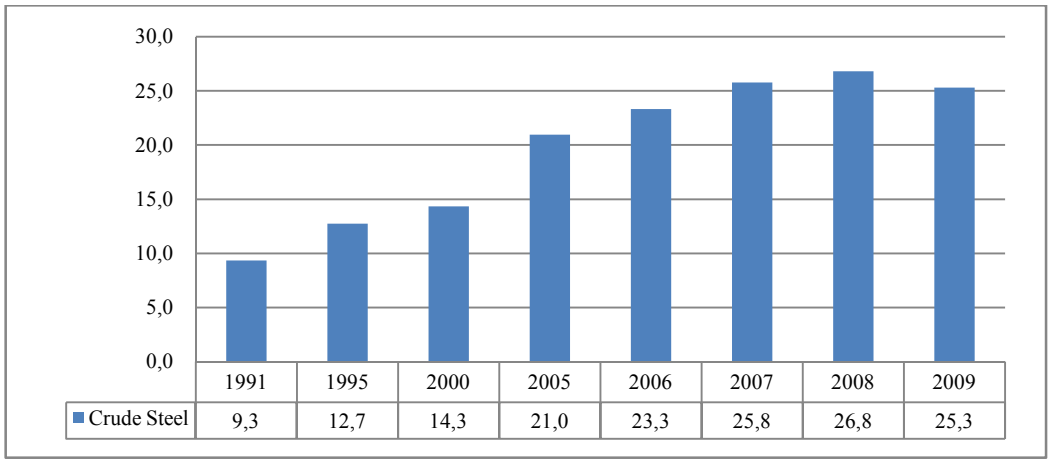



Figure 19: Crude Steel Production in Turkey (Million tons)

Source: Association of Iron and Steel Producers, 2009

"Chemicals and Related Products" referring to SITC section 5, is another important sector in manufactures. As it stated in the Table 8, the sector consists of organic and inorganic chemicals, dyeing and Tanning Materials, medical and pharmaceutical products, perfume materials and etc. The export values of chemicals in Turkey declined by 14.6% and stayed at 4.8 billion dollars in 2009. Likewise, import values of the mentioning sector decreased by 20.5% to 20 billion dollars approximately.

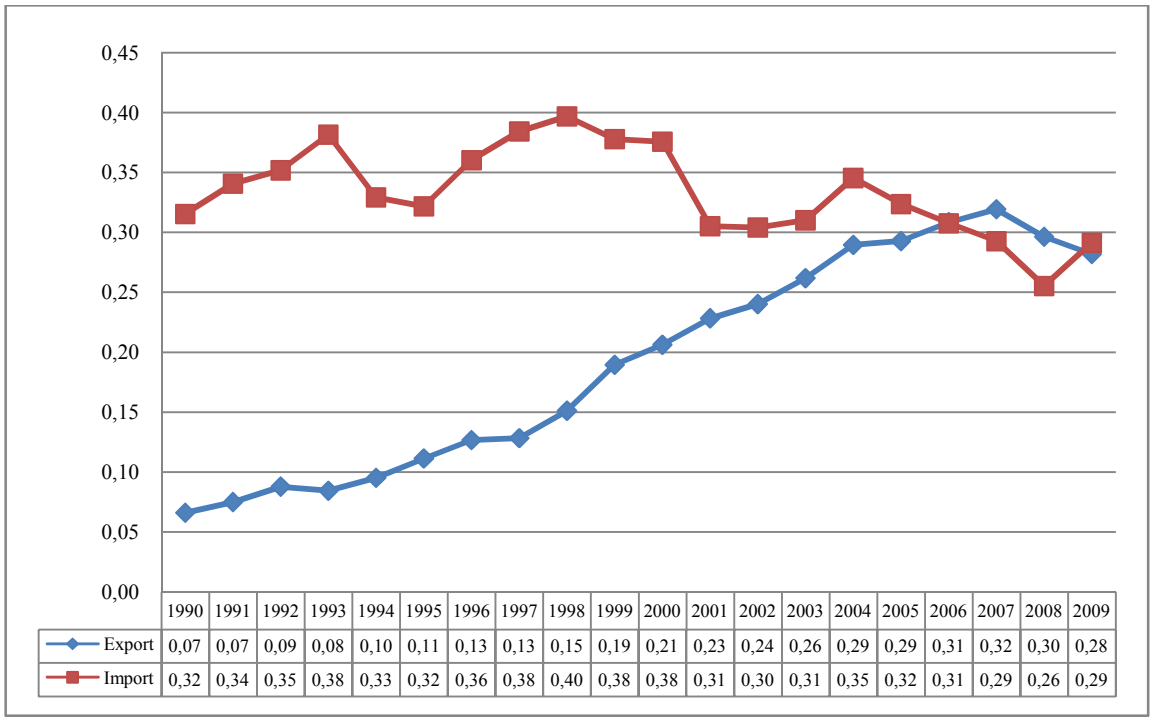
70% of the goods produced under chemical sector go to other sectors as intermediate goods and the remaining 30% reaches to final consumer. Thus, it is one of the significant and indispensable branches of industry. The sector having wide range of products is import dependent mainly due to the fact that basic input of the sector is petroleum. Parallel to that fact, the export coverage ratio of imports is very low in this sector having the rate 24.1% in 2009. Production level of chemical sector in Turkey increased 8.7% in 2007, whereas it decreased 0.3% in 2008 with the negative effects of economic crises (Ministry of Industry and Trade, 2010).

"Machinery and Transport Equipments" referring to SITC section 7 consists of different types of machineries, vehicles, telecommunication tools and other

transport equipments. The export and import values in this sector have the highest shares in total exports and imports as 28.2% and 29.1% respectively. Trade balance in 2009 has a negative sign indicating the deficit with the value around 12.2 billion dollars.

The Figure 20 demonstrates the share of machinery and transport equipment (SITC Section 7) exports and imports in total exports and imports. There exists a clear increasing trend in the share of exports which is 7% in 1990 whereas it reached in to 28% in 2009. The share of imports, on the other hand, has a little decreasing trend reached to lowest value as 26% in the year 2008.

Machinery industry is one of the crucial sectors both around the world and for Turkey. The sector has taken 12.4% share from all trade activities around the world in 2008 (*Ministry of Industry and Trade*, 2010). The sector plays leading role in the industrialization of countries. Like in many other countries, small and medium size enterprises (SME) dominate most of the sector in Turkey. Relatively cheaper labor and advanced engineering techniques increase international competitiveness of SMEs (Undersecreteriat of the Prime Ministry for Foreign Trade, 2009). Parallel to that, in Turkey machinery manufacturing industry uses domestic inputs at a rate of approximately 80% (Ministry of Industry and Trade, 2010).




| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Export | 0,07 | 0,07 | 0,09 | 0,08 | 0,10 | 0,11 | 0,13 | 0,13 | 0,15 | 0,19 | 0,21 | 0,23 | 0,24 | 0,26 | 0,29 | 0,29 | 0,31 | 0,32 | 0,30 | 0,28 |
| Import | 0,32 | 0,34 | 0,35 | 0,38 | 0,33 | 0,32 | 0,36 | 0,38 | 0,40 | 0,38 | 0,38 | 0,31 | 0,30 | 0,31 | 0,35 | 0,32 | 0,31 | 0,29 | 0,26 | 0,29 |

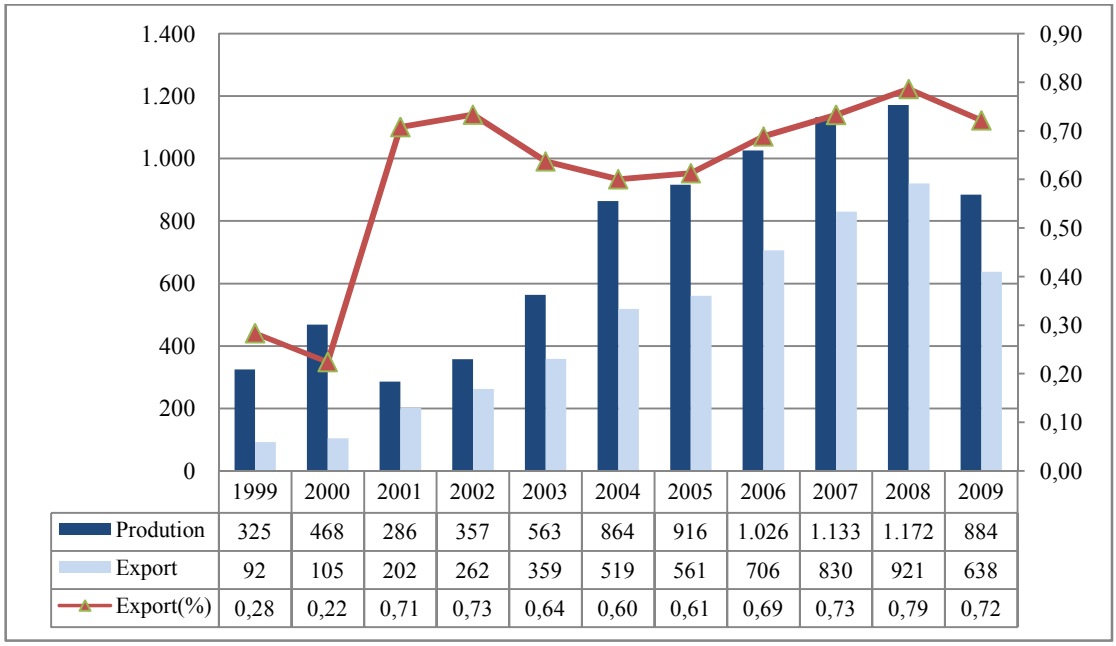
Figure 20: The share of machinery and transport equipment (SITC Section 7) exports and imports in total exports and imports (%)

Source: UN Comtrade database

Automotive industry is another sector under manufactures which has also high importance. Automotive industry trade refers mainly to SITC section 7 and division 78, namely “Road Vehicles (Including Air-Cushion Vehicles)”. As it can be seen also from the Table 8, shares of road vehicles’ export in total exports is around 11% in 2009 which also shows the importance of sector. The mentioning rate is around 6% for the imports.

Due to the issues such as, the sector’s share in GDP, wide employment opportunities, high competitive power in international markets and high openness to trade, automotive industry is one of the leading industries in Turkey. At the same time, since it has a global and technology based structure automotive industry reserves R&D activities more than any other industries. Following figure represents

the production and export amount and the share of exports to production amounts in Turkish automotive industry.




| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Prodution | 325 | 468 | 286 | 357 | 563 | 864 | 916 | 1.026 | 1.133 | 1.172 | 884 |
| Export | 92 | 105 | 202 | 262 | 359 | 519 | 561 | 706 | 830 | 921 | 638 |
| Export(%) | 0,28 | 0,22 | 0,71 | 0,73 | 0,64 | 0,60 | 0,61 | 0,69 | 0,73 | 0,79 | 0,72 |

Figure 21: Production, export and the share of exports in production in Turkish automotive industry (thousand, %)

Source: Automotive Manufacturers Association

There are around 20 firms operating in Turkey and producing automobile products (Ministry of Industry and Trade, 2010) As it seen in the figure below, the share of exports in production amounts has a growing tendency in Turkey.

Textile sector, which refers to SITC division 65, is one of the important sectors in manufactures. As it stated in the Table 7, the export in 2009 is amounted to 7.2 billion dollars having the share of 7.56% from all exports in Turkey. Table below shows the export and import values with their shares of the products classified under SITC group 651 to 659 which are the basic textile products.

| SITC Group Number | SITC Group Definition | Export Value | Share in Textile Export | Import Value | Share in Textile Import |
|---|---|---|---|---|---|
| 651 | Textile Yarn | 1.051 | 0,14 | 1.819 | 0,39 |
| 652 | Cotton Fabrics, Woven (Not Including Narrow or Special Fabrics) | 923 | 0,12 | 825 | 0,17 |
| 653 | Fabrics, Woven, of Man-Made Textile Materials | 1.258 | 0,16 | 679 | 0,14 |
| 654 | Other Textile Fabrics, Woven | 134 | 0,02 | 234 | 0,05 |
| 655 | Knitted or Crocheted Fabrics | 979 | 0,13 | 230 | 0,05 |
| 656 | Tulles, Lace, Embroidery, Ribbons, Trimmings And Other Small Wares | 249 | 0,03 | 101 | 0,02 |
| 657 | Special Yarns, Special Textile Fabrics and Related Products | 413 | 0,05 | 580 | 0,12 |
| 658 | Made-Up Articles, Wholly or Chiefly of Textile Materials, N.E.S. | 1.640 | 0,21 | 108 | 0,02 |
| 659 | Floor Coverings, Etc. | 1.077 | 0,14 | 142 | 0,03 |

Table 7: Trade Values of Textile Products and Their Shares in Total Textile Exports and Imports in 2009 (SITC Group From 651 to 659) (Million $, %)

Source: UN Comtrade database

In the textile sector, which has a high importance in the industrialization process of Turkey, the comparative advantage has been affected negatively in the recent years. Income levels, consumer behaviors, excess supply market volume and related issues should be analyzed together in order to overcome the problems recently seen in the sector (Ministry of Industry and Trade, 2010).

## Other Products

Other products sector indeed refers mainly to the SITC section 9. The mentioning section includes the products such as special transactions and commodities not classified, coin, gold and non-monetary products. As it stated in Table 8 the export value of other products is around 5.9 million dollars with the increase of 18.5% in 2009. The import value of other products is around 12.4 million dollars in 2009 with the decrease rate of 42% compared to previous year.

Table 8: Values and Shares of Sector Based International Trade In Turkey with the SITC Divisions. (Million Dollars, %)

| SITC Division Number and Definition | Export | | | | Import | | | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | | 2009 | | 2008 | | 2009 | |
| | Value | Share | Value | Share | Value | Share | Value | Share |
| 00. Live Animals Other Than Animals of Division 03 | 12,9 | 0,01 | 24,4 | 0,02 | 41,4 | 0,02 | 33,7 | 0,02 |
| 01. Meat And Meat Preparations | 102,7 | 0,08 | 173,8 | 0,17 | 4,1 | 0,00 | 2,5 | 0,00 |
| 02. | 254,6 | 0,19 | 267,7 | 0,26 | 132,5 | 0,07 | 119,9 | 0,09 |
| 03. Fish (Not Marine Mammals), Crustaceans, Molluscs And | 408,3 | 0,31 | 339,0 | 0,33 | 119,1 | 0,06 | 107,9 | 0,08 |
| 04. Cereals And Cereal Preparations | 1.385,1 | 1,05 | 1.481,9 | 1,45 | 2207,6 | 1,09 | 1284,6 | 0,91 |
| 05. Vegetables And Fruit | 5.305,3 | 4,02 | 5.352,4 | 5,24 | 805,8 | 0,40 | 617,4 | 0,44 |
| 06. Sugars, Sugar Preparations And Honey | 352,3 | 0,27 | 301,2 | 0,29 | 92,1 | 0,05 | 56,6 | 0,04 |
| 07. Coffee, Tea, Cocoa, Spices, And Manufactures Thereof | 501,3 | 0,38 | 473,3 | 0,46 | 445,2 | 0,22 | 444,4 | 0,32 |
| 08. Feeding Stuff For Animals (Not Including Unmilled Cereals) | 68,2 | 0,05 | 74,8 | 0,07 | 773,0 | 0,38 | 556,4 | 0,39 |
| 09. Miscellaneous Edible Products And Preparations | 763,0 | 0,58 | 637,9 | 0,62 | 403,3 | 0,20 | 365,8 | 0,26 |
| 11. Beverages | 186,1 | 0,14 | 175,9 | 0,17 | 64,6 | 0,03 | 79,1 | 0,06 |
| 12. Tobacco And Tobacco Manufactures | 704,5 | 0,53 | 757,1 | 0,74 | 391,7 | 0,19 | 399,8 | 0,28 |
| 21. Hides, Skins And Furskins, Raw | 10,7 | 0,01 | 6,0 | 0,01 | 236,2 | 0,12 | 122,6 | 0,09 |
| 22. Oil-Seeds And Oleaginous Fruits | 89,4 | 0,07 | 95,4 | 0,09 | 1320,1 | 0,65 | 914,3 | 0,65 |
| 23. Crude Rubber (Including Synthetic And Reclaimed) | 30,9 | 0,02 | 20,6 | 0,02 | 945,3 | 0,47 | 568,2 | 0,40 |
| 24. Cork And Wood | 30,6 | 0,02 | 37,2 | 0,04 | 548,5 | 0,27 | 359,7 | 0,26 |
| 25. | 7,4 | 0,01 | 5,7 | 0,01 | 473,0 | 0,23 | 342,5 | 0,24 |
| 26. Textile Fibres (Other Than Wool Tops And Other Combed | 302,8 | 0,23 | 192,4 | 0,19 | 2074,3 | 1,03 | 1894,1 | 1,34 |
| 27. Crude Fertilizers, Other Than Those Of 56, And | 956,9 | 0,72 | 860,2 | 0,84 | 478,9 | 0,24 | 262,4 | 0,19 |
| 28. Metalliferous Ores And Metal Scrap | 1.316,9 | 1,00 | 891,3 | 0,87 | 9865,7 | 4,88 | 5235,3 | 3,72 |
| 29. Crude Animal And Vegetable Materials, N.E.S. | 117,6 | 0,09 | 114,4 | 0,11 | 257,4 | 0,13 | 233,5 | 0,17 |
| 32. Coal, Coke And Briquettes | 32,4 | 0,02 | 1,9 | 0,00 | 3411,8 | 1,69 | 3113,4 | 2,21 |
| 33. Petroleum, Petroleum Products And Related Materials | 7.166,8 | 5,43 | 3.557,9 | 3,48 | 27034,4 | 13,39 | 15153,7 | 10,76 |
| 34. Gas, Natural And Manufactured | 258,7 | 0,20 | 201,7 | 0,20 | 2349,7 | 1,16 | 1640,1 | 1,16 |
| 35. Electric Current | 73,3 | 0,06 | 139,7 | 0,14 | 15,5 | 0,01 | 17,2 | 0,01 |
| 41. Animal Oils And Fats | 26,5 | 0,02 | 2,8 | 0,00 | 154,2 | 0,08 | 106,3 | 0,08 |
| 42. Fixed Vegetable Fats And Oils, Crude, Refined Or | 269,3 | 0,20 | 240,3 | 0,24 | 1446,5 | 0,72 | 929,5 | 0,66 |
| 43. Animal Or Vegetable Fats And Oils, Processed; Waxes | 274,5 | 0,21 | 184,1 | 0,18 | 101,6 | 0,05 | 86,5 | 0,06 |
| 51. Organic Chemicals | 444,2 | 0,34 | 311,4 | 0,30 | 3880,4 | 1,92 | 2941,1 | 2,09 |
| 52. Inorganic Chemicals | 232,6 | 0,18 | 164,1 | 0,16 | 1667,5 | 0,83 | 1079,8 | 0,77 |
| 53. Dyeing, Tanning And Colouring Materials | 462,9 | 0,35 | 438,0 | 0,43 | 1585,8 | 0,79 | 1279,0 | 0,91 |
| 54. Medicinal And Pharmaceutical Products | 469,2 | 0,36 | 473,2 | 0,46 | 4738,4 | 2,35 | 4419,2 | 3,14 |
| 55. Essential Oils And Resinoids And Perfume Materials; | 1.074,8 | 0,81 | 1.030,7 | 1,01 | 1244,4 | 0,62 | 1190,2 | 0,84 |
| 56. Fertilizers (Other Than Those Of Group 272) | 216,8 | 0,16 | 83,2 | 0,08 | 1474,6 | 0,73 | 1051,7 | 0,75 |
| 57. Plastics In Primary Forms | 614,0 | 0,47 | 521,5 | 0,51 | 7321,0 | 3,62 | 5301,6 | 3,76 |
| 58. Plastics In Non-Primary Forms | 1.751,5 | 1,33 | 1.461,5 | 1,43 | 1165,0 | 0,58 | 939,8 | 0,67 |

