THE IMPACT OF TECHNOLOGY LEVEL AND STRUCTURAL CHANGE OF EXPORTS ON THE DYNAMICS OF INTERNATIONAL COMPETITIVENESS: A SECTORAL DISAGGREGATED ANALYSIS OF TURKISH MANUFACTURING SECTOR

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ABSTRACT

THE IMPACT OF TECHNOLOGY LEVEL AND STRUCTURAL CHANGE OF EXPORTS ON THE DYNAMICS OF INTERNATIONAL COMPETITIVENESS: A SECTORAL DISAGGREGATED ANALYSIS OF TURKISH MANUFACTURING SECTOR

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The major aim of this thesis is to analyze the impact of structural change of exports and technology level on the international competitiveness. In order to analyze international competitiveness, export market shares are used. The empirical analysis suggested in this thesis includes two steps. In the first step, constant market share analysis is conducted to understand the causes of changes in export market shares from one period to another and in the second step a difference generalized method of moments model is proposed for 44 manufacturing sectors, which are classified with respect to their technology intensities, over 2003- 2008 period. The results are highly sensitive to the technology intensity of sectors.

Keywords: International Competitiveness, Technology Level, Structural Change of Exports, Difference GMM Model, Constant Market Share Analysis

ÖZ

TEKNOLOJİ SEVİYESİ VE İHRACATTAKİ YAPISAL DEĞİŞİMİN ULUSLARARASI REKABETİN DİNAMİKLERİNE ETKİSİ: TÜRKİYE İMALAT SANAYİİNİN SEKTÖREL ANALİZİ

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Bu tezin temel amacı, teknoloji seviyesi ve ihracattaki yapısal değişimlerin, uluslararası rekabet gücüne etkisini incelemektir. Bu analizi yapmak için ihracat pazar payları kullanılmıştır. Bu çerçevede, yapılan ampirik analiz iki kısımdan oluşmaktadır. İlk bölümde sabit pazar payı analizi ile ihracat pazar paylarındaki değişimin kaynakları araştırılmış ikinci bölümde de fark genelleştirilmiş momentler yöntemi kullanılarak ekonometrik tahmin gerçekleştirilmiştir. Bu analizler tekonoloji yoğunluğuna göre sınıflandırılan 44 imalat sanayi sektörü ve 2003-2008 dönemi için yapılmıştır. Sonuçlar sektörlerin teknoloji seviyelerine göre değişmektedir.

Anahtar Kelimeler: Uluslararası Rekabet, Teknoloji Seviyesi, İhracatın Yapısal Değişimi, Fark GMM Modeli, Sabit Pazar Payı Analizi

To my beloved family

and to my lovely nephew Kadir Efe ŞAHAN

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CHAPTER 1

INTRODUCTION

The world economy has undergone notable structural changes with the rapid improvement of technology. The technological advancements has effected world trade patterns remarkably. These developments together with the improving free trade conditions have altered the dynamics of international competition for the countries. The international trade theories have adapted to this fast changing nature of the production processes which are led by the enhancements of technological capacities.

The traditional factor endowments approach fails to capture the true nature of the innovation-led economic growth and international trade patterns. When competitiveness and innovation came into picture, this theory failed to explain the real world facts, since it assigns identical production functions to each country. The unrealistic assumptions of classical trade theories, such as perfect competition, constant returns to scale in production and immobility of the factors of production between countries failed to explain innovation-led trade flows. As Dosi and Soete (1988:406) summarize “factor prices are not generally equalized, there are oligopolistic rents, trade patterns do not depend only on countries’ endowments, the degrees and forms of market ‘imperfections’ become a determinant on their own of productive locations and trade.”

The new trade theories were born on the pillars like imperfect competition, increasing returns to scale in production. In fact, the literature concerning the influence of technology on trade dates back to the seminal contributions of Schumpeter (1939). Schumpeter attacked the price competitiveness notion of capitalist production structure and underlined a more dynamic competition structure based on innovations. At the firm level, this stance concerning the nature of competition comes up with large business enterprises and monopolies. When the assumptions of Schumpeter are adapted to industry and country level, the identical production functions assumption of the conventional trade theories will be blighted.

Starting from 1960s, with the rise of product cycle and technology gap approaches, these aspects of the international trade attracted more attention of the researchers. Especially, after 1970s, with the contributions of Krugman (1979) and Grossman and Helpman (1991) the new trade theories assigned central role to diversity and quality progresses in the traded commodities as a determining factor of international trade flows. The new trade theories try to explain the dynamics of international trade patterns by relaxing some assumptions of the factor endowments theory, such as perfect competition and constant returns to scale. In these models, the driving force of trade is not only price factors, such as costs, but also non-price factors, namely innovations. Besides, the evolutionary approach to explain international competitiveness was developed. This approach is basically based on the Schumpeterian explanations of the technological change and is better suited to explain the inherent dynamic nature of technological advancements.

The literature on the determinants of international competitiveness includes numerous empirical works that tries to map the technology level of the countries to their trade performances. These studies are conducted not only at country level, but also at the firm level and sector level. The disaggregated approach to the issue of innovativeness and competition is also important to delve into the background of the issue. There are also various measures used for competitiveness and export market share of a country in the exports of a group of countries is among the most widely used ones. The international competition, thus, will be considered as export competition in this study.

Most of the studies in the innovation-driven competitiveness debate concentrate on the developed countries. On the one hand, in developed countries technology is created through innovations and investments; and production expansion occurs as a result of innovations. On the other hand, in developing countries, the mechanism works in a reverse order; the technology is transferred from developed countries and the production capabilities and investment are expanded. Innovations will be implemented subsequent to technology transfer in these countries (Özçelik & Taymaz, 2004:412). The developing countries are, hence, mostly technologically lagging countries and this is the underlying reason for the relative rareness of studies directed to developing countries. The need for the new strategies to develop technology level, nevertheless, for developing countries deserves much more attention.

Turkey, as a developing country, implemented its export orientation in the 1980s. International competitiveness has been tried to be achieved via currency devaluations and real wage reductions in 1980s. These points provided price competitiveness for the economy and exports have risen significantly. What is missing essentially in the export orientation program of Turkish economy has been the absence of a coherent strategy that aims to enhance innovative capacity and that considers specific conditions of the country. In 2000s, exports and GDP soared and this increase is reflected in export market shares. Figure 1 illustrates the evolution of Turkish export market shares which is calculated by taking into account 29 major trading partners which take place in Appendix A in Table 17, beginning from 1990. The figure clearly indicates the increase beginning in 2002.

Exploring the dynamics of this increase in the export market shares of Turkey is the major motivation of this study. What are the factors that led to this increase in the 2000s? Which price and non-price factors impacted to this increase and to what extent? What is the role of technology level in this export market share rise? These are the main research questions that this study deals with. These questions are handled for 44 manufacturing sectors which are classified according to Statistical Classification of Economic Activities in the European Community (NACE REV. 1.1) over the period 2003-2008. The reason for the selection of time span and sectors is the availability of data. The sectors are classified according to technology intensities and empirical procedures are implemented separately to the sectors belonging to each group. The first methodology applied is the constant market share analysis (CMSA) which is used to evaluate the structural change of the exports relative to main export partners over 2003-2008 period and as a second methodology, a dynamic econometric model of export market share of Turkey is proposed and estimated over the period 2003-2008.

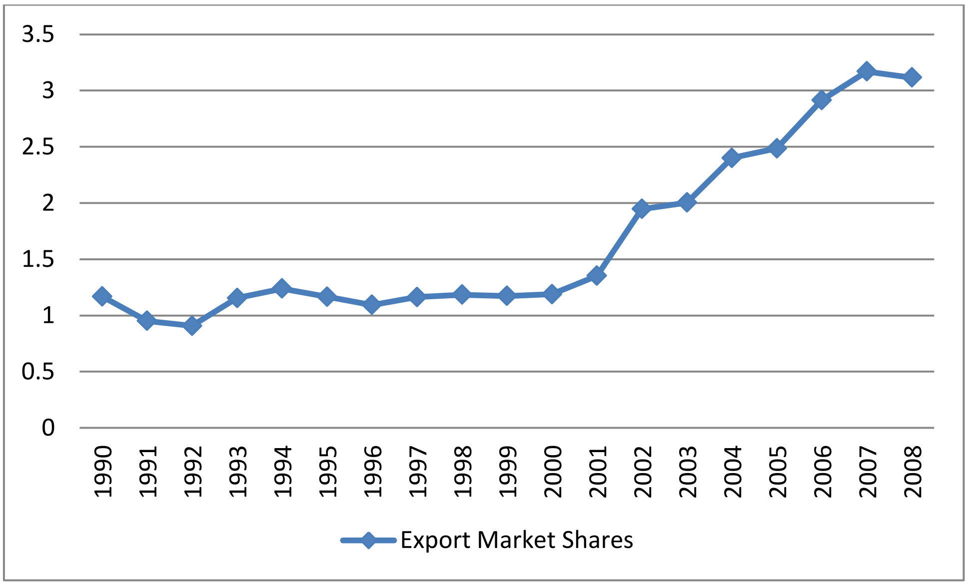

Figure 1: The Evolution of Export Market Share of Turkey in the 29 Major Trading Partners' Exports (%) (Source: Author's Calculations based on UNIDO Industrial Balance Statistics)

The remainder of the study is organized as follows; the following chapter deals with the theoretical background of the technology and international competitiveness debate. In that part evolution of theoretical aspects of technology and trade relationship is debated from the point of view of various theories. Moreover, the determinants of international competitiveness are explained and empirical applications of them are shown in Chapter 2. The studies in this section are selected on the basis of similarity to this study in terms of their empirical procedures. Chapter 3 examines export performance of Turkey in the 2000s on a descriptive basis. In that section, a number of indices, namely revealed comparative index, intra industry trade index, as well as some structural indicators such sectoral and country distribution of the exports are computed. In that chapter, evolution of the determinants of the export market shares is also underscored. Chapter 4 deals firstly with the structural decomposition analysis on an industrial basis. The method used to decompose export market share evolution is the CMSA methodology. Secondly, a dynamic difference generalized method of moments (GMM) model is set forth for 44 manufacturing sectors over 2003-2008 period and the last chapter gives a summary of what we have done as well as our conclusions.

CHAPTER 2

INTERNATIONAL COMPETITIVENESS: THEORETICAL BACKGROUND AND EMPIRICAL APPLICATIONS

The link between technology and trade has become a very popular research area in the literature. The issue gains special emphasis in line with the technological change occurring in the world in the recent decades. The fast changing rate of the technology and innovations has altered the composition of international trade in terms of comparative advantage. Then, how is the link between technology and international trade established? What are the theoretical pillars that help us to associate technological advancements with international trade and competitiveness of nations? This section deals with these questions.

The neo classical orthodoxy has paid little attention to technology in predicting direction of trade flows. Most of the early works scrutinized this link by assigning identical production functions to countries, that is, the technology levels of the countries are assumed to be included in the production functions and these production functions are supposed to be identical across countries (Dosi & Soete,1988: 403). That approach was limited from many respects and a new research agenda has emerged with the rise of endogenous growth theory. The work of Romer (1986) within endogenous growth theory ascribed technology a central role in trade studies (Krugman,1995) and innovations are thought to be the major determinant of economic growth and international trade in the new literature.[1] The common buttresses of the technology-induced trade theories can be compiled as market

[1] e.g. Aghion and Howitt (1992)

imperfections, oligopolistic market structure and trade structure that do not rely solely on factor endowments (Dosi & Soete, 1988).

The rest of this chapter proceeds as follows: In the first section, the place of technology in specifying the direction of trade flows in early international trade theories is discussed. The second section deals with the product cycle and technology gap approaches which gave rise to the emergence of international competitiveness debate based on the technology. In that section, the technical change in the new trade theories is examined, as well. In the following section, determinants of the international competitiveness, measured as export market shares are highlighted and their association with the competitiveness is established. In the third section, empirical applications of the determinants of international competitiveness are shown. The last section summarizes and concludes this chapter.

2.1. The Link between Technology and International Trade

2.1.1. Technology in Early Trade Theories

Technology has been part of trade theories beginning from the first studies. In the Ricardian approach, trade takes place due to productivity differences. He attributes these productivity differentials to climate or national characteristics, while they can also be attributed to differences in knowledge bases (Krugman,1995). The empirical works of MacDougal (1951 and 1952) point out that the ratio of the US productivity[2] to the UK labor productivity is positively correlated with ratio of the US exports to the UK exports. This result is extended by Balassa (1963) by using data set that refers to 1950 in contrast to MacDougal (1951 and 1952) who used data that belong to 1930s. Balassa (1963) also included control variables such as wages and capital costs in order to examine export market shares of the UK and the US and found a high correlation between productivity and export market shares. Keeping in

[2] This productivity is labor productivity, since in the classical theory labor is the only factor of production.

mind that these studies find cost factors as the main driver of the trade patterns, they constitute a basis for the notion that technology in the form of productivity differentials matters for the trade patterns of the countries.

The Heckscher-Ohlin trade theory[3] (H-O, henceforth) presents little evidence in technology differences among the trading nations owing to its main assumption that technology is identical in both trading countries in a two country world, in other words, the production functions are the same among the countries (Appleyard, Field & Cobb,2008:127) . The objection of Leontief (1953) to the mainstay of H-O by finding that although the US has the highest capital/labor ratio in the world, its exports embodies more labor than capital. What is important for the discussion of this thesis in Leontief's work is his interpretation of the results of the input output analysis conducted for 1947 foreign trade data of the US. The underlying reason of the US exports' labor intensiveness, as Leontief specifies, is the productivity of the US labor. That is, if one takes the productivity of one man year of labor into account, one will find that the US exports are more labor intensive compared to the Rest of the World (Leontief, 1953). These findings paved the way for trade theories that ascribe to technology a more central place.

The findings of Leontief, later named as "Leontief paradox", is explained from different aspects. One can, however, combine the explanations for the Leontief paradox under two major headings; explanations within the H-O theory, namely *factor intensity reversal*, implying that factor intensity of the same commodity may change in different countries, *demand reversal*, inferring the preference of the countries may reverse the comparative advantage of the countries, *tariff structure*, meaning special protection for the scarce factor of production (capital, labor) and new theories including *imitation lag* that tries to delve the diffusion of technology, *economies of scale* based explanation which points economies of scale occurring in industries and the demand based. What is essential here is that economists try to

[3] The Heckscher-Ohlin theory states that a country which has aboundant resources in a factor of production should export the commodities that use the abundant factor intensively.

elaborate Leontief paradox by including additional factors of production in their analysis. The research and development (R&D) factor is of special importance in these explanations. The R&D expenditures are alleged to be major determinant of the US trade competitiveness and international trade competitiveness debate comes into picture with these studies. Keesing (1967), for instance, studied the impact of R&D on US export competitiveness among other factors, such as capital requirements, natural resource requirements, labor skill requirements and economies of scale. By utilizing correlation analysis, he highlighted the R&D intensive sectors which use skill intensive labor as the major source of US export competitiveness. In another example, Gruber, Mehta and Vernon (1967) found that the industries in which high R&D effort takes place exhibit trade surpluses. They also indicate innovations as the major source the US export competitiveness at the industry level. Both of these studies together with the others point to technological advancements from which international competitiveness of a country emanates.

2.1.2. Post Leontief Paradox Theories

Leontief paradox propelled the researchers to exit from very limited realm of H-O model and explore new determinants of international trade and international competitiveness. The theories starting from 1960s take the dynamic nature of the technological advancements into account more seriously in explaining trade flows. Among these theories, technology gap and product cycle trade theories has a special importance for our discussion, since they treat technology as the main impetus of trade flows. In this sub section, hence, technology gap and product cycle approaches are explained and then combining these two aspects emergence of the new trade theories is discussed.

Technology gap trade theory is initiated by Posner (1961). He argues that it is technical change that determines direction of trade flows rather than factor endowments. The first and foremost assumption of Posner (1961) is that the technology is not a freely available good for all the countries. It, thus, relaxes the assumption of H-O theory that technology is the same everywhere. He incorporates time dimension to the analysis in explaining income and technology level disparities among the countries that is, when an innovation occurs in one country it is not diffused to the other countries instantly. It takes time for other countries to imitate the innovation and this time period is called as *imitation lag*. The new product is exported to other countries after it is started to be demanded by consumers of other countries and this time passed until the demand is created in the other countries is called as *demand lag*. Technology gap theory asserts that the innovating country will export new product between the time demand created in the other countries and the new product is imitated in the other countries and this time period where trade takes place is called *net lag* (Appleyard, Field, & Cobb, 2008:174). The technology gap approach is important for the subject of this study, since it incorporates innovativeness as one of the main determinants of world trade patterns and since it enabled to the rise of product cycle theory (PCT) which is a better-known theory.

Another theory explaining Leontief paradox is the PCT which is introduced by Vernon (1966). Vernon (1966), firstly, showed that the technical innovations require skilled labor and capital. He, then, explained that countries can be ranked by their technology levels and their innovative capacities depend upon their ranking. As a result, he proposed a three stage trade pattern in explaining international trade flows. In the first stage, an innovation occurs in a country which is on the top of the technology ladder. In this stage, which is called as *new product stage*, the new product is consumed only in the innovating country and no international trade takes place. In the second stage, in Vernon's terms *maturing product stage*, the new product is matured and the innovating country will export this product, since there is a rising external demand. In the maturing product stage, the new product is started to be produced by using mass production techniques and as a result, economies of scale is started to be experienced. As one can grasp, it relaxes constant returns to scale assumption of H-O trade theory. In this stage, moreover, the innovating country firms begin to search for a more suitable place to decline production costs. In the third stage, which Vernon called as *standardized product stage*, features of the new product are known to both consumers and producers from different countries. In that stage, production of the new product may be conducted in the less developed countries. In the shift of production facilities to the less developed countries, the labor costs will be the dominant factor. Once the new product is standardized, the innovating country will be trying to introduce a new innovation, while the less developed country will be trying to produce it in the most efficient manner. These three stages explains life cycle of a new product as a result of an innovation. What is the importance of PCT for international competitiveness is that the comparative advantage may shift from one country to another. In other words, technologically lagging countries may gain competitive advantage in the production of the new product in the standardized product stage through their low levels of labor costs in the large scale manufacturing production.

The PCT and technology gap approaches formulate diffusion of the innovations to the less developed nations. How can the demand for a new product be created? How can a country gain from a product innovation? The literature related to the answers of these questions can be combined in two strands; one is product variety and the other one is quality ladder (Grossman & Helpman, 1991: 43-101). The product variety approach is based on the idea that the innovation creates a new product that is an imperfect substitute of the old product. Krugman (1979) modeled product variety model on the basis of continuing process of the technological progress in the innovating country. His model includes two countries; the innovating North and imitating South. Entrepreneurs in the North innovate continuously to capture the monopoly rents. They export their new product to the South till the South completes its imitation lag. The monopoly rents can be accounted for the wage differential in equally productive two countries, North and South. This model is important for justifying PCT model on the empirical grounds (Krugman,1995). The quality ladder approach suggests that the innovation brings about an increment in the quality of the products which is the perfect substitute for the old product. The innovation here does not offer monopoly rents; instead it offers “quasi-rents” from the advantage of temporary technology change. In this case also, the products can be improved continually and there is no limit to improve the product quality (Grossman & Helpman, 1991:85). These two strands are essential in competitiveness debate.

Since the wages in South is lower than those in the North, they will have a competitive advantage over the North. If the North cannot innovate incessantly, their real income will decline and South will have an opportunity to catch up them. This strand of the international trade theory brings about significant results, later it will be known as the 'new trade theory'.

The impact of the technology on growth and trade is also modeled systematically with the rise of endogenous growth theory with Romer (1986) and Aghion and Howitt (1992). If one thinks within the context of product variety approach introduced above, the new product is introduced by individual firms by devoting resources to innovative activities. Then, the mechanism follows Schumpeter's description of new innovations introduced into the system. Once this investment turns into innovation, the firms will gain monopoly power on the new product. This "monopoly rent" is the main motivation of the innovating firm. After a while other firms will adapt to the new product and if the firm cannot make a new innovation, monopoly power of the innovating firm erodes (Schumpeter, 1939). The continuous innovation, hence, is needed for perpetual growth of firms. How can it be possible? The answer requires necessity of the external economies that will enable firms to accumulate knowledge to diminish cost of each additional innovation (Krugman,1995). That is, cost of the new innovation to the firms decrease by gaining more knowledge on a particular product. If there is a knowledge base that offers accumulated knowledge gained from past experiences, then this would ease creation of innovations and the result of this process will be continuous growth. The same mechanism goes with the quality ladder approach with slight a difference. In that case, rather than new product, quality of the existing product will be increased via innovations.

Considering the relationship of international trade with endogenous innovation models, the impact of technology depends on the countries. The large countries grow faster and more likely to innovate, as they offer a wide knowledge base and larger markets which provide big rewards in terms of monopoly rents for innovation (Krugman, 1995:356). Considering the fact that countries can improve their knowledge bases by trading, barriers to free trade may harm growth of non-innovating countries. The diffusion of knowledge through free trade, thereby, provides the basis for technological progress for the trading countries. Rivera-Batiz and Romer (1991) put forward a model and tests their model through simulations. In the first simulation, they allowed for the free flow of goods but not ideas[4], in the second, they allow for free flow of ideas but not goods. They have found that in order for trade to lead to a permanent long run growth, both free flow of goods and ideas should be assured.

Now, assume that there exist impediments to free flow of knowledge. Is there still an incentive for non-innovating countries to engage in trade? It is obvious that in the absence of free diffusion of knowledge, the innovative firms from technologically leading countries will be innovating persistently. Many studies have shown that technologically leading country in a specific sector will specialize in this sector, because they have competitive advantage, in other words, other countries are not able to compete with the innovating country as they do not have any idea on the new product[5]. That case will push late-comers of the technology to out of the international markets. For technologically lagging countries, therefore, there will be no room except protection to specific sectors for the catch up in the absence of free diffusion of knowledge across countries. Krugman (1987) indicates that international markets are characterized by imperfect competition and increasing returns to scale. In such a world, the mutual gains from trade can be acquired by protecting the strategic sectors in a country. “Government policy can tilt the terms of oligopolistic competition to shift the external returns from foreign to domestic firms” (Krugman, 1987:134). By doing so, the countries may enjoy from increasing international competitiveness and perpetual economic growth. As one can easily realize, the new trade theory provides rationale for the protection of specific sectors.

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[4] In that case, they assume there is no reverse engineering possibility.

[5] e.g. Porter (1990)

The debate on the international trade and international competitiveness shows innovativeness of the countries as one of the major determinants. The new trade studies mainly focus on the technological capabilities of the countries and how to improve them in order to increment their international competitiveness. The major way of closing technology gaps for developing countries passes through innovating continuously. Then, what does one mean by the term innovation? Applying Schumpeter (1939: 80)'s definition;

> Technological change in the production of commodities already in use, the opening up of new markets or of new sources of supply, Taylorization of work, improved handling of material, the setting up of new business organizations such as department stores—in short, any "doing things differently" in the realm of economic life— all these are instances of what we shall refer to by the term Innovation.

The definition of the innovation suggests that the capacity to do the things differently during and after the production and of the commodities ascertains innovativeness of the countries or the firms which is of essential prominence for the competitiveness. In the light of above discussion, the next section deals with the measurement of the competitiveness and its determinants.

2.2. The Determinants of International Competitiveness

The theories concerning the association between technology and international trade is structured around innovation-driven international competitiveness concept. Most of the theorists emphasize the role of technology for a country that wants to compete in international markets. However, what does the international competitiveness refer to? How can it be measured? What determines the competitiveness of the countries? This section deals with these questions.

The definition of international competitiveness is highly controversial. The countries' competitiveness makes this definition harder, since the countries do not compete with each other as firms. Firms can go out of business or can lay off the labor they used in the production. For the countries, it is impossible to go out of business or lay off the citizens (Krugman,1994). The definition, thus, is not an easy task and there are different approaches. Boltho (1996), for instance, defines it as the "highest possibility growth of productivity that was compatible with the external equilibrium" (Boltho,1996:3). In the Global Report of the Competitiveness of 2011-2012 of World Economic Forum, it is defined as " the set of institutions, policies, and factors that determine the level of productivity of a country." (Sala-I Martin, Bilbao-Osorio, Blanke, Hanouz & Geinger, 2011:4). Perceiving international competitiveness as the productivity differentials is not an adequate definition, as the productivity differentials are only one aspect of competitiveness and there are other factors, such as costs, investment. The definition of the OECD (1996) as "the ability of companies, industries, regions, nations or supranational regions to generate, while being and remaining exposed to international competition, relatively high factor income and factor employment levels on a sustainable basis" (OECD,1996:20). It lacks some important elements, since it just considers creating national income under competition. The true definition must contain market failures, such as imperfect competition. It should, furthermore, reflect welfare of citizens of the countries, usually measured as GDP per capita and trade performance of the countries (Fagerberg, Srholec & Knell, 2007). Combining all these aspects together, one can apply to Lall (2001:6)'s definition such that;

> Competitiveness in industrial activities means developing relative efficiency along with the sustainable growth. Competitiveness is, thus, more a *process* than an *absolute* state, and can only be assessed in a *relative* sense.

How can one measure competitiveness? There is no consensus in specifying the indicators of international competitiveness of a country. The discussion goes on with the distinction between absolute and comparative advantages. The absolute advantage (AA) is used more in analyzing world sectoral export performances, while comparative advantage (CA) is more appropriate for the analyses of trade specializations of the countries (Montobio,2003). One can, therefore, claim that CA is adopted in studies that take into account inter sectoral adjustments of trade, whilst AA is more towards intra industry adjustments in sectors within a country, hence, AA indicates competitiveness more accurately. The measures of AA in the literature are miscellaneous and are mainly trade-related, such as profitability of industries and firms, the import penetration ratios, export/import ratios (Ioannidis & Schreyer,1997). Among others, export market shares are widely applied as a proxy for international competitiveness[6] in the literature. In this study, therefore, export market shares are adopted as a measure of the international competitiveness of Turkey. The competitiveness is well defined if it is taken on a sectoral basis due to two basic factors;

i) The innovative capacity of sectors differ to a great extent due to differing technological opportunity in different sectors, so the probability of innovation occurring in some specific sectors may be ignored in an aggregated analysis at country level (Malerba & Orsegnio,1997).

ii) The relative cost differences in the sectors may affect innovativeness of the sectors differently (Dosi, Pavitt & Soete, 1990).

Policy makers and other decision makers contemplate on how to increase the competitiveness of the industrial sectors. They try to identify the factors which are crucial in raising the competitiveness of a country. Then one question arises: which factors determine international competitiveness of countries, in this study export market shares? There are various factors; six of them are examined below.