| SITC Division Number and Definition | Export | | | | Import | | | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | | 2009 | | 2008 | | 2009 | |
| | Value | Share | Value | Share | Value | Share | Value | Share |
| 59. Chemical Materials And Products, N.E.S. | 397,9 | 0,30 | 353,3 | 0,35 | 2176,3 | 1,08 | 1867,3 | 1,33 |
| 61. Leather, Leather Manufactures, N.E.S., And Dressed | 150,8 | 0,11 | 116,2 | 0,11 | 392,5 | 0,19 | 231,7 | 0,16 |
| 62. Rubber Manufactures, N.E.S. | 1.775,2 | 1,34 | 1.445,9 | 1,42 | 1225,7 | 0,61 | 931,1 | 0,66 |
| 63. Cork And Wood Manufactures (Excluding Furniture) | 503,8 | 0,38 | 472,7 | 0,46 | 617,7 | 0,31 | 376,6 | 0,27 |
| 64. Paper, Paperboard And Articles Of Paper Pulp, Of Paper | 1.043,4 | 0,79 | 974,7 | 0,95 | 2564,8 | 1,27 | 2175,6 | 1,54 |
| 65. Textile Yarn, Fabrics, Made-Up Articles, N.E.S., And | 9.399,3 | 7,12 | 7.723,8 | 7,56 | 5646,1 | 2,80 | 4718,4 | 3,35 |
| 66. Non-Metallic Mineral Manufactures, N.E.S. | 3.987,7 | 3,02 | 3.510,7 | 3,44 | 1430,8 | 0,71 | 1055,0 | 0,75 |
| 67. Iron And Steel | 16.841,6 | 12,76 | 9.081,2 | 8,89 | 15031,4 | 7,44 | 7670,2 | 5,44 |
| 68. Non-Ferrous Metals | 2.094,7 | 1,59 | 1.377,6 | 1,35 | 6385,8 | 3,16 | 3930,6 | 2,79 |
| 69. Manufactures Of Metals, N.E.S. | 4.798,1 | 3,63 | 3.897,9 | 3,82 | 2997,9 | 1,48 | 2081,6 | 1,48 |
| 71. Power-Generating Machinery And Equipment | 2.499,0 | 1,89 | 1.711,4 | 1,68 | 6236,3 | 3,09 | 5585,8 | 3,97 |
| 72. Machinery Specialized For Particular Industries | 2.273,7 | 1,72 | 1.709,4 | 1,67 | 5325,6 | 2,64 | 3281,8 | 2,33 |
| 73. Metalworking Machinery | 748,4 | 0,57 | 502,9 | 0,49 | 1554,9 | 0,77 | 1190,4 | 0,85 |
| 74. General Industrial Machinery And Equipment, N.E.S., And | 3.072,8 | 2,33 | 2.455,0 | 2,40 | 7899,7 | 3,91 | 5846,8 | 4,15 |
| 75. Office Machines And Automatic Data-Processing Machines | 151,4 | 0,11 | 103,8 | 0,10 | 3126,3 | 1,55 | 2793,8 | 1,98 |
| 76. Telecommunications And Sound-Recording And Reproducing | 2.202,4 | 1,67 | 1.887,4 | 1,85 | 4046,0 | 2,00 | 3698,6 | 2,63 |
| 77. Electrical Machinery, Apparatus And Appliances, N.E.S., | 7.277,7 | 5,51 | 6.347,1 | 6,21 | 8255,6 | 4,09 | 6923,8 | 4,92 |
| 78. Road Vehicles (Including Air-Cushion Vehicles) | 17.991,2 | 13,63 | 11.897,3 | 11,65 | 12358,3 | 6,12 | 8741,8 | 6,21 |
| 79. Other Transport Equipment | 2.905,3 | 2,20 | 2.189,3 | 2,14 | 2769,7 | 1,37 | 2984,2 | 2,12 |
| 81. Prefabricated Buildings; Sanitary, Plumbing, Heating | 1.388,0 | 1,05 | 1.129,2 | 1,11 | 644,6 | 0,32 | 406,8 | 0,29 |
| 82. Furniture, And Parts Thereof; Bedding, Mattresses, | 1.367,0 | 1,04 | 1.180,4 | 1,16 | 733,8 | 0,36 | 548,2 | 0,39 |
| 83. Travel Goods, Handbags And Similar Containers | 141,1 | 0,11 | 111,1 | 0,11 | 405,6 | 0,20 | 222,2 | 0,16 |
| 84. Articles Of Apparel And Clothing Accessories | 13.590,7 | 10,30 | 11.555,9 | 11,31 | 2216,2 | 1,10 | 2147,3 | 1,52 |
| 85. Footwear | 344,9 | 0,26 | 289,6 | 0,28 | 672,9 | 0,33 | 539,5 | 0,38 |
| 87. Professional, Scientific And Controlling Instruments And | 327,5 | 0,25 | 287,2 | 0,28 | 2406,2 | 1,19 | 1985,0 | 1,41 |
| 88. Photographic Apparatus, Equipment And Supplies And | 40,2 | 0,03 | 38,6 | 0,04 | 745,7 | 0,37 | 606,3 | 0,43 |
| 89. Miscellaneous Manufactured Articles, N.E.S. | 3.427,2 | 2,60 | 2.785,7 | 2,73 | 3389,2 | 1,68 | 2651,5 | 1,88 |
| 93. Special Transactions And Commodities Not Classified | 1.355,1 | 1,03 | 1.267,5 | 1,24 | 16443,5 | 8,14 | 10.795,3 | 7,66 |
| 96. Coin (Other Than Gold Coin), Not Being Legal Tender | 0,0 | 0,00 | 0,0 | 0,00 | 0,0 | 0,00 | 0,0 | 0,00 |
| 97. Gold, Non-Monetary (Excluding Gold Ores And Concentrates) | 3.631,1 | 2,75 | 4.641,4 | 4,54 | 4991,0 | 2,47 | 1632,4 | 1,16 |

Soruce: UN Comtrade database

# CHAPTER 4

# LITERATURE REVIEW

There are many factors affecting export performance. On a broader term these factors can be divided into two levels such as price and non-price factors. Price factors are more likely to affect the export performance in the short run. Whereas, non-price factors have relationships between export performances more in the long run. This dissertation, in analyzing export performance, focuses on the R&D expenditures which is non-price factor. Thus, the literature review gives the attention to non-price factors particularly technology indicators and R&D.

In the first part of this chapter the focus is on the theoretical background of technology and competitiveness in obeying the chronological order as much as possible. Economic growth is mentioned with enormous amounts of studies in literature. Accordingly, in reality many developing countries started to follow export-led growth strategies by 1980s. Some countries in Asia so-called “Asian Tigers” are shown as successful samples. Since, it is beyond the aim of this dissertation it is not to be mentioned about the developments in export-led economic growth literature. However, it should be noted that export-led growth is one of the effective ways for economic growth.

The second part is devoted to present some empirical evidences accordingly. In the late paragraphs of the second part there are also some studies showing the empirical evidences on the sector based export performance of R&D activities. Eventually, the concluding remarks are stated.

## Theoretical Background

The roots of R&D activities depend mainly on Schumpeter's conceptual framework. Schumpeter saw the R&D activities and innovation as the engine for economic growth. The importance of technology in economic growth was first argued by Schumpeter (Schumpeter, 1962) However, theoretical majority of neoclassical approaches did not welcome the ideas of Schumpeter in 1950s and 1960s. The general view tended to ignore his ideas in those time periods. The fundamental providence of neo-classical view is the convergence of growth rates among countries which indeed acknowledged the theory of low income countries' growth rates will be higher in order to establish mentioning convergence. Neo-classics then, saw the technology as exogenous factor for growth which is assumed to be stable among countries (Çiftci and Özer, 2009).

The relationship between technology and growth were highlighted by Solow and Swan Model in neo-classical approach. The common result coming from Solow and Swan is about the relationship between economic growth and factors of production which are labor and capital. Thus, the view mentioned 4 sources of growth: labor, capital stock, natural resources and technological developments. First three variables indicate the effects of production factors to growth whereas the last one is assumed to be "residual" (Kendrick, 1956).

One of the main criticisms about the Solow Model was about the convergence idea stating the theoretical difficulty of it while developing and developed countries have same level of savings. Parallel to Solow, Baumol (1986) has tested and confirmed the convergence idea over the years of 1870-1979 stating that there is a closing gap between the poor and rich countries. However, the results of De Long (1988) were against the convergence view. Some scholars like Denison (1967) added

the concept of "human capital" as effective in economic surplus, stating that the crucial contribution of education on growth.

The effects of technology in economic growth were not easily accommodated in neo-classics. However, the Leontief (1954) stated that the roots of the US competitive power come from the technological capabilities rather than her capital-intensive structure. Many authors gave support to him as focusing on the effects of US superior technology. This theoretical environment occurred at that time is named as neo-technological trade theories of 1960s including the main emphasis of the cross-country technological differences.

In 1970s, following models in same logic were generally named as north-south models. The basic idea behind these models is that the innovative south has high wages, and the south which imitates enjoys the cost advantages with low wages. According to these theories balance of innovation and imitation is determinant of the wage gap. It was stated that the only way for north to slow down the catch-up of south is to accelerate the innovation process. North-south models were the first signs of new growth theories the so-called "endogenous". Former theories saw the technological improvements as exogenous factor while the latter ones brought the idea that technology as an endogenous factor (Fagerberg, 1996).

Through focusing on different characteristics of technology, the common results of the scholars suggest that the economic growth is based on the learning activities and their spillover effects on the new investments. Romer (1986) assessed the technological advancement with the concept of learning by doing. According to him the countries which specialize in high-tech sectors will have better growth rates. Romer (1990) and Grossman and Helpman (1991) highlighted the R&D and spillover effects for growth and trade. They asserted that the countries with a high

R&D spending and large domestic market are more likely to specialize in high-tech industries and grow faster. These theorists improved the ideas of Schumpeter, arguing that the innovation through technological advancements is one of the main frameworks for capitalism. The general understanding of these models have three pillars: R&D sector which plays a key role, intermediary goods sector and the final product sector. The role of R&D sector is to develop new ideas and designs for intermediary sector. These creative ideas are converted into new intermediary goods besides their patents are assured. In the following process, these goods are sold to final product sector.

One more crucial notion in those theories is the knowledge spill-over. Theories suggest that if a country has more opportunities to reach foreign markets compared to domestic market, this situation fosters technology flow and economic growth due to increased trade. The mentioning technology spillovers have been a topic for many scholars in literature. The models generally saw the R&D and its spillover effects as empowering factor of export performances. According to literature R&D plays a key role at least from two perspectives. First, technology is a factor, through which firms can increase their market shares, or at least keep their existing shares stable with the help of also cost reductions and product differentiations. Secondly, R&D is thought as an investment in knowledge capabilities, thus affecting indirectly the economic growth. (Coe and Helpman, 1995)

## Empirical Evidences

There exist many empirical studies in literature which test competitiveness and technology. Export performance is used one of the major indicators for competitiveness. Generally functional relationship is constructed in the way like the export performance is thought as dependent variable whereas the technology and

other variables are set as independent variables. Technology variables can be divided in two forms such as input and output variables. Most commonly used input variables are R&D spending and scientific personnel. Major output variables on the other hand, are patent based measures and innovation counts.

There are also some micro level analyses in the area. Zhao and Li (1997) in the lights of neo-technological theories of trade analyzed the role of R&D in defining the export propensity and export growth based on a large micro level data from Chinese manufacturing firm. They found a significant positive relationship between R&D and export propensity and export growth. The study has also some findings about the relationships between R&D and profitability, capital intensity. Additionally, the study concludes that relative firm sizes are effective in export propensity and export growth. There are also some limitations regarding this study and resembling ones. First, the model uses only R&D intensity that is R&D share in firm's sales, as technology indicator which cannot fully capture the effects of whole technological progress. Another limitation is that the model is static due to the fact that only cross-sectional data is available.

A similar sample comes from the Pucik and Ito (1987) analyzing the R&D, competition and the export performance. They used Japanese manufacturing firms to test their export performance indicators. The indicators in the study are such as R&D spending, firm size and domestic competitive position. There exist some hypotheses in the study claiming positive relationships among indicators. First is about the relation between export sales and the amount of R&D expenditures and the second one is the relation of export ratio and R&D intensity. Third hypothesis indicates the relation between the export sales and R&D intensity. The final hypothesis is focuses on the relation between export ratio and industry R&D intensity. The findings are the

followings: R&D expenditures, firm size and average R&D intensity of industry are positively related with export sales. Also, a firm's export ratio is related to industry R&D ratio however it is not related with the firm's R&D ratio.

The technology and income convergences were tested by Granados and Sanz (2008). They used the European Union region and the period of 1990-2002. In addition to convergence they also pointed out the relationship between the technology indicators and income. Main inspiration behind the study is that the R&D activities generate innovation and new technologies, then innovation and new technologies generate economic growth. They found that the R&D indicators such as government and private sector R&D expenditures, higher education R&D sector and patents, and income levels had lived a convergence among regions. The other finding is that there is a positive and strong relationship between the distribution of R&D activities and the distribution of regional income levels in Europe.

It should also be noted that the direction of causality between technology indictors and competitiveness has been argued by some scholars. Altın and Kaya (2009) studied the causality relationship between R&D and economic growth in Turkey. Using vector error correction model they tested the direction of relationship. According to the results reached, in the long run there is a positive significant relationship between R&D expenditures and economic growth directed from former to latter.

There are also some sector based studies indicating the relationship between export performance and R&D activities. The relationships between technology variables such as R&D, patents and productivity based measures can sometimes give confusing results. As Patel and Pavitt (1994) indicated, innovative activities of engineers occurred in learning by doing, not necessarily tied with the R&D activities.

Additionally, some industries need high levels of R&D whereas they do not need patents. Conversely, some sectors accumulate patents with little or no R&D activities. However, those variables of R&D, patents and productivity based measures are closely correlated in national levels (Fagerberg, 1996).

In late 1960s, in the time when neo-technological trade theories exist, there were many models concentrated on the US export performance using sector based data. Some of these studies like Gruber (1967) supported that the R&D activities have importance in export performance. Parallel to that, Sveikauskas (1983) tied the competitiveness of US exports to R&D and innovation. The importance of R&D and skilled labor also argued in literature. Thus, these kinds of studies have shown that the domestically made innovations through R&D activities can affect the export level.

Amable and Verspagen (1995) studied 18 sectors with 5 countries in the years between 1970 and 1991. General result of the study represents a positive relationship between many industries and export performance. More commonly, the chemicals and machinery sectors are the industries which are in the forefront. The positive results are not solely show high-tech industries. Clearly, there are also some industries, for which R&D affects export performance however they are not high-tech industries. The samples of mentioning sectors are metal products, foods and drinks.

Amable and Verspagen (1995) emphasized on the price and non-price factors affecting the export performance of different sectoral classifications in their paper. Accordingly, patent counts, investments and price factor of competitiveness were set as explanatory variable in the export market share model using 18 industries and 5 countries. Estimation results showed that both price and non-price factors affect the

export market shares. According to this study, patents are important factor in most of the sectors and countries. Wage costs, according to estimations are crucial in most of the countries and in one third of the industries as well. Investment on the other hand, is the least significant variable although it plays a key role in some sectors.

Özer and Çiftci (2009) investigated the relationship between R&D expenditures and export levels. Regarding the export level they made a division such as the general export, information and communication technologies (ICT) exports and high-tech exports. They found a positive and strong relationship between the R&D expenditures and export levels. They used a panel data analysis for OECD countries for a period that covers the years from 1990 to 2005 and interpret the results according to fixed effect and random effect models. The study also suggests that, in order for the developing countries to have sustainable economic growths these countries should produce and export the high value added products with high technology. To do that, R&D sector should be developed with qualified human capital which results in high international competitiveness.

In some studies financial reforms were mentioned in addition to R&D activities. Chang and Hung (2005) constructed a model with setting the independent variables as R&D expenditures and financial developments and the dependent variable as exports of manufactured goods. The model is utilized both on manufacture-based and agriculture-based countries to see the differences. They concluded that the countries which want to enhance their export performances should invest on financial reforms and R&D activities. The study firstly showed that well functioning financial markets will have a comparative advantage in exports. Secondly, R&D activities have positive impact on exports more on manufacturing based countries compared to agriculture-based countries. The conclusion of the

mentioning paper emphasizes both the importance of a better financial market and the role of R&D activities.

Braunerhjelm and Thulin (2006) emphasized the importance of R&D expenditures and market size in affecting the comparative advantage of countries. The tested the mentioning impact on the high-technology exports. A gripping result of the study is that the one percentage increase in the R&D investments magnifies the share of high-technology exports by three percent. On the other hand, the study found no statistical significance between the size and high technology exports.

Most of the studies emphasized the importance of direct R&D and innovations on exports. However, technology inflows from other firms, sectors or countries also took some attentions. Fagerberg (1996) studied the effects of direct R&D and indirect R&D gained via buying intermediary capital goods from both domestic and foreign buyers. He established the study on 20 OECD countries. According to the results attained, both direct and indirect R&D activities have positive impact on the export performance. The results claimed also that the indirect R&D activities have even more effective on the export performance in comparison the direct activities. Additionally, the results showed that domestic indirect inflows are more helpful to increase competitiveness than the inflows coming from abroad. This argument automatically favors the firms operating in large countries due to their opportunity of purchasing most of the inputs domestically. Another outcome of the study is that the direct R&D is effective on export performance more on large countries.

## Concluding Remarks

Until the 1980s the Solow Model has been tested and the theory of convergence between developed and developing countries could not be affirmed by scholars. After it is seen that the developing or undeveloped countries do not actually converging to developed countries the suspects increased on the basic idea of neo-classical theory which claims the technology as exogenous and stable factor of growth functions. Then, some growth functions has started to be developed which eliminates the idea that the technology is exogenous and stable among actors. Some scholars like Romer (1986) have presented models which take technology as endogenous and they have gained more acceptance than the neo-classical theories. Accordingly, some scholars like Romer (1990) and Grossman and Helpman (1991) have suggested R&D based models to establish competitive performance analyses. As it stated earlier, these models basically indicated the three-pillar structure of R&D sector, intermediary goods sector and final goods sector. The R&D sector among them has played a key role according to the models suggested.

To sum up, there are many factors affecting the competitiveness or export performance of a country. This chapter is prepared through investigating the factors affecting export level in the long run focusing particularly on the technology factor. To do that, theoretical background with empirical evidences were highlighted. Theoretical framework started with the impacts of technology on economic growth. Accordingly, effects of technology and its factors on the export performance have given. Studies showed there is a strong support that the technology has positive impacts on trade performance. Some major findings could be noted with attention getting results after reviewing the existing literature. First, R&D activities, and technology accordingly, are crucial for the exports in many sectors. These sectors

meanwhile are not solely high-tech sectors. Second, particularly for some sectors which depend on extremely high-tech activities, such as aerospace industry, size of the domestic market is important. Third, besides direct R&D activities, the spillover effects coming from other firms, industries or countries also crucial in effecting the export performance as indirect R&D activities. This result also claims that the private R&D activities should be increased in order to increase the spillover effects. Thus, in the long term R&D and technology spillovers are very important factors effecting the growth and welfare suggesting countries to have certain specialization areas and devote their R&D resources accordingly.

# CHAPTER 5

# METHODOLOGY AND DATA

## The Data

The data used in the model have been retrieved from different sources. World export market shares of four basic manufacturing sector segregations are utilized as dependent variable in each model. These data were attained from United Nations Commodity Trade Statistics Database (UN Comtrade). It is one of the most comprehensive trade databases with more than 1 billion records including sector based trade data. The data of exports in US dollars cover the period from 1994 to 2007. In order to classify the export data in terms of sectors the SITC Revision 3 was used. SITC Rev. 3 was approved in the twenty third session of Statistical Commission of United Nations in February 1985. In 2006, due to changing nature of technology and products, SITC Rev.4 was announced but since the data used in the analysis covers the period until 2007, the classification of Rev.3 was applied. Table 9 below is prepared in order to demonstrate the classification numbers and definitions of the dependent variable.

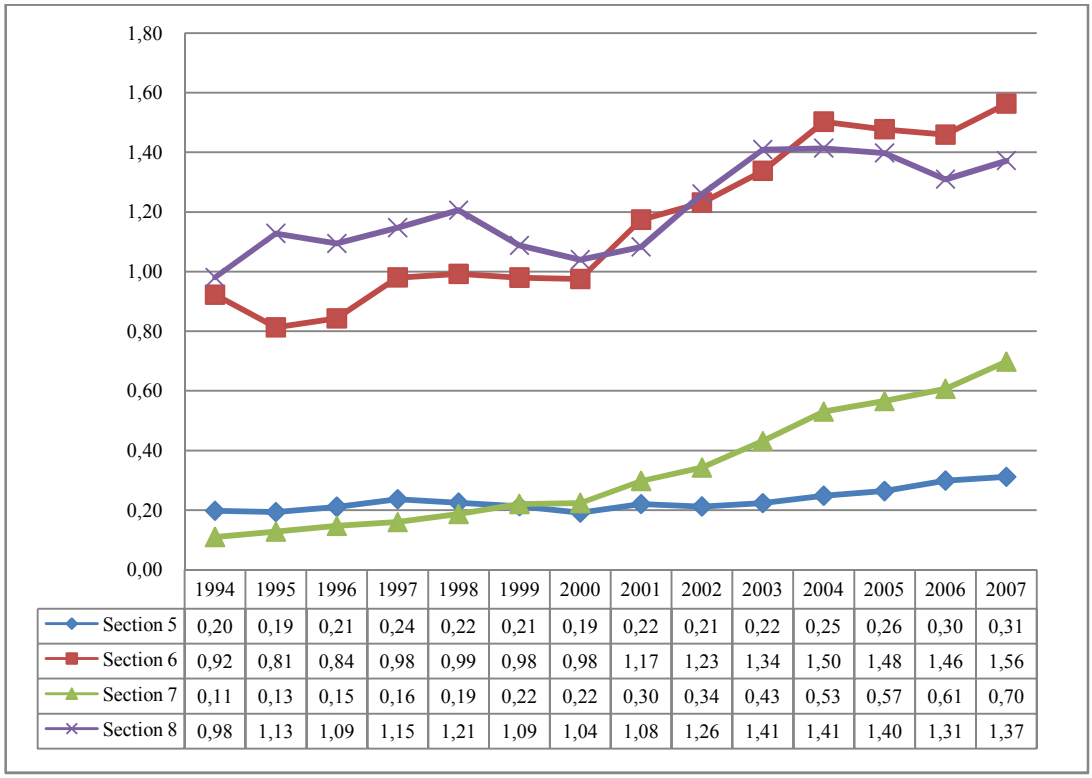
Table 9: Manufacturing Exports According to Standard International Trade Classification

| SITC Section Number | SITC Section Definition |
|---|---|
| 5 | Chemicals and Related Products |
| 6 | Manufactured Goods Classified Chiefly by Material |
| 7 | Machinery and Transport Equipment |
| 8 | Miscellaneous Manufactured Articles |

Source: UN Comtrade database

The following part of the chapter is devoted to demonstrate the trend of dependent and independent variables on the figures. The data cover eight countries, Turkey, Hungary, China, Czech Republic, Poland, Romania, Slovakia and Slovenia for the

period between from 1994 to 2007. Hungary, Czech Republic, Poland, Slovakia and Slovenia were accepted as member for European Union (EU) in 2004. The accession year of Romania is 2007. All of these countries are emerging countries and the recent members of EU. Turkey, as being an emerging economy, is also a candidate for EU membership. That is why these countries were chosen in the model. China is also an emerging country with high level of performance in R&D, thus China is also included as a benchmark to remaining countries.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,20 | 0,19 | 0,21 | 0,24 | 0,22 | 0,21 | 0,19 | 0,22 | 0,21 | 0,22 | 0,25 | 0,26 | 0,30 | 0,31 |
| Section 6 | 0,92 | 0,81 | 0,84 | 0,98 | 0,99 | 0,98 | 0,98 | 1,17 | 1,23 | 1,34 | 1,50 | 1,48 | 1,46 | 1,56 |
| Section 7 | 0,11 | 0,13 | 0,15 | 0,16 | 0,19 | 0,22 | 0,22 | 0,30 | 0,34 | 0,43 | 0,53 | 0,57 | 0,61 | 0,70 |
| Section 8 | 0,98 | 1,13 | 1,09 | 1,15 | 1,21 | 1,09 | 1,04 | 1,08 | 1,26 | 1,41 | 1,41 | 1,40 | 1,31 | 1,37 |

Figure 22: Shares of manufacturing sectors' exports in the world market (Turkey). (%)

Source: UN comtrade database

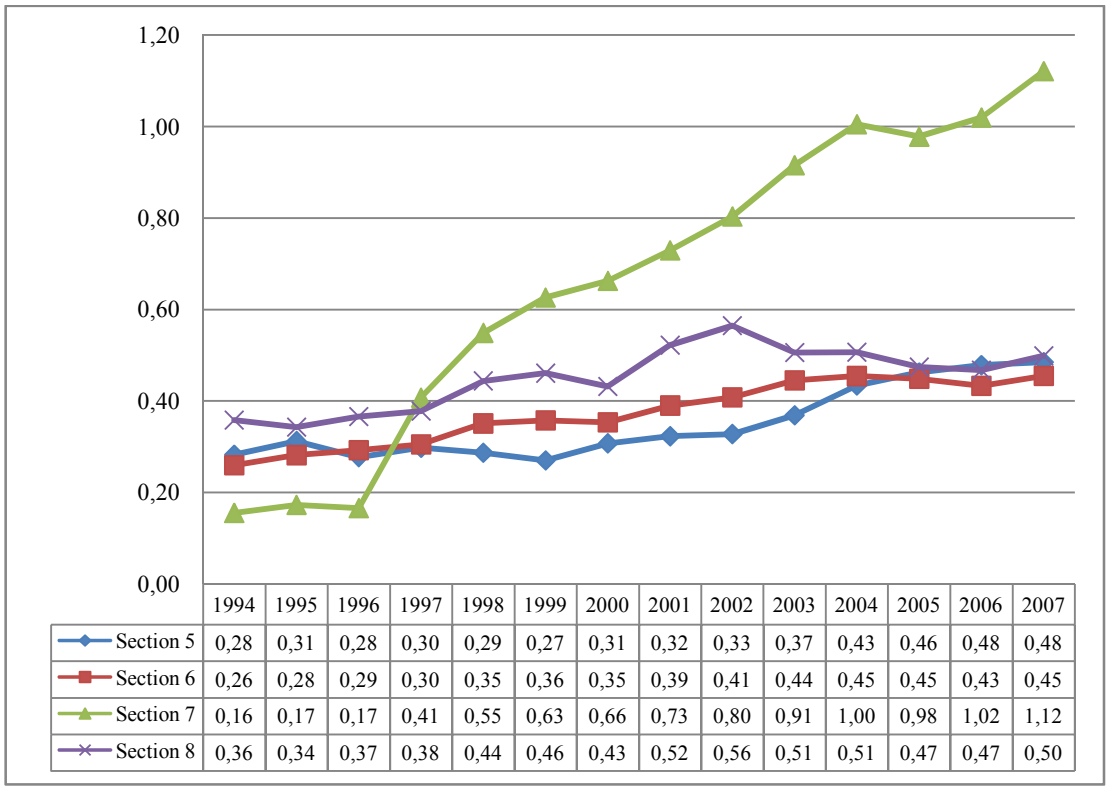
The world export market shares are founded through getting sector based export percentages from the total export value of the world in the relevant sector. Exports market shares are used in order to see the placement of the country manufacturing exports in the world market with the R&D effects.

In Turkey, manufacturing sectors' export market shares in the world are said to have a general increasing tendency in the years. Section 6, namely, Manufactured Goods Classified Chiefly by Material, has the highest share of %1.56 in the year 2007. Export market shares of textiles, iron and steel industries are the major contributors to the SITC section 6 as it can be seen in the Table 7. Besides, road vehicles industry which is the main industry of SITC section 7 empowers the increasing trend of the mentioning sector. The figure above shows also the fact that in the early years of 2000s; economic crisis did not have a clear impact on the export market shares of manufacturing sector except a little impact seen on the SITC section 8.

In order to have value based understanding about some international trade facts, the following statistics are explained in this paragraph for Turkish manufacturing sector. Section 5 including chemicals and related products forms the lowest share of manufacturing exports in 2007 with the value of approximately 4.3 billion dollar. It has a growing tendency in the years from 1994 to 1997 and a stable period followed in the years from 1998 to 2000. Then, increasing trend continued until 2007. Section 6 which includes manufactured goods classified chiefly by material, have also a positive growing tendency in all years examined except the stable period in 1998 and 1999. The export values of Section 7 including the machinery and transport equipments have become approximately 20 times higher in 2007 compared to the level of 1994. Road Vehicles which is under division 78 has the majority share from machinery and transport equipments sector. Electrical machinery and appliances follow it as the second important industry under division 77, which can also be seen in the Table 7. The reason behind the sharply increasing tendency seen in the Section 7 is mainly due to the developments in Turkish

automotive industry. Section 8 including the miscellaneous manufactured articles such as prefabricated buildings, furniture, footwear and etc, have also increasing trend in all examined years except 1999 with a little amount of decrease compared to previous year. Eventually, all sectors have increasing tendencies in general. The years of crises in the early 2000s have affected the data only through diminishing growth rates.