2.2.1. Factor Productivity

The inputs to technological advancement, such as R&D, human capital may not come up with innovations, if the agents of economic system do not interact with each other efficiently. Katz and Stumpo (2001) suggest that for innovations to take place in a country, the interaction of macroeconomic and microeconomic actors plays a central role. The instability of macroeconomic variables affects the productivity and competitiveness performance of the industries. The macro performance of the economy, thus, matters for competitiveness. The income per capita is an important macroeconomic measure indicating the overall performance of the economy. As Dosi, Pavitt and Soete (1990:52) put it;

[6] e.g. Magnier and Toujas-Bernate (1994), Amable and Verspagen (1995), Montobio (2003)

> The national specificities in the timing, intensity and success in industrialization and development correspond to distinguishable levels and patterns of evolution of productivities and incomes. The persistent difference in the levels and rates of growth of output per head and per man hour is fundamental feature of industrialized economies and, *a fortiori*, of the whole set of developed and developing countries.

Then, what can income per labor input do for the international competitiveness? The answer to this question recalls Fagerberg (1988). Those of the countries, he asserts, who want to improve their competitiveness must establish the link between income growth and balance of payments. This relation can be in both directions between growth and balance of payments; if the countries can balance its balance of payments through current account, this may contribute to economic growth induced by trade balance. In that case, the causality goes from balance of payments to economic growth. For the other direction the association between growth and balance of payment, there are three ways: First, the demand created in a country may induce innovation and this innovation may come up with export market share gains. Second, when the demand to the new product exceeds the production capacity, this will encourage the investments in new productive resources to expand production capacity in order not to lose market shares to foreign firms. Third, when economic growth occurs in a country, it is expected to raise wages and productivity at the same time. Since former is related to unit labor cost and the unit labor costs have an adverse relation with productivity, the net effect of growth on export market shares will depend on efficiency of national systems (Fagerberg, 1988:361-362).

Thus, in competitiveness researches, it is necessary to include a proxy that shows efficiency of the national production system and export success. The value added per labor input (productivity) in that respect can be a good indicator of efficiency of general working of the economy. In spite of the fact that total factor productivity is better suited, data availability dictates to work with labor productivity in this study, since capital stock data is not available for the Turkish manufacturing sector over the period 2003- 2008 and without this data it is not possible to calculate capital productivity. Labor productivity is considered as the manufacturing value added which is divided by the number of people employed in each sectors.

2.2.2. Technology Level

Posner (1961) and Vernon (1966) accentuated technology levels of the countries as the main determinants of trade patterns. Posner (1961),in addition, have shown technology as the main determinant of the export market shares. The countries in which innovations take place will enjoy improving trade balance in the short-run owing to the rise in exports. In the long-run, as a result of the process occurring after an innovation described above, the terms of trade will go up and countries will be specializing in the high rewarding sectors in terms of export market share gains (Archibugi & Michie,1998). Hence, their return to national competitiveness will be high.

How is the link between innovativeness of a country and its international competitiveness established? The answer to this question has already been discussed in the previous section to some extent. The mechanism goes as follows; when an innovation occurs in country *j* in sector *i*, then the sector's world market shares raises because of the monopoly power in the new product and the average technology level of country *j* goes up. Rising technology level will adjust the wages correspondingly in response to the effect of rising world market shares to domestic income growth, to changes in exchange rates and to changes in productivity growth. Changing wages will alter the allocation of investment and employment among the sectors based on profitability of sectors. As a result, price of the product of sector *i* will change relative to other products (Dosi, Pavitt & Soete,1990:152). The history of knowledge accumulation plays an important role in this set-up that is the countries with high technology levels and high productivity levels perform better in terms of international competitiveness. The technologically lagging countries may use policy interventions to establish these links and enter into a catch up process (Grossman & Helpman, 1991: 206-233).

The link between technology level and export market shares is widely studied in neo-Schumpeterian literature. The neo-Schumpeterian arguments on international competitiveness suggest that competitive advantages of countries' and sectors' within the countries are based on the research and development (R&D) and innovation activities (Montobio,2003). Countries, thus, specialize in sectors with different technology intensities. The countries may specialize in distinctive sectors, but their overall R&D efforts converge to each other, in other words, aggregate level of resources devoted to R&D may be at close levels although sectoral composition of it may differ. This fact is tested empirically by Archibugi and Pianta (1994). They compared growth figures, innovativeness indicators and world rankings of the countries and found that countries specialize in different sectors but there is a convergence in terms of overall technology levels meaning that their cumulative technology levels are approaching to each other. The fact that the industries in which most of the countries specialize differs, as Archibugi and Pianta (1994) claim, can be attributed to nation specific and institutional factors. The diversity of industrial specialization, as Krugman (1979) asserts, makes listing the countries in a hierarchical order regarding their innovativeness possible. Whether the bottom of this hierarchical list can converge to the top in terms of innovativeness, therefore, is determined by nation specific characteristics of the countries.

What is the place of domestic markets in enhancing the international competitiveness through innovations? Porter (1990) supplies the basis for this discussion. He highlights that the price determinants of competitiveness, such as interest rates, exchange rates, labor costs excluding nation specific factors fail to capture the dynamics contributing to competitiveness of a nation. Nations gain competitive advantage depending on their home environment. “Suppliers and end-users located near each other can take advantage of short lines of communication, quick and constant flow of information, and an ongoing exchange of ideas and innovations” (Porter,1990:83).

Porter (1990) sheds light on the domestic factors in explaining national innovativeness and competitiveness. Fagerberg (1993) found strong support for the interaction between ‘advanced domestic users’ and national competitiveness in 16 OECD countries in enhancing competitiveness of nations. He also underlines that the relationship is even closer when home country is open to foreign competition through exports. Another evidence is conveyed by Freeman (1995). He puts special emphasis on the nation specific factors in explaining the introduction of differentiated products by showing evidence especially from Britain in late eighteenth century. In sum, the direct interaction between domestic users and producers play a crucial role in enhancing the competitiveness through innovations, what is called as 'home market' effect, since this interaction reduces transaction costs and thus proliferate transactions.

How can one measure innovativeness of a country? Generally speaking, there are two strands on which the debate goes on; technology input and technology output. The technology input is the expenditure for the R&D activities. The technology output is patenting activities of the firms. As Dosi, Pavitt and Soete (1990) put it both of the indicators are related to innovative activities due to two reasons; first, a firm allocates resources to both R&D and patenting activities in order to innovate. Second, the two measures are complementary to each other. Firms adopt R&D as inputs to innovative activities and get patents as the output of innovative activities. The two indicators, thus, are closely related (Dosi, Pavitt & Soete, 1990:44-53).

Since the disaggregated data at sectoral level is not available for R&D expenditures, patents are used as a proxy of technology level in this study. Table 1 indicates the growth of world export market shares and growth of patenting activities for the period 1985-1998. The table suggests that the export market share in sectors where technological opportunity is high and low in sectors where growth of patents low, although there is exceptions such as electricity and electric power. As is seen, the patenting activities and world market shares show a parallel and positively related pattern across most of the sectors.

2.2.3. Unit Labor Cost

There is no consensus on the relation between international competitiveness and unit labor costs (ULC). In general, when one asks what happens to market shares of a country while unit labor costs are going up, one would probably answer it as follows; the rising ULC will result in a loss of market shares and impede growth and

Table 1: World Export Market Share Growth and Patent Share Growth for 1985- 1998 Period (% Changes)

Industry	Annual growth 1985–98	
	Patents	Exports
Computing and data processing	108.96%	33.80%
Electricity and electric power	2.77%	24.77%
Electronics and components classes	94.15%	62.38%
Optics–radiant energy–photography	30.36%	−7.37%
Communications and networking	94.98%	14.77%
Other science and engineering, measurement, nuclear	16.00%	17.09%
Music–education–games	−12.12%	8.84%
Electronics, Physics	*42.93%*	*25.19%*
Biochemistry (pharmaceuticals)	34.19%	38.14%
Chemical engineering	−38.34%	−28.46%
Organic chemistry	−25.50%	−2.95%
Surgery–body care–cosmetics	62.60%	8.27%
Materials–compositions–explosives	−15.92%	1.37%
Agriculture and farming	−39.89%	−1.49%
Chemistry, Biology	*−12.46%*	*−9.35%*
Material or article handling	−35.17%	10.25%
Heating–cooling–buildings–fluid/gas handling	−26.95%	5.67%
Earth working and civil engineering	−32.38%	−14.62%
Vehicles and transportation	−30.19%	1.48%
Office devices–paper handling–coatings	−5.95%	0.19%
Textiles and apparel	−48.59%	−1.46%
Engineering, Transportation	*−30.99%*	*0.86%*
Tools–hardware–pipes–joints	−28.92%	−5.96%
Receptacles–containers–supports–furniture	−2.72%	18.97%
Manufacturing assembling–metal working	−19.40%	−2.50%
Motors–engines–pumps	−43.59%	11.81%
Rotary machines and mechanical power	−21.19%	10.41%
Machining and cutting	−24.58%	1.54%
Mechanics	*−26.56%*	*2.00%*

Source: Montobio and Rampa (2005:528)

trigger unemployment. The empirical evidence, on the other hand, may be the other way around, i.e. a positive relation might exist between growth in ULC and growth in export market shares. Kaldor (1978) paved the way for the second strand. He started his analysis by looking at the low competitiveness of the US and UK and high competitiveness of Germany and Japan in the post-World War II period. His measurement for the competitiveness was ULC and the analysis depends upon the period between 1963- 1977. He found a positive correlation between ULC and export shares in nine of twelve countries analyzed[7].In other words, he found that, the countries who have experienced fastest export market share gains are the countries who also experienced greatest increase in the ULC and this, to some extent,

[7] UK, US, France, Germany, Italy, Belgium, Luxembourg, Sweden, Japan

paradoxical finding is called ‘Kaldor Paradox’(KP). Later, Fagerberg (1996) extended the analysis of Kaldor (1978) to 1994 and the results of his study are in favor of the KP. One explanation of KP may be that ULC is expected to contribute to competitiveness positively in technology intensive sectors due to the fact that, in high technology sectors, as the skill requirements are high and these high skill requirements come up with high wages, ULC may be positively related to export market share (Laursen,1999).

There is still scope for the arguments suggesting a negative relationship between ULC and international competitiveness. The extent to which, our competitiveness measured as export market shares, responds to changes in ULC varies across countries and industries (Carlin, Glyn & Van Reenen, 1999).

2.2.4. Other Determinants of International Competitiveness

In addition to the above determinants, there are other factors explaining international competitiveness. The first indicator is investment. The investment is included in the analysis, since it shows by how much physical capacity of the countries grow. This is partly important for international competitiveness, since it shows physical capacity of production in a country. Fagerberg (1988) states that the investment in physical capacity is complementary to growth of resources such as number of R&D personnel, electronical equipment. It is, therefore, one of the factors explaining international competitiveness.

Another factor determining the international competitiveness measured by export market shares of the countries are structural shifts in the world demand. This variable indicates how structural changes in demand of rest of the world alter with respect to home country. As one can grasp, it detects the direction of innovative activities across industries and the adaptability of countries to the changes in world trends. Following Montobio and Rampa (2005) and Laursen (1999), this variable is obtained from structural decomposition of the export market shares in this study.

Other determinants of the international competitiveness, although generally not included in the literature, can be skill upgrading, access to the capital goods in core technologies and infrastructures (Montobio & Rampa,2005:531). These indicators are even more important in the case of developing countries, as they are costly activities. Fostering the skill base for developing countries is one of the central elements for the national innovation systems and thus competitiveness (Lall,2001:129-165). The education systems of the developing countries, for instance, play a crucial role in knowledge accumulation, access to new technologies. Moreover, the role of large firms in an economy is another important factor that advances technology induced international competitiveness. In this study, it is impossible to include all these factors due to the data availability and disaggregated nature of the analysis, nevertheless, a proxy for the human capital will be used in the empirical analysis.

2.3. Empirical Application of the Determinants of International Competitiveness

The international competitiveness studies are among the most widely studied areas in the international economics literature. Since international competitiveness measured by export market shares at the sectoral level, in this study, generally, this section deals with the literature on export market shares, meanwhile there is also other studies that proxy competitiveness by other export-related indicators. The first part of the studies listed is conducted at industry and country levels and in the second part there are also studies conducted at firm level.

Soete (1981) studied market shares in his search for an indicator that will enable to compare technology output internationally and relate this indicator to international trade flows. He outlines the major problems concerning use of technology indicators and then develops an indicator which relies on the patents relative to patents granted from one country like the US. His main proposition is that international technology analysis is a phenomenon that concerns industry or commodity specific characteristics rather than country specific features at an aggregated level. His model includes 40 industrial sectors and 22 OECD countries and takes export market shares as dependent variable and export over import ratio, the share of exports in the GDP, gross fixed capital formation, population of each country and patent shares in US foreign patents as independent variables. He proposes six models to test the significance of independent variables over 40 sectors for the year 1977 by adopting static cross sectional analysis. The consequences indicate that for innovative industries, namely aircraft, machinery, trade performance of the OECD countries is a function of their relative technological performance. The industries, such as textiles, food, and railroad equipment are found to be low technology sectors and their trade performance is not closely linked to the behavior of any technology indicator (Soete,1981:651).

Dosi and Soete (1983) studied determinants of the international competitiveness. Their main insight is that the positions of the countries in the international global order are determined by their technology levels. As opposed to Ricardian approach, specialization patterns of the countries rely heavily on their absolute advantages rather than comparative advantages. To measure absolute advantages, they used patents per head, value added per employee, a proxy for the capital investment. The dependent variable is an indicator of the export performance which is exports per head. They analyzed 66 manufacturing sectors, including 2, 3 and 4 digit International Standard Industrial Classification (ISIC) sectors, for the years 1977-1978. The estimation upshots point out the fact that boundaries of economic activity are determined by the technological capabilities, in other words, available production techniques and product technology determine the limits of technological activity. Since innovativeness brings about new products, as they argue, the composition of the international trade flows are determined by the technological progresses.

Fagerberg (1988) projects the same issue with a different methodological approach. He tested the model which is based on the pooled cross country analysis for the period 1960-1983 covering 15 industrialized countries. The model consists of several variables including both price factors, such as balance of payments and non-price factors such as technology indicator, real GDP, investment in physical capital, export and import market shares. His technology indicator is a composite index of R&D spending and patent numbers. His findings specify the arguments that prop up the Kaldor Paradox for Japan, UK and USA. Regarding the investment, he underlines expansion of the production capacity as a vital factor contributing to technological advancements and competitiveness.

Greenhalgh (1990) attempted to ascertain the causes of low competitiveness of the UK trade performance. The underlying reasons, he puts forward, are not only related to price factors but they are also associated with non-price factors such as product variety and product quality. The methodology he used contains determining these price and non-price elements of the UK net trade performance by taking disaggregated industry-level time series approach. His model includes exports over imports ratio as dependent variable and real incomes, real price of exports, real price of imports, number of strikes in manufacturing sectors, and number of innovations as independent variables. His technology variable is different from the existing indicators in the sense that he derives an innovation output variable which is based on the innovation surveys conducted by Science Policy Research Unit of University of Sussex. Greenhalgh (1990) utilized error correction and cointegration methodology for 39 sectors, of which 23 are manufacturing sectors, for the period 1954-1981. He also checked for dynamics through distributed lag models. The results show that innovating sectors turn out to be net exporters and trade is promoted by innovations in six sectors (tobacco, oil products, chemicals, iron and steel, shipbuilding, other vehicles). Innovator industries, moreover, have high income elasticities and lower price elasticities.

Amendola, Dosi and Papagni (1993) questioned the subject with the major motivation of whether there is correspondence between the international market share of a firm and a country. The empirical model of their study includes export market shares as dependent variable and patent shares in 16 OECD countries' patents, real investment in machinery and equipment and relative unit labor costs as independent variables. The Auto Regressive Distributed Lag model is employed for the 16 OECD countries over the period from 1967 to 1987 and the manufacturing sector at an aggregated level is taken into consideration. The patents and investment variables have a significant effect with three year and four year lags, respectively.

ULC, in addition, perform significant effects in the short run, in contrast its significance disappears in the long run. Their results, as they put forward, is more in favor of the KP implying the positive correlation between ULC and export market shares. They underscore the heterogeneity among the countries in terms of competitiveness and ascribe these differences to institutional structure of the countries.

Magnier and Toujas-Bernate (1994) selected inter-sectoral R&D rivalry between countries among others to explain export market shares. Their main insight is that traditional trade theories fail to explain trade flows and volumes, because they take only price factors into consideration. Magnier and Toujas-Bernate (1994) included both price (export prices) and non-price (R&D expenditures and investment in fixed capital) factors in explaining the market shares and applied feasible generalized least squares method to 20 manufacturing sectors over the period 1971- 1987. The technology indicator of their study is R&D expenditures and the other variables are investment and export prices. When one takes technology intensities of the sectors into account, their results point out that technology intensive sectors[8] seem to gain competitive advantage in terms of export market shares. They also underlined inter country disparities and found significant relation between investment and export market shares in Germany, UK, France and USA, whereas no significant impact in Japan. In case of R&D expenditures, Japanese competitiveness performs best among the other countries. As regards to price competitiveness, the export market shares of UK, USA and Japan exhibit sensitive figures to changing prices, while the market shares of Germany and France does not appear to be affected by prices significantly. As a result of these analyses, their study underlined the non-price factors in explaining the market shares with the help of dynamic and disaggregated empirical model.

Amable and Verspagen (1995) extended the analysis of Magnier and Toujas-Bernate (1994). They study sectoral market shares of 18 industries of 5

[8] e.g. aerospace, office machinery and computers

industrialized countries over 22 years by utilizing the error correction method. The explanatory variables in their model are again composed of price factors, such as cost indicators, and non-price factors, namely patenting and investment. Their analyses show that unit labor costs have a negative effect, while the investment and patents have a positive impact on the export market shares. The results of their study provide evidence for the importance of technological capabilities measured by patent share of each country in average of all countries' patent shares on export market shares. Another significant result of Amable and Verspagen (1995) is that the impact of explanatory variables on the market shares varies across industries depending on their technology intensity that can be observed through different sector groups classified by using the taxonomy which is put forward by Pavitt (1984).

Ioannidis and Schreyer (1997) put forward their model for 10 OECD countries and 22 manufacturing industries for three periods that are 1977- 1980, 1980- 1985 and 1985- 1990. They differentiate two types of innovations named as process and product innovations. The process innovation, basically, refers to innovations which enable to get more efficient production structure as well as diminishing the unit labor costs. Product innovation, in addition, allows altering product quality. The technological advance in international competitiveness occurs through the choices of the countries between these two. Their model contain two parts; demand and supply equations. The econometric methodology of this study is estimating OLS coefficients for different technology intensity sectors. Ioannidis and Schreyer (1997) segregated sectors as fragmented and segmented and defined the technology intensities within each of these two categories. The fragmented sectors are sectors with low concentration and the sectors in which factor costs and exchange rates play important role in explaining the growth of export market shares; on the other hand, segmented sectors are dominated by high mark ups and high concentration tendency. The dependent variable is export market shares of a country in a sector and independent variables are R&D stocks, unit labor cost, value added at constant prices and market composition effect. Their results concerning the determinants of export market shares differ significantly across industries despite the presence of some common features. Non-technology variables such as unit labor costs and exchange rates play important role in fragmented sectors. The R&D activities, moreover, tend to be a significant contributor to the export competitiveness of a country.

Voon and Wei (1997) scrutinized export competition of China and East Asian countries[9] in the US market. They utilized OLS model at the country level for 15 years and used export market shares as dependent variable and price variables such as exchange rates, import and export price ratios and non-price factors, including product quality as independent variables. Their results reveal the fact that Malaysia succeeded to transform its production to more human capital intensive and this is reflected in their competition in the US market. Together with low wages and low exchange rates, China is gaining market share since 1979 and dominates the competition in the US market. The main shortcoming of their paper is that their analyses are based on the aggregated country level.

Fagerberg (1997) analyzed competitiveness, scale and technology levels of the countries. His model uses standard OLS models for 10 countries and 22 industries. He analyzed export performances of the countries by adopting direct and indirect R&D intensities (proxied by purchases of capital goods), domestic and foreign R&D spending, wages, gross fixed capital formation, the size of home market and domestic demand structure as independent variables. As a result of these analyses, he mainly comes up with positive correlation between direct and indirect R&D and competiveness. The indirect R&D is twice as important as direct R&D for competitiveness. The other result he draws from his analysis is that the size of home market, measured by population, has negative impact to the competitiveness. Wage levels, additionally, are found to be insignificant for the competitiveness. The last finding of this study is that the large countries generally specialize on the high technology industries indicating the importance of scale for the competitiveness.

[9] Indonesia, Malaysia, Singapore, Thailand

Laursen (1999) examined specialization patterns of the countries on the industry level. He criticizes traditional static models related to export performance models and highlights the requirement of dynamic point of view. His main research questions involves whether export market share growth can be ascribed to the enlargement in countries' resources endowments or it can be concerned with sectors offering high returns. His model takes export market share[10] as dependent variable and technology proxy derived from world patent shares, growth in unit labor costs, investment-output ratio, a proxy showing structural change of rest of the world demand which he calls structural market effect, a proxy indicating the effect of change in technological opportunity, a proxy for countries' ability to specialize in high technology sectors. The last three indicators are retrieved from the structural decomposition analysis of patent shares and export market shares by utilizing constant market share analysis. They employ a pooled panel data model for 19 OECD countries and 17 industries for three sub periods which are 1965- 1973,1973-1979 and 1979- 1988.In the estimations, he only found investment variable, which is measured by investment-output ratio, and the structural market effect as significant. The conclusions he draw from this model can be combined in three aspects. First, the results contrasted with resource based approach, in other words, the countries' endowments are not of crucial importance to fulfill technology catch up. Second, initially, the developing countries experienced high export growth but the specialization patterns have a negative impact on these countries' export performance. As for the developed countries[11], their specialization is more towards high technology sectors. Third, catch-up countries have high growth rates in technological opportunity, while they specialized in the 'wrong' sectors which are the sectors offering low technological opportunity.

[10] The dependent variable is the contribution to trade balance statistics which is the methodology adopted in Chapter 4.

[11] Germany, US, Switzerland and Great Britain

Carlin, Glyn and Van Reenen (1999) concentrated on the cost competitiveness of the OECD countries. This study is conducted in two phases; firstly they question to what extent unit labor costs affect export market shares and secondly, they dissect what other factors are important for the export market shares. They employ a pooled panel data model with instrumental variable techniques constructed for 14 OECD countries and 12 manufacturing subdivisions over the period 1970-1992. The model regresses export market shares first on relative unit labor costs second on other variables such as investment, R&D intensity, patenting activities. Using distributed lag models, they perform a dynamic analysis and find the well-known "J-curve" effect for the relationship between export market shares and unit labor costs, in other words, unit labor costs are negatively related to market shares up to a specific time period and after that period, the relationship between these two variables turns into positive. As for other factors, they found that R&D intensities of the sectors are closely related to the export market shares. They also indicate that the technology intensity plays a crucial role for the sensitivity of market share changes to relative cost variation. Finally, they provide strong support for the institutional factors, such as "system of human capital formation, patterns of diffusion of incremental innovation within and between industries and the role of committed owners in fostering long-term relationships within and between companies" (Carlin, Glyn & Van Reenen, 1999:18) in enhancing the international competitiveness.

Laursen and Meliciani (2000) proposed a model that is, in their words, similar to Amendola, Dosi and Papagni (1993) in a dynamic setting to test whether home market hypothesis, which implies the impact of direct interaction between the domestic users and domestic suppliers on international competitiveness, and foreign knowledge spillovers have substitute or complementary effects on the international competitiveness. They used export market shares as the dependent variable and R&D expenditures, patents, unit labor costs, investment-output ratios as independent variables. They, furthermore, introduced upstream and downstream linkages, which measure spillovers, as independent variables. Downstream linkages refer to a sector's importance as a user of another sector's production; in addition, upstream linkages refer to deliveries of the sector in question. The model covers the period 1973- 1991 and 19 manufacturing sectors in 9 OECD countries. Pooled least square methodology is used to estimate short run and long run coefficients and the sectors are classified according to their technology intensities by using Pavitt (1984). Their model indicates that in scale intensive and specialized supplier industries, upstream and downstream linkages have a positive effect. Unit labor cost, additionally, has the largest effect in supplier dominated industries and in the case of science based industries, patents have the largest role. Intersectoral linkages, furthermore, are not significant in science based industries.

Stehrer and Wörz (2001) analyzed technological convergence and its impacts on the trade performance. They divided the countries into three sub categories as innovative OECD North, non-innovative OECD South and East Asian countries. They regress net exports of a country on wages, productivity, unit labor costs for 32 industries in 25 countries for the period between 1981-1997 by adopting fixed effect regression. The coefficients are estimated for different technology levels, including low technology, medium high technology, medium low technology and low technology. Their main findings are worth to mention. First, they found that the innovative OECD North's competitive advantage is exacerbated by East Asian countries in high technology industries. Net exports are found to be rising in both high technology and low technology sectors, however, in low technology sectors, it increases at a slower pace. Also, the unit labor cost and productivity are found to be significant determinants of the international competitiveness. Lastly, they found an increase in the OECD countries' competitiveness relative to the US in low technology and medium technology sectors.

Montobio (2003) handle the subject from the point of view of the neo-Schumpeterian evolutionary perspective. The model he projected is of a dynamic nature and evaluates sectoral patterns of the export market share dynamics. His regression is structured as follows; growth in export market share of a country in a specific sector is regressed on three explanatory variables, which are growth in R&D expenditures, growth in gross fixed capital formation and growth in unit labor costs for periods 1980- 1983, 1984- 1987 and 1988- 1990 and for 14 countries. The sectors are divided into three sub-categories, namely high technology, medium technology and low technology. The outcomes of his estimation disclose that the positive effect of R&D expenditures in high tech sectors is greater than medium tech and low tech sectors and it is only significant in high tech sectors. As for the unit labor costs, the sign of the coefficient turns from being positive to negative as one moves along the way beginning from high tech sectors to low tech sectors and it is only significant in the case of low technology sectors. The estimation for the coefficient of the gross fixed capital formation, in addition, is only significant and positive in the case of medium tech sectors. The interaction between R&D and gross fixed capital formation has a positive influence on the export market shares and this is an important finding of this study. In the dynamic specification, he found similar results that are the effects of both price and non-price factors on export market share dynamics are sensitive to the technology intensity of sectors.

Montobio and Rampa (2005) examined 9 developing countries in contrast to the previous studies which concentrate only on OECD countries. They followed Laursen (1999)'s methodology in their empirical analysis. Firstly, the structural decomposition of the data is conducted and in the second step the regression analysis is directed by employing OLS methods. In their specifications, they used export market shares as dependent variable, and the patent shares, manufacturing value added, tertiary enrollments, foreign direct investment and the variables obtained from the structural decomposition indicating the structural shifts in the world export demand as independent variable. All the variables are specified as growth rates. The model covers 25 manufacturing industries and for the two periods 1985-1988 and 1995-1998. Findings of this analysis underline that developing countries tend to concentrate their innovative activities on the sectors which are technologically stagnant at the world level. The export market shares and patenting activities performs similar figures. If the countries generate export market gains, it will be the result of innovative activities in high technology sectors and the result of initial specialization in sectors whose market share is increasing in overall world exports in low technology sectors. To sum up, this study highlighted the importance of education and skill development for international competitiveness and the structural changes in terms of innovative activity will be translated into the export market gains.

Fagerberg, Srholec and Knell (2007) projected a model which is based on Schumpeterian ideas concerning the business cycles. They underline four basic types of competitiveness that constitute the overall competitiveness of a country, which are technological competitiveness, demand competitiveness, capacity competitiveness and price competitiveness. They measure technology competitiveness with telephone mainlines per head, capacity competitiveness by schooling and secondary and tertiary enrollments, the extent of domestic credits, money supply, degree of monetary stability represented by inflation, price competitiveness by growth of unit labor costs and lastly demand competitiveness by structure of the world demand representing the commodity composition of the each countries' exports. They, furthermore, included initial GDP per capita as a proxy for the potential of diffusion as well as control variables such as geography indicators, history indicators, climate and nature indicators, since their dependent variable is growth of GDP. The model is estimated for 90 countries from various regions of the world and for the period 1980-2002. The results of the analysis point out the fact that price competitiveness, among the other three, has the smallest importance for the competitiveness of a nation. The major reason for the developing countries for falling behind is weakening technology competitiveness and capacity competitiveness. This fact hampers catch up potential of these countries.

Castillo, Santibanez and Bolivar (2011) run their model for the determinants of export market shares of the Mexican manufacturing exports in the US market. Their methodology is an extended version of Ioannidis and Schreyer (1997). Their model uses export market shares of 20 Mexican industries for the period 1987-2007. The industrial taxonomy they adopted is based on the intra industry[12] (IIT, henceforth) trade index. The explanatory variables are growth in R&D expenditures, growth in intermediate and capital goods imports, and growth in change of demand structure of the US, growth in IIT index and growth in market shares of export shares in the US market. They reached similar conclusions with the previous studies on the close relationship between technology and international competitiveness. They find unit labor costs, wages as important determinants of Mexican international competitiveness in low concentration and low IIT sectors. The IIT, moreover, is only essential for the high technology industries. The R&D variable is an important variable for all the industries belonging to different technology and IIT groups.

In addition to the above examples, there are several studies that are conducted at the industry-level and that are similar to the above-mentioned papers. In addition to the evidence found in the industry-level papers, there is also strong support from the literature about the close relationship between trade patterns and technological advancements conducted at the firm level.

Kumar (1987) investigated Indian manufacturing industries for the local R&D and technology imports. His model examines the determinants of R&D intensity by regressing R&D spendings on the share of foreign controlled enterprises in total industry sales, industry dummies, factor intensity, skill intensity, licensing of technology, patents, concentration ratio, profit margin and advertisements for the periods 1978-1979 and 1980-1981. They end up with the conclusions that are licensing of technology, advertisements and the dummies for chemical industries are positively associated with the R&D intensity, while foreign controlled enterprises in total sales, capital intensity, concentration ratio, consumer goods dummy has a negative impact on the local R&D efforts of the firms. Among these finding, one point deserves attention; the finding of foreign controlled enterprises in total sales indicates that the firms controlled by foreigners devote fewer resources than the

[12] IIT means exports and imports of similar goods and services. It is used in Castillo, Santibanez and Bolivar (2011) to classify sectors by their common features.

others, in other words, technology imports through FDI has a negative impact on firms' R&D intensity.

Tan and Hwang (2002) questioned the complementarity of the imported technology and R&D at the firm level for Taiwanese electronic industry via a bivariate probit model. They found that technology importers are less engaged in in house R&D expenditures and the greater integration to international markets will decline in house R&D activities.

Bleaney and Wakelin (2002) conducted their research to determine the relation between innovations and export behavior of the UK firms. They highlighted innovating and non-innovating firms' export performances by employing a probit regression. Innovating firms are found to be more advantageous in entering to export markets, whereas non-innovating firms are likely to be exporters if they have low unit labor costs as a result of the empirical analyses. The innovation level, measured by the R&D expenditures, is the main determinant of the UK exports at the firm level.

Hasan and Raturi (2003) studied investment in technology and export performance relation for Indian firms. They utilize a probit model at firm level. The results of their analysis show that investing in technology through R&D activities enables firms to enter export markets especially in the scientific sectors, but the influence of R&D activities on the volume of exports remained limited. For India, the labor intensive sectors perform better than the other sectors in incrementing the volume of exports.

Rodriguez and Rodriguez (2005) conducted research on the Spanish firm level data to analyze export behavior of the firms and their technology levels through a logit model. Their major result is that technological capacity of the firms has a critical role in their international competitiveness. The technological capacity is measured by both R&D investment and product innovations. The technological capacity, additionally, facilitates the firms to enter international export markets.

2.4. Evaluation

So far, the debate concerning the link between technology and trade has been discussed. After, the determinants of international competitiveness indicated by export market shares in this study are underscored. To combine the things, one can write the following identity;

$$X_i = f(T_i, C_i, N_i), \text{ i=1,2,..,N} \quad (1)$$

In equation (1), X_i denotes international competitiveness of a country and T_i, C_i and N_i are technology level (innovativeness), cost and other determinants, respectively. N is the number of sectors used in the analysis. Incorporating the indicators to this identity;

$$XMS_i = f(PAT_i, ULC_i, PROD_i, INV_i, MST_i, HC_i) \quad (2)$$

In equation (2);

XMS_i = Export market share of sector i used to proxy international competitiveness

PAT_i = Number of patents granted in sector i used as a proxy of innovativeness

ULC_i = Unit Labor Cost in sector i adopted as the cost in indicator

$PROD_i$= Labor productivity in sector i that is an indicator of the efficiency of the overall economic performance

INV_i = Investment in physical capital in sector i used to proxy gross investment in fixed capital

MST_i = A proxy indicating structural changes in rest of the world demand

HC_i = Human capital level in sector i adopted as an indicator of skill upgrading

Table 2: Empirical Application of the Determinants of International Competitiveness

Study	Data	Aggregation	Econometric Methodology
Soete (1981)	22 OECD countries 40 Industrial Sectors	US Standard Industrial Classification	Static Cross Section
Dosi and Soete (1983)	Number of countries that take patents from the US 40 Industrial Sectors	2,3,4 Digit ISIC	Static Cross Section
Fagerberg (1988)	15 Industrialized Countries	-	Least Square Dummy Variable Random Effects Model
Greenhalgh (1990)	39 Sectors (of which 23 are Manufacturing Sectors)	4 Digit SIC	Error Correction, Cointegration
Amendola,Dosi and Papagni (1993)	16 OECD Countries 1 Sector	-	Auto Regressive Distributed Lag
Magnier and Toujas-Bernate (1994)	5 Industrialized Countries 20 Manufacturing Sectors	-	Feasible Generalized Least Square
Amable and Verpagen (1995)	5 Industrialized Countries 18 Industries	4 Digit ISIC	Error Correction
Ioannidis and Schreyer (1997)	10 OECD Countries 22 Manufacturing Industries	2,3,4 Digit ISIC	Ordinary Least Square
Voon and Wei (1997)	5 East Asian Countries	-	Ordinary Least Square
Fagerberg (1997)	10 Countries 22 Industries	4 Digit ISIC	Ordinary Least Square
Laursen (1999)	19 OECD Countries 17 Industries	4 Digit SITC	Ordinary Least Square
Carlin, Glyn and Van Reenen (1999)	14 OECD Countries 12 Manufacturing Industries	-	Distributed Lag Model
Laursen and Meliciani (2000)	9 OECD Countries 19 Manufacturing Sectors	-	Ordinary Least Square
Stehrer and Wörz (2001)	25 Countries 32 Industries	2,3,4 Digit ISIC	Fixed Effect Regression
Montobio (2003)	14 Countries 12 Sectors	2,3,4 Digit ISIC	Ordinary Least Square
Montobio and Rampa (2005)	9 Developing Countries 25 Manufacturing Industries	4 Digit ISIC	Least Square Dummy Variable
Fagerberg, Srholec and Knell (2007)	90 Countries	-	Ordinary Least Square
Castillo, Santibanez and Bolivar (2011)	20 Mexican Industries,	2 Digit ISIC	Least Square Dummy Variable

Table 2 (Continued)

Study	Dependent Variable	Independent Variables
Soete (1981)	XMS[13]	Exports/GDP,GFCF,Population,Patent Shares in the US Patents
Dosi and Soete (1983)	Exports Per Head	Patents per Head , Value Added per Employee,Capital Investment
Fagerberg (1988)	XMS	TL, GFCF, Growth in World Trade, Growth of Technological Competitiveness
Greenhalgh (1990)	Exports/Imports	Real Income, Export Price, Import Price, Innovation Proxy
Amendola,Dosi and Papagni (1993)	XMS	Patent Shares in 16 Countries GFCF,ULC
Magnier and Toujas-Bernate (1994)	XMS	Export Prices,R&D,GFCF
Amable and Verpagen (1995)	XMS	ULC, Patents, Investment
Ioannidis and Schreyer (1997)	XMS	Market Composition Effect, R&D, ULC,Value Added
Voon and Wei (1997)	XMS	Exchange Rate,Import Prices, Export Prices,Product Quality
Fagerberg (1997)	Exports	Direct and Indirect R&D, Foreign Share, GFCF, Wages, Domestic Demand
Laursen (1999)	XMS	Technology Level,ULC,Investment-Output Ratio, Structural Market Effect, Tehcnological Opportunity, Ability to Specialize in High Tech Sectors
Carlin, Glyn and Van Reenen (1999)	XMS	ULC,Investment,R&D Intensity,Patents
Laursen and Meliciani (2000)	XMS	R&D Expenditure, Patents, ULC, Investment-Output Ratio, Linkages between sectors
Stehrer and Wörz (2001)	Net Exports	Wages, Productivity, ULC
Montobio (2003)	XMS	R&D Expenditure, GFCF,ULC
Montobio and Rampa (2005)	XMS	Patent Shares,Manufacturing Value Added, Patent Shares in Total World Patent,Structural Market Effect,Tertiary Enrollment, Foreign Direct Investment
Fagerberg, Srholec and Knell (2007)	GDP	Initial GDP per Capita, Telephone mainlines pr head,capacity competitiveness, ULC, structural change of World demand,geography indicator,history indicator,climate indicator
Castillo, Santibanez and Bolivar (2011)	XMS	R&D Expenditures, Intermediate Goods and Capital Goods Imports, Changes in Demand Structure of the US, Intra Industry Trade Index

[13] XMS: Export Market Share, ULC: Unit Labor Cost, GFCF: Gross Fixed Capital Formation

Changes in export market shares, an indicator of international competitiveness, depend on the number of patents granted, unit labor costs, productivity of labor, investment in physical equipment, structural changes in the world demand and human capital level in sector i as can be grasped from (2).

Section 2.3 presents the empirical application of the models similar to equation (1) and (2). All of the studies presented in this section indicate the empirical relevance of the arguments presented in the previous sections of this chapter. One lesson from this review is that technological advancements and structure of world trade are closely related to each other. The composition of the commodities, moreover, flowing between countries is highly dependent on the innovativeness of the countries. When an innovation occurs in an economy, it will not only result in rising domestic returns led by the monopoly power, but also a gain in international competitiveness through market shares.

The selected studies in Section 2.3 also indicate that results of the applications for export market shares analysis are sensitive to the analysis type. That is, results may change depending on the level of aggregation: country level, industry level or firm level. This is partly important in the case of scale indicator, for example, because, when one employs firm level analysis, some firms dominates some industries and this will underline the scale effects. In the industry case, technology levels of the sectors are distinctive for the export analyses of the countries. In the case of country level studies, the results point out the fact that leading countries in terms of GDP per capita are technologically leading at the same time and from the point of view of technology gap theory, the catch up for the developing countries will be tough. The level of analysis, hence, is important for the analysis. Regarding the aggregation, in a great deal of the studies, there exist industrial taxonomies based on the technology levels. The results are also sensitive to this kind of sectoral classifications, that is whether the country is gaining export market shares in a specific sector depends upon its technology intensity and thus, which sector is listed as high technology and which is low technology impacts the outcomes of the analyses. In that sense, there are two major approaches, the first one is R&D based classification and the second one is Pavitt taxonomy, both of the two are widely applied in the literature.

Another lesson that can be drawn from the empirical applications of the determinants of export market shares is that determinants of the market shares changes across industries and countries whereas there is some common features. The researchers usually take manufacturing sector into consideration in their account for the export market share dynamics. One reason for this selection is that the probability of occurrence of innovations in the manufacturing sector is higher in comparison to the other sectors, including service sector and agricultural sector. Another reason may be the data availability. Countries usually collect regular data through industrial surveys and this may come up with reliable data to work with. In most of the studies, additionally, countries gain competitiveness through not only price factors but also non-price factors. The price factors, generally, are proxied by unit labor costs; in spite of the existence of some indicators namely exchange rates, balance of payments and the non-price factors include innovations, productivity, skills and the like. The variables chosen in this study, hence, are relevant indicators of the determinants of export market shares.

The proxies used to measure the technological capabilities (innovativeness) differ through the studies outlined, but generally speaking, most of the studies either used patents or R&D intensity or a composite variable obtained from both patents and R&D expenditures. Considering the impact of technology, the results outline positive contribution to the export market shares in most of the studies. In the studies, likewise, the skill development takes limited place due to the restricted the data available at sectoral level, nevertheless, in the studies it is included, it also affects the export market dynamics of the countries positively via providing a basis for enhancing innovativeness. In the case of unit labor costs, the empirical results support the KP arguments generally, despite particular exceptions like Carlin, Greene and Van Reenen (1999). One can conclude that, KP holds for most of the cases. As regards to the gross investment in fixed capital, factor productivity and structural changes in the world demand, they also play a central role in the export market share gains.

There are also some remarks concerning the econometric methodology used that one can acquire from the studies outlined in Section 2.3. First of all, most of the recent studies used econometric techniques that are dynamic in nature (Table 2).This is partly crucial since the technological progresses of the countries are also dynamic processes. Hence, our dynamic approach employed in Chapter 4 to this issue gains relevance from these studies. In almost all of the studies, furthermore, the models are based on the Schumpeterian ideas of evolutionary perspective which outlined in Section 2.2. The variables are, generally, taken as in their growth rates. The relativeness of the selected variables in the selected studies is another lesson that can be grasped by scanning the literature. The proxies are taken as their relative levels to the other countries in the studies where there exist more than one country in the analysis.

In sum, theoretical considerations on the international competitiveness are numerous and it is not possible to include all of them within the confines of this study. This section, thus, discussed main tenants of determinants of international competitiveness measured as export market shares. This chapter, furthermore, outlined empirical models related to the determinants of international competitiveness. The examination of these studies reveals the fact that the results are diverse both across countries and across industries and this indicates that the institutional structure of a country determines its international competitiveness. In the light of above discussion, the following chapter deals with Turkey’s structural changes in production and exports as well as an overview of the science and technology policies. The main concern in the following chapter will be whether the Turkish competitiveness is consistent with the theoretical framework presented in this chapter.

CHAPTER 3

AN OVERVIEW OF INTERNATIONAL COMPETITIVENESS OF THE TURKISH ECONOMY

Turkey, as a developing country, has experienced structural changes in 1980 in parallel with the neoliberal wave that was prevailing all over the world. After this neoliberal restructuring, the shift from traditional import substitution policies to export orientation led to a new form of production structure. In that period, Turkish economy experienced two big financial crises, led by volatile inflation rates and exchange rates. In the decade following the 2001 crisis, Turkey's growth rate was positive in 27 successive quarters in 2002-2008 period. During this time, Turkish exports almost quadrupled, it soared from 36 million dollars in 2002 to 132 million dollars in 2008. In this export rise, the manufacturing sector was dominant with its share of 23 % in the GDP and 92 % in total exports[14]. The transformation of Turkish economy brought various changes in the structure of both production and exports. What kind of structural changes occurred in the Turkish economy? Does the country gain competitive advantage from these changes especially in technology intensive sectors? These questions are handled on a descriptive basis in this chapter to get a better understanding of the keystones of this transformation. The remainder of this chapter proceeds as follows; the first section outlines structural changes occurred in the neo liberal era after 1980 and the second section presents structural shifts in the structure of manufacturing exports. In the following section, competitiveness indicators are dealt with and the last section evaluates the main findings and concludes this chapter.

[14] The share of manufacturing exports in total Turkish exports belongs to the period 1996-2011 period and the data is from TURKSTAT.

3.1. Structural Changes in the Turkish Economy after 1980

24th January 1980 has a special place in the Turkish economic history since, on this date, the start of neoliberal era for the Turkish economy was announced by the government. The 24th January liberalization program brought about export oriented policies for the economy. The export orientation occurred through three instruments; strong export subsidies, declining labor costs and exchange rate regimes that aim to recover the economy from the harmful effects of 1980 devaluation (Boratav, 2007:152). These policies would allow industrial commodities to be

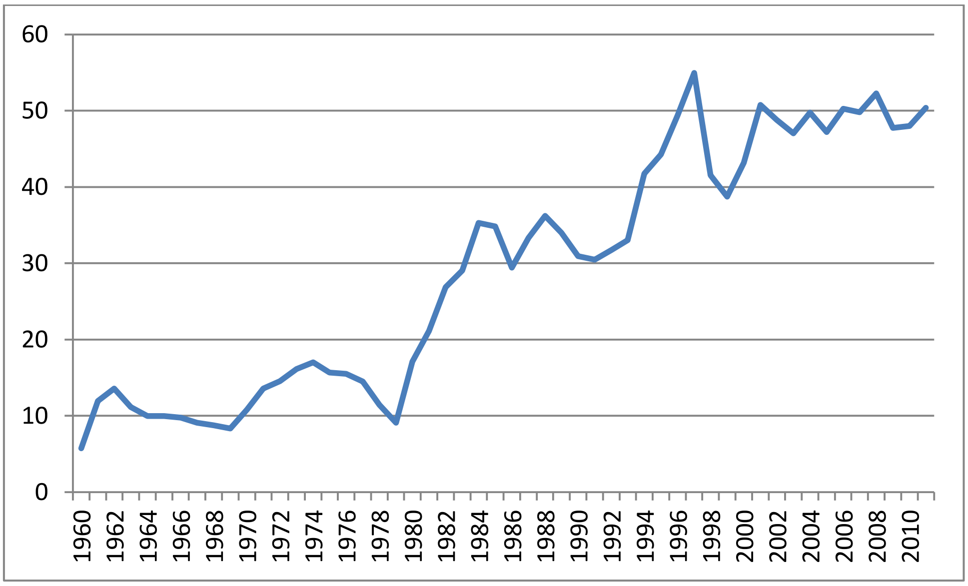

Figure 2: Trade Rate as a Share of GDP (Source: World Bank, World Development Indicators)

exported to the rest of the world. The trade rate[15] as a share of GDP thus increased significantly after 1980, from 11.8 % on average in 1960-1980 period, to 35 % in 1980-2000 period and to 48 % in 2000-2012 period. This number indicates that international trade has witnessed significant increases (Figure 2).

Has that increase in international trade come up with an increase in GDP? Figure 3 illustrates that the increase in trade and the GDP rise moves together

[15] The trade is computed as the sum of exports and imports of goods and services in World Bank World Development Indicators.

throughout the period in question, although there is no one to one relationship. Considering the composition of GDP, one will see that the structure of the value added has altered towards services and industry sector. Figure 4 depicts the sectoral shares of total value added created in Turkey. There is a clear decline in the share of agriculture, while the share of services and industry increases. All of these three figures points out that there is a clear structural shift in the Turkish production structure after 24th January stabilization program. In the case of manufacturing, the sector's share is 21 % on average for the period 1980-1999 and 19 % on average for the period 2000-11, so the share of manufacturing sector in total value added created has not changed significantly until 1980s.

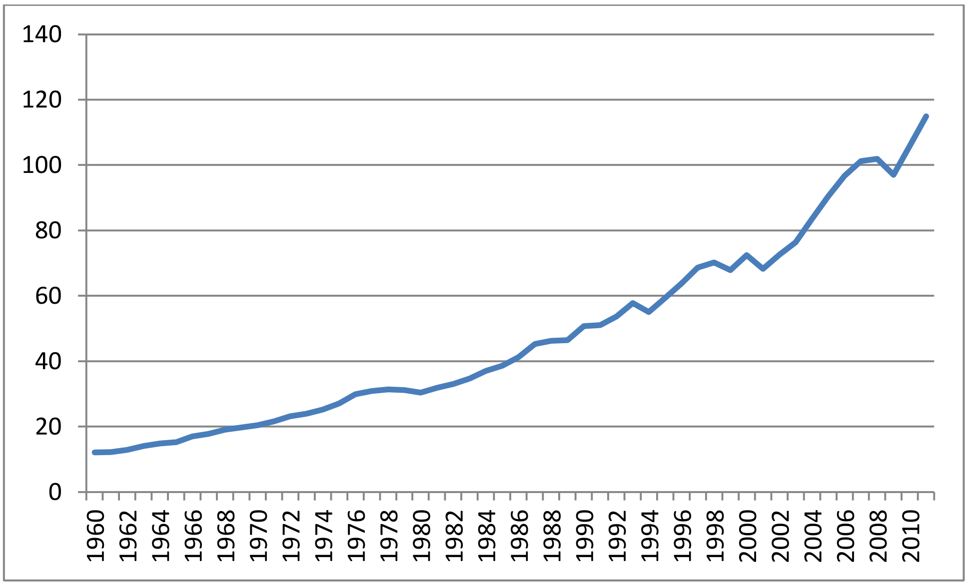

Figure 3: Gross Domestic Product (1998 prices, TL) (Source: World Bank, World Development Indicators)

The foreign trade statistics are important indicators of this transformation, as the new era sets forth export promotion policies. The foreign trade figures for the post-

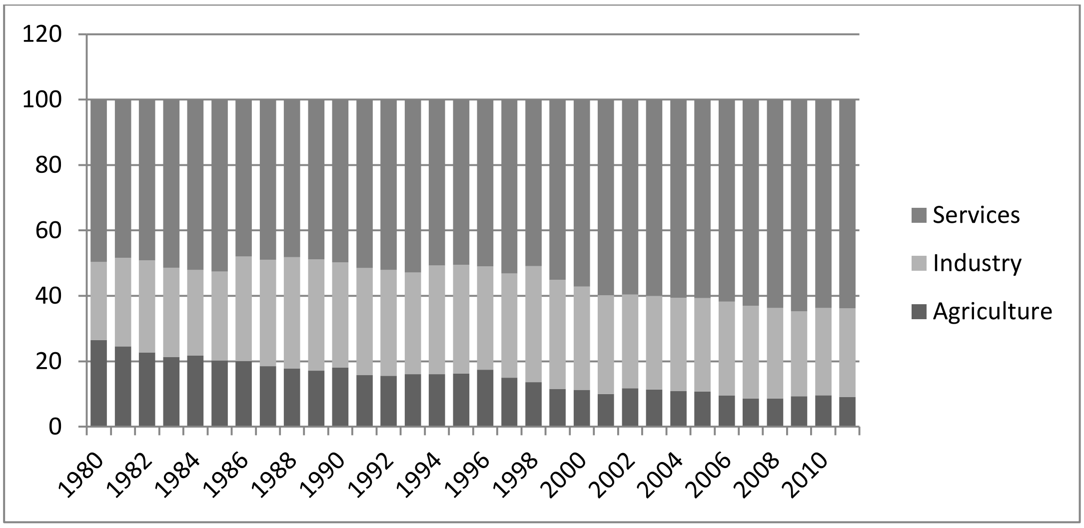

Figure 4: Composition of GDP by Main Economic Activities (Source: World Bank, World Development Indicators)

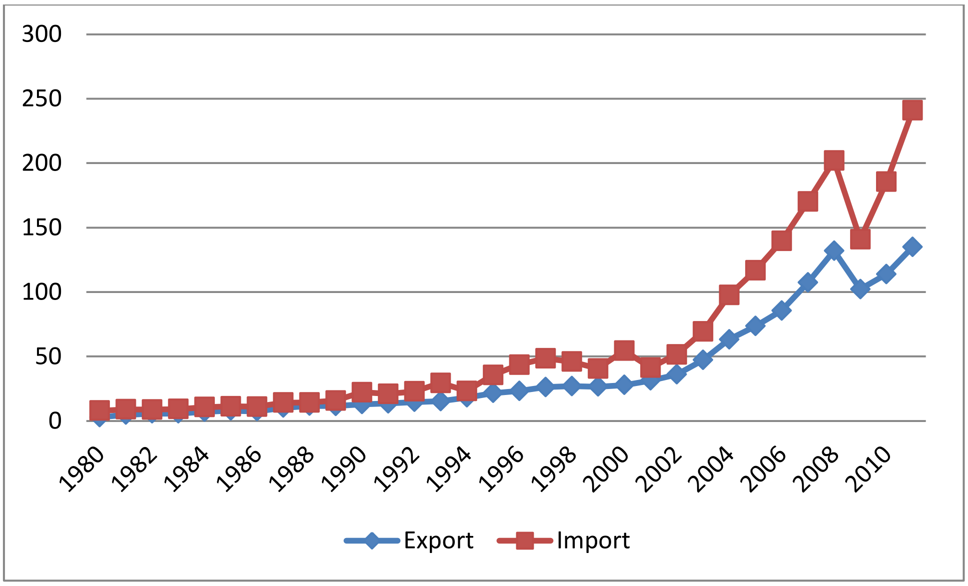

Figure 5: Export and Import Values in Million US Dollars (Source: TURKSTAT, Foreign Trade Statistics)

1980 period, depicted by Figure 5, shows that exports and imports are coupled and especially after 2002, the exports is always under the imports, that is, there exist trade deficits in the economy. The value added figures shown above supports the idea that Turkish exports boom in the post-1980 era achieved through import rise. The following section provides a more detailed account of the export structure of Turkey.