The following figure represents the world export market shares of Turkish manufacturing sectors' export values.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,28 | 0,31 | 0,28 | 0,30 | 0,29 | 0,27 | 0,31 | 0,32 | 0,33 | 0,37 | 0,43 | 0,46 | 0,48 | 0,48 |
| Section 6 | 0,26 | 0,28 | 0,29 | 0,30 | 0,35 | 0,36 | 0,35 | 0,39 | 0,41 | 0,44 | 0,45 | 0,45 | 0,43 | 0,45 |
| Section 7 | 0,16 | 0,17 | 0,17 | 0,41 | 0,55 | 0,63 | 0,66 | 0,73 | 0,80 | 0,91 | 1,00 | 0,98 | 1,02 | 1,12 |
| Section 8 | 0,36 | 0,34 | 0,37 | 0,38 | 0,44 | 0,46 | 0,43 | 0,52 | 0,56 | 0,51 | 0,51 | 0,47 | 0,47 | 0,50 |

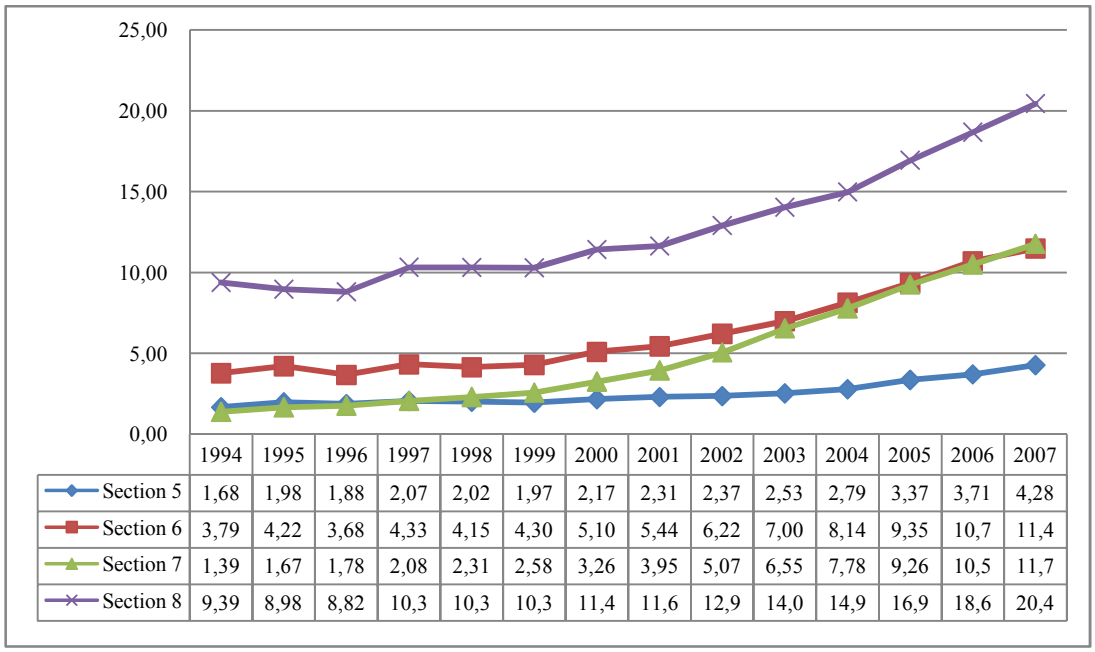
Figure 23: Shares of manufacturing sectors' exports in the world market (Hungary). (%)

Source: UN Comtrade database

Manufacturing sectors' export market shares in the world are said to have a general increasing tendency in Hungary. Exceptionally, in SITC section 6 namely, Manufactured Goods Classified Chiefly by Material has a decreasing trend between

the years from 2002 to 2006. The remarkable result is seen in the export market share of SITC section 7 which includes the machinery and transport equipments.

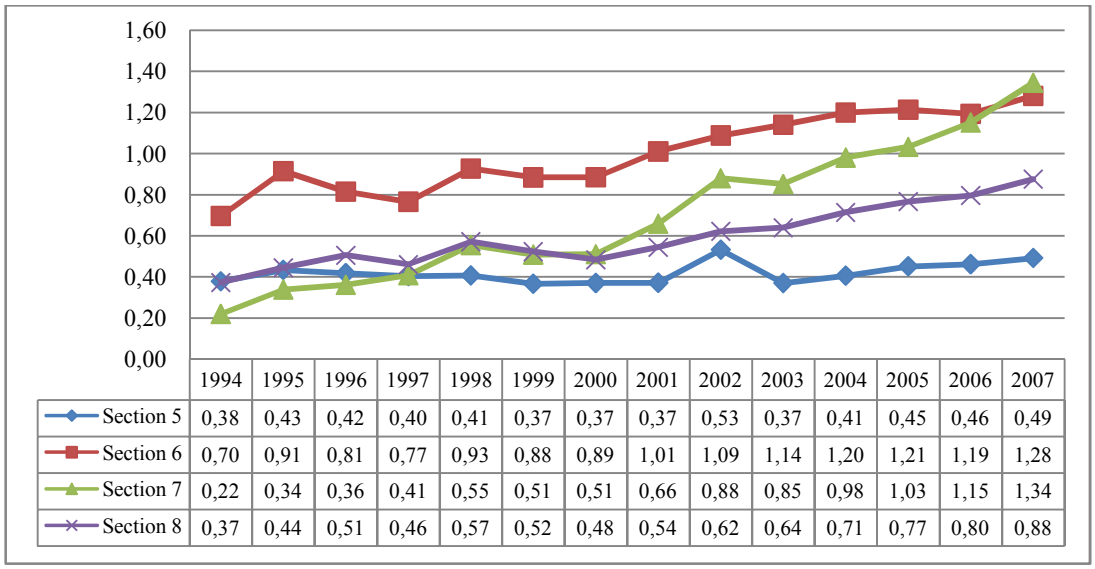
The following figure represents the export markets shares of China in manufacturing sectors. Relatively high shares are seen in the data of China. SITC section 8 which includes the industries like articles of apparel and clothing, footwear, photographic apparatus and prefabricated buildings, have the highest share of %20 in the year 2007.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 1,68 | 1,98 | 1,88 | 2,07 | 2,02 | 1,97 | 2,17 | 2,31 | 2,37 | 2,53 | 2,79 | 3,37 | 3,71 | 4,28 |
| Section 6 | 3,79 | 4,22 | 3,68 | 4,33 | 4,15 | 4,30 | 5,10 | 5,44 | 6,22 | 7,00 | 8,14 | 9,35 | 10,7 | 11,4 |
| Section 7 | 1,39 | 1,67 | 1,78 | 2,08 | 2,31 | 2,58 | 3,26 | 3,95 | 5,07 | 6,55 | 7,78 | 9,26 | 10,5 | 11,7 |
| Section 8 | 9,39 | 8,98 | 8,82 | 10,3 | 10,3 | 10,3 | 11,4 | 11,6 | 12,9 | 14,0 | 14,9 | 16,9 | 18,6 | 20,4 |

Figure 24: Shares of manufacturing sectors' exports in the world market (China) (%)
Source: UN Comtrade database

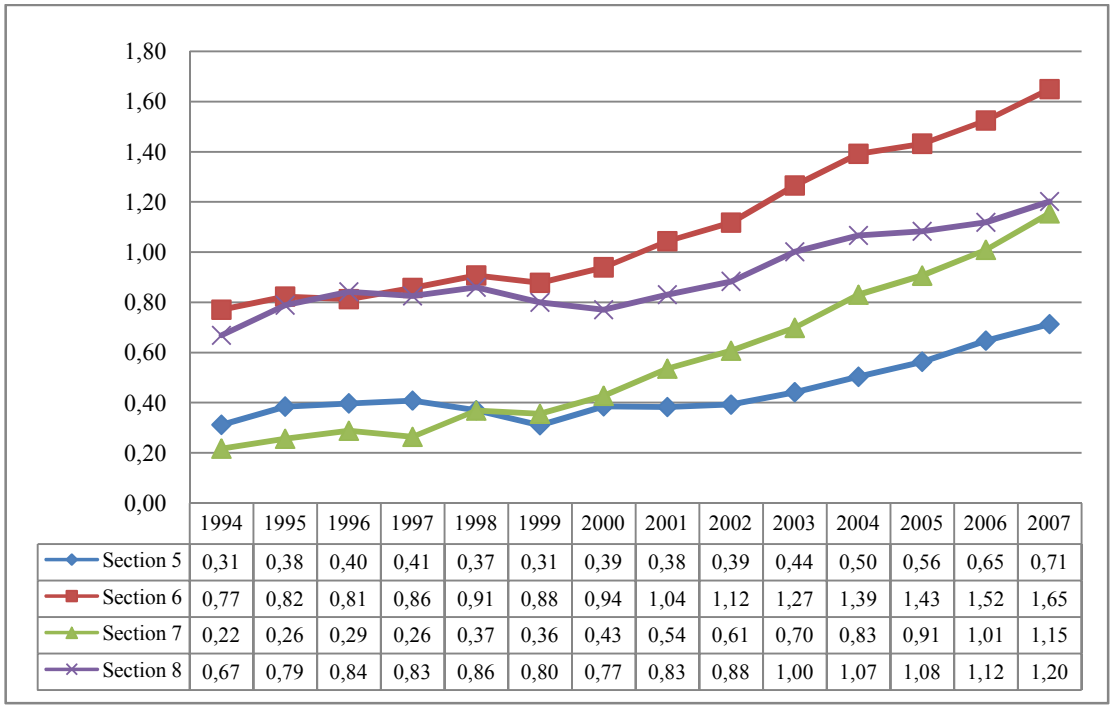
The following figure represents the market shares of Czech Republic manufacturing sectors' exports in the total world export market in relevant sectors. The general increasing tendency is seen in the examined sectors' market shares. The results in the market share of machinery and transport equipments (SITC section 7) are striking. It has the lowest share as %0.37 in 1994 whereas it has reached to the highest share with %1.34 among other manufacturing sectors in 2007.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,38 | 0,43 | 0,42 | 0,40 | 0,41 | 0,37 | 0,37 | 0,37 | 0,53 | 0,37 | 0,41 | 0,45 | 0,46 | 0,49 |
| Section 6 | 0,70 | 0,91 | 0,81 | 0,77 | 0,93 | 0,88 | 0,89 | 1,01 | 1,09 | 1,14 | 1,20 | 1,21 | 1,19 | 1,28 |
| Section 7 | 0,22 | 0,34 | 0,36 | 0,41 | 0,55 | 0,51 | 0,51 | 0,66 | 0,88 | 0,85 | 0,98 | 1,03 | 1,15 | 1,34 |
| Section 8 | 0,37 | 0,44 | 0,51 | 0,46 | 0,57 | 0,52 | 0,48 | 0,54 | 0,62 | 0,64 | 0,71 | 0,77 | 0,80 | 0,88 |

Figure 25: Shares of manufacturing sectors' exports in the world market (Czech Rep.). (%)

Source: UN Comtrade database



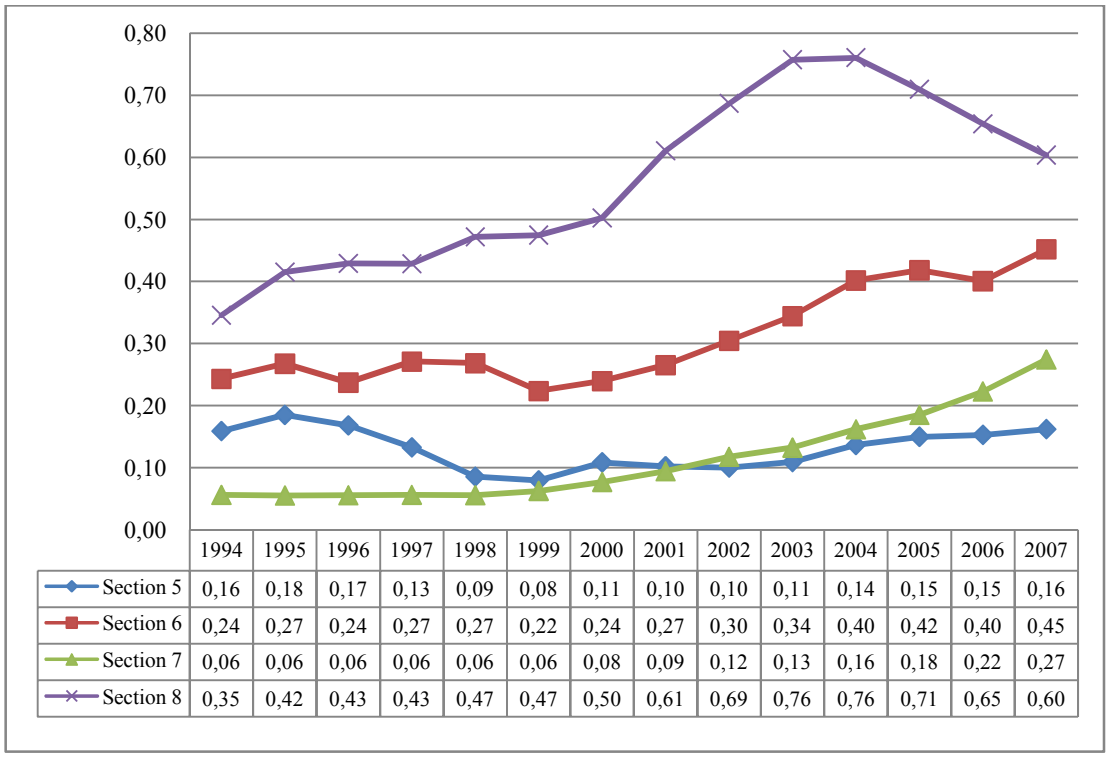

| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,31 | 0,38 | 0,40 | 0,41 | 0,37 | 0,31 | 0,39 | 0,38 | 0,39 | 0,44 | 0,50 | 0,56 | 0,65 | 0,71 |
| Section 6 | 0,77 | 0,82 | 0,81 | 0,86 | 0,91 | 0,88 | 0,94 | 1,04 | 1,12 | 1,27 | 1,39 | 1,43 | 1,52 | 1,65 |
| Section 7 | 0,22 | 0,26 | 0,29 | 0,26 | 0,37 | 0,36 | 0,43 | 0,54 | 0,61 | 0,70 | 0,83 | 0,91 | 1,01 | 1,15 |
| Section 8 | 0,67 | 0,79 | 0,84 | 0,83 | 0,86 | 0,80 | 0,77 | 0,83 | 0,88 | 1,00 | 1,07 | 1,08 | 1,12 | 1,20 |

Figure 26: Shares of manufacturing sectors' exports in the world market (Poland) (%)

Source: UN Comtrade database

The figure above highlights the market shares of Poland manufacturing sectors' exports in the total world export market in relevant sectors. Particularly after the

years 1999 and 2000 the share demonstrates a clear increasing tendency as it seen in the figure. However, in the period between 1994 and 1999 the international export market shares move more likely on a stable path. Like many other countries the share of machinery and transport equipments' export has more sharply increasing trend compared to other sectors.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,16 | 0,18 | 0,17 | 0,13 | 0,09 | 0,08 | 0,11 | 0,10 | 0,10 | 0,11 | 0,14 | 0,15 | 0,15 | 0,16 |
| Section 6 | 0,24 | 0,27 | 0,24 | 0,27 | 0,27 | 0,22 | 0,24 | 0,27 | 0,30 | 0,34 | 0,40 | 0,42 | 0,40 | 0,45 |
| Section 7 | 0,06 | 0,06 | 0,06 | 0,06 | 0,06 | 0,06 | 0,08 | 0,09 | 0,12 | 0,13 | 0,16 | 0,18 | 0,22 | 0,27 |
| Section 8 | 0,35 | 0,42 | 0,43 | 0,43 | 0,47 | 0,47 | 0,50 | 0,61 | 0,69 | 0,76 | 0,76 | 0,71 | 0,65 | 0,60 |

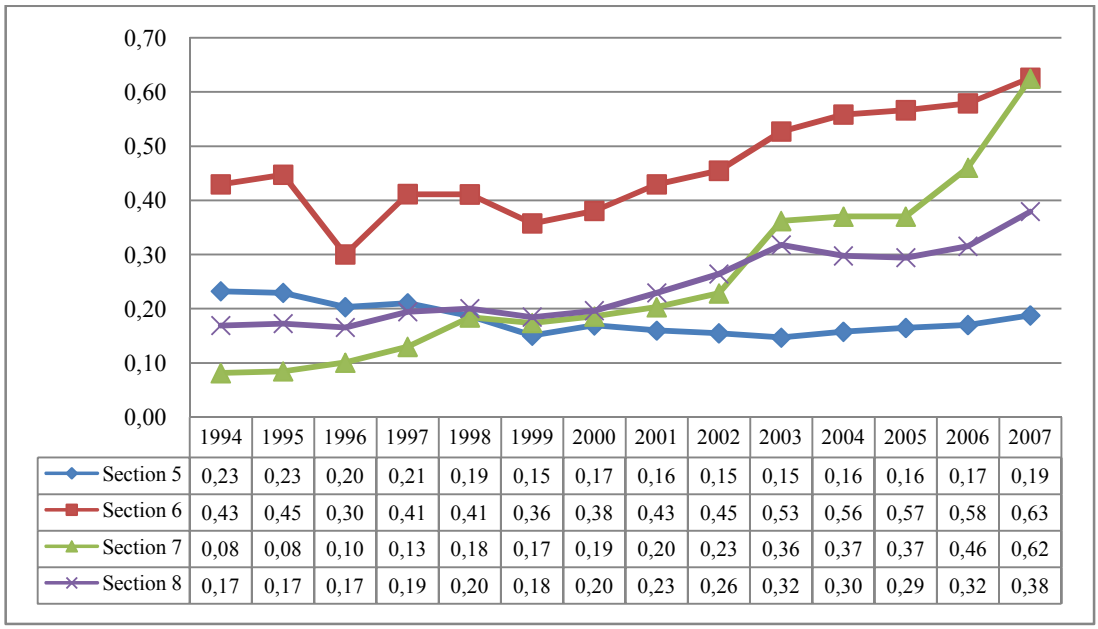
Figure 27: Shares of manufacturing sectors' exports in the world market (Romania). (%)

Source: UN Comtrade database

Resembling to many other developing countries, there is an increasing tendency in the export market share of manufacturing sectors in Romania. Exceptionally, after the year 2004 the share of Miscellaneous Manufactured Articles (SITC section 8) has decreased.

The following figure represents the export markets shares of Slovakia in manufacturing sectors. The success in the market share of machinery and transport

equipments (SITC section 7) is also crucial in this country. It has the lowest share of %0.08 in the year 1994 whereas the share has reached to %0.62 in 2007 which is the second highest share right after the %0.63 share of Manufactured Goods Classified Chiefly by Material (SITC section 6).

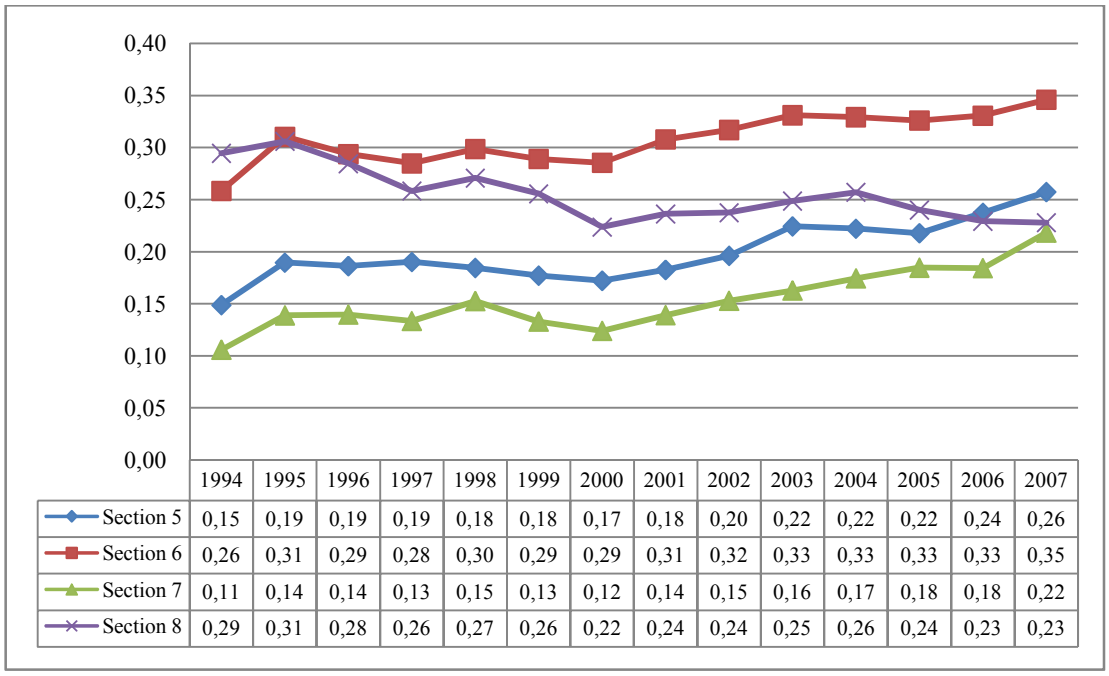



| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,23 | 0,23 | 0,20 | 0,21 | 0,19 | 0,15 | 0,17 | 0,16 | 0,15 | 0,15 | 0,16 | 0,16 | 0,17 | 0,19 |
| Section 6 | 0,43 | 0,45 | 0,30 | 0,41 | 0,41 | 0,36 | 0,38 | 0,43 | 0,45 | 0,53 | 0,56 | 0,57 | 0,58 | 0,63 |
| Section 7 | 0,08 | 0,08 | 0,10 | 0,13 | 0,18 | 0,17 | 0,19 | 0,20 | 0,23 | 0,36 | 0,37 | 0,37 | 0,46 | 0,62 |
| Section 8 | 0,17 | 0,17 | 0,17 | 0,19 | 0,20 | 0,18 | 0,20 | 0,23 | 0,26 | 0,32 | 0,30 | 0,29 | 0,32 | 0,38 |

Figure 28: Shares of manufacturing sectors' exports in the world market (Slovakia). (%)

Source: UN Comtrade database

The following figure above demonstrates the market shares of Slovenia manufacturing sectors' exports in the total world export market in relevant sectors. In general it can be said that there is an increasing trend in the sectors. However, through the year 2000 all sectors have a little decreasing period.

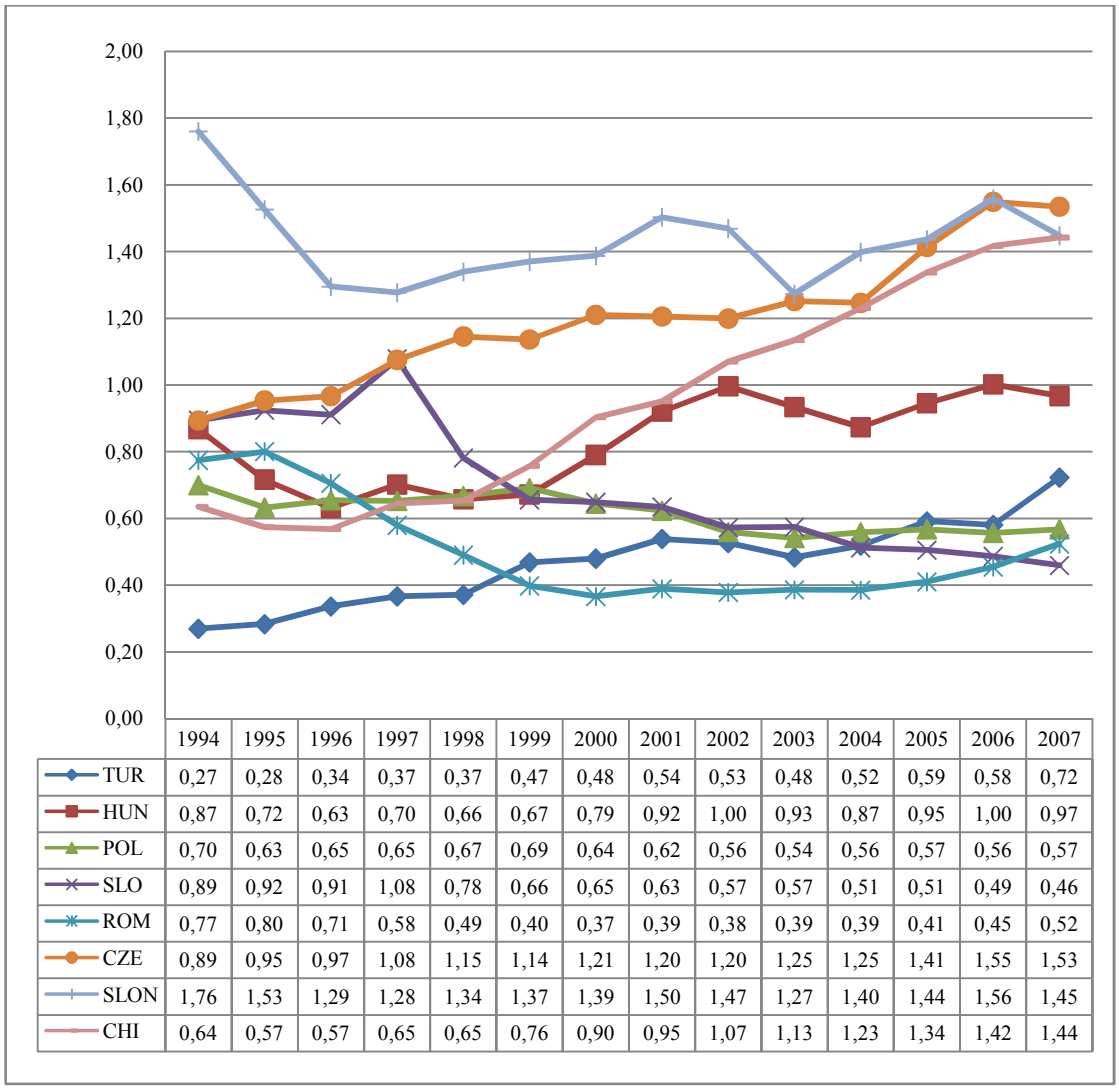



| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section 5 | 0,15 | 0,19 | 0,19 | 0,19 | 0,18 | 0,18 | 0,17 | 0,18 | 0,20 | 0,22 | 0,22 | 0,22 | 0,24 | 0,26 |
| Section 6 | 0,26 | 0,31 | 0,29 | 0,28 | 0,30 | 0,29 | 0,29 | 0,31 | 0,32 | 0,33 | 0,33 | 0,33 | 0,33 | 0,35 |
| Section 7 | 0,11 | 0,14 | 0,14 | 0,13 | 0,15 | 0,13 | 0,12 | 0,14 | 0,15 | 0,16 | 0,17 | 0,18 | 0,18 | 0,22 |
| Section 8 | 0,29 | 0,31 | 0,28 | 0,26 | 0,27 | 0,26 | 0,22 | 0,24 | 0,24 | 0,25 | 0,26 | 0,24 | 0,23 | 0,23 |

Figure 29: Shares of manufacturing sectors' exports in the world market (Slovenia). (%)

Source: UN Comtrade database

The Figure 30 represents the shares of total R&D expenditures in GDP (GERD) for the countries used in the model. In the year 1994 Turkey has the lowest R&D share among the countries examined. There has been an increasing trend in the GERD of Turkey and it has reached to point of % 0.72 in 2007. There has been both increasing and increasing trends in different countries in different time periods which can be followed in the figure.




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TUR | 0,27 | 0,28 | 0,34 | 0,37 | 0,37 | 0,47 | 0,48 | 0,54 | 0,53 | 0,48 | 0,52 | 0,59 | 0,58 | 0,72 |
| HUN | 0,87 | 0,72 | 0,63 | 0,70 | 0,66 | 0,67 | 0,79 | 0,92 | 1,00 | 0,93 | 0,87 | 0,95 | 1,00 | 0,97 |
| POL | 0,70 | 0,63 | 0,65 | 0,65 | 0,67 | 0,69 | 0,64 | 0,62 | 0,56 | 0,54 | 0,56 | 0,57 | 0,56 | 0,57 |
| SLO | 0,89 | 0,92 | 0,91 | 1,08 | 0,78 | 0,66 | 0,65 | 0,63 | 0,57 | 0,57 | 0,51 | 0,51 | 0,49 | 0,46 |
| ROM | 0,77 | 0,80 | 0,71 | 0,58 | 0,49 | 0,40 | 0,37 | 0,39 | 0,38 | 0,39 | 0,39 | 0,41 | 0,45 | 0,52 |
| CZE | 0,89 | 0,95 | 0,97 | 1,08 | 1,15 | 1,14 | 1,21 | 1,20 | 1,20 | 1,25 | 1,25 | 1,41 | 1,55 | 1,53 |
| SLON | 1,76 | 1,53 | 1,29 | 1,28 | 1,34 | 1,37 | 1,39 | 1,50 | 1,47 | 1,27 | 1,40 | 1,44 | 1,56 | 1,45 |
| CHI | 0,64 | 0,57 | 0,57 | 0,65 | 0,65 | 0,76 | 0,90 | 0,95 | 1,07 | 1,13 | 1,23 | 1,34 | 1,42 | 1,44 |

Figure 30: Shares of total R&D expenditures in GDP (%)

Source: OECD MSTI database

The main models which are shown in the following parts of the chapter analyze the impacts of the share of gross domestic R&D expenditures in GDP on the different manufacturing sectors. The extra models are utilized in order to see the difference between the impacts of government R&D expenditure shares (GOVERD) and business enterprise R&D expenditure shares (BERD).

Table 10: The Shares Of Government R&D Expenditures (GOVERD) and Business Enterprise R&D Expenditures (BERD) in GDP of the Countries (%)

| Countries | R&D Exp. | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turkey | Goverd | 0,02 | 0,02 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 | 0,04 | 0,04 | 0,05 | 0,04 | 0,07 | 0,07 | 0,08 |
| | Berd | 0,07 | 0,07 | 0,09 | 0,12 | 0,12 | 0,18 | 0,16 | 0,18 | 0,15 | 0,11 | 0,13 | 0,20 | 0,22 | 0,30 |
| Hungary | Goverd | 0,24 | 0,18 | 0,18 | 0,18 | 0,21 | 0,22 | 0,21 | 0,24 | 0,33 | 0,29 | 0,26 | 0,27 | 0,25 | 0,23 |
| | Berd | 0,31 | 0,31 | 0,27 | 0,29 | 0,25 | 0,27 | 0,35 | 0,37 | 0,35 | 0,34 | 0,36 | 0,41 | 0,48 | 0,49 |
| Poland | Goverd | 0,25 | 0,22 | 0,20 | 0,21 | 0,21 | 0,21 | 0,21 | 0,20 | 0,25 | 0,22 | 0,22 | 0,21 | 0,21 | 0,20 |
| | Berd | 0,29 | 0,25 | 0,27 | 0,26 | 0,28 | 0,29 | 0,23 | 0,22 | 0,11 | 0,15 | 0,16 | 0,18 | 0,18 | 0,17 |
| Slovakia | Goverd | 0,38 | 0,37 | 0,36 | 0,19 | 0,19 | 0,18 | 0,16 | 0,15 | 0,15 | 0,18 | 0,16 | 0,15 | 0,16 | 0,16 |
| | Berd | 0,47 | 0,50 | 0,51 | 0,82 | 0,51 | 0,41 | 0,43 | 0,43 | 0,37 | 0,32 | 0,25 | 0,25 | 0,21 | 0,18 |
| Romania | Goverd | 0,11 | 0,16 | 0,16 | 0,09 | 0,09 | 0,07 | 0,07 | 0,11 | 0,09 | 0,12 | 0,13 | 0,14 | 0,15 | 0,18 |
| | Berd | 0,65 | 0,62 | 0,52 | 0,47 | 0,38 | 0,30 | 0,25 | 0,24 | 0,23 | 0,23 | 0,21 | 0,20 | 0,22 | 0,22 |
| Czech Rep. | Goverd | 0,19 | 0,25 | 0,30 | 0,29 | 0,29 | 0,28 | 0,31 | 0,29 | 0,28 | 0,29 | 0,28 | 0,28 | 0,29 | 0,32 |
| | Berd | 0,51 | 0,62 | 0,58 | 0,68 | 0,74 | 0,71 | 0,73 | 0,73 | 0,73 | 0,76 | 0,78 | 0,89 | 1,01 | 0,95 |
| Slovenia | Goverd | 0,52 | 0,39 | 0,35 | 0,36 | 0,41 | 0,39 | 0,36 | 0,37 | 0,34 | 0,28 | 0,28 | 0,35 | 0,38 | 0,35 |
| | Berd | 0,75 | 0,71 | 0,66 | 0,68 | 0,70 | 0,75 | 0,78 | 0,87 | 0,88 | 0,81 | 0,94 | 0,85 | 0,94 | 0,87 |
| China | Goverd | 0,27 | 0,24 | 0,24 | 0,26 | 0,28 | 0,29 | 0,28 | 0,28 | 0,31 | 0,31 | 0,28 | 0,29 | 0,28 | 0,28 |
| | Berd | 0,27 | 0,25 | 0,25 | 0,30 | 0,29 | 0,38 | 0,54 | 0,58 | 0,66 | 0,71 | 0,82 | 0,91 | 1,01 | 1,04 |

Source: OECD MSTI database

The independent variables are obtained from OECD main science and technology indicators (MSTI). This database is published twice a year and includes final or provisional results and estimates established by government authorities

The Table 10 above represents the shares of government and business enterprise R&D expenditures in GDPs. For Turkey, the share of business enterprise R&D expenditures (BERD) is higher than the share of government R&D expenditures (GOVERD) in all years examined. It should be noted that the GOVERD data does not include the expenditures of higher education R&D activities. There are both increasing and decreasing trends shown in the data for different periods and countries which can be seen in the table.

## The Model and the Variables

Many scholars studied on the relationship of R&D expenditures and exports. These studies historically are grounded on growth-export relationships. Developing countries have more likely to formed their development strategies on exports by 1980s. For Turkey, the situation is similar. Export based development strategies' success has been highlighted in many studies. However, before following this strategy the infrastructure of a country as well as the quality of human capital should be arranged accordingly. In today's highly competitive international markets, countries can take or increase a market share through producing better quality products with cheaper costs.

In order to survive in the markets, some industries need more R&D activities than others. Manufacturing is one of the main sectors including many sub-sectors which need high level of R&D in order to increase their shares in either domestic or foreign markets. The model is established with the basic aim of analyzing the impacts of the share of total R&D expenditures in GDP on the export market share of manufacturing sectors. Second basic goal is to analyze the difference between the private and government R&D activities' impacts on the export market shares in different manufacturing sectors.

Özer and Çiftçi (2009) define the general relationship between competitiveness and technology by regressing export performance on the share of total R&D expenditure in GDP and constructed their models as:

$$EXGOODS_{it} = \beta_0 + \beta_1 GERD_{it} + \varepsilon_{it} \quad (1)$$

$$EXICT_{it} = \beta_0 + \beta_1 GERD_{it} + \varepsilon_{it} \quad (2)$$

$$HTECHEX_{it} = \beta_0 + \beta_1 GERD_{it} + \varepsilon_{it} \quad (3)$$

They defined the relationship between the gross domestic R&D expenditures as a percentage of GDP (GERD) (%) and exports of goods (EXGOODS), export of information and communication technologies (EXICT) and high-tech exports (HTECHEX), which are in million US dollars. They used the panel data analysis method to examine the data from 30 OECD countries.