The price and quantity indices for Turkey are other important indicators of the transformation of Turkish exports in the post 1980 era. Figure 6 portrays export price and quantity indices after 1982. The P_x/P_m ratio indicates that the terms of trade (TOT) for the Turkish commodities have deteriorated especially in the 2000s, that is, the price of exported goods in terms of imported goods and services declined. Besides, the relative quantities traded (either exported or imported) have a more volatile trend in comparison to TOT. Although 2000s started with a high increase in the quantity ratios, it remained under the TOT curve. The difference between TOT and relative quantity indices indicates trade balance, in other words, whenever the TOT curve is located above the relative quantities curve, this will appear as deterioration in the trade balance. One can, thus, conclude that Figure 6 displays parallelism with Figure 5 in terms of trade balance. In 2008- 2011 period, for example, the trade balance improvement occurred in Turkey and TOT curve positioned under the quantity curve.

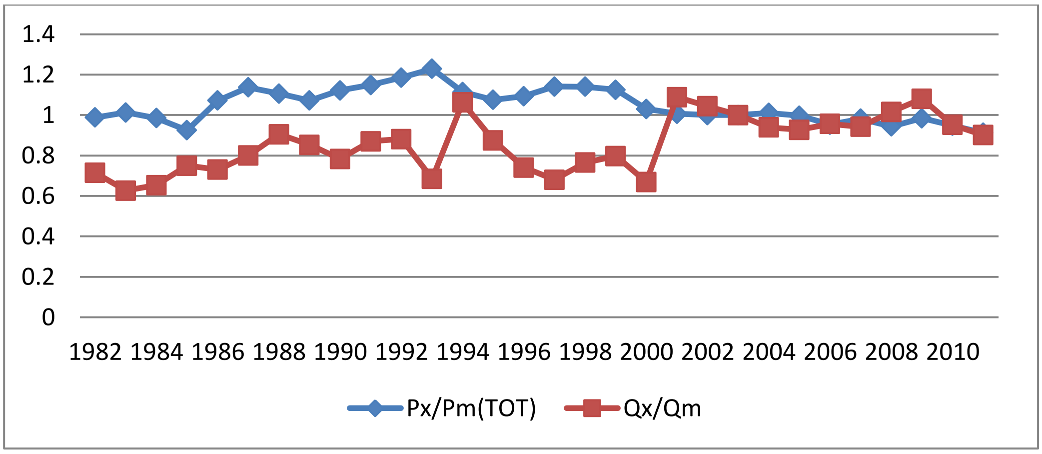

Figure 6: Price and Quantity Indices for Turkey[16] (Source: TURKSTAT, Foreign Trade Indices)

Furthermore, productivity changes constitute another pillar of the restructuring of the post-1980 period in Turkish economy. The productivity of the Turkish economy has increased especially in the 2000s. Ignoring the sharp declines in the

[16] Px/Pm: The ratio of Export Unit Value Index/ Import Unit Value Index, Qx/Qm: The Ratio of Export Quantity Index/Import Quantity Index

years 1994 and 2001 since they are crisis years, there is a continuous improvement in the productivity figures. The OECD productivity index[17] numbers are 42 in 1980, 63 in 1990, 75 in 2005 and 110 in 2011 which means more than two fold increase in the productivity after 1980 restructuring (Figure 7). It is also observable from Figure 7 that the productivity numbers gained momentum especially in the 2000s. A more detailed analysis of productivity takes place in the subsection 4.3.3.

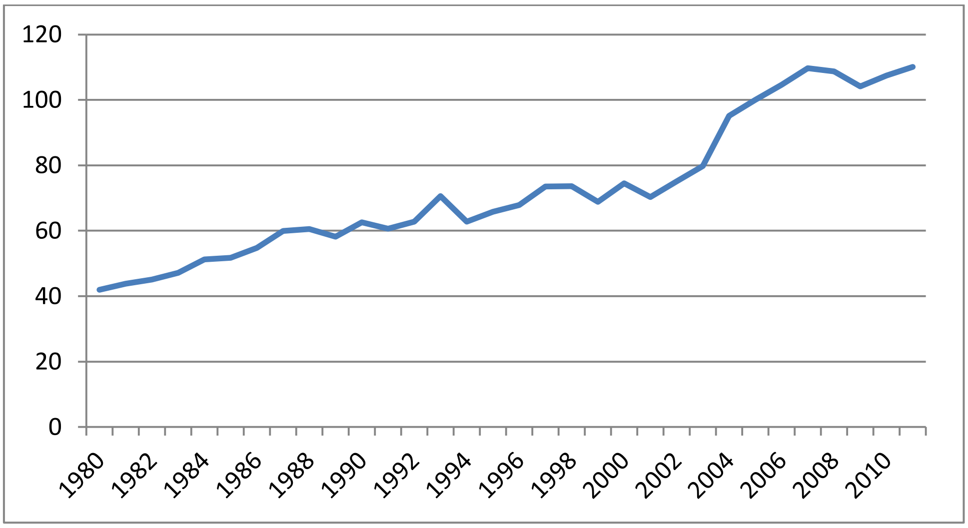

Figure 7: OECD Productivity Index For Turkey (2005=100) (Source: OECD Stat Extracts)

The examination of general picture of the post 1980 era in Turkish economy underscored that 2000s have witnessed a significant upsurge in exports, imports, and productivity. The next section, hence, takes a closer look at the export performance of early 2000s and the following section deals with other competitiveness indicators.

3.2. A Closer Look at the Structure of Exports

Overview of the Turkish economy after 1980 points to the fact that Turkish economy has been transformed significantly and the source of the transformations are the alterations in the trade patterns. The analysis conducted in Section 4.1, additionally, underlined the fact that the steady increase in GDP growth, imports

[17] The productivity index shows GDP per hour worked and computed by taking 2005 as the base year

exports and productivity occurred after 2000s. This makes analyzing the exports of 2000s meaningful.

Average export growth went up from 8 % in 1990s to 22 % after in 2001-2008 period[18]. What is the role of this dramatic rise in exports for international competitiveness of Turkey? What kind of structural changes occurred in the trade patterns of the country? Answers to these questions require a detailed analysis of exports. In order to do so, firstly, sectoral composition of the exports is depicted. Secondly, the Intra Industry Trade index is computed and then country composition of the exports is evaluated. Thirdly, the commodity structure of exports is also examined by broad categories. This section is concluded with the revealed comparative advantage analysis on a sectoral basis.

Considering the sectoral composition of the exports, one can realize that the share of high technology sectors[19] is, roughly, one half of the low technology sectors. Table 3 indicates changes of different sectors, which have different technology intensities, in the overall export of the economy. As is seen from the table, the share of high technology sectors almost remained constant around 5 % level. The medium high technology sectors, although limited, increased from 26 % in 2003 to 31 % in 2008. As regards to the medium low technology sector, their share increased by 15 % in 2003-2008 period, however, the average shares are close to medium high technology sectors. Finally, the shares of low technology sectors diminished significantly in total exports. Overall, one can conclude that the decline in the shares of low technology is accompanied by a rise in medium technology sectors. From a theoretical point of view, this may hamper international competitiveness of Turkey in terms of innovativeness.

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[18] TURKSTAT

[19] The Technology classification is made by considering OECD criteria which is based on the R&D intensities of the sectors (Hatzichronoglou, 1997). The classification is made by using ISIC (REV. 3) criteria and the detailed list of the sectors is performed in Appendix B in Table 20.

Table 3: Structural Change in Exports

Years	High Tech	Medium High Tech	Medium Low Tech	Low Tech
2003	0.06	0.26	0.23	0.45
2004	0.07	0.28	0.26	0.40
2005	0.06	0.28	0.27	0.39
2006	0.06	0.31	0.29	0.35
2007	0.04	0.33	0.30	0.33
2008	0.03	0.31	0.38	0.28
Average	**0.05**	**0.29**	**0.29**	**0.36**

Source: TURKSTAT

Intra Industry Trade index (IIT) is another measure used to evaluate the structure of exports of a country. The IIT simply means the export and import of similar goods and services. It shows, points to the degree of product differentiation. That is, the countries may trade with each other by selling and buying different commodities that belong to the same sectors. In addition, by producing a particular product, firms will gain experience in the production of a particular commodity over time and cost reductions occur. This 'learning by doing' process is called as dynamic economies of scale and IIT indicates this fact (Appleyard, Field & Cobb, 2008:192-193). It is, therefore, worth to touch upon in explaining structural shifts in the exports.

The measure used for IIT is the index proposed by Grubel and Lloyd (1971). They measure the IIT of Australia for different SITC commodities up to 7 digit commodity classifications. They also applied this methodology to other countries for 3 digit Standard International Trade Classification (SITC) commodity groups. As a result of this analysis, their index has gained empirical relevance has been started to be used in the relevant literature. The formula for the IIT index of Grubel and Llloyd (1971) is as follows;

$$IIT_i = 1 - \frac{\sum_{i=1}^{N} |X_i - M_i|}{\sum_{i=1}^{N} (X_i + M_i)} \tag{3}$$

In equation (3), X_i denotes exports in sector i, M_i represents imports in sector i and N represents the number of different kinds of products. As is apparently seen from the formula, the closer the X_i and M_i to each other, the greater IIT takes place in the economy. The numbers for the IIT index for Turkish exports are depicted in Table 4.

The numbers indicate that Turkey's IIT is concentrated on the medium technology sectors. The high technology sectors have low levels of intra industry trade and low technology sectors have second lowest IIT values. These findings support the outcomes of Table 3 concerning the structural shift of exports in Turkey. Table 4 also indicates that the product differentiation occurred in medium technology sectors.

Table 4: Grubel- Lloyd Index for Different Technology Levels

Years	High Tech	Medium High Tech	Medium Low Tech	Low Tech
2003	0.21	0.53	0.63	0.38
2004	0.23	0.55	0.65	0.40
2005	0.22	0.56	0.69	0.41
2006	0.25	0.57	0.68	0.44
2007	0.32	0.57	0.69	0.46
2008	0.31	0.58	0.75	0.48
Average	**0.25**	**0.56**	**0.68**	**0.43**

Source: Author's calculations based on TURKSTAT ISIC (REV. 3) four-digit Data

Another aspect of structural change is the country composition of exports. Table 5 presents the share of 5, 10, 20 and 29 countries to which Turkey exports most in total Turkish exports. In the period in question, the shares of all four categories perform a decline. Among the others, exports are concentrated in 29 countries which will provide the basis for the constant market share analysis conducted in the following chapter. Looking at Table 5, although there is a reduction in concentration trend in the exports, one can conclude that exports are mainly carried over to 29 countries.

Table 5: Country Composition of Exports

	Top 5	Top10	Top 20	Top 29
2003	0.44	0.58	0.73	0.81
2004	0.43	0.59	0.74	0.82
2005	0.40	0.57	0.72	0.81
2006	0.38	0.55	0.71	0.80
2007	0.36	0.54	0.70	0.79
2008	0.33	0.50	0.67	0.77
Average	**0.39**	**0.56**	**0.71**	**0.80**

Source: Author's calculations based on TURKSTAT Data

What are these top countries? Does Turkey export to the same countries? The answer is depicted in Table 6. The exports by broad country groups suggest that the exports are highly focused on the members of European Union countries (EU-27). The share of EU-27 is more than 55 % in all years, if one takes into account other non-EU European countries, the share becomes 64 %. One can, thus, conclude that exports are dependent mainly on the European countries. The Near and Middle Eastern countries, furthermore, gained momentum especially after 2005. Before that date, Northern American countries were third. The share of Near and Middle Eastern

Table 6: Composition of Exports by Broad Country Groups

	EU-27	Near and Middle Eastern Countries	Other European Countries
2003	0.58	0.12	0.07
2004	0.58	0.13	0.07
2005	0.56	0.14	0.08
2006	0.56	0.13	0.09
2007	0.56	0.14	0.10
2008	0.48	0.19	0.12
Average	**0.55**	**0.14**	**0.09**

Source: Author's calculations based on TURKSTAT Data

countries rose to 14 % on average. As for the shares of individual countries in total exports (see Appendix A, Table 17) Germany comes first as the major export partner of Turkey over 2003-2008 period. The USA and other major European countries also enter into the top five export partners of Turkey in all 6 years in question. It is important to note that in 2008, United Arab Emirates is the third most important export destination in the list. This deserves attention in such a highly concentrated export structure, since it is located in another area.

The country composition of exports indicates that exports rely heavily on European countries. This situation may be hazardous in crises times like the 2008 global turmoil. The export structure should be diversified to reduce the risk of failure in a crisis time. For the competitiveness debate, moreover, the countries like Germany, France and USA, which are in top 5 in all 6 years, are not easy to compete with since they are technologically leading countries.

The commodity composition by broad economic activities is presented in Table 7. In the table, as is seen explicitly, intermediate goods dominate imports with its share being 75 % in 2008, whereas the intermediate goods exports, in spite of an increasing trend, has remained at 51 % level in 2008. Consumption goods trade, additionally, reveal a better performance in terms of imports and exports. The consumption goods industries are, in a sense, low value added sectors, namely automobile, consumer durables. Since most of the consumer goods are intermediate goods dependent, the import dependency of Turkish exports come into the forefront.

Table 7: Exports and Imports by Broad Economic Activity

Years	CAPITAL		INTERMEDIATE		CONSUMPTION	
	Import	Export	Import	Export	Import	Export
2003	0.16	0.09	0.72	0.39	0.11	0.51
2004	0.18	0.10	0.69	0.41	0.12	0.48
2005	0.17	0.11	0.70	0.41	0.12	0.47
2006	0.17	0.11	0.71	0.44	0.12	0.44
2007	0.16	0.13	0.73	0.46	0.11	0.41
2008	0.14	0.13	0.75	0.51	0.11	0.36

Source: TURKSTAT, Foreign Trade Statistics

Saygılı, Cihan, Yalçın and Hamsici (2010) surveyed 145 manufacturing firms to detect the underlying reasons for import dependency of Turkish economy. Their findings can be combined in three basic headings. First, 60 % of the import dependency emanates from the insufficiency of domestic production of intermediate and capital goods. Second, the producers demand high quality capital and intermediate goods to insure technology transfer from abroad. This factor is responsible for 20 % of import dependency. Third, the specialization patterns of Turkish production structure are towards those sectors which require imported inputs more intensively, including motors and vehicles sectors, consumer durable sectors and main metal sector, in comparison to traditional labor intensive sectors (Saygılı, Cihan, Yalçın & Hamsici, 2010: 121-127).

The last part of examination of the export structure is the revealed comparative advantage (RCA) analysis. It simply measures the specialization patterns of the exports. The index measure used in this study is the one developed by Balassa (1965). Balassa (1965) analyzed the reallocation of the resources after trade liberalization in the US and UK and he underscores the need for a relative measure for trade performance. As a consequence he developed RCA index which can be formulated as;

$$RCA_i = \frac{X_i / \sum_{i=1}^{N} X_i}{X_i^w / \sum_{i=1}^{N} X_i^w} \tag{4}$$

In equation (4), X_i represents the export of a country in sector i, X_i^w denotes the world total exports of the sector i and N is the total number of sectors.

The RCA index is computed as the ratio of share of sector i in total exports of a country to the share of total world export of sector i to total world exports. If the index is more than 1, then there is a comparative advantage in sector i for the country in question. It is applied to evaluate Turkish export performance by Erlat and Erlat (2005) and Yılmaz (2002) in the European Union markets. The index used here is the same as the one used by Erlat and Erlat (2005) and comparative export performance index of Yılmaz (2002). Yılmaz (2002) used RCA to evaluate export performance of Turkey in EU-15 countries for the years between 1987-1997 for 24 SITC groups. Later, Erlat and Erlat (2005) applied the RCA index that is analogous to Yılmaz (2002)'s comparative export performance index to 256 SITC commodity groups. Their measure differs from that of Yılmaz (2002) due to two reasons; First, they use Balassa (1965)' preferred RCA index and second, they applied it to three-digit SITC sectors for a longer time span. As Erlat and Erlat (2005:4) puts forward, the index can be either applied to world shares or it can also be employed to a group of countries.

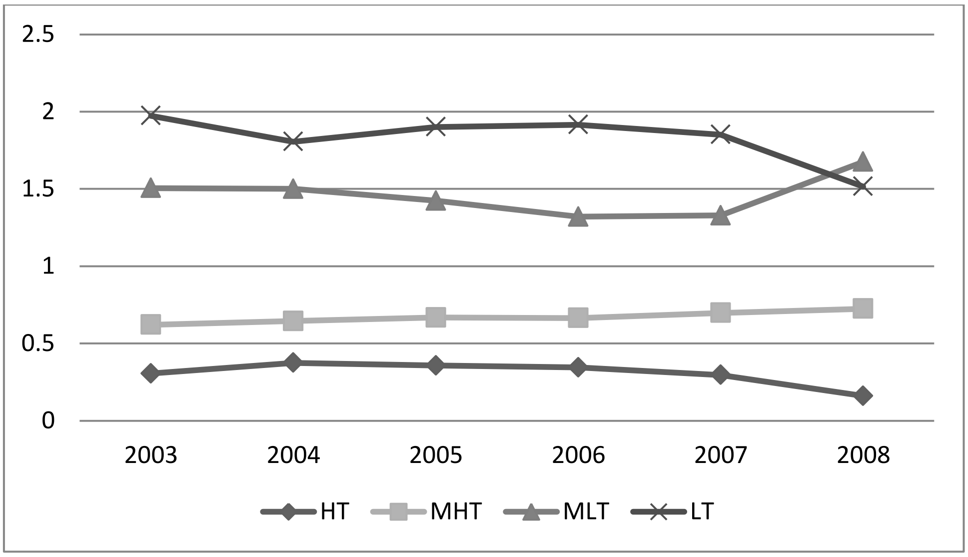

Figure 8: RCA Index by Different Technology Groups[20] (Source: Author's calculations based on UNIDO Industrial Balance Statistics)

Figure 8 indicates the movement of the RCA indices relative to 29 countries computed for the total sector groups that belong to different technology intensity groups. The comparative advantage index firstly indicates that Turkey's specialization pattern is more towards low technology sectors, despite the fact that the medium low technology sectors takes the lead in the year 2008. The index numbers of medium high technology and high technology sectors remained limited in terms of comparative advantage.

When one takes sectoral decomposition of the RCA index into account, as shown in Table 8 which includes sectors classified according to ISIC (REV. 3), the picture will be clearer. In the low technology sectors,

[20] HT: High Technology Sectors, MHT: Medium High Technology Sectors, MLT: Medium Low Technology Sectors, LT: Low Technology Sectors

15- Manufacture of food products and beverages

16 - Manufacture of tobacco products (only in 2008)

17 - Manufacture of textiles

18 - Manufacture of wearing apparel; dressing and dyeing of fur

36 - Manufacture of furniture; manufacturing n.e.c.[21]

sectors seem to be comparatively advantageous sectors. In the medium low technology sectors,

25 - Manufacture of rubber and plastics products

26 - Manufacture of other non-metallic mineral products

27 - Manufacture of basic metals

28 - Manufacture of fabricated metal products, except machinery and equipment

351 - Building and repairing of ships and boats

are the sectors in which Turkey enjoys comparative advantage over the 29 export partners.

The medium high technology and high technology sector performance of Turkey is rather weak in comparison to the other sectors in terms RCA index.

[21] Not elsewhere classified

Table 8: Sectoral Decomposition of RCA Index

Sector	Name	2003	2004	2005	2006	2007	2008
LOW TECHNOLOGY							
15	Manufacture of food products and beverages	1.36	1.32	1.49	1.14	1.03	1.1
16	Manufacture of tobacco products	0.8	0.56	0.76	0.99	0.92	1.16
17	Manufacture of textiles	5.87	4.9	5.3	8.83	8.4	6.7
18	Manufacture of wearing apparel; dressing and dyeing of fur	10.1	8.74	8.54	7.1	6.74	5.59
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.63	0.62	0.71	0.65	0.67	0.52
20	Manufacture of wood and of products of wood and cork, except furniture	0.42	0.39	0.42	0.43	0.45	0.55
21	Manufacture of paper and paper products	0.34	0.32	0.35	0.3	0.35	0.42
22	Publishing, printing and reproduction of recorded media	0.17	0.16	0.14	0.15	0.15	0.17
36	Manufacture of furniture; manufacturing n.e.c.	1.36	1.36	1.49	1.24	1.4	0.92
MEDIUM LOW TECHNOLOGY							
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.87	0.74	0.97	0.85	0.84	0.81
25	Manufacture of rubber and plastics products	1.04	1	1.14	1.06	1.11	1.27
26	Manufacture of other non-metallic mineral products	2.72	2.52	2.79	2.21	2.13	2.51
27	Manufacture of basic metals	1.87	1.94	1.68	1.48	1.5	2.3
28	Manufacture of fabricated metal products, except machinery and equipment	1.15	1.21	1.28	1.17	1.18	1.41
351	Building and repairing of ships and boats	2.43	2.67	0.42	3.41	3.39	4.29
MEDIUM HIGH TECHNOLOGY							
24-2423	Manufacture of chemicals and chemical products	0.39	0.35	0.35	0.34	0.31	0.33
31	Manufacture of electrical machinery and apparatus n.e.c.	0.62	0.55	0.61	0.67	0.78	0.83
34	Manufacture of motor vehicles, trailers and semi-trailers sector	0.89	1.06	1.08	1.06	1.12	1.23
29	Manufacture of machinery and equipment n.e.c.	0.5	0.46	0.49	0.49	0.51	0.53
352	Manufacture of railway and tramway locomotives and rolling stock	0.05	0.04	0.12	0.05	0.02	0.03
359	Manufacture of transport equipment n.e.c.	0.48	0.46	0.46	0.34	0.3	0.24
HIGH TECHNOLOGY							
2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	0.18	0.26	0.17	0.21	0.2	0.09
353	Manufacture of aircraft and spacecraft	0	0	0	0.23	0.23	0.13
30	Manufacture of office, accounting and computing machinery	0.04	0.04	0.05	0.05	0.08	0.05
33	Manufacture of medical, precision and optical instruments, watches and clock	0.06	0.08	0.08	0.08	0.08	0.07
32	Manufacture of radio, television and communication equipment and apparatus	0.92	1	1.09	0.85	0.71	0.39

In the medium high technology sectors, the comparatively advantageous sector is;

34 - Manufacture of motor vehicles, trailers and semi-trailers sector gains comparative advantage in the period 2004- 2008.

In the high technology sectors, there is only one sector on which Turkey experiences comparative advantage in 2004- 2005 period which is;

32 - Manufacture of radio, television and communication equipment and apparatus

As a result of this investigation on RCA, one can conclude that the export patterns of Turkey are more towards low technology and medium low technology sectors. In five of ten low technology sectors and five of six medium low technology sectors, Turkey has enjoyed comparative advantage, whereas one of six medium high technology sectors and one of five high technology sectors reveal more than unity RCA.

The examination above can be summed up under a number of headings. First, Turkish export boom in 2000s has failed to transform the trade structure to more technology intensive sectors. The specialization patterns and the characteristics of imports and exports of broad commodity groups indicate that the export structure is based on low value added, low technology sectors. Second, the country concentration of exports points out that major trading partners of Turkey are EU-27 countries and exports are concentrated in this region. The concentration of the exports may be harmful, since in case of a crisis occurring in the main trading partner, exports may come down and the harmful effects of the crisis may easily spread over Turkey. Third, exports are found to be import dependent as pointed out by other researches[22]. Among the others, intermediate goods imports dominate the

[22] e.g. Saygılı, Cihan, Yalçın and Hamsici (2010)

import structure. In the light of above discussion, the next section scrutinizes competitiveness indicators for the period in question in Turkey on a sectoral basis.

3.3. Competitiveness Indicators

In this section, a number of Turkey's competitiveness indicators will be analyzed on a descriptive basis for the indicators outlined in Section 2.4 for the period in question. First, the technology level of exports of Turkish manufacturing sector will be examined via various indicators. Second, the unit labor costs will be explained. In the third sub section, productivity will be underscored and in the following subsection, skill development will be clarified. The results of this overview will set up the basis for the econometric analysis which will be presented in Chapter 4.

3.3.1. Technology Level

Science and technology (S&T) policies had been ineffective in Turkey until 1990s, although there is some struggles to establish a systematic S&T framework. Rodrik (1995) compares two groups of countries in their export performances, Turkey and Chile on the one hand, South Korea and Taiwan on the other. He states that Turkey and Chile fails to provide a well-defined investment and S&T framework to promote exports and their exports has relied on continuous exchange rate devaluations. In contrast, the two East Asian countries, South Korea and Taiwan succeeded to establish an investment and S&T framework for their export rise. As a result, the S&T policies remained fruitless in 1980s through 2000s in Turkey. Turkish Economy, therefore, tries to gain competitiveness through price variables. Looking deeper to the innovativeness and export performance relation for Turkey, Pamukçu (2003) and Özçelik and Taymaz (2004) found that the firms introducing innovations are more likely to be exporters by applying firm level data for Turkish manufacturing industry. Despite the fact that the close relation between innovativeness and export performance is captured at the firm level, but at the country level, the close relation is not observable for Turkey.

The S&T policies can be classified in three major periods, namely 1960- 1980 period, 1980-2000 period and 2000- 2011 period. Table 9 summarizes the major developments in S&T policies of Turkey in these three periods. The first part of the table supports Rodrik (1995) in the failure of Turkey in setting up an S&T infrastructure.

In 1963- 1980 period, there is limited effort in the S&T policies. The main developments in this period were the establishment of the Scientific and Technological Research Council of Turkey (TUBITAK) and Marmara Research Center (MAM). The main intuition for the foundation of these centers was to develop a framework for the production of intermediate and capital goods (Şenses & Taymaz,2003). The outward orientation of the Turkish economy after 1980s brought about rise of technology development funds which are provided to fund R&D activities (Tandoğan & Pamukçu, 2011). R&D supports are shaped around this notion after 1980s onward. In 1980-2000 period, the Supreme Council for Science and Technology (BTYK) is established. The first S&T strategy was

Table 9: An Overview of S&T Policies in Turkey

Periods	Events
1960-1980	1963-The establishment of TUBITAK, Marmara Research Center
1980-2000	1983- The first technology Policy Document of Turkey 1983- The Establishment of BTYK 1990- KOSGEB 1991- First technopark in METU 1994- The start of R&D subsidies to private firms 1995- TTGV, Patent Institute, Turkish Acedemy of Sciences 1997- TUBITAK Innovation Projects(TEYDEB)
2000-2011	2004- 'National Science and Technology Policies-2003-2023 Strategy' Document 2007- SMEs startup subsidies program 2008- Law of R&D 2010- Technology Production Centers 2011- Industrial Strategy Document 2011-2014

Source: Prepared by using Şenses and Taymaz (2003)

announced by BTYK for the period 1983-2003. The program failed to realize its major goals and S&T policies are neglected till 1990s.[23] In 1990s, especially with the foundation of Technology Development Foundation of Turkey (TTGV), the Technology Monitoring and Evaluation board of the Scientific and Technical Research Council of Turkey (TIDEB) and Small and Medium Enterprises Development Organization (KOSGEB), R&D supports to firms has gained momentum. These foundations were to give R&D loans to private firms. In 2000s, these subsidies to private firms continued at an increasing level. As an indicator of this increase, the share of direct support to R&D in total private R&D expenditures was less than 1 % in 1995 and it soared to 10 % in 2008. 6122 of 10161 projects supported to TUBITAK-TEYDEB were supported in 1995-2009 period. The average subsidy per supported project was 80000 USD in 2002 and it became 270000 USD in 2008. As for TTGV projects, 179 projects were supported in 1992-1999 period and 891 projects were supported in 2000-2009 period (Tandoğan & Pamukçu, 2011). All of these numbers point to the fact that R&D supports has risen in 2000s to a considerable extent. Özçelik and Taymaz (2008) studied the impacts of these R&D grants on enhancing the innovativeness of Turkey at the firm level. They found that public R&D support stimulates involvement of the firms in R&D activities. Larger firms are inclined to be interested in R&D activities. Their last finding is that R&D subsidies are more efficient in encouraging innovation in comparison to tax incentives.

After giving an overview of S&T policies in Turkey, the evolution of technology level measured by R&D expenditures is summarized in Figure 9. The numbers highlight that the R&D share in GDP has doubled in the first decade of 2000s. One

[23] The BTYK was expected to meet two times in a year. However, they made the second meeting in 1993, ten years later than the first one.This is also an evidence of the neglect of S&T policies in 1980s (Şenses & Taymaz,2003). In addition, this also props up the diagnosis of Rodrik(1995).

can, nevertheless, may find it insufficient if it is compared with the Lisbon strategy, which aims 3 % of GDP should be devoted to R&D activities.[24] In addition, the

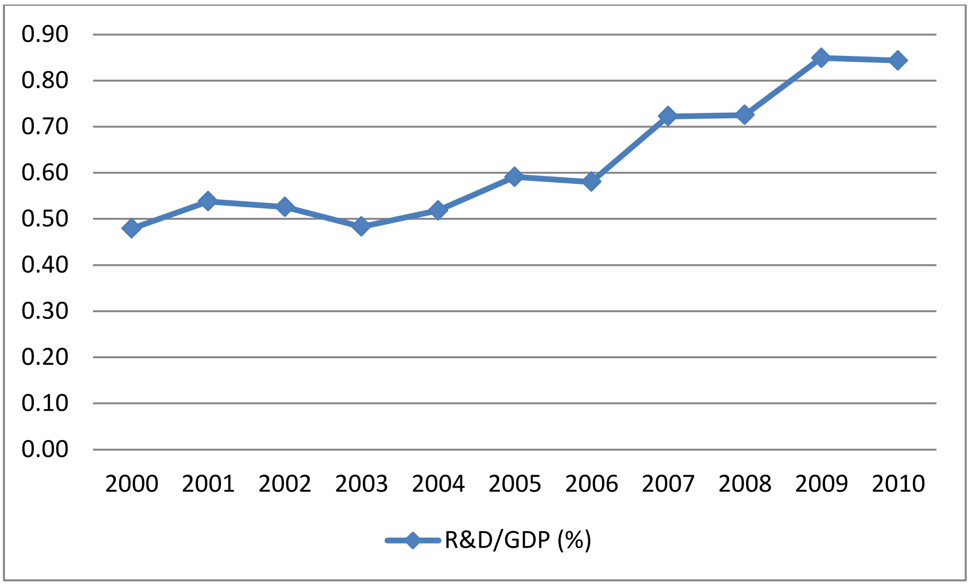

Figure 9: The Share of R&D in GDP (Source: TURKSTAT)

goal of 9th Development Plan for R&D to GDP ratio is 2 % for 2013 (SPO,2006:60). The overall R&D effort of economy seems, thus, to be inadequate for Turkish economy in terms of both national and international goals.

The composition of R&D by main sectors of performance indicates that higher education institutions take the lead with its share 55 % on average in the 2000- 2010 period. The business enterprise comes second with its share 35 % and the government's direct involvement in R&D activities as a performer has the least share (10 % on average). The 9th development plan sets 60 % for private sector; however, it seems far away from realizing this goal (Figure 10).

[24] European Council (2002)

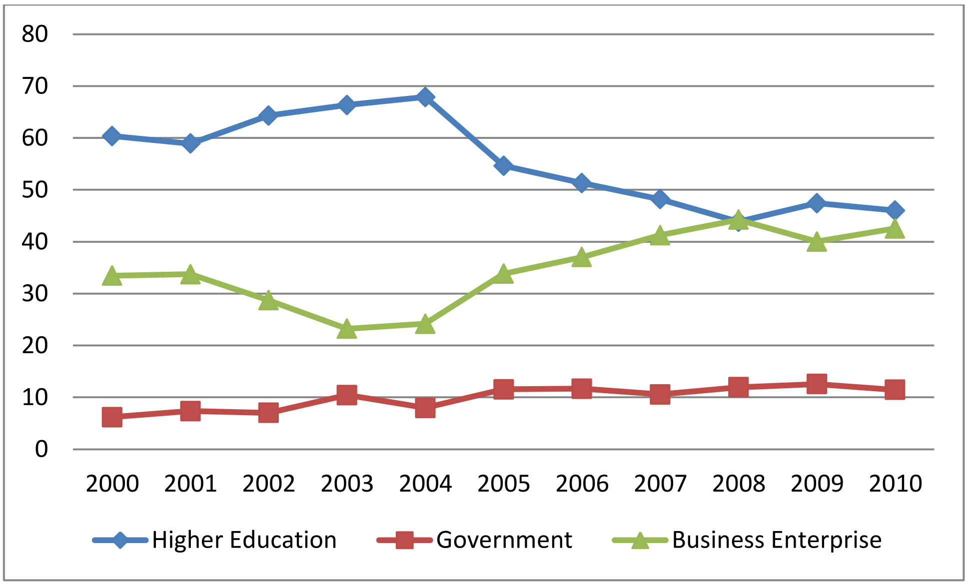

Figure 10: The Composition of R&D by Main Sectors of Performance (Source: TURKSTAT)

The sectoral composition of the R&D expenditures as a share of total R&D spending is presented in Table 10. The data availability dictates to classify sectors into two broad categories by two classes in one category in contrast to other analysis conducted in the preceding section. When one looks to the figures in Table 10, the top three sectors coming to the forefront are as follows;

15- Manufacture of food products and beverages

17 - Manufacture of textiles

26- Manufacture of other non-metallic mineral products in low technology and medium low technology sectors,

29-Manufacture of machinery and equipment n.e.c. (13.6 %)

32-Manufacture of radio, television and communication equipment and apparatus (19 %)

Table 10: Composition of R&D Expenditures in the Manufacturing Sectors

Sectors	Name	2003	2004	2005	2006	2007	Average
	LOW TECHNOLOGY+ MEDIUM LOW TECHNOLOGY						
15	Manufacture of food products and beverages	0.109	0.035	0.03	0.03	0.034	*0.048*
16	Manufacture of tobacco products	0	0	0	0	0	*0*
17	Manufacture of textiles	0.151	0.013	0.031	0.02	0.018	*0.047*
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.005	0.001	0.004	0.002	0.003	*0.003*
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.007	0.001	0.002	0.002	0.002	*0.003*
20	Manufacture of wood and of products of wood and cork, except furniture	0	0	0	0.001	0.001	*0*
21	Manufacture of paper and paper products	0.074	0.002	0.002	0.002	0.001	*0.016*
22	Publishing, printing and reproduction of recorded media	0.003	0	0	0	0	*0.001*
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.012	0.003	0.001	0.001	0.002	*0.004*
25	Manufacture of rubber and plastics products	0.032	0.022	0.02	0.019	0.019	*0.022*
26	Manufacture of other non-metallic mineral products	0.04	0.026	0.034	0.029	0.019	*0.03*
27	Manufacture of basic metals	0.006	0.007	0.009	0.013	0.008	*0.008*
28	Manufacture of fabricated metal products, except machinery and equipment	0.025	0.01	0.006	0.006	0.004	*0.01*
36	Manufacture of furniture; manufacturing n.e.c.	0.047	0.071	0.005	0.005	0.01	*0.028*
Total		**0.512**	**0.192**	**0.145**	**0.129**	**0.12**	***0.22***
	HIGH TECHNOLOGY+ MEDIUM HIGH TECHNOLOGY						
24	Manufacture of chemicals and chemical products	0.109	0.117	0.098	0.083	0.096	*0.1*
29	Manufacture of machinery and equipment n.e.c.	0.155	0.137	0.13	0.13	0.128	*0.136*
30	Manufacture of office, accounting and computing machinery	0	0.001	0.001	0.001	0.001	*0.001*
31	Manufacture of electrical machinery and apparatus n.e.c.	0.129	0.035	0.042	0.033	0.023	*0.052*
32	Manufacture of radio, television and communication equipment and apparatus	0.023	0.208	0.234	0.22	0.268	*0.191*
33	Manufacture of medical, precision and optical instruments, watches and clock	0.031	0.01	0.018	0.01	0.007	*0.015*
34	Manufacture of motor vehicles, trailers and semi-trailers sector	0.039	0.297	0.3	0.355	0.306	*0.259*
35	Manufacture of other transport equipment	0.002	0.003	0.033	0.038	0.052	*0.026*
Total		**0.488**	**0.808**	**0.855**	**0.871**	**0.88**	***0.78***

34- Manufacture of motor vehicles, trailers and semi-trailers (26 %) in medium high technology and high technology sectors.

Further, the patent statistics are depicted in Figure 11. The figure indicates that most of the patents granted in Turkey are taken by foreigners. This is a striking finding in the sense that the foreign patents (or non-residential patents) do not contribute at least directly to export market share and international competitiveness of the home country. The technology level, therefore, will come up as very low in terms of patents.

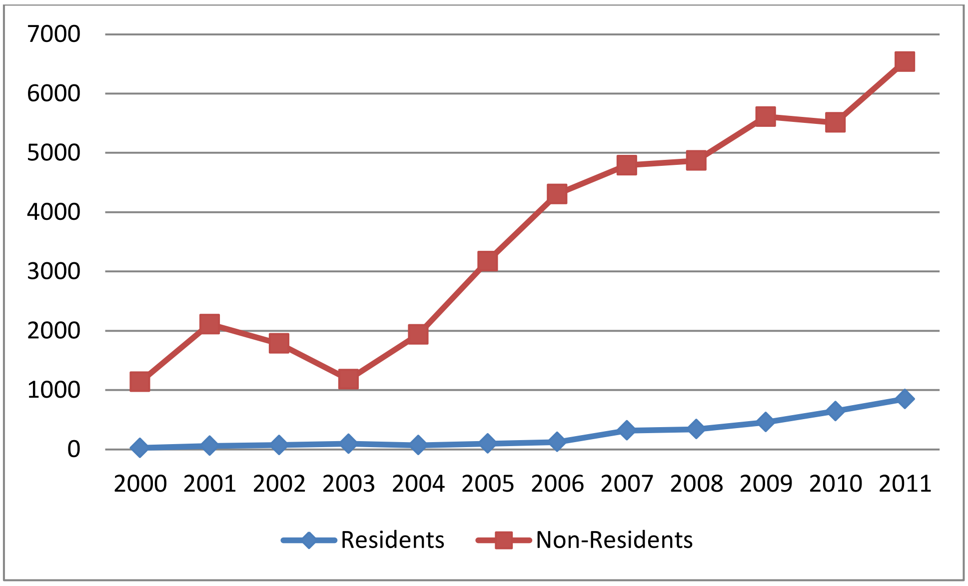

Figure 11: Patents Granted to Residents and Non-Residents (Source: Turkish Patent Institute, Sectoral Patent Statistics)

As regards to the sectoral patents granted, the decomposition is summarized in Table 11. The dominance of high technology and medium high technology sectors are obvious in the patent case as well. The prominent three sectors are as follows;

25- Manufacture of rubber and plastics products

Table 11: Sectoral Composition Patents Granted as Share of Total Patents

Sectors	Name	2003	2004	2005	2006	2007	2008	Average
LOW TECHNOLOGY+ MEDIUM LOW TECHNOLOGY								
15	Manufacture of food products and beverages	0.019	0.020	0.021	0.021	0.021	0.022	*0.021*
16	Manufacture of tobacco products	0.001	0.003	0.002	0.003	0.002	0.003	*0.002*
17	Manufacture of textiles	0.009	0.011	0.008	0.005	0.006	0.007	*0.008*
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.007	0.005	0.004	0.004	0.003	0.005	*0.005*
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.004	0.006	0.004	0.003	0.003	0.003	*0.004*
20	Manufacture of wood and of products of wood and cork, except furniture	0.003	0.004	0.003	0.003	0.003	0.004	*0.003*
21	Manufacture of paper and paper products	0.003	0.006	0.006	0.004	0.007	0.005	*0.005*
22	Publishing, printing and reproduction of recorded media	0.000	0.000	0.000	0.000	0.000	0.000	*0.000*
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.004	0.002	0.004	0.003	0.002	0.002	*0.003*
25	Manufacture of rubber and plastics products	0.068	0.072	0.072	0.068	0.058	0.064	*0.067*
26	Manufacture of other non-metallic mineral products	0.040	0.034	0.038	0.034	0.036	0.037	*0.036*
27	Manufacture of basic metals	0.017	0.015	0.023	0.021	0.022	0.018	*0.019*
28	Manufacture of fabricated metal products, except machinery and equipment	0.098	0.079	0.085	0.070	0.067	0.065	*0.077*
36	Manufacture of furniture; manufacturing n.e.c.	0.057	0.057	0.054	0.057	0.053	0.050	*0.055*
Total		**0.330**	**0.314**	**0.324**	**0.297**	**0.282**	**0.285**	***0.305***
HIGH TECHNOLOGY+ MEDIUM HIGH TECHNOLOGY								
24	Manufacture of chemicals and chemical products	0.148	0.178	0.190	0.204	0.209	0.206	*0.189*
29	Manufacture of machinery and equipment n.e.c.	0.328	0.315	0.286	0.291	0.285	0.289	*0.299*
30	Manufacture of office, accounting and computing machinery	0.020	0.019	0.018	0.018	0.022	0.021	*0.020*
31	Manufacture of electrical machinery and apparatus n.e.c.	0.033	0.029	0.025	0.027	0.031	0.025	*0.028*
32	Manufacture of radio, television and communication equipment and apparatus	0.028	0.026	0.029	0.037	0.039	0.035	*0.032*
33	Manufacture of medical, precision and optical instruments, watches and clock	0.060	0.065	0.068	0.071	0.073	0.076	*0.069*
34	Manufacture of motor vehicles, trailers and semi-trailers sector	0.046	0.044	0.050	0.045	0.048	0.048	*0.047*
35	Manufacture of other transport equipment	0.007	0.010	0.011	0.009	0.011	0.013	*0.010*
Total		**0.670**	**0.686**	**0.676**	**0.703**	**0.718**	**0.715**	***0.695***

36- Manufacture of furniture; manufacturing n.e.c. in low technology and medium low technology sectors;

24- Manufacture of chemicals and chemical products

29- Manufacture of machinery and equipment n.e.c.

34- Manufacture of motor vehicles, trailers and semi-trailers in high and medium high sectors.

The results of this analysis suggest that the technology inputs are not converted into technology outputs in most of the sectors, when one perceives the R&D as technology input variable and patents as the technology output variable. The R&D expenditures and patent analysis put forward that the return to investment on technology is high in high technology sectors, if it is compared with the RCA analysis conducted in the previous chapter.

3.3.2. Unit Labor Cost

As a price competitiveness indicator, the real exchange rates (RER) and unit labor costs (ULC) are the highlighted ones among the others. On the one hand, there is empirical support for the use of RER as an indicator for competitiveness, such as Fagerberg (1988), on the other hand, the unit labor cost is shown to be closely related to both export performance and international competitiveness of a country. Sarıkaya (2004) studied the main determinants of export performance for the period 1989-2003 by using a structural vector auto-regression model. He mainly proposes that it is real unit labor costs rather than real wages that affect the export performance of Turkey after 1999. Later, Saygılı (2010) utilized a panel cointegration model for 17 Turkish manufacturing industries to analyze the sectoral export dynamics. Her results show that the ULC has more explanatory power for explaining the export market dynamics of Turkey in comparison to RER. In addition to these two studies, the fact that Turkish economy has displayed appreciation of Turkish Lira and export boom together in the 2000s indicates that the RER fails to capture dynamics of export performance (Aysan & Hacıhasanoğlu,2007:18).

The definition of ULC can sometimes change, however, there is a generally accepted definition provided by OECD (2011) such that the ULC "measures the average cost of labor per unit of output. They are calculated as the ratio of total labor costs to real output, or equivalently, as the ratio of average labor costs per employee to labor productivity (output per person employed)." (OECD, 2011:6)

At first glance, it is clear that a country may raise its price competitiveness, either through repression of wages or by increasing productivity. Keyder, Sağlam and Öztürk (2004) computed competitiveness-based ULC index and their computations fit the definition of OECD. They also include exchange rates in the computation of ULC index. Considering the fact that the ULC indicator adopted in this study resembles to the one used by Keyder, Sağlam and Öztürk (2004), the ULC encompasses exchange rates, labor productivity and wage rates. It can be formulated as;

$$ULC_t^i = W_t^i / VA_t^i \times \varepsilon_t^i \text{ where } W_t^i = \frac{PC_t^i}{E_t^i} \times L_t^i \text{ , i=1,2,..,N , t=1,2,..,T} \quad (5)$$

In equation (5);

ULC_t^i	:	Unit Labor Cost
W_t^i	:	Labor cost of sector i in year t
VA_t^i	:	Value added at factor cost of sector i in year t (2003 prices)
PC_t^i	:	Personnel cost of sector i in year t
E_t^i	:	Number of employees in sector i in year t
L_t^i	:	Number of people employed in sector i in year t
ε_t^i	:	$/TL Exchange rate

The third column of Table 12 presents the growth rates of ULC on the sectoral basis. The medium high technology and high technology sectors exhibit a higher unit labor cost growth on average (12 %, roughly), nevertheless, the medium low technology sectors and low technology sectors record lower ULC growth. The reason could be that the human capital input used in the high technology sectors is costly. The developments, thus, in those sectors comes up with a higher growth in labor costs.

Table 12: Average Growth Rates of Investment, Productivity, ULC and Human Capital Over 2003- 2008 Period (%)

Sectors	Names	Investment	Productivity	ULC	HC
LOW TECH+MEDIUM LOW TECH					
15	Manufacture of food products and beverages	16.3	14.6	10.7	2.6
16	Manufacture of tobacco products	-38.2	22.9	2.6	-1.1
17	Manufacture of textiles	46.8	9.6	13.8	5.3
18	Manufacture of wearing apparel; dressing and dyeing of fur	-0.4	3.7	17.9	7.5
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	28.2	7.1	16.6	6.4
20	Manufacture of wood and of products of wood and cork, except furniture	17	21.7	1.8	4.5
21	Manufacture of paper and paper products	42.9	9.5	4.4	0.2
22	Publishing, printing and reproduction of recorded media	-5.3	11.5	16.3	4.9
23	Manufacture of coke, refined petroleum products and nuclear fuel	119.6	46	9.8	-8.3
25	Manufacture of rubber and plastics products	8.6	13.3	12.8	4.5
26	Manufacture of other non-metallic mineral products	37	19.6	6.4	-1.3
27	Manufacture of basic metals	29.3	49.9	9.4	-6.5
28	Manufacture of fabricated metal products, except machinery and equipment	30.3	20.6	7.9	-0.5
36	Manufacture of furniture; manufacturing n.e.c.	15.8	13.7	14.4	3.6
HIGH TECH+MEDIUM HIGH TECH					
24	Manufacture of chemicals and chemical products	16.8	11.4	13.9	3.1
29	Manufacture of machinery and equipment n.e.c.	41.2	13.4	9.6	3
30	Manufacture of office, accounting and computing machinery	116.9	11.6	19.5	16.2
31	Manufacture of electrical machinery and apparatus n.e.c.	33.3	24.1	2.9	-1.4
32	Manufacture of radio, television and communication equipment and apparatus	5.7	9.5	20.3	5.8
33	Manufacture of medical, precision and optical instruments, watches and clock	52.1	0.8	15.9	15.5
34	Manufacture of motor vehicles, trailers and semi-trailers sector	25.3	4.8	13.1	5.9
35	Manufacture of other transport equipment	133.4	3.6	1.5	29

3.3.3. Productivity

The contribution of productivity to international competitiveness was discussed in the ULC subsection. The studies on the productivity and export relationship indicate that the causality goes from productivity to exports at the firm level[25]. The productivity growth, therefore, is of essential importance for the export performance of Turkey.

Figure 12 illustrates the graph for ULC and productivity. The figures reveal the fact that productivity and ULC moved in the opposite directions especially after 2003, showing the fact that labor productivity increase in manufacturing sector compensates the high personnel costs. The enhancement of labor productivity in the Turkish economy in early 2000s can be ascribed to investments in machinery and equipment led by the use of external resources (Aydın, Saygılı & Saygılı,2007:10).

The second column of Table 12 presents average growth of productivity in the 2003-2008 period. Figures in the table show productivity increases mostly in the low technology and medium low technology sectors. The three leading sector in productivity growth are as follows;

27- Manufacture of basic metals

23-Manufacture of coke, refined petroleum products and nuclear fuel

16-Manufacture of tobacco products

As regards to high technology and medium high technology sectors, the leading three sectors in terms of productivity growth are;

31- Manufacture of electrical machinery and apparatus n.e.c.

29- Manufacture of machinery and equipment n.e.c.

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[25] For instance, Clerides, Lach and Tybout (1998) found this association between productivity and export performance at the plant level for Colombia, Morocco and Mexico.

30- Manufacture of office, accounting and computing machinery

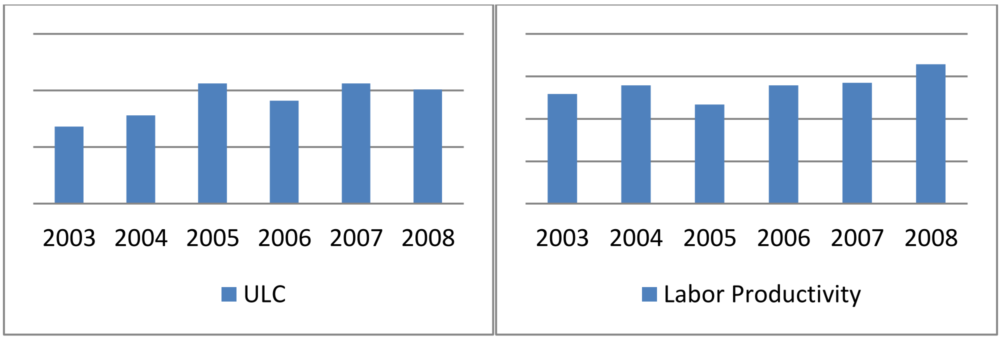

Figure 12: ULC and Labor Productivity for Total Manufacturing (Source: Author's Calculations based on TURKSTAT Data)

3.3.4. Gross Investment in Fixed Capital

The gross investment in fixed capital is one of the most widely used indicators to proxy investment in the literature. It shows how the productive capacity of sectors improves. Lequiller and Blade (2006:132) put forward in a more formal manner;

> Gross fixed capital formation is precisely defined in the national accounts as the net acquisition of produced fixed assets, i.e. assets intended for use in the production of other goods and services for a period of more than one year: machinery, vehicles, offices, industrial buildings, software, etc.

Figure 13 illustrates growth of gross fixed capital formation for the economy over 2003-2008. The figure suggests that the growth of investment has a declining trend for the period in question. As for the sectoral decomposition of it, following TURKSTAT (2010:10-11), the gross investment in tangible goods of Yearly Industry and Service statistics are adopted. The findings at sectoral level are summarized in the first column of Table 12. The three sectors that come to forefront in gross investment in fixed capital are;

23- Manufacture of coke, refined petroleum products and nuclear fuel

17- Manufacture of textiles

21- Manufacture of paper and paper products in low technology and medium low technology sectors and

35- Manufacture of other transport equipment

30- Manufacture of office, accounting and computing machinery

33- Manufacture of medical, precision and optical instruments, watches and clock in high technology and medium high technology sectors.

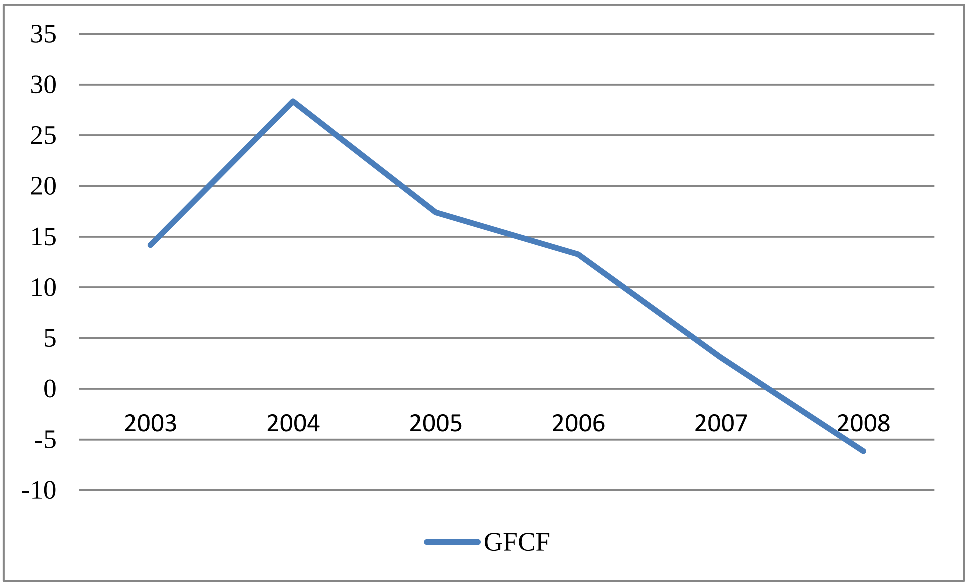

Figure 13: Growth of Gross Fixed Capital Formation for Overall Economy (at 1998 Prices) (Source: TURKSTAT)

3.3.5. Human Capital Development

The skill development or human capital development in an economy has a central position in enhancing the technological ability of a country. In a middle income country as Turkey, the skill upgrading establishes the basis for the technological change. Meschi, Taymaz and Vivarelli (2011) provide empirical evidence for this argument with a model covering 17,462 Turkish firms for the period 1980-2001. One can, accordingly, claim that the skill upgrading is of vital importance to boost the competitiveness through fostering technology improvements.