Thus, the model of Özer and Çiftçi (2009) are rewritten below in order to analyze the impacts of the gross domestic R&D expenditures' share in GDP on the market shares of manufacturing sectors' exports. The models starting with the number 4 are utilized in four different sector divisions.

$$\ln(CHEMEX_{it}) = \beta_0 + \beta_1 \ln(GERD_{it}) + \varepsilon_{it} \quad (4.a.)$$

$$\ln(MANMATEX_{it}) = \beta_0 + \beta_1 \ln(GERD_{it}) + \varepsilon_{it} \quad (4.b.)$$

$$\ln(MACTREX_{it}) = \beta_0 + \beta_1 \ln(GERD_{it}) + \varepsilon_{it} \quad (4.c.)$$

$$\ln(MISCEX_{it}) = \beta_0 + \beta_1 \ln(GERD_{it}) + \varepsilon_{it} \quad (4.d.)$$

Additionally the models with the number 5 are used in order to test the difference between impacts of private R&D expenditures and government R&D

expenditures as a percentage of GDP on the manufacturing sectors' export market shares. Thus, the model of Ozer and Ciftci (2009) are rewritten for the mentioning aims with the equations numbered with 5:

$$\ln(CHEMEX_{it}) = \beta_0 + \beta_1 \ln(GOVERD_{it}) + \beta_2 \ln(BERD_{it}) + \varepsilon_{it} \quad (5.a.)$$

$$\ln(MANMATEX_{it}) = \beta_0 + \beta_1 \ln(GOVERD_{it}) + \beta_2 \ln(BERD_{it}) + \varepsilon_{it} \quad (5.b.)$$

$$\ln(MACTREX_{it}) = \beta_0 + \beta_1 \ln(GOVERD_{it}) + \beta_2 \ln(BERD_{it}) + \varepsilon_{it} \quad (5.c.)$$

$$\ln(MISCEX_{it}) = \beta_0 + \beta_1 \ln(GOVERD_{it}) + \beta_2 \ln(BERD_{it}) + \varepsilon_{it} \quad (5.d.)$$

The dependent and independent variables are defined as follows:

$CHEMEX_{it}$ : The export market share in the world, for chemicals and related products sector (SITC Section 5) in US $ in year t for the country i.

$MANMATEX_{it}$ : The export market share in the world, for manufactured goods classified by material sector (SITC Section 6) in US $ in year t for the country i.

$MACTREX_{it}$ : The export market share in the world, for machinery and transport equipments sector (SITC Section 7) in US $ in year t for the country i.

$MISCEX_{it}$ : The export market share in the world, for miscellaneous manufactured articles sector (SITC Section 8) in US $ in year t for the country i.

GERD$_{it}$ : Gross domestic R&D expenditures as percentage of GDP for the country i and in year t.

GOVERD$_{it}$ : Government R&D expenditures as percentage of GDP for the country i and in year t.

BERD$_{it}$ : Business enterprise R&D expenditures as percentage of GDP for the country i and in year t.

The dependent variables, the export market shares of manufacturing sector divisions, are expressed in percentage terms. The independent variables, shares of gross domestic, government and business enterprise R&D expenditures in GDP are also defined in percentage terms. Interpreting the changes as percentage rather than absolute amounts is more useful. Thus, in the model logarithmic versions of the data are used. The logarithmic-logarithmic model is structural form.

Almost all sectors need R&D activities for enhancements. However, most of the industries which need high level of R&D activities are classified under manufacturing sector and its sub-sectors. Thus, in order to analyze the impacts of R&D expenditures on the export performance the manufacturing sector's main divisions are chosen in the models.

In summary, markets shares of exports are used as dependent variables, whereas the R&D expenditures as percentage of GDP are used as independent variables in the models.

The effect of R&D expenditures on export performance in Turkey and comparative emerging markets is analyzed by utilizing Fixed Effects Model (FEM) of panel data. The model is estimated for the time period of the year from 1994 to 2007.

Özkan-Günay (2004) describes panel data procedures as the simultaneous investigation of equation systems considering that the both country specific characteristics and change over the time. Fixed Effect Model (FEM) assumes that the effects of the many omitted individual time varying variables are individually unimportant but are collectively significant. The individual effects can be absorbed into the intercept term of a regression model as a means to explicitly allow for individual or time heterogeneity in the temporal cross-sectional data. Thus $\alpha$ is a separate constant term for each unit that varies both cross-sectionally across countries and over time.

Since the independent variables are the products of R&D activities there are high correlations between them. Thus, there exists the need to analyze the independent variables in different models. (Özcelik, 2002).

Fixed Effect Model (FEM) used in the model. The Hausman test is used to also to test the effectiveness of random effect model (REM). Test results favor both FEM and REM together.

E-views 5.1 has been used in computing the regression analyses.

## Empirical Findings

Before testing the impacts of R&D expenditures on the manufacturing sector export performance with the Fixed Effects Model, the descriptive statistics of data of Turkey has been figured out in order to see the relations between variables.

Table 11 illustrates the correlations of R&D variables and the world market share of chemical and related product exports for each country included in the model.

In general, the correlation between GOVERD and BERD is at low rates. Exceptionally, it is around the 79% in Turkey.

Table 11: Correlations of Variables in (4.a.) and (5.a.)

| TURKEY | CHEMEX | GERD | GOVERD | BERD | CHINA | CHEMEX | GERD | GOVERD | BERD |
|---|---|---|---|---|---|---|---|---|---|
| CHEMEX | 1,00 | | | | CHEMEX | 1,00 | | | |
| GERD | 0,76 | 1,00 | | | GERD | 0,91 | 1,00 | | |
| GOVERD | 0,91 | 0,83 | 1,00 | | GOVERD | 0,29 | 0,58 | 1,00 | |
| BERD | 0,78 | 0,93 | 0,79 | 1,00 | BERD | 0,93 | 1,00 | 0,53 | 1,00 |
| CZECH REP. | CHEMEX | GERD | GOVERD | BERD | HUNGARY | CHEMEX | GERD | GOVERD | BERD |
| CHEMEX | 1,00 | | | | CHEMEX | 1,00 | | | |
| GERD | 0,44 | 1,00 | | | GERD | 0,72 | 1,00 | | |
| GOVERD | 0,20 | 0,59 | 1,00 | | GOVERD | 0,45 | 0,82 | 1,00 | |
| BERD | 0,46 | 0,99 | 0,58 | 1,00 | BERD | 0,90 | 0,83 | 0,44 | 1,00 |
| POLAND | CHEMEX | GERD | GOVERD | BERD | ROMANIA | CHEMEX | GERD | GOVERD | BERD |
| CHEMEX | 1,00 | | | | CHEMEX | 1,00 | | | |
| GERD | -0,72 | 1,00 | | | GERD | 0,71 | 1,00 | | |
| GOVERD | -0,35 | -0,03 | 1,00 | | GOVERD | 0,82 | 0,42 | 1,00 | |
| BERD | -0,59 | 0,96 | -0,23 | 1,00 | BERD | 0,47 | 0,94 | 0,09 | 1,00 |
| SLOVAKIA | CHEMEX | GERD | GOVERD | BERD | SLOVENIA | CHEMEX | GERD | GOVERD | BERD |
| CHEMEX | 1,00 | | | | CHEMEX | 1,00 | | | |
| GERD | 0,77 | 1,00 | | | GERD | -0,21 | 1,00 | | |
| GOVERD | 0,82 | 0,69 | 1,00 | | GOVERD | -0,60 | 0,69 | 1,00 | |
| BERD | 0,53 | 0,93 | 0,39 | 1,00 | BERD | 0,61 | 0,28 | -0,38 | 1,00 |

The highest correlation between GERD and CHEMEX is found in China with the rate 91%. Slovakia is the second having the rate 77%. The highest correlation between GOVERD and CHEMEX is found in Turkey which has the rate 91%. China takes the lead also in the BERD and CHEMEX correlation with the rate of 93%.

Table 12 below represents the correlations of R&D variables and the world export market share of countries in the sector of manufactured goods classified chiefly by material. The highest correlation between GERD and MANMATEX is found in the countries of China and Turkey having the rates 96% and 87% respectively. The highest correlation between GOVERD and MANMATEX is found again in Turkey with 84%. China takes the lead in the BERD and MANMATEX correlation with the rate of 97%.

Table 12: Correlations of Variables in (4.b.) and (5.b.)

| TURKEY | MANMATEX | GERD | GOVERD | BERD | CHINA | MANMATEX | GERD | GOVERD | BERD |
|---|---|---|---|---|---|---|---|---|---|
| MANMATEX | 1,00 | | | | MANMATEX | 1,00 | | | |
| GERD | 0,87 | 1,00 | | | GERD | 0,96 | 1,00 | | |
| GOVERD | 0,84 | 0,83 | 1,00 | | GOVERD | 0,37 | 0,58 | 1,00 | |
| BERD | 0,70 | 0,93 | 0,79 | 1,00 | BERD | 0,97 | 1,00 | 0,53 | 1,00 |
| CZECH REP. | MANMATEX | GERD | GOVERD | BERD | HUNGARY | MANMATEX | GERD | GOVERD | BERD |
| MANMATEX | 1,00 | | | | MANMATEX | 1,00 | | | |
| GERD | 0,87 | 1,00 | | | GERD | 0,71 | 1,00 | | |
| GOVERD | 0,49 | 0,59 | 1,00 | | GOVERD | 0,69 | 0,82 | 1,00 | |
| BERD | 0,86 | 0,99 | 0,58 | 1,00 | BERD | 0,71 | 0,83 | 0,44 | 1,00 |
| POLAND | MANMATEX | GERD | GOVERD | BERD | ROMANIA | MANMATEX | GERD | GOVERD | BERD |
| MANMATEX | 1,00 | | | | MANMATEX | 1,00 | | | |
| GERD | -0,85 | 1,00 | | | GERD | -0,32 | 1,00 | | |
| GOVERD | -0,21 | -0,03 | 1,00 | | GOVERD | 0,59 | 0,42 | 1,00 | |
| BERD | -0,77 | 0,96 | -0,23 | 1,00 | BERD | -0,59 | 0,94 | 0,09 | 1,00 |
| SLOVAKIA | MANMATEX | GERD | GOVERD | BERD | SLOVENIA | MANMATEX | GERD | GOVERD | BERD |
| MANMATEX | 1,00 | | | | MANMATEX | 1,00 | | | |
| GERD | -0,69 | 1,00 | | | GERD | -0,19 | 1,00 | | |
| GOVERD | -0,44 | 0,69 | 1,00 | | GOVERD | -0,68 | 0,69 | 1,00 | |
| BERD | -0,72 | 0,93 | 0,39 | 1,00 | BERD | 0,68 | 0,28 | -0,38 | 1,00 |

Table 13: Correlations of Variables in (4.c.) and (5.c.)

| TURKEY | MACTREX | GERD | GOVERD | BERD | CHINA | MACTREX | GERD | GOVERD | BERD |
|---|---|---|---|---|---|---|---|---|---|
| MACTREX | 1,00 | | | | MACTREX | 1,00 | | | |
| GERD | 0,90 | 1,00 | | | GERD | 0,97 | 1,00 | | |
| GOVERD | 0,90 | 0,83 | 1,00 | | GOVERD | 0,42 | 0,58 | 1,00 | |
| BERD | 0,77 | 0,93 | 0,79 | 1,00 | BERD | 0,98 | 1,00 | 0,53 | 1,00 |
| CZECH REP. | MACTREX | GERD | GOVERD | BERD | HUNGARY | MACTREX | GERD | GOVERD | BERD |
| MACTREX | 1,00 | | | | MACTREX | 1,00 | | | |
| GERD | 0,94 | 1,00 | | | GERD | 0,72 | 1,00 | | |
| GOVERD | 0,51 | 0,59 | 1,00 | | GOVERD | 0,64 | 0,82 | 1,00 | |
| BERD | 0,92 | 0,99 | 0,58 | 1,00 | BERD | 0,76 | 0,83 | 0,44 | 1,00 |
| POLAND | MACTREX | GERD | GOVERD | BERD | ROMANIA | MACTREX | GERD | GOVERD | BERD |
| MACTREX | 1,00 | | | | MACTREX | 1,00 | | | |
| GERD | -0,84 | 1,00 | | | GERD | -0,37 | 1,00 | | |
| GOVERD | -0,22 | -0,03 | 1,00 | | GOVERD | 0,56 | 0,42 | 1,00 | |
| BERD | -0,76 | 0,96 | -0,23 | 1,00 | BERD | -0,66 | 0,94 | 0,09 | 1,00 |
| SLOVAKIA | MACTREX | GERD | GOVERD | BERD | SLOVENIA | MACTREX | GERD | GOVERD | BERD |
| MACTREX | 1,00 | | | | MACTREX | 1,00 | | | |
| GERD | -0,82 | 1,00 | | | GERD | -0,15 | 1,00 | | |
| GOVERD | -0,60 | 0,69 | 1,00 | | GOVERD | -0,50 | 0,69 | 1,00 | |
| BERD | -0,79 | 0,93 | 0,39 | 1,00 | BERD | 0,61 | 0,28 | -0,38 | 1,00 |

In the Table 13 above the correlations between R&D variables the world export market shares of countries in the machinery and transport equipments sector are seen. There are positive and high correlations seen between GERD and MACTREX in

Turkey, China, Czech Republic and Hungary. However these variables are negatively correlated in the remaining countries examined.

The correlations of MACTREX with GOVERD and BERD differ in many ways in countries. For example, correlation between GOVERD and MACTREX is 90% and 42% in Turkey and China respectively. However, the situation is reverse for BERD and MACTREX for these countries where the correlation of BERD and MACTREX is higher in China.

Table 14 below highlights the correlation between R&D variables and the world export market share of countries in miscellaneous manufactured articles sector. The correlation between GERD and MISCEX and is very high in China and Czech Republic with the rates 97% and 93% respectively. There exist positive correlations between mentioning variables also in Hungary and Turkey which are relatively low.

Table 14: Correlations of Variables in (4.d.) and (5.d.)

| TURKEY | MISCEX | GERD | GOVERD | BERD | CHINA | MISCEX | GERD | GOVERD | BERD |
|---|---|---|---|---|---|---|---|---|---|
| MISCEX | 1,00 | | | | MISCEX | 1,00 | | | |
| GERD | 0,65 | 1,00 | | | GERD | 0,97 | 1,00 | | |
| GOVERD | 0,72 | 0,83 | 1,00 | | GOVERD | 0,43 | 0,58 | 1,00 | |
| BERD | 0,43 | 0,93 | 0,79 | 1,00 | BERD | 0,97 | 1,00 | 0,53 | 1,00 |
| CZECH REP. | MISCEX | GERD | GOVERD | BERD | HUNGARY | MISCEX | GERD | GOVERD | BERD |
| MISCEX | 1,00 | | | | MISCEX | 1,00 | | | |
| GERD | 0,93 | 1,00 | | | GERD | 0,68 | 1,00 | | |
| GOVERD | 0,55 | 0,59 | 1,00 | | GOVERD | 0,81 | 0,82 | 1,00 | |
| BERD | 0,92 | 0,99 | 0,58 | 1,00 | BERD | 0,48 | 0,83 | 0,44 | 1,00 |
| POLAND | MISCEX | GERD | GOVERD | BERD | ROMANIA | MISCEX | GERD | GOVERD | BERD |
| MISCEX | 1,00 | | | | MISCEX | 1,00 | | | |
| GERD | -0,83 | 1,00 | | | GERD | -0,74 | 1,00 | | |
| GOVERD | -0,32 | -0,03 | 1,00 | | GOVERD | 0,18 | 0,42 | 1,00 | |
| BERD | -0,70 | 0,96 | -0,23 | 1,00 | BERD | -0,85 | 0,94 | 0,09 | 1,00 |
| SLOVAKIA | MISCEX | GERD | GOVERD | BERD | SLOVENIA | MISCEX | GERD | GOVERD | BERD |
| MISCEX | 1,00 | | | | MISCEX | 1,00 | | | |
| GERD | -0,82 | 1,00 | | | GERD | 0,19 | 1,00 | | |
| GOVERD | -0,62 | 0,69 | 1,00 | | GOVERD | 0,43 | 0,69 | 1,00 | |
| BERD | -0,78 | 0,93 | 0,39 | 1,00 | BERD | -0,66 | 0,28 | -0,38 | 1,00 |

The impacts of R&D expenditures as a percentage of GDP on the export market shares of countries are analyzed for the period of 1994-2007 by applying Fixed Effects Model (FEM). The countries are chosen from emerging economies. OECD MSTI database include limited number of countries' R&D data. Thus, maximizing both the number of sample developing countries and the number of years is aimed in selecting the data.

The impacts of R&D expenditures as a percentage of GDP on the export market shares of countries are analyzed in different models. First, the impact of gross domestic R&D expenditures is analyzed on four main divisions of manufacturing sector with four models. Then, the governmental and private R&D expenditures' impact is analyzed in the same divisions. These aims brought the study to be shaped with 8 different models.

R&D activities lead to produce new and creative designs. These new designs are used in production processes which also cause to produce efficiently with lower costs. Thus, R&D activities coming from any sources are expected to enable the exporter firms of a country to become more competitive in international markets.

In the following parts of the chapter the regression results are shown in tables.

Table 15 below consist of regression results which represent the estimates of the impact of gross domestic R&D activities' share in GDP on the world export market shares in chemical and related products. The sign of the independent variable is positive as expected. The coefficient of GERD in the model is 0.38. The $R^2$ refers to the explanatory power of the model which is 98%. Additionally, the variable is statistically significant at %1 level.

Table 15: Estimates for Impacts of Gross Domestic R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Chemical and Related Products Sector (1994-2007): Fixed Effect Model

Dependent Variable: LNCHEMEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.995150 | 0.018761 | -53.04250 | 0.0000 |
| LNGERD | 0.380413 | 0.053692 | 7.085075 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.984229 | Mean dependent var | -1.099871 |
| Adjusted R-squared | 0.980549 | S.D. dependent var | 0.876836 |
| S.E. of regression | 0.122290 | Akaike info criterion | -1.190669 |
| Sum squared resid | 1.345944 | Schwarz criterion | -0.656678 |
| Log likelihood | 88.67748 | F-statistic | 267.4561 |
| Durbin-Watson stat | 0.752879 | Prob(F-statistic) | 0.000000 |

Table 16 demonstrates the regression results which show estimates for the impact of gross domestic R&D activities' share in GDP on the world export market shares in manufactured goods classified chiefly by material.

Table 16: Estimates for Impacts of Gross Domestic R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Manufactured Goods Classified Chiefly by Material Sector (1994-2007): Fixed Effect Model

Dependent Variable: LNMANMATEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.230478 | 0.015950 | -14.45010 | 0.0000 |
| LNGERD | 0.178873 | 0.045646 | 3.918690 | 0.0002 |

| | | | |
|---|---|---|---|
| R-squared | 0.990588 | Mean dependent var | -0.279718 |
| Adjusted R-squared | 0.988392 | S.D. dependent var | 0.964947 |
| S.E. of regression | 0.103965 | Akaike info criterion | -1.515366 |
| Sum squared resid | 0.972776 | Schwarz criterion | -0.981375 |
| Log likelihood | 106.8605 | F-statistic | 451.0589 |
| Durbin-Watson stat | 0.572020 | Prob(F-statistic) | 0.000000 |

It is seen that the signs of independent variable is positive, as expected. The coefficient is 0.17 which is lower relative to the previous model. This is also expected due to the fact that chemical sector includes the industries which are more dependent on R&D activities compared to the industries under the sector of manufactured goods classified chiefly by material. The variable in model is also statistically significant at 1% level. Additionally, the $R^2$ is very high which is more than accepted.

Table 17: Estimates for Impacts of Gross Domestic R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Machinery and Transport Equipments Sector (1994-2007): Fixed Effect Model

Dependent Variable: LNMACTREX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.873912 | 0.033368 | -26.19045 | 0.0000 |
| LNGERD | 0.220354 | 0.095493 | 2.307543 | 0.0233 |

| | | | |
|---|---|---|---|
| R-squared | 0.973857 | Mean dependent var | -0.934572 |
| Adjusted R-squared | 0.967757 | S.D. dependent var | 1.211244 |
| S.E. of regression | 0.217497 | Akaike info criterion | -0.039100 |
| Sum squared resid | 4.257427 | Schwarz criterion | 0.494891 |
| Log likelihood | 24.18958 | F-statistic | 159.6458 |
| Durbin-Watson stat | 0.368893 | Prob(F-statistic) | 0.000000 |

Table 17 above consists of regression result representing the estimates of the impact of gross domestic R&D expenditures as percentage of GDP on the world export market shares in machinery and transport equipments sector. The coefficient of independent variable is positive as expected which means that the R&D activities effect the export performance of mentioning sector positively. The coefficient took the value of 0.22 which is in between the coefficient values in Table 14 and 15. This situation is also expected due to the reason that the machinery and transport sector

includes many sub-sectors like automotive and machinery industries which are highly dependent on R&D activities but not as much as the dependence in chemical sectors. Additionally, the $R^2$ is quite high and the variables are statistically significant at 5% level which is different than the earlier models.

Table 18 below is constructed in order to highlight the regression results representing the estimates of the impact of gross domestic R&D expenditures as percentage of GDP on the world export market shares in miscellaneous manufactured articles sector.

Table 18: Estimates Estimates for Impacts of Gross Domestic R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Miscellaneous Manufactured Articles Sector. (1994-2007): Fixed Effect Model

Dependent Variable: LNMISCEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.289814 | 0.021232 | -13.65007 | 0.0000 |
| LNGERD | -0.052167 | 0.060762 | -0.858553 | 0.3929 |

| | | | |
|---|---|---|---|
| R-squared | 0.989212 | Mean dependent var | -0.275454 |
| Adjusted R-squared | 0.986695 | S.D. dependent var | 1.199770 |
| S.E. of regression | 0.138393 | Akaike info criterion | -0.943277 |
| Sum squared resid | 1.723725 | Schwarz criterion | -0.409286 |
| Log likelihood | 74.82351 | F-statistic | 392.9737 |
| Durbin-Watson stat | 0.317038 | Prob(F-statistic) | 0.000000 |

This model is not statistically significant. Miscellaneous manufactured articles sector includes divisions such as prefabricated buildings, furniture, clothing accessories, footwear, photographic apparatus and etc. Many of these industries are not highly dependent of R&D. However, some of them like photographic apparatus industry needs considerable amount of R&D. Thus, the expectation about the model was

favored the statistical significance with low coefficients. However, the results did not match with the expectations which can be seen in the table above.

Table 19 below is constructed with the aim of analyzing the impacts of government and private sector R&D expenditures on the export performance of manufacturing sector divisions.

CHEMEX is affected positively by both GOVERD and BERD. The coefficient of BERD is higher as expected. Due to the characteristics of the chemical industries, the R&D activities are done mostly by private sector.

Table 19: Estimates for Impacts of Government and Business Enterprise R&D Expenditures (As Percentage of GDP) on The World Export Market Share in Manufacturing Sector Divisions. (1994-2007): Fixed Effect Model

| Dependent Variable: LNCHEMEX<br>Sample: 1994 2007<br>Cross-sections included: 8<br>Total panel (balanced) observations: 112 | | | | | Dependent Variable: LNMANMATEX<br>Sample: 1994 2007<br>Cross-sections included: 8<br>Total panel (balanced) observations: 112 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | -0.684438 | 0.092140 | -7.428.263 | 0.0000 | C | -0.077933 | 0.079676 | -0.978130 | 0.3307 |
| LNGOVERD | 0.127438 | 0.058203 | 2.189.552 | 0.0312 | LNGOVERD | 0.080074 | 0.050330 | 1.590.996 | 0.1152 |
| LNBERD | 0.197598 | 0.037882 | 5.216.104 | 0.0000 | LNBERD | 0.065171 | 0.032758 | 1.989.461 | 0.0497 |
| R-squared | 0.984039 | Mean dependent var | | -1.099.871 | R-squared | 0.990145 | Mean dependent var | | -0.279718 |
| Adjusted R-squared | 0.980093 | S.D. dependent var | | 0.876836 | Adjusted R-squared | 0.987709 | S.D. dependent var | | 0.964947 |
| S.E. of regression | 0.123713 | Akaike info criterion | | -1.160.849 | S.E. of regression | 0.106979 | Akaike info criterion | | -1.451.524 |
| Sum squared resid | 1.362.143 | Schwarz criterion | | -0.602585 | Sum squared resid | 1.018.553 | Schwarz criterion | | -0.893261 |
| Log likelihood | 8.800.752 | F-statistic | | 2.494.119 | Log likelihood | 1.042.854 | F-statistic | | 4.064.549 |
| Durbin-Watson stat | 0.722607 | Prob(F-statistic) | | 0.000000 | Durbin-Watson stat | 0.552209 | Prob(F-statistic) | | 0.000000 |
| | | | | | | | | | |
| Dependent Variable: LNMACTREX<br>Sample: 1994 2007<br>Cross-sections included: 8<br>Total panel (balanced) observations: 112 | | | | | Dependent Variable: LNMISCEX<br>Sample: 1994 2007<br>Cross-sections included: 8<br>Total panel (balanced) observations: 112 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | -0.541664 | 0.162298 | -3.337.464 | 0.0012 | C | -0.347973 | 0.102714 | -3.387.798 | 0.0011 |
| LNGOVERD | 0.228470 | 0.102520 | 2.228.533 | 0.0284 | LNGOVERD | -0.008611 | 0.064882 | -0.132716 | 0.8947 |
| LNBERD | 0.003922 | 0.066727 | 0.058777 | 0.9533 | LNBERD | -0.057605 | 0.042230 | -1.364.082 | 0.1760 |
| R-squared | 0.974048 | Mean dependent var | | -0.934572 | R-squared | 0.989406 | Mean dependent var | | -0.275454 |
| Adjusted R-squared | 0.967633 | S.D. dependent var | | 1.211.244 | Adjusted R-squared | 0.986787 | S.D. dependent var | | 1.199.770 |
| S.E. of regression | 0.217913 | Akaike info criterion | | -0.028592 | S.E. of regression | 0.137911 | Akaike info criterion | | -0.943570 |
| Sum squared resid | 4.226.254 | Schwarz criterion | | 0.529672 | Sum squared resid | 1.692.721 | Schwarz criterion | | -0.385307 |
| Log likelihood | 2.460.113 | F-statistic | | 1.518.374 | Log likelihood | 7.583.992 | F-statistic | | 3.778.116 |
| Durbin-Watson stat | 0.398621 | Prob(F-statistic) | | 0.000000 | Durbin-Watson stat | 0.328981 | Prob(F-statistic) | | 0.000000 |

Thus, business enterprise sector R&D activities are expected to have more impact on the export performance in chemical industries. Accordingly the model results are in line with the expectations as having the BERD and GOVERD coefficients of 0.19 and 0.12 respectively. Additionally BERD and GOVERD are statistically significant at 1% and 5% levels respectively.

MANMATEX is seemed to be affected positively by both GOVERD and BERD. The BERD is statistically significant at 5% level however the statistical significance of GOVERD is not so high. The values of coefficients are close to each other reflecting both GOVERD and BERD seem to have similar impacts on export performance in this sector. The sector includes the industries such as iron and steel, leather, textile, wood and etc. for which R&D is important but not as much as chemical sector. Thus, the lower coefficients are in line with the expectations.

MACTREX is affected positively by GOVERD with the statistical significance at 5% level. The coefficient of GOVERD is 0.22 which is even higher than the coefficient of GOVERD in chemical sector model. On the other hand, BERD is not statistically significant in this model which differs from the expectation.

Miscellaneous manufacturing articles sector does not include highly R&D intensive sectors as explained earlier. Thus the statistical insignificance is not a surprising result seen in the table above.

Additionally, the impacts of government and business enterprise R&D activities on the export performance are analyzed in univariate models. Estimated empirical models can be found in the Appendices section.

# CHAPTER 6

# CONCLUSIONS AND POLICY IMPLICATIONS

International markets have been moving through in a very competitive environment. Each nation, especially the developing ones, struggles to grab a share from the pie of international trade and this is getting even harder. The situation works also for Turkey experiencing high trade deficits mainly due to the fact that many of its exports are dependent on imported intermediary goods. This study on a very broader term aims to show some clues about enhancing export performance through R&D activities focusing empirically on the manufacturing sectors.

The relationship of economic growth, technology, R&D and export performance has been argued in enormous amounts of studies. Although their causality relations are diverged, in general higher R&D activities lead to enhanced technology. Creative designs and lower costs occur afterwards which enable exporters to gain more stuffed shares from the international trade pie. From the causality perspective, this dissertation focuses on the direction of the impacts of R&D activities on the export performance manufacturing sector divisions.

In the literature Schumpeter mentioned about the power of technology in economic growth in the first half of the twentieth century. However, Schumpeterian ideas were not welcomed by neo-classics. Neo-classic theories, on the other hand saw the technology as exogenous factor which is assumed to be stable among countries. Another fundamental theory of neo-classics is the convergence of economies stating that the developing countries' growth rates are higher than the developed ones. These theories of convergence and the technology as exogenous factor have been eliminated by many other theories such as in the study of Romer

(1986). By these developments, the idea that the technology is indeed an endogenous factor in economic growth has been started to get an acceptance by neo-classic theorists as well. These models support the three-pillar structure that the R&D sector with a key role, intermediary goods sector and final goods sector (Schumpeter, 1962).

From the empirical perspective, the impact of technology or R&D activities on the export performance is studied by many scholars. These studies showed there is a strong support that the technology is positively related to export performance. The results are in line with the findings such as, R&D activities are crucial for the exports in many sectors which are not only R&D intensive industries but also some of the other industries. Another result coming from the empirical literature is that for some sectors depending mainly on the R&D activities the size of the domestic market is also important. Moreover, in addition to direct R&D activities, the spillover effects inflowing from other firms or countries also have crucial importance which is called as indirect R&D activities.

The main hypothesis of this dissertation is that the gross domestic R&D expenditures have positive impact on the manufacturing sector export performance in developing countries. Additionally, it is assumed that the R&D impact on the manufacturing sector exports differs in different sector divisions of the sector. Second aim is to test the differences between governmental and business enterprise R&D activities on the export performance of mentioning sector divisions. In order to run the model the Fixed Effect Model of panel data analysis method has been used.

Model and its results consist of two parts. In the first part, impact of gross domestic expenditures R&D expenditures (as percentage of GDP) on export market shares of manufacturing sector divisions is tested. All four models except the one

testing the impact of gross domestic R&D activities on the miscellaneous manufactured articles are statistically significant. Model estimates that the highest effect of gross domestic R&D activities is seen on the export market share of chemical sector which is in line with the expectations. Sectors of machinery and transport equipments and manufactured goods classified chiefly by material are comes second and third respectively in the mentioning ranking.

In the second part of the model, the difference between impacts of government and business enterprise R&D activities on the export performance of the manufacturing sector divisions is tested. The results showed that for the chemical sector both sources of R&D is statistically significant. Accordingly, business enterprise R&D activities have more impact on the export performance of mentioning sector compared to government R&D activities. For the sectors of manufactured goods classified chiefly by material and machinery and transport equipments respectively the business enterprise R&D activities and government R&D activities are statistically significant. For the miscellaneous manufactured articles sector both R&D variables are not statistically significant.

The main contributions of this study to literature are as follows; the study is one of the first studies which analyze the impact of gross domestic R&D expenditures on the export market shares of manufacturing industry divisions in developing countries. Accordingly, although the level of exports or ratio of exports to GDP has been used in the literature before, this study is one of the main studies which use the world export market shares of countries. Secondly, the study is one of the first studies which test the government and business enterprise differences of R&D activities' impacts on the manufacturing export performance. Thirdly, the study includes a wide range of sector based coverage. Although some studies focused

on the manufacturing sector, this study differs from those studies through emphasizing four main divisions of manufacturing sector. That is, rather than focusing on single industries, the study covers the whole manufacturing industry via four main divisions.

There are also indirect consequences for the study about the trade balances. Turkey is a developing country which has been struggling big problems over trade deficits as well as the current account deficits. Since, the results of the study are also about how to increase the export performance which indirectly favors the betterment of current account balance.

According to this study there should be some policy implications for Turkey as one of the remarkable developing countries such as:

- The need for increase in gross domestic R&D investments to enhance export performance
- The importance of sector based differences in export returns of R&D investments on determining national R&D strategies
- Sector based focus must be noticed in distributing R&D sources
- The importance of differences between government and business enterprise R&D activities as well as the gross domestic R&D activities in affecting the export performance of manufacturing industries
- Importance of R&D activities in chemical sectors
- Trade deficits can be analyzed and struggled from the sector based approach

In future studies, the study can be usefully extended by adding other emerging countries for example Brazil, Russian Federation and India which are the remaining members of BRIC countries to test the R&D activities' impacts on export performance. Additionally, other sectors can also be added to make even more extended sector based analyze. Moreover, developed countries can also be added with second set of model in order to see the differences with developing ones.