The widely accepted method in order to proxy human capital is using school enrollments. The tertiary school enrollments, hence, is depicted by Figure 14. The figure clearly shows an upward trend in the skill development for Turkey. As for the sectoral data on skills, the enrollments data is unavailable. Therefore, following Pamukçu (2003:1448), the wages and salaries per persons employed is adopted as an indicator of skill level at the sectoral level. Sectoral data about human capital development is summarized in the fourth column of Table 12. In the human capital developments, high technology and medium high technology sectors dominate the growth figures. The leading three sectors in skill development as follows;

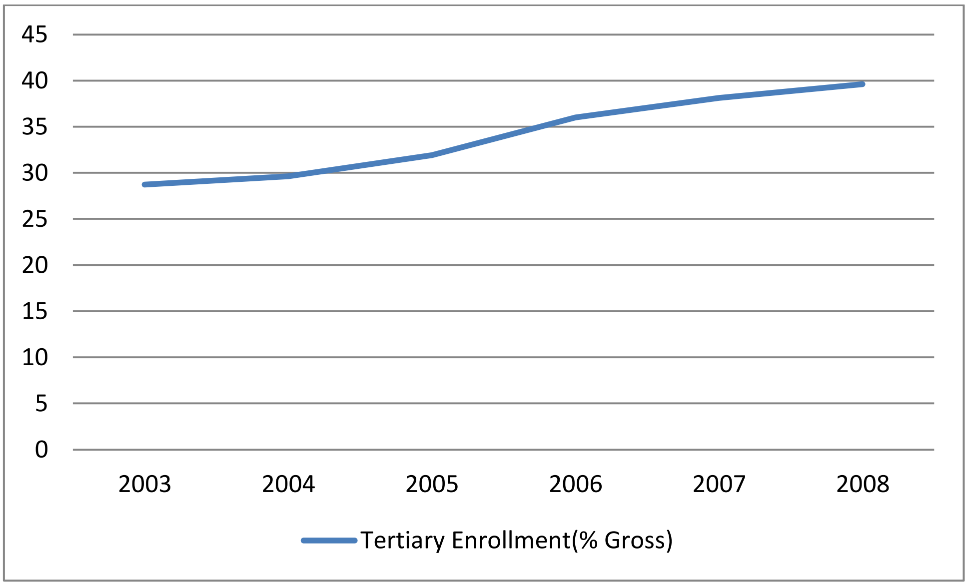

Figure 14: Tertiary School Enrollments (% of Gross Enrollments) (Source: World Bank, World Development Indicators)

18- Manufacture of wearing apparel; dressing and dyeing of fur

19- Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

20- Manufacture of wood and of products of wood and cork, except furniture in the low technology and medium low technology sectors;

35- Manufacture of other transport equipment

30- Manufacture of office, accounting and computing machinery

33- Manufacture of medical, precision and optical instruments, watches and clock in high technology and medium high technology.

3.4. Evaluation

In this chapter, an overview of Turkish international competitiveness is given on a descriptive basis. The first section reveals the fact that 1980 was a turning point in terms of structural changes and export orientation. After 1980, Turkish economy performed significant rises in the output and exports despite the presence of instabilities. The export performance of the economy in that period improved a considerable extent. The examination in the first section indicated three major bases of the Turkish Economy's structural transformation after 1980, namely the share of trade volume in GDP, productivity and distribution of value added among three basic sectors. The main conclusion one can draw from this analysis is that in 2000s, both exports and productivity triggered, hence, the analysis period of this study that covers the period between 2003- 2008 is a meaningful choice. Another lesson from Section 3.1 is that the neoliberal policies implemented in Turkey seem to come up with a high export and GDP levels, again especially in the recent decade, on the other hand, it remained limited in technological progress.

What does this investigation imply for the competitiveness discussion? The export orientation may have occurred in the sectors which offer low technological opportunity. Section 3.2 seeks support for these arguments by taking a closer look on the export structure of Turkey in 2000s. The closer scrutiny of exports raises several points. First, the shares of low technology sector in the overall exports remained high, although significant declines occurred. Falling export shares of low technology sectors do not seem to be in favor of high technology sectors. In other words, structural change of the economy does not seem to be towards industries that offer high technological opportunity. The exports, in addition, do not seem to be concentrated in one specific sector.

Section 3.3 investigates the evolution of competitiveness indicators in the period in question. In the first subsection, the technology policies are reviewed shortly. The technology level of the manufacturing industry, then, is both examined on the basis of R&D expenditures and patents. The major consequence that one can draw from this investigation is that some progress has been made but there is still far to go in terms of innovativeness.

Growth of ULC figures is expected to prop up the competitiveness as is seen from the inspection in the following section. The decline in ULC growth figures does not seem to be emanating from declining personnel compensation and appreciating exchange rate, instead it seems to be the result of soaring labor productivity. The investment growth, further, underlines the fact that the Turkish economy's overall level of investment remains insufficient. Therefore, the need for investment stimulating policies stands out. As Rodrik (1995) puts it, low saving rates are fundamental reasons for the limited investment growth. Among the sectors, there is substantial growth in the investment in high technology sectors in 2003-2008 period. As for skill development, the improvement attracts the attention in terms of tertiary enrollment at overall level. Sectoral decomposition of the skill development puts forward that most of the skill growth occurred in the high technology and medium high technology sectors. These figures also indicate the necessity for a system that advances skill base through education.

Whether these developments contributed into the competitiveness and if so to what extent they contribute are the questions that the succeeding chapter deals with. The foremost conclusion from this chapter is that there is a clear upward trend in the exports; however, the structural examination of this upward trend raises questions on the contribution of it to national competitiveness of Turkey. Finally, the impact of evolution of competitiveness indicators on the competitiveness is expected to be sensitive to the technology intensities of the sectors.

CHAPTER 4

EMPIRICAL ANALYSIS OF EXPORT MARKET SHARES OF TURKISH MANUFACTURING SECTOR

Up to now, the theoretical background of the empirical analysis to be conducted in this chapter has been stressed. The first chapter highlighted technology and trade relationship beginning from the classical international trade theories to the recent studies. In the second chapter, the selected literature based on the impact of the technology on international competitiveness has been presented. In the third chapter, the descriptive facts regarding Turkey, is given. This chapter harmonizes the outcomes of these three chapters and seeks for empirical evidence. Do the determinants outlined in the first and second chapters affect the competitiveness of Turkey? If so, to what extent? What determines the international competitiveness of Turkey? These questions are dealt with a two-step empirical procedure in this chapter. In the first step, the structural decomposition is conducted and in the second step an econometric model is introduced.

The rest of this chapter goes as follows; the following section deals with structural decomposition analysis, Section 4.2 presents the data and independent variables which are adopted to set up econometric model. Section 4.3 discusses econometric methodology and Section 4.4 illustrates estimation results. The results point out the fact that the extent to which determinants of competitiveness affect export market shares is sensitive to the technology intensities of the sectors.

4.1. Constant Market Share Analysis

The first technique used to evaluate export performance is called as ‘Constant Market Share Analysis (CMSA). The CMSA method, ultimately, underlines the causes of changes in the market shares of a country relative to other countries. This is a commonly used tool in the empirical analysis of international trade.

The CMSA methodology was introduced by Tyszynski (1951). In that paper he analyzed the export performances of 11 countries and 16 commodity groups for five peak years[26] in the period 1899-1950. He discusses that a country's share of world trade alter due to either as a result of change in the structure of world trade or as a change in the competitiveness of a country. This work constituted a basis for CMSA analysis. Following Tyszynski (1951), the main intuition of the CMSA analysis is how the aggregate export market share of a country changes when the world export market shares of individual industries or commodity groups stay constant.

Leamer and Stern (1970) also used this method in their influential book on quantitative international trade. They detailed the analysis of Tyszynski (1951) by adding commodity composition effect, showing whether the export concentration of the countries are on the commodity groups whose market shares are growing faster than world exports, and market distribution effect, indicating whether the export concentration of the countries are on the markets whose share is growing more than the world average market shares to decomposition of market shares. Leamer and Stern (1970) state that a country's export shares decline due to three main causes. First, exports may be concentrated in commodities or sectors which have relatively low demand, second, the partner region is a stagnant region and third, the country may fail to compete effectively with the other countries. As one can realize they assign geography as a determinant of the competitiveness of a country.

Richardson (1971) opposed to this approach. He indicates that Leamer and Stern (1970)'s commodity composition and market distribution effects depend on the order of calculation. That is, the order of calculation of commodity effects and market effects may change the result of CMSA analysis. He also criticized Leamer and Stern (1970)'s CMSA analysis concerning the choice of the base year, either

[26] Those years were 1899,1913,1929,1937 and 1950

initial or final year, since the CMSA analysis is conducted by using discrete time periods. These criticisms, nevertheless, have not prevented the researchers from the usage of CMSA methodology in quantitative international economic studies.

Fagerberg and Sollie (1987) discussed the major weaknesses delineated above. They reconsidered the methodology of Tyszynski (1951) and Leamer and Stern (1970) and developed a more comprehensive framework for the CMSA analysis. They decomposed changes in export market shares of the countries into five basic effects, namely commodity composition effect, market composition effect, market share effect, commodity adaptation and market adaptation effects. The first three effects were already introduced by Tyszynski (1951) and Leamer and Stern (1970) and the following two is added to overcome the foremost shortcoming of the previous method which is related with the "adaptability of different countries to changes in the patterns of world trade." (Fagerberg & Sollie,1987:1580).Among the last two effects, the commodity adaptation effect shows how a country can adapt to changes in commodity structure of the world exports and the market adaptation effect measures to what extent a country can adapt its exports in response to changes in the country composition of the world exports.

After that research, CMSA model has been widely adopted in the applied international economics literature. Although various modifications take place, the main tenets of Fagerberg and Sollie (1987) have been preserved. Merkies and Meer (1988), for instance, applied this methodology to United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) countries, USA and rest of the world trade for the years 1972 and 1976 and for 5 digit SITC product groups. They decomposed exports of the ESCAP countries into four sub categories, the world term, the market term, the commodity term and the competitiveness term. The export shares of a country, they claim, changes as reactions to changes in the world price changes. Moreover, Amador and Cabral (2008) employed CMSA to investigate the Portuguese export shares in 79 countries and for 121 manufacturing goods obtained from four digit ISIC sectors, for 1967-2006 period. They decompose the change of export market shares into four subcomponents; growth of world trade, competitiveness, geographic structure and commodity composition. As a last example, Athanasoglou, Bakinezos and Georgiou (2010) implemented CMSA for Greek exports in 280, 4 digit SITC commodity groups. They decompose exports into four components; growth of world trade, commodity composition, geographic structure and competitiveness indicator. The major result from these studies is that CMSA can be applied in various ways to different data, either commodity-based groups or industry-based groups.

The CMSA is applied to Turkish economy by various studies. Lohrman (2000), for instance, investigated the performance of Turkish exports for the period 1980-1993 and for 2 digit SITC sectors. The results of his analysis point out that Turkey failed to meet the changing demand conditions of the OECD markets in 1980s. Second, Klasra and Fidan (2007) employed CMSA to analyze the fishery exports of 12 countries, including Turkey, for 3 digit SITC groups. The consequence of this work indicates that the structural factors are more important for a country's export growth. They find Turkish fishery exports as one of the most dynamic four countries' fishery exports. Thirdly, Erlat and Erlat (2004) applied CMSA for the exports of Turkey with 8 Middle Eastern (ME) countries for the period 1998-2000. The results indicate that there is a decline in the market shares of Turkey in ME, the main source of this decline arises from the dominance of commodity composition effect. There is also positive contribution of commodity adaptation and market adaptation effects. These three examples on Turkey may end up with applicability of CMSA to Turkish exports from several aspects. Together with the studies listed above, the literature survey on the CMSA applied to Turkish economy indicates that it is widely used for commodity-based classification or the industry-based classifications are not common in the relevant literature.

CMSA can also be employed for industry level data.[27] The methodology used in this study is similar to Laursen (1999). Assume that a country's export share is defined as;

[27] e.g. Laursen(1999), Montobio and Rampa (2005)

$$a = \frac{\sum_i X_{ij}}{\sum_i \sum_j X_{ij}}, \text{ i=1,2,…,N, j=1,2,…,K} \tag{6}$$

In equation (6), X_{ij}=country j's export in sector i, N is the number of sectors and K is the number of countries. The equation (6) can be written as;

$$a = \sum_i \left(\frac{X_{ij}}{\sum_i \sum_j X_{ij}}\right), \text{i=1,2,…,N; j=1,2,…,K} \tag{7}$$

If one multplies the inside of the brackets in (7) with $\sum_j X_{ij} / \sum_j X_{ij}$, nothing will change. Then (7) is formulated as;

$$a = \sum_i \left(\frac{X_{ij}}{\sum_j X_{ij}} \times \frac{\sum_j X_{ij}}{\sum_i \sum_j X_{ij}}\right), \text{ i=1,2,…,N; j=1,2,…,K} \tag{8}$$

In equation (8), export market share of the jth country is obtained by the multiplication of two ratios. For the sake of simplicity, if one defines $b = X_{ij} / \sum_j X_{ij}$ which shows the share of country j's exports in total exports in sector i and $c = \sum_j X_{ij} / \sum_i \sum_j X_{ij}$ which indicates the share of total exports in sector i in total world exports. Then (8) would be;

$$a = \sum_i (b \times c), \text{ i=1,2,…,N} \tag{9}$$

Since the CMSA deals with growth of a which is the change in country j's export market shares , then change of a can be formulated as;

$$\Delta a = a^t - a^{t-1} = \sum_i (b^t c^t - b^{t-1} c^{t-1}), \text{ i=1,2,…,N} \tag{10}$$

In equation (10), subscript t denotes the current time period and t-1 represents the previous time period. Adding and subtracting $b^{t-1} c^{t-1}$, $b^{t-1} c^t$ and $b^t c^{t-1}$ from the identity inside the brackets in (10) will give the following identity;

$$\Delta a = \sum_i (\Delta b c^{t-1} + \Delta c b^{t-1} + \Delta b \Delta c), \text{ i=1,2,…,N} \tag{11}$$

Further decomposing $\Delta b\Delta c$ part of (11) by adding and substracting $|\Delta c\,|$ from $\Delta b\Delta c$ and multiplying and dividing it by 2 results in the following formula;

$$\Delta a = \sum_i (\Delta b c^{t-1} + \Delta c b^{t-1} + \frac{\Delta b(\Delta c+|\Delta c\,|)}{2} + \frac{\Delta b(\Delta c-|\Delta c\,|)}{2}), \text{ i=1,2,…,N} \qquad (12)$$

(12) can be written as;

$$\Delta a = \sum_i (\Delta b c^{t-1}) + \sum_i (\Delta c b^{t-1}) + \sum_i \left(\frac{\Delta b(\Delta c+|\Delta c\,|)}{2}\right) + \sum_i \left(\frac{\Delta b(\Delta c-|\Delta c\,|)}{2}\right), \text{ i=1,2,…,N} \qquad (13)$$

In (14);

$\sum_i (\Delta b c^{t-1})$ = *Market Share Effect*
$\sum_i (\Delta c b^{t-1})$ = *Structural Market Effect*
$\sum_i \left(\frac{\Delta b(\Delta c+|\Delta c\,|)}{2}\right)$ = *Market Growth Adaptation Effect*
$\sum_i \left(\frac{\Delta b(\Delta c-|\Delta c\,|)}{2}\right)$ = *Market Stagnation Adaptation Effect*

The ***market share effect*** measures the impacts of the change in the structure of the Rest of the World (ROW) exports, which is defined as the top 29 export partners of Turkey, on export market share of the home country, since the changes in a is led mainly by the changes in b. The ***structural market effect*** measures the effect of trade specialization, which is supposed not to change in one analysis period, on the export market share change, as the change in export shares originates from the changes in c. ***Market growth adaptation effect*** measures the influence of the move towards the sectors that are growing above international averages and ***market stagnation adaptation effect*** measures the impact of the move out of the sectors that are stagnating internationally, because they are based on the changes in both c and b.

Table 13 illustrates the average percentage changes of these four effects for the period between 1992- 2008. The underlying reason for the selection of periods is the crisis years, since Turkish economy has experienced the most severe financial crisis of its history in 1999-2002 period. Entries in the table indicate average growth rates of the four effects. In the high technology sectors, the market share effect, market growth adaptation effect and market stagnation adaptation effect growth does not

Table 13: CMSA with Respect to ROW (% Changes) [28]

Sectors	Effect	1992-1998	1999-2002	2003-2008
HIGH TECH	MSH[29]	-133.5	-189.4	-163.8
	MST	330.5	339.8	200.3
	MGR	-275.8	-288.2	-296.7
	MSG	156.5	154.8	127.5
	TOTAL	**77.7**	**17.0**	**-132.6**
LOW TECH	MSH	-146.3	-157.0	-155.5
	MST	2035.5	1518.8	-221.2
	MGR	-108.0	-104.8	-104.0
	MSG	134.8	123.6	-106.3
	TOTAL	**1915.9**	**1380.7**	**-587.0**

change significantly from one period to another over 2003-2008 period. The only significant change takes place in the case of structural market effect. The market share effect has a negative growth trend in all these three periods indicating the fact that changes in the structure of ROW exports has affected Turkish economy negatively in all three periods. In the structural market effect case, which measures the specialization pattern of the country in question, the historical facts display a positive impact on the export market share growth. The market growth adaptation effect underlines that Turkish exports do not move towards the sectors that are growing above international averages in all three time periods. The market stagnation adaptation effect, in addition, has a positive sign indicating that Turkish exports perform specialization that indicates move out of the sectors that are not promising anymore. The dominance of market growth adaptation effect over market

[28] A Sectoral disaggregated version of this table takes place in Appendix A, in Table 18.

[29] MSH: Market Share Effect, MST: Structural Market Effect, MGR: Market Growth Adaptation Effect, MSG: Market Stagnation Adaptation Effect

stagnation effect points out that the export structure achieves to get export differentiation and to enter the dynamic sectors.

As regards to the low technology sectors, the market share effect displays a similar pattern as in the case of high technology sectors. The structural market effect, however, turns into negative in the 2003-2008 period, showing the fact that changes in the trade specialization of Turkey have negative impact on the export market shares of the country. The market growth adaptation effect, although small in magnitude, has a negative sign as in the high technology sectors, in all three time periods. That is, the exports do not move in favor of the sectors whose exports grow above international averages. The market stagnation adaptation effect, finally, performs similar results with high technology sectors for the two periods. In the third period, nevertheless, its sign turns out to be negative, indicating that Turkish exports concentrated on the “wrong” sectors for the competitiveness of the country in the 2003- 2008 period. One last point, the absolute magnitude of the growth of market growth adaptation effect is smaller than market stagnation adaptation effect’s growth. That is to say, the exports fail to achieve differentiation and fail to enter the dynamic sectors, since the move out of the sectors that are not stagnating internationally is greater than the move towards the sectors that are growing above internationally.

In Appendix A in Table 18 the sectoral decomposition of the CMSA analysis is reported. According to the results, in high technology sectors, the sectors which have positive average change of market share effect, change of structural market effect and change of market growth adaptation effect and change of market stagnation adaptation effect and thus, which contribute to export market share of Turkey positively are depicted in Table 14.

Table 14: Sectors that Show Positive Average Change of Four Effects

Tech. Intensity	MARKET SHARE EFFECT	
	Sector	**Name**
HIGH TECH	**245**	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
	294	Manufacture of machine tools
	296	Manufacture of weapons and ammunition (only in 1992-1998 period)
	297	Manufacture of domestic appliances n.e.c.
	311	Manufacture of electric motors, generators and transformers
	314	Manufacture of accumulators, primary cells and primary batteries
	332	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment (only in 2003-2008 period)
	34	Manufacture of motor vehicles, trailers and semi-trailers (except 1992-1998 period)
LOW TECH	**16**	Manufacture of tobacco products (only in 1992-1998 period)
	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
	26	Manufacture of other non-metallic mineral products (only in 2003-2008 period)
	36	Manufacture of furniture; manufacturing n.e.c (except 1992-1998 period)

Table 14 (Continued)

Tech. Intensity	STRUCTURAL MARKET EFFECT	
	Sector	**Name**
HIGH TECH	**241**	Manufacture of basic chemicals
	244	Manufacture of pharmaceuticals, medicinal chemicals and botanical products (only in 2003-2008 period)
	245	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
	292	Manufacture of other general purpose machinery (except 2003-2008 period)
	293	Manufacture of agricultural and forestry machinery (only in 2003-2008 period)
	294	Manufacture of machine tools
	295	Manufacture of other special purpose machinery (except 2003-2008 period)
	297	Manufacture of domestic appliances n.e.c. (only in 2003-2008 period)
	300	Manufacture of office machinery and computers
	313	Manufacture of insulated wire and cable
	314	Manufacture of accumulators, primary cells and primary batteries (except 2003-2008 period)
	316	Manufacture of electrical equipment n.e.c.
	322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (only in 1992-1998 period)
	331	Manufacture of medical and surgical equipment and orthopedic appliances
	332	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
	333	Manufacture of industrial process control equipment (except 1992-1998 period)
	34	Manufacture of motor vehicles, trailers and semi-trailers
	35	Manufacture of other transport equipment
LOW TECH	**16**	Manufacture of tobacco products (only in 1992-1998 period)
	17	Manufacture of textiles
	18	Manufacture of wearing apparel; dressing and dyeing of fur (only in 1992-1998 period)
	21	Manufacture of pulp, paper and paper products
	25	Manufacture of rubber and plastic products
	27	Manufacture of basic metals (except 1992-1998 period)
	28	Manufacture of fabricated metal products, except machinery and equipment (only in 1999-2002 period)

Table 14 (Continued)

Tech. Intensity		MARKET GROWTH ADAPTATION EFFECT
	Sector	**Name**
HIGH TECH	**314**	Manufacture of accumulators, primary cells and primary batteries
	321	Manufacture of electronic valves and tubes and other electronic components (only in 2003-2008 period)
	322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (except 2003-2008 period)
	331	Manufacture of medical and surgical equipment and orthopedic appliances (only in 1992-1998 period)
	332	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
	334	Manufacture of optical instruments and photographic equipment (except 2003-2008 period)
LOW TECH	**15**	Manufacture of food products and beverages (except 1999-02 period)
Tech. Intensity		**MARKET STAGNATION ADAPTATION EFFECT**
	Sector	**Name**
HIGH TECH	**291**	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines (only in 2003-2008 period)
	292	Manufacture of other general purpose machinery
	293	Manufacture of agricultural and forestry machinery (except 1999-2002 period)
	294	Manufacture of machine tools
	295	Manufacture of other special purpose machinery (except 2003-2008 period)
	296	Manufacture of weapons and ammunition
	297	Manufacture of domestic appliances n.e.c
	300	Manufacture of office machinery and computers
	323	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods (only in 2003-2008 period)
	331	Manufacture of medical and surgical equipment and orthopaedic appliances
	35	Manufacture of other transport equipment (only in 2003-2008 period)
LOW TECH	**16**	Manufacture of tobacco products (except 2003-2008 period)
	26	Manufacture of other non-metallic mineral products (only in 2003-2008 period)
	28	Manufacture of fabricated metal products, except machinery and equipment

As stated above, the dominance of market growth adaptation effect over market stagnation adaptation effect indicates the ability to achieve the export differentiation of the country in question. In 14 out of 30 high technology sectors and 7 out of 14 low technology sectors market growth adaptation effect dominates the market stagnation adaptation effect in 2003-2008 period (Appendix A, Table 18). In these sectors, Turkish exports seem to concentrate on the dynamic sectors with respect to the ROW.

The structural market effect displays positive entries in 14 out of 30 high technology sectors and 4 out of 14 low technology sectors; for these sectors, changes in the export specialization contributes to changes in export market shares positively in 2003-2008 period. In addition, 5 out of 30 high technology sectors and 1 out of 14 low technology sectors, the structural market effect turns out to be negative in 1992-1998 periods to positive in the 2003-2008 period. Thus, the changes in specialization pattern of the economy displays a negative role for the export market share dynamics in the majority of the sectors, although, the shifts towards high rewarding high technology sectors take place.

The market share effect indicates that there are significant changes in 2 of 30 high technology and 2 of 14 low technology sectors with respect to the ROW for 2003-2008 period in comparison to 1992-1998 period. That is, the enhancement of the export market shares in almost all of the sectors is not led by the structure of the exports of ROW, in other words, the export market share gains that occurred after 2003 is not led by the gains emanating from the competitive advantage with respect to ROW.

After comparing the figures between periods, the value for the 2003-2008 period which constitutes the basis for the econometric analysis which will be presented in Section 4.3 is worth mentioning. In the 2003- 2008 period, among the four effects, the market share effect dominates 7 of the growth of the high technology sectors' export market shares. Meanwhile, structural market effect, market growth adaptation effect and market stagnation adaptation effect dominate 14, 4 and 5 sectors respectively. One can, therefore, observe the dominance of the contribution of structural market effect (either positive or negative) to the export performance of high technology sectors, meaning that specialization patterns play a significant role in the determination of export market shares in comparison to the other three effects. As regards to low technology sectors, market share , structural market, market growth adaptation and market stagnation adaptation effects dominate in 3,6,1 and 4 sectors' contributions to the growth of export market shares respectively. The same trend follows in the low technology sectors, concerning the structural market effect. In this case, however, market stagnation effect is more effective than market share effect which can be commented as the economy's ability to move out of the sectors which offer low market opportunity is more important than structure of the ROW's demand.

To sum up, Turkish export structure has shifted to a great extent in the 2003-2008 period. Once all three periods are taken into account, one can conclude that the significant changes in export market shares occurred via changes in structural market effect. As regards to technology intensities of the sectors, it is clear that the positive contribution for the high technology sectors is seen in the 2003-2008 period. All in all, one can conclude that, despite the fact that the strong impact of the low technology sectors can be observed, the structure of exports moves towards more dynamic, high rewarding sectors in comparison to the previous periods.

4.2. Data Used in Econometric Analysis

This section presents the data used in the succeeding section by outlining the construction of their formulas. The computations are based on calculations of the literature which used similar models. Since most of the indicators are retrieved from the TURKSTAT Industry and Services Statistics Database (ISD) and since this data is only available for the 2003-2008 period, the analysis will be conducted for the 2003-2008 period. The summary statistics of the variables used are illustrated in Appendix C in Table 21.