# APPENDICES

APPENDIX A: Estimates for Impacts of Government and Business Enterprise R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Chemical and Related Products Sector with Univariate Models (1994-2007): Fixed Effect Model

Dependent Variable: LNCHEMEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.683207 | 0.104699 | -6.525454 | 0.0000 |
| LNGOVERD | 0.244737 | 0.061000 | 4.012071 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.979160 | Mean dependent var | -1.099871 |
| Adjusted R-squared | 0.974297 | S.D. dependent var | 0.876836 |
| S.E. of regression | 0.140576 | Akaike info criterion | -0.911963 |
| Sum squared resid | 1.778556 | Schwarz criterion | -0.377972 |
| Log likelihood | 73.06991 | F-statistic | 201.3581 |
| Durbin-Watson stat | 0.613733 | Prob(F-statistic) | 0.000000 |

Dependent Variable: LNCHEMEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.869211 | 0.037762 | -23.01801 | 0.0000 |
| LNBERD | 0.229646 | 0.035669 | 6.438184 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.983179 | Mean dependent var | -1.099871 |
| Adjusted R-squared | 0.979254 | S.D. dependent var | 0.876836 |
| S.E. of regression | 0.126294 | Akaike info criterion | -1.126240 |
| Sum squared resid | 1.435517 | Schwarz criterion | -0.592249 |
| Log likelihood | 85.06942 | F-statistic | 250.5000 |
| Durbin-Watson stat | 0.679581 | Prob(F-statistic) | 0.000000 |

APPENDIX B: Estimates for Impacts of Government and Business Enterprise R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Manufactured Goods Classified by Material Sector with Univariate Models (1994-2007): Fixed Effect Model

Dependent Variable: LNMANMATEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.077528 | 0.080974 | -0.957432 | 0.3409 |
| LNGOVERD | 0.118761 | 0.047178 | 2.517311 | 0.0136 |

| | | | |
|---|---|---|---|
| R-squared | 0.989707 | Mean dependent var | -0.279718 |
| Adjusted R-squared | 0.987305 | S.D. dependent var | 0.964947 |
| S.E. of regression | 0.108722 | Akaike info criterion | -1.425870 |
| Sum squared resid | 1.063850 | Schwarz criterion | -0.891880 |
| Log likelihood | 101.8487 | F-statistic | 412.0780 |
| Durbin-Watson stat | 0.574282 | Prob(F-statistic) | 0.000000 |

Dependent Variable: LNMANMATEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.194034 | 0.032258 | -6.015090 | 0.0000 |
| LNBERD | 0.085308 | 0.030470 | 2.799723 | 0.0063 |

| | | | |
|---|---|---|---|
| R-squared | 0.989865 | Mean dependent var | -0.279718 |
| Adjusted R-squared | 0.987500 | S.D. dependent var | 0.964947 |
| S.E. of regression | 0.107885 | Akaike info criterion | -1.441337 |
| Sum squared resid | 1.047522 | Schwarz criterion | -0.907346 |
| Log likelihood | 102.7149 | F-statistic | 418.5678 |
| Durbin-Watson stat | 0.520621 | Prob(F-statistic) | 0.000000 |

APPENDIX C: Estimates for Impacts of Government and Business Enterprise R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Machinery and Transport Equipments Sector with Univariate Models (1994-2007): Fixed Effect Model

Dependent Variable: LNMACTREX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.541639 | 0.161396 | -3.355955 | 0.0012 |
| LNGOVERD | 0.230798 | 0.094034 | 2.454414 | 0.0160 |

| | | | |
|---|---|---|---|
| R-squared | 0.974047 | Mean dependent var | -0.934572 |
| Adjusted R-squared | 0.967991 | S.D. dependent var | 1.211244 |
| S.E. of regression | 0.216703 | Akaike info criterion | -0.046410 |
| Sum squared resid | 4.226418 | Schwarz criterion | 0.487581 |
| Log likelihood | 24.59895 | F-statistic | 160.8486 |
| Durbin-Watson stat | 0.399403 | Prob(F-statistic) | 0.000000 |

Dependent Variable: LNMACTREX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.872923 | 0.066577 | -13.11155 | 0.0000 |
| LNBERD | 0.061377 | 0.062887 | 0.975993 | 0.3317 |

| | | | |
|---|---|---|---|
| R-squared | 0.972600 | Mean dependent var | -0.934572 |
| Adjusted R-squared | 0.966207 | S.D. dependent var | 1.211244 |
| S.E. of regression | 0.222663 | Akaike info criterion | 0.007852 |
| Sum squared resid | 4.462086 | Schwarz criterion | 0.541843 |
| Log likelihood | 21.56030 | F-statistic | 152.1269 |
| Durbin-Watson stat | 0.360833 | Prob(F-statistic) | 0.000000 |

APPENDIX D: Estimates for Impacts of Government and Business Enterprise R&D Expenditures (As Percentage of GDP) on the World Export Market Share in Miscellaneous Manufactured Goods Sector with Univariate Models (1994-2007): Fixed Effect Model

Dependent Variable: LNMISCEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.348332 | 0.103203 | -3.375201 | 0.0011 |
| LNGOVERD | -0.042807 | 0.060129 | -0.711914 | 0.4784 |

| | | | |
|---|---|---|---|
| R-squared | 0.989184 | Mean dependent var | -0.275454 |
| Adjusted R-squared | 0.986661 | S.D. dependent var | 1.199770 |
| S.E. of regression | 0.138569 | Akaike info criterion | -0.940736 |
| Sum squared resid | 1.728111 | Schwarz criterion | -0.406745 |
| Log likelihood | 74.68120 | F-statistic | 391.9654 |
| Durbin-Watson stat | 0.316308 | Prob(F-statistic) | 0.000000 |

Dependent Variable: LNMISCEX
Sample: 1994 2007
Cross-sections included: 8
Total panel (balanced) observations: 112

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.335488 | 0.041010 | -8.180656 | 0.0000 |
| LNBERD | -0.059770 | 0.038737 | -1.542972 | 0.1263 |

| | | | |
|---|---|---|---|
| R-squared | 0.989404 | Mean dependent var | -0.275454 |
| Adjusted R-squared | 0.986931 | S.D. dependent var | 1.199770 |
| S.E. of regression | 0.137156 | Akaike info criterion | -0.961229 |
| Sum squared resid | 1.693056 | Schwarz criterion | -0.427238 |
| Log likelihood | 75.82884 | F-statistic | 400.1698 |
| Durbin-Watson stat | 0.328485 | Prob(F-statistic) | 0.000000 |

# REFERENCES


Adak, M. (2007) AR&GE ve Ekonomik Büyüme [R&D and Economic Growth] (Ph.D. thesis, Marmara University, 2007)

Altın, O., and Kaya, A. (2009). Türkiye'de Ar-Ge Harcamaları ve Ekonomik Büyüme Arasındaki Nedensel İlişkinin Analizi [Analsysis of the Casual Relationship Between R&D Expenditures and Economic Growth for Turkey]. *Ege Academic Review,* 9*,* 251-259. Retrieved on July 11, 2010, from http://www. http://eab.ege.edu.tr

Amable, B., and Verspagen, B. (1995). The Role of Technology in Market Shares Dynamics. *Applied Economics,* 27*,* 197-204. Retrieved on September 10, 2010, from http://www. https://atmire.com

Arslan, S. (2007) Türkiye'de Bilgiye Dayalı İktisadi Büyümeye Geçiş [Knowledge Based Economic Growth in Turkey] (Ph.D. thesis, Anadolu University, 2007)

Association of Iron and Steel Producers, (2009) Crude Steel Production Statistics in Turkey. Retrieved on September 12, 2010, from www.dcud.org.tr

Association of Iron and Steel Producers (2010). Türkiye'de Ham Çelik Üretimi [Crude Steel Production in Turkey]. Retrieved on June 10, 2010, from http:// http://www.dcud.org.tr

Automotive Manufacturers Association (2010). Otomotive Sektörü Aylık Raporlar Aralık 2009 [Automotive Industry Monthly Reports December 2009]

Baumol, W. J. (1986). Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show. *The American Economic Review,* 76*,* 1072-1085. Retrieved on August 18, 2010, from http://www.jstor.org

Braunerhjelm, P., and Thulin, P. (1999). Can Countries Create Comparative Advantages? R&D Expenditures, High-Tech Exports and Country Size in 19 OECD Countries 1981-1999. Retrieved on November 8, 2010, from http://www.snee.org

Chang, Y., and Hung, M. (2005). Trade, R&D Spending and Financial Development. *Applied Financial Economics,* 15*,* 809-819. Retrieved on November 8, 2010, from http://econpapers.repec.org

Coe, D. T., and Helpman, E. (1995). International R&D Spillovers. *The European Economic Review,* 39*,* 859-870. Retrieved on October 1, 2010, from http://www.sciencedirect.com

Çiftçi, N., and Özer. M. (2009). Ar-Ge Harcamaları ve İhracat İlişkisi: OECD Ülkeleri Panel Veri Analizi [The Relationship of R&D Expenditures and Export: Panel Data Analysis on OECD Countries]. *Dumlupınar University Social Sciences Journal*, 23, 39-49. Retrieved on June 11, 2010, from uvt.ulakbim.gov.tr

De Long, J. B. (1988). Productivity Growth, Convergence, and Welfare: Comment. *The American Economic Review,* 78*,* 1138-1154. Retrieved on August 20, 2010, from http://www.jstor.org

Denison, E. F. (1967). Sources of Postwar Growth in Nine Western Countries. *The American Economic Review,* 57*,* 325-332. Retrieved on August 20, 2010, from http://www.jstor.org

Fagerberg, J. (1996). Technology and Competitiveness. *Oxford Review of Economic Policy,* 12*,* 39-51. Retrieved on August 10, 2010, from http://www.jstor.org

Granados, C. M., and Sanz, I. (2008). The Dispersion of Technology and Income in Europe: Evolution and Mutual Relationship Across Regions. *Research Policy,* 37, 836-848. Retrieved on October 15, 2010, from http://www.elsevier.com

Grosman, G., and Helpman, E. (1991). *Innovation and Growth in the Global Economy*, Cambridge, Mass U. A., MIT Press.

Gruber, W., and Metha, D. (1967). The R&D Factor in International Trade and International Investment of United States Industries. *Journal of Political Economy,* 75, 20-37. Retrieved on August 22, 2010, from http://www.dspace.mit.edu

Kendrick, J. W. (1956). Productivity Trends: Capital and Labor. *The Review of Economics and Statistics,* 38*,* 248-257. Retrieved on October 29, 2010, from http://www.jstor.org

Kiper, M., and Demir, S. T. (2009). University-Industry Linkages in Turkey. Retrieved August 17, 2010, from http://www.ttgv.org.tr

Leontief, W. (1954). Domestic Production and Foreign Trade; The American Capital Position Re-Examined. *American Philosophical Society,* 97*,* 332-349. Retrieved on August 9, 2010, from http://www.jstor.org

Ministry of Industry and Trade (2010). Sektörel Raporlar ve Analizler Serisi, Demir Çelik Sektörü Raporu 2009 [Sectoral Reports Series, Iron and Steel Sector Report 2009]. Retrieved on October 1, 2010, from http://www.sanayi.gov.tr

Ministry of Industry and Trade (2010). Sektörel Raporlar ve Analizler Serisi, Kimya Sektör Raporu 2009 [Sectoral Reports Series, Chemical Sector Report 2009]. Retrieved on October 2, 2010, from http://www.sanayi.gov.tr

Ministry of Industry and Trade (2010). Sektörel Raporlar ve Analizler Serisi, Makina Sektör Raporu 2009 [Sectoral Reports Series, Machinery Sector Report 2009]. Retrieved on October 2, 2010, from http://www.sanayi.gov.tr

Ministry of Industry and Trade (2010). Sektörel Raporlar ve Analizler Serisi, 2009 Yılı Otomotiv Sanayinde Ülkemiz ve Dünyadaki Gelişmeler [Sectoral Reports Series, Developments of Automotive Industry in our Country and in the World in the Year 2009]. Retrieved on October 2, 2010, from http://www.sanayi.gov.tr

Ministry of Industry and Trade (2010). Sektörel Raporlar ve Analizler Serisi, Tekstil Hazır Giyim Deri ve Deri Ürünleri Sektörleri 2009 [Sectoral Reports Series, Sectors of Textile Hazır Giyim Deri ve Deri Products 2009]. Retrieved on October 10, 2010, from http://www.sanayi.gov.tr

OECD (2002). Frascati Manual Proposed Standard Practice For Surveys on Research and Experimental Development. Retrieved on June 13, 2010, from http://www.oecd.org

OECD (2009). OECD Science Technology and Industry Scoreboard 2009. Retrieved on June 20, 2010, from http:// www.oecd.org

OECD Main Science and Technology Database, (2009). Main Science and Technology Indicators (2007), Retrieved on July 20, 2010, from www.stats.oecd.org

Öner, A. (2006). *ArGe Yönetimi Metodoloji Önerileri Şirketlerden Örnekler Araştırma Sonuçları* [*R&D Management Metodological Samples Company Samples Research Results*]. İstanbul: Boğaziçi University.

Özçelik, E. (2002). Does Innovativeness Matter for International Competitiveness in Developing Countries? The Case of Turkish Manufacturing Industries. Retrieved on October 20, 2010, from www.erc.metu.edu.tr

Özkan-Günay, E.N., (2004) The Impact of Deregulation on Market Structure and Performance in the Turkish Banking Industry. Yapı Kredi Economic Review, 15, 11-144

Patel, P., and Pavitt, K. (1994). The Continuing, Widespread (and Neglected) Importance of Improvements in Mechanical Technologies. *Research Policy,* 23*,* 533-545. Retrieved on July 14, 2010, from http://www.sciencedirect.com

Pucik, V., and Ito, K. (1987). R&D Spending, Domestic Competition, and Export Performance of Japanese Manufacturing Firms. Retrieved on October 5, 2010, from http://www.onlinelibrary.wiley.com

Romer, P. M. (1986). Increasing Returns and Long-Run Growth. *The Journal of Political Economy,* 94*,* 1002-1037. Retrieved on August 25, 2010, from http://www.jstor.org

Romer, P. M. (1990). Endogenous Technological Change. *The Journal of Political Economy,* 98, 71-102. Retrieved on October 1, 2010, from http://www.jstor.org

Schumpeter, J. (1962) *Capitalism, Socialism and Democracy,* New York, Harper & Row.

State Planning Organization (1963). Kalkınma Planı Birinci Beş Yıl 1963-1967 [Development Plan First Five Year 1963-1967]. Retrieved on September 22, 2010, from http://www.dpt.gov.tr

State Planning Organization (1968). İkinci Beş Yıllık Kalkınma Planı 1968-1972 [Second Five Year Development Plan 1968-1973]. Retrieved on September 22, 2010, from http://www.dpt.gov.tr

State Planning Organization (1974). Üçüncü Beş Yıllık Kalkınma Planı 1973-1977 [Third Five Year Development Plan 1973-1977]. Retrieved onSeptember 22, 2010, from http://www.dpt.gov.tr

State Planning Organization (1979). Dördüncü Beş Yıllık Kalkınma Planı 1979-1983 [Fourth Five Year Development Plan 1979-1983]. Retrieved onSeptember 22, 2010, from http://www.dpt.gov.tr

State Planning Organization (1984). Beşinci Beş Yıllık Kalkınma Planı 1985-1989 [Fifth Five Year Development Plan 1985-1989]. Retrieved on September 23, 2010, from http://www.dpt.gov.tr

State Planning Organization (1989). Altıncı Beş Yıllık Kalkınma Planı 1990-1994 [Sixth Five Year Development Plan 1990-1994]. Retrieved on September 23, 2010, from. http://www.dpt.gov.tr

State Planning Organization (1995). Yedinci Beş Yıllık Kalkınma Planı 1996-2000[Seventh Five Year Development Plan 1996-2000]. Retrieved on September 23, 2010, from http://www.dpt.gov.tr

State Planning Organization (2000). Sekizinci Beş Yıllık Kalkınma Planı 2001-2005 [Eighth Five Year Development Plan 2001-2005]. Retrieved on September 24, 2010, from http://www.dpt.gov.tr

State Planning Organization (2006). Dokuzuncu Beş Yıllık Kalkınma Planı 2007-2013 [Ninth Five Year Development Plan 2007-2013]. Retrieved on September 24, 2010, from http://www.dpt.gov.tr

Sveikauskas, L. (1983). Science and Technology in United States Foreign Trade. *The Economic Journal,* 93*,* 542-554. Retrieved on September 15, 2010, from http://www.jstor.org

Tübitak [The Scientific and Technological Research Council of Turkey] (2010). The Republic of Turkey's Model of Instigating an STI Impetus. Retrieved on September 1, 2010, from http://www.tubitak.gov.tr

Tübitak [The Scientific and Technological Research Council of Turkey] (2004). Ulusal Bilim ve Teknoloji Politikaları 2003-2023 Strateji Belgesi [National Science and Technology Policies 2003-2023 Strategy Document]. Retrieved on September 1, 2010, from http://www.tubitak.gov.tr

Turkish Patent Institute, (2010). Total patent applications in Turkey, Retrieved on July 20, 2010, from www.turkpatent.gov.tr

Undersecreteriat of the Prim Ministry For Foreign Trade (2009). Dış Ticaretin Görünümü 2008 [Review of International Trade 2008].

United Nations Commodity Trade Statistics Database, (2008). International Trade Statistics Yearbook 2008, Retrieved on July 20, 2010, from comtrade.un.org

World Trade Organization Databse, (2010). International Trade Statistics 2010, Retrieved on September 12, 2010, from www.wto.org

Zhao, H., and Li, H. (1997). R&D and Export: An Empirical Analysis of Chinese Manufacturing Firms. *The Journal of High Technology Management Research,* 8, 89-105. Retrieved on October 1, 2010, from http://www.elsevier.com