The dependent variable used in this study is growth of export market share of Turkish manufacturing industries. It is calculated as growth observed in the share of export of sector i in ROW. Equation (10) can be written as;

$$\Delta a = a^t - a^{t-1} = \sum_i (GXMS_{ij}) \tag{14}$$

In (14), $GXMS_{ij} = \Delta bc^{t-1} + \Delta cb^{t-1} + \Delta b\Delta c$ from equation (11). By doing this, the dependent variable captures both national dynamics and structural change. It is, hence, not only an indicator of simple export market shares of a sector, but it also accounts for the contribution of each sector to overall trade performance, since Δb and Δc captures national and international trade patterns and b^{t-1} and c^{t-1} takes historical factors into account (Montobio & Rampa,2005:537). The dependent variable, GXMS, therefore, considers the contribution of each sector to overall trade performance of Turkey. The data is obtained from United Nations Industrial Development Organization (UNIDO) industrial balance statistics for ISIC (REV. 3) four-digit sectors.

The first independent variable is GMST, which indicates the structural changes in the world demand and adaptability of the home exports to the ROW demand changes. It is the structural market effect obtained in the preceding section as the consequence of decomposition analysis, i.e. Δcb^{t-1} by (13).

The second independent variable is the technology indicator which is the patent shares (PSHR). Since the available data for the R&D investment is limited over 2003-2008, the patents are selected as innovativeness indicator. The patent data is acquired from Turkish Patent Institute. The patent shares of each sector in total patents granted to residents are calculated and employed in the analysis. The sectors contain 44 manufacturing sectors classified according to Statistical Classification of Economic Activities in the European Community (NACE REV. 1.1). two and three digit levels.

GINV, the third independent variable, is used as a proxy of gross fixed capital formation. It is retrieved from TURKSTAT ISD. Since disaggregated data at the sectoral level is not available for gross fixed capital formation, following TURKSTAT(2010)'s suggestion, it is calculated as gross investment to tangible goods which is the sum of gross investment in land, gross investment in existing buildings and structures, gross investment in construction and alteration of buildings, gross investment in machinery and equipment and gross investment in other tangible goods. The data is classified according to NACE (REV. 1.1). The growth rate of this variable is calculated by employing the following formula;

$$GINV = logx_t - logx_{t-1} \qquad (15)$$

where x_t denotes gross investment in physical capital at time t. It is deflated with 2003 producer price index of TURKSTAT.

Another explanatory variable is the unit labor costs, GULC. In the computation of unit labor costs, as already mentioned in Chapter 3, the OECD definition is used. It is simply calculated as the personnel cost per person divided by labor productivity per person employed times exchange rate in equation (5).The data for value added at factor cost is deflated by 2003 producer price index of TURKSTAT and after, productivity is computed.

Using the same logic with (15), growth rate of ULC is formulated as;

$$GULC = logULC_t^i - logULC_{t-1}^i \qquad (16)$$

The data is obtained from TURKSTAT ISD except exchange rates which are retrieved from OECD stat extracts and sectors are classified regarding to NACE (REV. 1.1). GLPD variable is calculated as the value added per capita in each sector. The data is retrieved from TURKSTAT ISD and it is classified according to NACE (REV. 1.1). The labor productivity is computed as follows;

$$LP_t^i = \frac{VA_t^i}{L_t^i} \qquad (17)$$

The notations are the same with equation (5). The value added at factor cost is deflated by 2003 Producer Price index. The growth of LP_t^i is calculated with the same methodology such that;

$$GLPD = logLP_t^i - logLP_{t-1}^i \tag{18}$$

The last explanatory variable is GLHC, which indicates the changes in human capital. This variable is included in the GULC to some extent in personnel compensation figures. However, it is also included as separate variable in the econometric model. It is wages and salaries paid per person employed, since skill levels and wages are correlated positively. Its formula is;

$$HC_t^i = \frac{\omega_t^i}{L_t^i} \tag{19}$$

where ω_t^i denotes the wages and salaries paid to each person employed in sector i. The ω_t^i is deflated by using 2003 Producer Price Index. The growth of HC_t^i is calculated as;

$$GLHC = logHC_t^i - logHC_{t-1}^i \tag{20}$$

This variable is also from TURKSTAT ISD as well and it is reported with NACE (REV. 1.1) classification.

As is seen GXMS and GMST variables are reported as ISIC (REV. 3) and the other independent variables are classified by using NACE (REV. 1.1). Therefore, use of concordance among the two industrial classifications is required. To convert ISIC to NACE, EUROSTAT's concordance tables are used. The Appendix B Table 19 provides detailed mapping of sectors between the two classification types at four digit level.

The technology intensities of the sectors are determined by OECD criterion which is based on the R&D intensities of the sectors. As the number of observations is limited, the sectors are classified into two categories; high technology sectors which comprise high and medium high technology sectors; the low technology sectors which are medium low technology and low technology sectors in OECD classification. The detailed list of the sectoral classification takes place in Appendix B in Table 19.

4.3. Econometric Methodology

The economic theory behind the model presented in Chapter 2 requires dynamic approach to the subject in question. The dynamic panel data model, therefore, is employed to estimate the econometric model. The dynamic model is in a log-linear form and can be specified as follows;

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + u_{it} \text{ where } u_{it} = \mu_i + \vartheta_{it} \tag{21}$$

where $\mu_i \sim IID(0, \sigma_\mu^2)$ and $\vartheta_{it} \sim IID(0, \sigma_\vartheta^2)$, x_{it} is a $K \times 1$ matrix of exogenous regressors and β is$1 \times K$ matrix of coefficients and δ is a scalar.

In equation (21), since y_{it} is a function of μ_i, the lagged values of the dependent variables will be correlated with the $y_{i,t-1}$ and this makes OLS estimation inconsistent (Baltagi,2008:147). The within transformation[30] eliminates μ_i which is the source of inconsistency. This transformation on the other hand, induces correlation between the transformed lagged dependent variable and transformed error term. That is, the transformed lagged dependent variable $y_{i,t-1} - \sum_{t=2}^{T-1} y_{i,t-1}/(T-1)$ and transformed error term $\vartheta_{it} - \sum_{t=2}^{T} \vartheta_{it}/(T-1)$ will have a non-negligible negative correlation when the time period is small. This correlation will not disappear as the number of individual units raise (Bond,2002:144). These differences from the average values are known as Nickell bias after Nickell (1981). The Nickell bias vanishes as the time period tends to infinity. Judson and Owen (1999) compared different estimators via Monte Carlo experiments for N=100 and T=5, 10, 20, 30. They found that the within estimator bias is minimized with an

[30] For a detailed account of within transformation see Baltagi (2008:13-31)

increasing T and the size of bias is 20 % when T=30. One can, thus, conclude that the within estimator will be biased and inconsistent for large N and small T.

The correlation between regressors and disturbance term due to the presence of lagged dependent variable entails the use of instrumental variable techniques. The instrumental variable estimation in that case provides a consistent estimator but it does not lead to use all moment conditions and thus it is not necessarily efficient. Instead of using the within transformation to eliminate μ_i, Anderson and Hsiao (1981 and 1982) put forward first difference transformation. Transforming (21) by first difference transformation;

$$(y_{it} - y_{i,t-1}) = \delta(y_{i,t-1} - y_{i,t-2}) + \beta\big(x_{it} - x_{i,t-1}\big)' + \big(\vartheta_{it} - \vartheta_{i,t-1}\big) \qquad (22)$$

Equation (22) provides a model with disturbance term with MA (1) process and two correlated regressors which are $(y_{i,t-1} - y_{i,t-2})$ and $\big(\vartheta_{it} - \vartheta_{i,t-1}\big)$. Anderson and Hsiao (1981, 1982) propose to use $y_{i,t-2}$ or $y_{i,t-2} - y_{i,t-3}$ as instruments which are uncorrelated with $\big(\vartheta_{it} - \vartheta_{i,t-1}\big)$ as long as ϑ_{it} is not serially correlated. Arellano and Bond (1991) develop the Anderson and Hsiao (1982) by proposing a more detailed version of it by applying GMM methodology. They argue that the entire set of the lagged variables can be used to instrument endogenous variables. Judson and Owen (1999) found that the standard deviation of Anderson-Hsiao estimator to be large when T $\leq$10, hence the use of it may be problematic.

Arellano and Bond (1991) basically developed an autoregressive model which is the same with (21) for N=100 and T=7 to evaluate the performance of Andersen-Hsiao estimator against various GMM estimators. They use first difference transformation and put forward a differenced model which eliminates the individual effects and time invariant variables. Through Monte Carlo computations, they found that the GMM estimators create a tiny bias and smaller variance in the one step GMM estimation. They applied the model to 140 UK companies for the period 1979-1984 and found that their model performs well in small T and large N cases.

This model, also known as difference GMM model, is employed for estimation in this study.

The consistency of Arellano-Bond estimator stems from the assumption that $E(\Delta\vartheta_{it}\Delta\vartheta_{i,t-2}) = 0$. Following this, Arellano and Bond (1991) proposes a test that checks for the presence of first order and second order serial correlation in disturbance terms. The null of the absence of first order serial correlation in disturbance term should be rejected and null of the absence of second order serial correlation in disturbance term should be failed to reject in order to check for autocorrelation.

The x'_{it} in (21) can either be strictly exogenous or predetermined. In the former case, all the available lags of x_{it} can be employed as valid instruments since $E(x_{it}\vartheta_{is}) = 0$ for t, s= 1,2,..,T, and in the latter case, all available lags of $x_{i,s-1}$ for $s < t$ can be applied as instruments, since $E(x_{it}\vartheta_{is}) \neq 0$. The researchers, for that reason, should adjust the instrument matrix.

One of the crucial assumptions of the GMM models is that instruments are exogenous. When the model is overidentified, testing the validity of the moment conditions (identifying restrictions) is impossible within the framework of GMM methodology (Roodman, 2009:97). One has to, therefore, test the overidentification of the model in the Arellano-Bond estimation. Hansen J statistic based on Hansen(1982), which resembles to the test statistic developed by Sargan(1958), is used to test the overidentification of the instruments, under the null hypothesis that instruments as a group are exogenous. Furthermore, the validity of the instruments can also be checked with difference-in-Hansen tests with the null of joint validity of the full instrument set (Roodman,2009:98). In addition, the number of moment conditions raises with the incrementing time period T. On the one hand, it increases the efficiency, on the other it introduce bias (Baltagi,2008:154). Therefore, Hansen test determines the level of efficiency and bias tradeoff by performing overidentification tests.

As a result the model to be estimated in this study is;

$$GXMS_{it} = \beta_1 GXMS_{i,t-1} + \beta_2 GINV_{it} + \beta_3 GMST_{it} + \beta_4 GLHC_{it} + \beta_5 GLPD_{it} + \beta_6 PSHR_{it} + \beta_7 GULC_{it} + u_{it} \quad (23)$$

where $u_{it} = \mu_i + \vartheta_{it}$

In equation (23);

$GXMS_{it}$= Growth in export market share of sector i at time t.

$GINV_{it}$=Rate of change of gross fixed capital formation in sector i at time t.

$GMST_{it}$=Growth in structural market effect in sector i at time t.

$GLHC_{it}$ = Rate of change of human capital in sector i at time t.

$GLPD_{it}$= Rate of change of labor productivity in sector i at time t.

$PSHR_{it}$=Patent share of total patents in sector i at time t.

$GULC_{it}$= Rate of change of unit labor cost in sector i at time t.

and μ_i represents the individual effects introduced as time dummies in this model.

The inspection in this section indicates that the most appropriate method to conduct panel estimation with 44 cross sectional units and 6 years is the difference GMM method which is asserted by Arellano and Bond (1991). The next section reports the results of the Arellano-Bond model estimation and its post estimation diagnostics.

4.4. Empirical Results

The model employed in this section uses 44 manufacturing sectors for the period 2003-2008 in Turkish economy. The estimation results are presented for high technology and low technology sectors separately in Tables 15 and 16, respectively. The variables which are not in a ratio form, including GINV and GLHC are logarithmically transformed in order to prevent large variations in the data.

The model includes time dummies for each year, as “the autocorrelation test and the robust estimates of the coefficient standard errors assume no correlation across individuals in the idiosyncratic disturbances. Time dummies make this assumption more likely to hold.” (Roodman, 2009:128) The model takes $GXMS_{t-1}$, GMST and GINV as endogenous variables, and the others as exogenous variables. The first and second variables are endogenous by definition and the GINV variable is endogenous by economic theory, since causality between GXMS and GINV may be in both directions.

Table 15 and Table 16 depict the estimation results for high technology industries and low technology industries separately. Each column of the tables corresponds to separate models. There are nine models for the high technology sectors and seven models for low technology sectors to check robustness of the estimates of the model (1).

At first glance one can see that the estimation results are sensitive to the technology intensities of the sectors, thus disaggregated analysis is meaningful in such a study.$GXMS_{t-1}$ variable, additionally, is the first lag of the dependent variable and is observed to be negatively associated with the growth of export market share in the current period.

The GMST variable, which indicates the structural changes in the world demand, seems to have no significant effect on the growth of export market shares as is seen from Table 15 in model (1). In the case of low technology sectors, however, this variable is significant in Table 16. It has a negative impact on the growth of export play a significant role only in the low technology case and it has a negative impact on the international competitiveness. When GMST variable increases by one unit, it will decline the growth of export market shares by 1.70, other things being equal, in low technology sectors. One can, therefore, conclude that structural changes in the world demand have negative impact on the export market share growth in low technology sectors.

Table 15: Estimation Results for High Technology Industries

GXMS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$GXMS_{t-1}$	-0.53788	-0.57768	-0.46524	-0.51973	-0.73663	-0.47633	-0.76125		
	(9.21)***	(4.56)***	(9.01)***	(5.70)***	(17.21)***	(6.79)***	(5.62)***		
PSHR	0.02313	0.02690							0.00669
	(1.69)	(1.76)*							(1.04)
$GLPD_{t-1}$	-0.00226	-0.00241	-0.00192	-0.00198	-0.00206		-0.00118	-0.00190	
	(2.60)**	(2.46)**	(2.43)**	(2.33)**	(2.16)**		(1.42)	(2.16)**	
GMST	0.18537		0.42665						
	(0.24)		(0.58)						
GINV	0.00210	0.00203	0.00193	0.00179	0.00257	0.00190		0.00366	0.00238
	(3.13)***	(3.37)***	(2.74)**	(2.68)**	(2.07)*	(1.20)		(1.65)	(1.19)
GULC	0.00050	0.00041	0.00054	0.00043					
	(1.84)*	(1.56)	(1.89)*	(1.56)					
GLHC									0.00891
									(1.23)
Diagnostics;									
F	*17.01****	*9.39****	*44.24****	*62.87****	*331.09****	*39.84****	*59.15****	*2.12*	*1.07*
AR(1)	*0.024*	*0.018*	*0.049*	*0.053*	*0.068*	*0.098*	*0.054*	*0.053*	*0.380*
AR(2)	*0.904*	*0.809*	*0.337*	*0.321*	*0.816*	*0.040*	*0.995*	*0.512*	*0.452*
Hansen	*0.990*	*0.775*	*0.980*	*0.631*	*0.553*	*0.544*	*0.048*	*0.511*	*0.796*
DinH1	*0.976*	*0.471*	*0.954*	*0.282*	*0.281*	*0.218*	*0.516*	*0.244*	*0.444*
DinH2	*0.848*	*0.962*	*0.867*	*1.000*	*1.000*	*1.000*	*0.009*	*1.000*	*1.000*
N	*63*	*63*	*63*	*63*	*64*	*86*	*73*	*64*	*86*

*Notes:** p<0.1; ** p<0.05; *** p<0.01, t statistics take place in parenthesis. F statistics for F test and p-values for the other tests are reported in diagnostics. In all the models estimated year dummies are included.

Diagnostic Tests; F: Test of joint significance; H_0:Independent variables are jointly equal to zero; AR(1): Arellano-Bond Test for Autocorrelation; H_0:There is no first order serial correlation in error term; AR(2): Arellano-Bond Test for Autocorrelation; H_0:There is no second order serial correlation in error term; Hansen: Hansen J Statistic of overidentifying restrictions; H_0:Model Specification is Correct and all instruments are valid instruments; DinH1: Difference in Hansen Test excluding group; H_0:GMM instruments without instrumental variable instruments are exogenous; DinH2: Difference in Hansen Test of exogeneity of standard instrument subsets; H_0:Standard IV instruments are exogenous and they increase Hansen J test.

Table 16: Estimation Results for Low Technology Industries

GXMS	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GXMS_{t-1}$	-0.40935	-0.43102	-0.45302	-0.47748	-0.59020	-0.20342	-0.39086
	(2.40)**	(2.80)**	(3.35)***	(4.04)***	(2.82)**	(3.10)***	(2.39)**
PSHR	-0.01088		-0.01179				-0.01162
	(0.81)		(0.83)				(0.81)
$GLPD_{t-1}$	0.00366	0.00390	0.00395	0.00421	0.00210		0.00344
	(2.02)*	(2.09)*	(2.33)**	(2.41)**	(1.66)		(1.90)*
GMST	-1.70467	-1.71507	-1.85075	-1.86889	-1.78069	-1.33015	-1.64811
	(2.07)*	(2.03)*	(2.14)*	(2.09)*	(2.14)*	(1.75)	(2.07)*
GINV	0.00151	0.00161					0.00210
	(0.45)	(0.47)					(0.65)
GULC	-0.00126	-0.00128	-0.00122	-0.00125		-0.00112	-0.00122
	(1.70)	(1.73)	(1.84)*	(1.86)*		(1.70)	(1.73)
GLHC							0.01325
							(0.64)
Diagnostics;							
F	*10.57****	*8.38****	*12.15****	*8.87****	*4.39***	*7.93****	*19.33****
AR(1)	*0.229*	*0.230*	*0.252*	*0.254*	*0.302*	*0.105*	*0.266*
AR(2)	*0.273*	*0.223*	*0.266*	*0.215*	*0.301*	*0.469*	*0.229*
Hansen	*1.000*	*1.000*	*0.998*	*0.993*	*1.000*	*1.000*	*1.000*
DinH1	*1.000*	*1.000*	*0.990*	*0.994*	*0.991*	*0.998*	*1.000*
DinH2	*1.000*	*0.967*	*0.922*	*0.682*	*1.000*	*0.948*	*1.000*
N	*42*	*42*	*42*	*42*	*42*	*56*	*42*

*Notes:** $p<0.1$; ** $p<0.05$; *** $p<0.01$, t statistics take place in parenthesis. F statistics for F test and p-values for the other tests are reported in diagnostics. In all the models estimated year dummies are included.

Diagnostic Tests; F: Test of joint significance; H_0:Independent variables are jointly equal to zero; AR(1): Arellano-Bond Test for Autocorrelation; H_0:There is no first order serial correlation in error term; AR(2): Arellano-Bond Test for Autocorrelation; H_0:There is no second order serial correlation in error term; Hansen: Hansen J Statistic of overidentifying restrictions; H_0:Model Specification is Correct and all instruments are valid instruments; DinH1: Difference in Hansen Test excluding group; H_0:GMM instruments without instrumental variable instruments are exogenous; DinH2: Difference in Hansen Test of exogeneity of standard instrument subsets; H_0:Standard IV instruments are exogenous and they increase Hansen J test.

The PSHR variable has low significance level in the high technology case (11 % roughly in model (1)). The low significance may have originated from the low share of the high technology sectors in total patents granted to the residents of Turkey. The impact of it to the growth of export market shares is positive as is expected previously. When the share of patents granted to domestic innovators increases by one unit, it contributes to the growth of export market shares by 0.023. Regarding the low technology case, the patents have no significant effect on the growth of export market shares. These findings underline the place of technology for the international competitiveness of Turkey.

GINV variable represents the investment in physical capacity. From the first column of Table 15, the growth of fixed capital investment has a significant positive effect at 1 % confidence level in the high technology sectors. That is, one unit rise in the investment will be converted to 0.002 unit export market share gain in the high technology sectors. As regards to low technology sectors, it has no significant effect on the growth of export market shares. These findings provide important outcomes for the policy makers in shaping the government subsidies.

The price variable, GULC, reflects diverse patterns in both of the sector groups. First of all, in both sectors, GULC has significant effect on GXMS. In the case of high technology sectors, the unit labor cost growth contributes positively to the growth of export market shares. One unit rise in GULC increments GXMS by 0.0005. This outcome props up the Kaldor paradox which asserts that both costs and competitiveness can move in the same direction. The underlying reason for this finding may be the wages paid to the workers employed in the high technology sectors, since the labor employed in such sectors are usually skilled labor. Thus, the increase in unit labor cost may contribute to export market share when the source of its increase is the use of skilled labor in the production. As for the low technology sectors, the traditional view is performed. In other words, the export market shares and unit labor cost growth are negatively related. One unit increase in the GULC reduces export market shares by 0.013 in the low technology sectors.

$GLPD_{t-1}$ variable indicates the first lag of labor productivity; it is taken with first lag due to its relatively higher correlation with GULC variable in comparison to the other variables (Table 22 in Appendix C). The labor productivity affects GXMS significantly in both sector groups, while its effect differs among the two sector groups. In high technology sectors, one unit rise in labor productivity declines the subsequent periods' export market share growth by 0.002. As regards to the low technology sectors, it enhances to export market share growth by 0.004. The essential reason for this difference may be due to the variation of unit labor costs over the period in question. The economic growth in 2003-2008 raised productivity while declining the unit labor costs. The counteraction of these two variables makes productivity effect negative in high technology sectors and positive in low technology sectors. This finding is consistent with Fagerberg (1988). Another explanation may be that since this indicator is used to proxy efficiency of working of the economic system, the efficient interaction between agents may contribute to international competitiveness in high technology sectors and affects adversely in low technology sectors. Considering the diversity between the two groups, the first explanation is more likely to be accurate.

GLHC is only included in model (9) in the high technology sectors and in model (7) in low technology sectors because of the fact that its dynamics are captured by GULC variable. It has no significant effect in both cases regardless of technology intensities of the sectors.

The nine models proposed in the Table 15 are used to check the robustness of the findings in model (1). The results indicate that the magnitude of the coefficients does not vary significantly in all cases. The specification (6) in Table 15 suffers from autocorrelation problem in its residuals, except this there is not a problem in diagnostics. In the models where PSHR variable is not introduced, namely (4) through (9), the Hansen test is observed to be weakened indicating that the specification of these models is weak in comparison to the models which includes PSHR. In addition, the estimate of $GXMS_{t-1}$ coefficient implies that the omitted variables' effects are reflected in this variable as a result of (5) through (7). Finally, the model (9) where GLHC is present fails to pass the joint significance F test. As a consequence, the estimation results of model (1) are robust to different specifications. The model (1) is also checked for low levels of instrument counts by dividing the instrument matrix into groups and the results did not change significantly.[31]Eventually, the model for high technology sectors are tested by limiting the lag lengths that are used as instruments. As a result of this inspection, the model is found to be robust to different lag lenghts.

The sensitivity of the results of low technology sectors to different specifications are presented in Table 16. There are large variations in $GXMS_{t-1}$ variable in models (5) through (7) since in these models, one of the GULC and $GLPD_{t-1}$ is excluded from the model, because these variables have relatively higher correlation as stated above. When both of these two variables are included in the model, the diagnostics do not deteriorate. These two variables together, therefore, can be included in the model. The significance of the GULC variable varies across different models. When the instruments are divided into subsets to test the robustness of the variables, the GULC variable turned out to be insignificant, whereas other variables remain significant. One can, therefore, conclude that the model for the low technology sectors is robust to changes not only in the instrument set (except GULC variable) but also to different specifications. Finally, the model for low technology sectors is checked for limiting the lags of the endogenous variables that are used as instruments and the results are also found to be robust to different lag lengths.

[31] This analysis is conducted by collapse option of xtabond2 command of STATA software program. For a detailed discussion, see Roodman(2009)

CHAPTER 5

CONCLUSION

The main motivation of this study is to shed light on the dynamics of export market share that occurred as a result of export boom in the 2000s. The structural change of exports and its impact on the international competitiveness measured through export market shares are analyzed empirically over the period 2003-2008. The difference of this study from the previous ones applied to Turkish manufacturing sector can be compiled in three major headings; First, the dynamic econometric approach that takes place at sectoral level to analyze export market share of Turkish manufacturing exports. This study takes disaggregated approach by classifying them according to their technology intensities. Second, the variety of the determinants of export market shares is another contribution of this study. The export market shares are examined in a detailed manner in order to control for most of the variables affecting it. Third, such an analysis is not conducted for the time period after 2003, where exports started to boost.

The second chapter deals with the theoretical aspects of the link between innovativeness and competitiveness. It clearly indicates that there is burgeoning literature appeared especially after 1960s and 1970s and went up in 1980s to significant numbers. The inspection of these theoretical contributions points out a strong link between the two concepts. Moreover, this chapter also outlines the determinants of export market shares by establishing their links. As a result of these investigations, six indicators are found to be as important determinants of the export market shares which are innovations, productivity, unit labor costs, investment in fixed capital, structural change of world export demand and human capital.

In that chapter there is also a survey concerning the empirical applications about the determinants of international competitiveness. The empirical methodology of this thesis gains relevance from the studies mentioned. In most of the works, concerning international competitiveness, more or less the determinants detected in the same chapter are used to seek empirical evidence. The empirical results, concerning the determinants of export market shares indicate that although low significances occur in some studies, there are different impacts of each determinant to export market share dynamics in different countries. The impact of unit labor costs to export market shares, for instance, is found to be negative in some studies and positive in the others. What is not changing is the role of innovativeness for export market share dynamics among the other variables. Furthermore, most of the studies employ dynamic approach in an evolutionary fashion and this fact legalizes the approach of this thesis.

Chapter 3 starts with an overview of the structural changes in the Turkish Economy. As a result of the examination, it is observed that the shares of medium low technology and low technology sectors dominate the exports of Turkey in the post 1980s era. These shares have declined to a considerable extent in 2000s and the share of medium low technology sectors increased. Thus, the export structure change is directed against the high technology sectors. Country composition of the exports, moreover, revealed high concentration towards the European Union markets. The results of the revealed comparative advantage point out that Turkey enjoys comparative advantage mostly in low technology and medium low technology sectors. The ISIC sectors such as 17, 18, come to forefront among others. With the technology intensity increasing, it is observed that the revealed comparative advantage index is decreasing.

In the second part of this chapter the evolution of competitiveness indicators are examined. The innovativeness figures perform parallelisms with the first part of this chapter. The foremost lesson concerning the technology level is that there is not a concrete strategy and policy designed to boost the competitiveness through technological change and innovation. The R&D figures indicate that the targets specified by government are far away from being achieved, although significant increase has taken place in the 2000s. As regards to the patents, most of the patents are granted to non-residents which have weak links with the growth of export market shares of Turkey. Putting R&D and patents together, additionally, one can detect the inefficiency of R&D expenditures in creating innovations, because the sectors leading in R&D expenditures and the sectors leading in patents granted do not match.[32] This finding underlines the efficiency of R&D policies which has, as Chapter 3 indicates, soared in the 2000s. Further, the unit labor cost figures indicate that there is not a considerable difference between the sectors that have different technology intensities. This finding can be important for the insufficiency of the skill intensity of labor employed in technology intensive sectors. Moreover, the investment in fixed capital growth is directed towards more technology intensive sectors. This fact together with the patent numbers also questions the efficiency of investments. Most of the labor productivity growth occurred in low technology and medium low technology sectors, showing the fact that the source of this productivity growth is not the innovations but may be other factors such as long working hours which may exacerbate unemployment. Finally, human capital growth is observed mostly in high technology and medium high technology sectors and it is not surprising since by definition it should be concentrated on technologically intensive sectors.

Chapter 4 presents empirical tests of the theoretical facts and the results of descriptive analysis for the research questions. In the first step, as a result of the constant market share analysis, on the one hand, the impact of low technology sectors[33] is obvious on the export market share growth of Turkey, on the other hand, the high technology sectors whose share in the total home exports went up contributed significantly to the growth of export market shares. Among the four

[32] This generalization is not valid for the ISIC sector 29- Manufacture of machinery and equipment n.e.c.

[33] As stated in Chapter 4, the low technology sectors comprise medium low technology sectors and low technology sectors of Chapter 3.

effects considered in our thesis, structural market effect and market stagnation adaptation effect indicates diversity among the two sector groups for the period 2003- 2008. The former effect underlines that growth of export market shares are influenced by specialization patterns negatively in low technology sectors and positively in high technology sectors. In the case of the latter, the changes in export market shares occurred in those sectors that grow below international sector averages and this affected export market share growth negatively in low technology sectors and positively in high technology sectors. This finding is important in the sense that the increase of the export market shares of high technology sectors contributes to the overall competitiveness of the country even if it was to be less than international averages.

In the second part of Chapter 4, a model is estimated by utilizing a dynamic panel data approach. The results are highly sensitive to the technology intensity of the sectors. In high technology sectors, positive contribution of patents underlines innovation once more for the competitiveness of the country. The unit labor costs are also another explanatory variable that contributes positively to the growth of export market shares in the high technology sectors. The main intuition for this finding is that when the increase in unit labor cost is led by employment of more skilled labor, then it will contribute export market shares. Therefore, even if the labor cost is high, it is necessary for the firms in high technology sectors to deal with these high costs in order to gain international competitiveness. This finding is also important for the policy makers in shaping the subsidies for boosting the overall technology level of the sectors. The negative estimates for the labor productivity is indicate that the interaction between the agents of the economy is not efficient in the sense that this interaction affects international competitiveness of Turkey negatively. Gross investment in fixed capital is another significantly and positively contributing variable to export market share growth for the high technology sectors. Investment in these sectors is important for the competitiveness of the Turkish manufacturing sector. This gives the conclusion that investment in these sectors to fixed capital, such as buildings, machinery should be supported for competitiveness. The result for the structural market effect indicates that the demand structure of the rest of the world is not significant for high technology sectors, pointing the fact that Turkish exports are still far away from adapting to the high technology export demand to the rest of the world. As regards to the results for low technology sectors, the rest of the world demand changes explain growth in export market shares negatively and significantly. This finding is important in the sense that the specialization patterns of Turkish exports are more towards to compete in low technology sectors rather than high technology sectors. The unit labor cost and productivity have adverse effects in comparison to high technology sectors. The labor costs in these sectors influence growth of export market shares negatively. The insignificant results for patents are not surprising in these sectors since they are low technology and the probability of innovation occurring in these sectors through patenting are much lower compared to high technology sectors. As a last point, investment in fixed capital has an insignificant effect on the growth of export market shares in low technology sectors, indicating that the fixed capital investment has poorly related to the competitiveness of low technology sectors.

To conclude, as stated above, the ready-made policies do not end up with increasing international competitiveness for developing countries. The empirical analysis conducted in this thesis confirms this result for Turkish manufacturing sectors. Structural changes in favor of innovativeness are reflected in export market share growth. Turkish export orientation policies, therefore, needs a strategy for the progress of innovativeness. Regarding the research questions of this thesis, one can observe that price factors do not explain alone the international competitiveness. There is an apparent need for policies directed towards technology intensive industries rather than devaluating currency or repressing the labor costs.

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APPENDICES

APPENDIX A

DETAILED TABLES RELATED TO STRUCTURAL CHANGE IN EXPORTS

Table 17: Country composition of the Export Shares

2008		2007	
Country	***Export Share***	***Country***	***Export Share***
Germany	0.10	**Germany**	0.11
United Kingdom	0.06	**United Kingdom**	0.08
U.A.E	0.06	**Italy**	0.07
Italy	0.06	**France**	0.06
France	0.05	**Russia**	0.04
Russia	0.05	**Spain**	0.04
USA	0.03	**USA**	0.04
Spain	0.03	**Romania**	0.03
Romania	0.03	**U.A.E**	0.03
Iraq	0.03	**Netherlands**	0.03
Netherlands	0.02	**Iraq**	0.03
Switzerland	0.02	**Greece**	0.02
Greece	0.02	**Bulgaria**	0.02
Saudi Arabia	0.02	**Belgium**	0.02
Ukraine	0.02	**Israel**	0.02
Bulgaria	0.02	**Saudi Arabia**	0.01
Belgium	0.02	**Ukraine**	0.01
Iran	0.02	**Iran**	0.01
Israel	0.01	**Poland**	0.01
Azerbaijan	0.01	**Algeria**	0.01
Algeria	0.01	**Kazakhstan**	0.01
Poland	0.01	**Azerbaijan**	0.01
China	0.01	**China**	0.01
Egypt	0.01	**Denmark**	0.01
Rep. of South Africa	0.01	**Switzerland**	0.01
Countries terr. not specified	0.01	**Turk Rep.Nor.Cyp.**	0.01
Syria	0.01	**Egypt**	0.01
Libya	0.01	**Sweden**	0.01
Qatar	0.01	**Austria**	0.01
Turk Rep.Nor.Cyp.	0.01	**Syria**	0.01
TOTAL	0.77		0.79

As a result of the inspection Table 17, the countries that are encompassed in the empirical analysis are; Austria, Azerbaijan, Belgium, Bulgaria, China, Denmark, Egypt, Poland, France, South Africa, Georgia, Netherlands, Germany, Greece, Iran,

Table 17 (continued)

2006		2005	
Country	***Export Share***	***Country***	***Export Share***
Germany	0.11	**Germany**	0.11
United Kingdom	0.08	**United Kingdom**	0.08
Italy	0.08	**Italy**	0.08
USA	0.06	**USA**	0.06
France	0.05	**France**	0.05
Spain	0.04	**Spain**	0.04
Russia	0.04	**Iraq**	0.04
Iraq	0.03	**Netherlands**	0.03
Netherlands	0.03	**Russia**	0.03
Romania	0.03	**Romania**	0.03
U.A.E	0.02	**U.A.E**	0.02
Greece	0.02	**Israel**	0.02
Bulgaria	0.02	**Belgium**	0.02
Israel	0.02	**Bulgaria**	0.02
Belgium	0.02	**Greece**	0.02
Ukraine	0.01	**Saudi Arabia**	0.01
Iran	0.01	**Iran**	0.01
Poland	0.01	**Poland**	0.01
Algeria	0.01	**Ukraine**	0.01
Saudi Arabia	0.01	**Algeria**	0.01
Switzerland	0.01	**Turk Rep.Nor.Cyp.**	0.01
Turk Rep.Nor.Cyp.	0.01	**Denmark**	0.01
Denmark	0.01	**Egypt**	0.01
Sweden	0.01	**Sweden**	0.01
Austria	0.01	**Austria**	0.01
Egypt	0.01	**Istanbul Leather Free Zone**	0.01
Kazakhstan	0.01	**Switzerland**	0.01
Azerbaijan	0.01	**Syria**	0.01
China	0.01	**China**	0.01
Istanbul Leather Free Zone	0.01	**Azerbaijan**	0.01
TOTAL	0.80		0.80

Israel, Ireland, Spain, Italy, Qatar, Kazakhstan, Hungary, Portugal, Romania, Russia, Ukraine, Sweden, United Kingdom, United States of America.[34]

Table 17 (continued)

	2004		2003	
	Country	***Export Share***	***Country***	***Export Share***
1	**Germany**	0.14	**Germany**	0.16
2	**United Kingdom**	0.09	**USA**	0.08
3	**USA**	0.08	**United Kingdom**	0.08
4	**Italy**	0.07	**Italy**	0.07
5	**France**	0.06	**France**	0.06
6	**Spain**	0.04	**Spain**	0.04
7	**Netherlands**	0.03	**Netherlands**	0.03
8	**Russia**	0.03	**Russia**	0.03
9	**Iraq**	0.03	**Israel**	0.02
10	**Israel**	0.02	**Greece**	0.02
11	**Romania**	0.02	**Belgium**	0.02
12	**Belgium**	0.02	**Romania**	0.02
13	**Greece**	0.02	**Iraq**	0.02
14	**U.A.E**	0.02	**Saudi Arabia**	0.02
15	**Bulgaria**	0.01	**U.A.E**	0.01
16	**Iran**	0.01	**Bulgaria**	0.01
17	**Algeria**	0.01	**Algeria**	0.01
18	**Saudi Arabia**	0.01	**Iran**	0.01
19	**Poland**	0.01	**China**	0.01
20	**Denmark**	0.01	**Poland**	0.01
21	**Istanbul Leather Free Zone**	0.01	**Austria**	0.01
22	**Ukraine**	0.01	**Sweden**	0.01
23	**Austria**	0.01	**Denmark**	0.01
24	**Sweden**	0.01	**Ukraine**	0.01
25	**Atatürk Airport Free Zone**	0.01	**Istanbul Leather Free Zone**	0.01
26	**Egypt**	0.01	**Atatürk Airport Free Zone**	0.01
27	**Turk Rep.Nor.Cyp.**	0.01	**Syria**	0.01
28	**Switzerland**	0.01	**Switzerland**	0.01
29	**Ireland**	0.01	**Egypt**	0.01
30	**Azerbaijan**	0.01	**Turk Rep.Nor.Cyp.**	0.01
	TOTAL	0.82		0.81

Source: TURKSTAT, Foreign Trade Statistics

[34] The countries such as United Arab Emirates, Iraq , Turkish Republic of Northern Cyprus does not take place in the analysis due to data availability.

Table 18: Sectoral Constant Market Share Analysis (Average % Changes)

HIGH TECH						
NACE	MSH			MST		
Sectors	1992-1998	1999-2002	2003-2008	1992-1998	1999-2002	2003-2008
241	-94.10	-174.92	-210.00	-42.02	-49.68	52.98
242	-14.29	-20.93	-104.68	-156.10	-141.70	-44.45
243	-192.86	-150.00	-185.74	-53.50	-47.66	-74.81
244	-45.47	-94.93	-324.10	164.92	154.22	135.46
245	96.66	119.30	119.66	1333.84	1327.88	1288.44
246	-336.74	-348.42	-378.71	-388.92	-377.31	-382.02
247	-52.24	-93.72	-75.57	-6784.29	-6752.02	-6795.85
291	-194.82	-180.53	-154.27	-272.50	-275.52	-157.34
292	-90.06	-57.70	-35.20	216.56	207.92	-269.48
293	-339.16	-319.75	-257.04	-1420.83	-1196.14	260.09
294	37.35	50.54	8.90	200.77	195.72	76.63
295	2028.92	-26.06	-31.84	3412.34	3335.89	-311.77
296	93.53	9.48	-3.97	-477.39	-481.82	-599.06
297	551.30	602.63	607.88	-13.77	-22.90	117.33
30	-189.38	-181.90	-239.57	772.62	769.23	921.95
311	75.14	93.68	93.91	-586.89	-584.43	-517.51
313	-275.84	-364.21	-355.74	793.84	822.56	276.94
314	304.40	298.16	186.87	31.79	21.89	-663.56
315	-91.12	-110.98	-166.64	-392.13	-391.57	-572.80
316	-145.35	-135.72	-130.36	7846.44	7859.84	7644.59
321	-236.69	-267.44	-153.86	-269.69	-270.44	-253.30
322	-22.56	-65.85	-166.77	102.15	-237.00	-290.42
323	-2418.21	-2412.05	-1281.35	-968.51	-962.02	-951.57
331	-270.15	-306.38	-317.51	186.60	116.52	24.38
332	-178.00	-156.69	39.18	6763.68	6778.12	6949.26
333	-1199.70	-1291.21	-1271.99	-216.90	254.71	18.33
334	-374.92	-385.20	-395.48	-50.95	-59.38	-81.39
335	-129.94	-112.13	-116.71	-47.49	-31.18	-38.54
34	-99.72	552.60	537.01	26.69	25.86	64.54
35	-200.61	-150.61	-148.85	205.06	204.28	183.02

Table 18 (continued)

LOW TECH						
NACE Sectors	**MSH**			**MST**		
	1992-1998	**1999-2002**	**2003-2008**	**1992-1998**	**1999-2002**	**2003-2008**
15	-203.25	-196.54	-149.05	-95.78	-9.25	-216.76
16	59.42	-190.70	-188.92	23340.59	23445.05	7.91
17	-142.05	-135.49	-121.48	29.64	56.32	45.68
18	-54.39	-63.32	-184.61	6810.29	-981.94	-955.31
19	6.05	27.37	25.58	-802.89	-788.72	-898.41
20	-341.60	-335.56	-391.80	-130.97	-100.48	-214.90
21	-562.54	-572.71	-568.24	150.01	120.72	67.20
22	-20.59	-111.42	-132.78	-133.80	-148.14	-182.12
23	-165.91	-170.61	-225.74	-393.07	-406.79	-386.14
25	-159.27	-215.78	-274.46	143.78	140.92	142.31
26	-177.14	-10.02	66.31	-247.75	-248.90	-206.20
27	-99.16	-104.90	-141.84	-155.72	206.13	227.02
28	-173.70	-164.35	-168.69	461.85	465.60	-39.93
36	-14.71	46.39	278.44	-479.35	-486.66	-486.52

HIGH TECH						
	MGR			**MSG**		
NACE Sectors	**1992-1998**	**1999-2002**	**2003-2008**	**1992-1998**	**1999-2002**	**2003-2008**
241	-61.92	-61.92	-124.46	-60.08	-60.45	-64.74
242	-25.88	-30.96	-190.92	-29.11	-29.11	-42.03
243	-252.83	-232.09	-272.17	-14.29	-14.29	-14.29
244	-196.71	-253.28	-290.94	-14.29	-14.29	-14.29
245	-2017.98	-2013.96	-2000.31	-14.29	-14.29	-28.57
246	-36.37	-36.37	-55.92	-42.86	-42.86	-42.86
247	-28.57	-14.29	-14.29	-150.37	-254.85	-245.69
291	-42.86	-42.86	-42.86	-53.04	-53.04	4.46
292	-65.53	-65.53	-65.53	520.50	520.50	4.96
293	-105.40	-105.40	-105.40	-28.58	141.13	152.41
294	-44.11	-44.11	-44.11	1275.49	1275.49	974.91
295	-43.52	-43.52	-43.52	498.57	498.57	-48.72
296	-28.57	-28.57	-42.86	886.69	880.18	894.47
297	-38.41	-36.37	-28.57	933.61	933.61	1069.90

Table 18 (continued)

30	-28.57	-28.57	-86.26	1518.00	1517.62	1531.91
311	-78.85	-76.84	-62.94	-28.42	-28.42	-28.42
313	-5242.11	-5242.11	-5137.25	-14.29	-162.79	-177.07
314	28.97	28.97	28.97	-40.03	-42.58	-42.58
315	-6.47	-20.76	-42.86	-57.51	-43.22	-57.51
316	-2273.73	-2273.73	-2205.57	-28.57	-26.81	-41.10
321	-54.36	-40.07	17.64	-51.67	-65.96	-51.67
322	253.27	253.27	-48.40	-14.29	-14.29	-14.29
323	-15.30	-15.30	-15.30	-34.38	-32.38	297.52
331	363.82	-19.59	-36.48	74.75	74.75	74.75
332	1878.29	1863.03	2089.89	-47.40	-28.57	-14.29
333	-56.98	-56.98	-28.57	-99.38	-85.09	-85.09
334	23.08	37.11	-5.17	-14.29	-28.57	-28.57
335	-14.29	0.00	0.00	-119.95	-119.95	-125.36
34	-48.72	-17.21	-17.21	-28.57	-28.57	-28.57
35	-14.29	-28.57	-28.57	-26.61	-8.10	16.14
LOW TECH						
NACE Sectors	**MGR**			**MSG**		
	1992-1998	**1999-2002**	**2003-2008**	**1992-1998**	**1999-2002**	**2003-2008**
15	-64.76	8.44	30.34	-428.58	-414.30	-414.30
16	-14.29	-14.29	-14.29	3185.47	3073.75	-206.39
17	-77.90	-70.20	-28.57	-299.29	-281.97	-296.29
18	-21.24	-28.57	-14.29	-162.56	-162.56	-212.10
19	-2.73	-2.73	-30.35	-44.09	-4.97	-17.14
20	-188.63	-188.63	-114.78	-35.84	-26.90	-41.19
21	-83.25	-97.54	-97.54	-76.86	-62.42	-32.68
22	-18.20	-32.49	-32.95	-30.39	-16.10	-30.39
23	-42.57	-42.57	-87.73	-53.16	-54.80	-40.52
25	-58.97	-69.49	-125.72	-14.29	-14.29	-14.29
26	-42.86	-42.86	-42.86	-39.91	-39.91	106.52
27	-50.99	-36.71	-36.71	-47.07	-260.74	-260.06
28	-830.70	-831.38	-845.66	39.28	39.28	0.44
36	-14.29	-17.61	-14.27	-106.12	-43.46	-30.43

APPENDIX B

DEFINITIONS OF THE SECTORS

The definitions of Classification of Economic Activities in the European Community (NACE REV. 1.1) and their corresponding codes in International Standard Industrial Classification of all Economic Activities (ISIC REV. 3) takes place in Table 19. These sectors are used in empirical analysis in Chapter 4.

Table 19: Definitions of the NACE (REV.1.1) sectors and their Correspondence to ISIC (REV. 3)

NACE Rev 1.1.	SECTORS	ISIC Rev 3.
LOW TECHNOLOGY SECTORS		
15	Manufacture of food products and beverages	15
16	Manufacture of tobacco products	16
17	Manufacture of textiles	171,810
18	Manufacture of wearing apparel; dressing and dyeing of fur	18-1810
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20
21	Manufacture of pulp, paper and paper products	21
22	Publishing, printing and reproduction of recorded media	22
23	Manufacture of coke, refined petroleum products and nuclear fuel	23
25	Manufacture of rubber and plastic products	25
26	Manufacture of other non-metallic mineral products	26
27	Manufacture of basic metals	27

Table 19 (continued)

28	Manufacture of fabricated metal products, except machinery and equipment	28
36	Manufacture of furniture; manufacturing n.e.c.	36
HIGH TECHNOLOGY SECTORS		
24.1	Manufacture of basic chemicals	241-2413
24.2	Manufacture of pesticides and other agro-chemical products	2413
24.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2422
24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	2423
24.5	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2424
24.6	Manufacture of other chemical products	2429
24.7	Manufacture of man-made fibres	2430
29.1	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines	2911,2912,2913
29.2	Manufacture of other general purpose machinery	2914,2915,2919
29.3	Manufacture of agricultural and forestry machinery	2921
29.4	Manufacture of machine tools	2922
29.5	Manufacture of other special purpose machinery	2923,2924,2925, 2926,2929
29.6	Manufacture of weapons and ammunition	2927
29.7	Manufacture of domestic appliances n.e.c.	2930
30	Manufacture of office machinery and computers	300
31.1	Manufacture of electric motors, generators and transformers	31.1
31.3	Manufacture of insulated wire and cable	31.3
31.4	Manufacture of accumulators, primary cells and primary batteries	31.4
31.5	Manufacture of lighting equipment and electric lamps	31.5
31.6	Manufacture of electrical equipment n.e.c.	3190
32.1	Manufacture of electronic valves and tubes and other electronic components	321

Table 19 (continued)

32.2	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	322
32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	323
33.1	Manufacture of medical and surgical equipment and orthopaedic appliances	3311
33.2	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	3312
33.3	Manufacture of industrial process control equipment	3313
33.4	Manufacture of optical instruments and photographic equipment	3320
33.5	Manufacture of watches and clocks	3330
34	Manufacture of motor vehicles, trailers and semi-trailers	34
35	Manufacture of other transport equipment	35

Source: EUROSTAT, Concordance Tables

Notes: n.e.c. means not elsewhere classified. The NACE sectors 2452 and 3622 are excluded from the analysis due to data availability in their ISIC correspondents.

Table 20: Technology Classification using ISIC (REV. 3)

ISIC Sector	**Definition**
LOW TECHNOLOGY	
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
36	Manufacture of furniture; manufacturing n.e.c.

Table 20 (continued)

MEDIUM LOW TECHNOLOGY	
23	Manufacture of coke, refined petroleum products and nuclear fuel
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
351	Building and repairing of ships and boats
MEDIUM HIGH TECHNOLOGY	
24-2423	Manufacture of chemicals and chemical products
31	Manufacture of electrical machinery and apparatus n.e.c.
34	Manufacture of motor vehicles, trailers and semi-trailers sector
29	Manufacture of machinery and equipment n.e.c.
352	Manufacture of railway and tramway locomotives and rolling stock
359	Manufacture of transport equipment n.e.c.
HIGH TECHNOLOGY	
2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
353	Manufacture of aircraft and spacecraft
30	Manufacture of office, accounting and computing machinery
33	Manufacture of medical, precision and optical instruments, watches and clock
32	Manufacture of radio, television and communication equipment and apparatus

Notes: n.e.c. means not elsewhere classified.

APPENDIX C

SUMMARY OF THE DATA USED

Table 21: Summary Statistics of the Data Used in Econometric Model

HIGH TECHNOLOGY					
Variable	**Observation**	**Mean**	**Std. Dev.**	**Min**	**Max**
GXMS	180	0.0000293	0.0002684	-0.0013059	0.00119
GMST	180	0.0000241	0.0003071	-0.0008992	0.0031363
GLHC	130	0.0039148	0.0043562	-0.0140443	0.0156293
GINV	113	0.0076935	0.0246619	-0.0773282	0.0760429
PSHR	180	0.0204451	0.0282558	0	0.1467262
GULC	123	-0.0094989	0.1089567	-0.297417	0.2727827
$GLPD_{t-1}$	99	-0.0017505	0.0343423	-0.0974757	0.1234899
$GXMS_{t-1}$	150	0.000042	0.0002881	-0.0013059	0.00119
LOW TECHNOLOGY					
Variable	**Observation**	**Mean**	**Std. Dev.**	**Min**	**Max**
GXMS	84	0.0000764	0.0004021	-0.0017276	0.001959
GMST	84	0.0000014	0.0001335	-0.0003741	0.0004964
GLHC	70	0.0050222	0.0032929	-0.0059993	0.0143596
GINV	69	0.0008856	0.0212869	-0.0837132	0.0608677
PSHR	84	0.0276177	0.0363409	0	0.1265022
GULC	70	-0.0316082	0.1109639	-0.3978957	0.2297477
$GLPD_{t-1}$	56	-0.0063035	0.0269004	-0.0746031	0.0550756
$GXMS_{t-1}$	70	0.0000847	0.0003635	-0.0017276	0.001959

Table 22: Correlation Matrix of the Variables Used

HIGH TECHNOLOGY									
	GXMS	**GMST**	**GINV**	**GLPD**	**PSHR**	**GULC**	**GLHC**	**$GLPD_{t-1}$**	**$GXMS_{t-1}$**
GXMS	1.0000								
GMST	-0.0267	1.0000							
GINV	0.1769	0.0392	1.0000						
GLPD	-0.0382	0.0469	0.2605	1.0000					
PSHR	0.1211	-0.0928	-0.0273	-0.0377	1.0000				
GULC	0.1028	-0.0694	0.1270	-0.3509	0.0013	1.0000			
GLHC	-0.0044	-0.1574	0.0493	-0.0065	0.0338	-0.1953	1.0000		
$GLPD_{t-1}$	0.0600	0.0085	-0.1851	-0.1336	0.0062	0.1184	-0.2822	1.0000	
$GXMS_{t-1}$	-0.2118	0.0632	-0.0495	0.0060	0.1684	0.0993	-0.2246	-0.0216	1.0000
LOW TECHNOLOGY									
	GXMS	**GMST**	**GINV**	**GLPD**	**PSHR**	**GULC**	**GLHC**	**$GLPD_{t-1}$**	**$GXMS_{t-1}$**
GXMS	1.0000								
GMST	0.2384	1.0000							
GINV	0.1494	-0.0843	1.0000						
GLPD	0.1778	0.0704	-0.0201	1.0000					
PSHR	0.0313	-0.0434	0.0836	-0.0787	1.0000				
GULC	-0.3801	-0.2876	0.1605	-0.7614	0.0346	1.0000			
GLHC	0.2026	0.2387	-0.1389	-0.0225	0.1638	-0.0635	1.0000		
$GLPD_{t-1}$	-0.1054	0.0524	-0.3210	-0.3901	-0.0953	0.2555	-0.0241	1.0000	
$GXMS_{t-1}$	0.0521	-0.1600	-0.0729	-0.1931	0.0619	0.1293	-0.1209	0.1984	1.0000

APPENDIX D

TEZ FOTOKOPİSİ İZİN FORMU

<u>ENSTİTÜ</u>

Fen Bilimleri Enstitüsü □

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü □

Enformatik Enstitüsü □

Deniz Bilimleri Enstitüsü □

<u>YAZARIN</u>

Soyadı : Şahan

Adı : Fatih

Bölümü : İktisat

<u>TEZİN ADI</u> (İngilizce) : The Impact of Technology Level and Structural Change of Exports on the Dynamics of International Competitiveness: A Sectoral Dissaggregated Analysis of Turkish Manufacturing Sector

<u>TEZİN TÜRÜ</u> : Yüksek Lisans ■ Doktora □

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ■

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullancılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) □

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

Yazarın imzası: Tarih: