TECHNOLOGICAL CAPABILITY AND ECONOMIC GROWTH: A STUDY ON THE MANUFACTURING INDUSTRIES IN TURKEY

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ABSTRACT

TECHNOLOGICAL CAPABILITY AND ECONOMIC GROWTH: A STUDY ON THE MANUFACTURING INDUSTRIES IN TURKEY

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This thesis was motivated by the importance of technological capability for economic growth process in developing countries. The main objective of this study is to analyze the creation of technological capability in the Turkish manufacturing industry; and to set out opportunities and impediments for technological development by ascribing special emphasis to MNCs in this process within the framework of national innovation system. The technology policy advice relying on attracting foreign firms is also questioned. In order to shed light on how technological capability is accumulated in the Turkish manufacturing industry; and to understand the role that MNCs play in this process, the thesis investigates static and dynamic spillover effects of MNCs in the Turkish manufacturing industry. The study also focuses on the factors that determine innovativeness of, and the technology transfer by the firms in Turkey, and the role of MNCs in this context. The probable effects of firm and technology specific characteristics such as size and technology level are taken into consideration in the analyses. Our results suggest that foreign firms are superior to domestic firms in many respects. There are no horizontal or vertical spillovers from MNCs in Turkey for the 1983-2000 period. We found lagged positive horizontal spillovers, though. However, these spillovers are far beyond to register a net dynamic benefit for the whole Turkish manufacturing industry to be felt in the current period. This lagged spillover is found for large firms; and one can mention net dynamic positive spillovers for the large firms. We also found positive spillovers from labor transfer from MNCs to domestic firms for the 1995 and 2000 period. We conclude that technological capability is limited in domestic firms; and it can be improved by on-the-job training and general education policies as well as increasing domestic R&D. The technology policies relying attracting more FDI should be reviewed given the insights provided by the analysis conducted in this thesis.

Keywords: Technological Capability, Multinational Corporations, Spillover, Technology Policy, National Innovation Systems, Evolutionary Economics

ÖZ

TEKNOLOJİK YETENEK VE İKTİSADİ BÜYÜME: TÜRKİYE'DEKİ İMALAT SANAYİLERİ ÜZERİNE BİR CALIŞMA

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Bu tezin esin kaynağı teknolojik yeteneklerin gelişmekte olan ülkelerin iktisadi büyüme süreçleri açısından sahip olduğu önemdir. Bu çalışmada Türkiye'de imalat sanayinin teknolojik yeteneklerinin oluşma sürecini ve mevcut durumunu nitel ve nicel olarak çözümlemek amaçlanmaktadır. Bu çözümleme yapılırken, Ulusal Yenilik Sistemleri yaklaşımı benimsenmekte ve Çokuluslu Şirketlerin gelişmekte olan ülkelerin teknolojik gelişmelerinde olası önemleri nedeniyle, bu şirketlerin sözkonusu süreçte oynadıkları role özel önem atfedilmektedir. Yabancı sermayeye dayalı teknolji politikaları da bu bağlamda sorgulanmaktadır. Nicel cözümleme sonuçları Türkiye imalat sanayinde yabancı firmaların endüstriyel etkinliklerinden kaynaklanan yatay veya dikey yayılma etkilerinin (horizontal or vertical spillovers) bulunmadığını göstermektedir. Sözkonusu dışsallıklar gecikmeli olarak ortaya çıkmakta; ancak net dinamik bir etki olarak gözlemlenememektedir. Firma büyüklüklerine gore yapılan nicel çözümleme, sözkonusu gecikmeli yararın sadece büyük firmalar için geçerli olduğunu; ve bu gecikmeli yararın dinamik etkisinin bulunduğunu göstermektedir. Ayrıca, daha önce yabancı firmalarda çalışmış olup sonradan yerli firmalarda çalışmaya başlayan işgücünün de yerli firmaların yenilik yaratama yeteneklerini geliştirdiği saptanmıştır. Nitel ve nicel çözümlemelerin bütününden Türk İmalat Sanayinde teknolojik yeteneklerin henüz yeterince gelişmemiş olduğu; bu yeteneklerin geliştirilmesi için insan sermayesi birikimin artırılması; bunun için de özellikle genel eğitimin yanısıra hizmet içi eğitimin önemi belirginleşmiştir. Ayrıca, yerli firmalarda çok yetersiz düzeyde bulunan araştıma ve geliştirme etkinliklerinin geliştirilmesi yaşamsal bir zorunluluk olarak ortaya çıkmaktadır. Teknolojik gelişmeyi sadece yabancı sermayeden bekleyen teknoloji politikaları yaklaşımı da bu tezde yapılan çömzümlemeler ışığında gözden geçirilmelidir.

Anahtar Sözcükler: Teknolojik Yetenek, Çokuluslu Şirketler, Yayılma Etkisi, Teknoloji Politikası, Ulusal Yenilik Sistemi, Evrimci İktisat

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

EU: European Union

FDI: Foreign Direct Investment

GMM: Generalized Method of Moments

IO: Input Output

ISIC: International Standard Industry Classification

MNC: Multinational Corporations

MITI: Ministry of Trade and Industry

OECD: Organization for Economic Cooperation and Development

R&D: Research and Development

SIS: State Institute Statistics of Turkey

SPO: State Planning Organization

TFP: Total Factor Productivity

UK: United Kingdom

UNIDO: United Nations Industrial and Development Organization

USA: United States of America

USD: United States Dollars

CHAPTER 1

OVERTURE

The problems of technological development in developing countries have been a very fruitful research area as reflected by the large volume of work in the issue. In the postwar period, the technology policy issues in developing countries have been essentially shaped and affected by the dominant economic rhetoric. One can label policy choices shaped by the dominant economic view in that era as the 'developmentalist/modernist'. The issue of technological development in this dominant approach was either ignored, as it can be exemplified by the Solowian type of neoclassical growth models; or was taken too abstracted, as in the case of new growth models based on R&D and human capital despite the acknowledgement of the role of technical change in the process of economic growth. More recently, there is an upsurge in the studies of technology problems of developing countries. One of the hallmarks of these recent studies is the essential departure from mainstream economics and the associated technology policy choices. A part of works of evolutionary theorists (i.e. Nelson and Winter, 1982; Dosi, 2000b; Lall, 1992) dwell on deficiencies of the neoclassical models.

The main emphasis in the neoclassical growth model is on capital accumulation. Therefore, on the empirical side, the long lasting debate in growth accounting exercises has continued for a couple of decades whether it is technological change, or capital accumulation that determines the well being of countries[1]. This debate has not affected the efforts made by developing countries for

[1] Easterly and Levine (2001) criticized the insights provided by this model, stating that the East Asian countries owe their success to the technological development rather than factor accumulation. Akyüz and Gore (1996), on the other hand, postulated the capital accumulation as the driving force of the success. However, we will not dwell on this debate further since it is out of the scope of our research.

attracting foreign direct investment since these countries were already convinced by the modernist/developmentalist arguments. The efforts continued, in the form of various incentives provided to Multinational Corporations (henceforth MNCs)[2] to make them invest in developing countries. But, the debate has affected the motivation of attracting foreign investment. Previously, the main motivation was to establish a better utilization of the resources which are underexploited because of the inadequate level of capital accumulation. In that period, MNCs were regarded as the remedy curing the lack of capital accumulation of which generally these countries were deprived. More recently, as a consensus on the role of technical change is maintained, also with the help of R&D growth models, the leading motivation became transferring new technologies to an economy that is either in the beginning, or on the way to become a developed country. So, the role attributed to MNCs in this context is the diffuser of new technologies[3],[4]. Therefore, any analysis investigating the technological development in a developing country should pay due attention to these firms.

Evolutionary theorists recently developed a new analytical tool for understanding technological change process at the system level, -so-called National Innovation Systems. Mowery and Oxley (1997) state that this effort them to spread the notion of absorptive capacity, which had been developed for the micro level analysis by Cohen and Levinthal (1990), to the national level; and to link it into the discussion of technical change. This approach, that is National Innovation Systems, replaced the conventional view which is characterized by a linear technical change process. It can be classified as an institutional approach since the subject of the analysis is institutions, effective on the process of technological change. National

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[2] We will use the term Multinational Corporations, Foreign Firms, Transnational Corporations interchangeably throughout my work to refer to the same concept. MNCs are defined in the relevant literature as the firms that have activity at least one country other than the home country that the firm is based.

[3] The other side of the technology transfer has also powerful incentives to internalize their production activity. In addition to cheap labor, scale effects, market accesses, export facilities, etc., as Zander (1998) argues MNCs have advantages to duplicate the advanced technological capabilities, accompanied with flexibility advantages and enhanced potential for cross-fertilization in different locations of activity.

[4] Patel and Pavitt (1991) are skeptical about this role of MNCs since most of the large firms conduct their R&D in their home countries.

Innovation Systems, was mainly developed for analyzing technical change for developed countries, was also extended for the analysis of technical change in developing countries within evolutionary framework. Given this broader framework, the role of MNCs can be analyzed for the technological change in host economies of developing countries, as the institutions that are effective on technical change.

This thesis was motivated by the ramifications of the aforementioned discussions for the economic growth process in developing countries. Therefore, technological capability[5] in these countries is postulated to be one of the most important determinants of economic growth and development. The main objective of this study is to analyze the creation of technological capability in the Turkish manufacturing industry; and to set out opportunities and impediments for technological development by ascribing special emphasis to MNCs in this process within the framework of national innovation system[6]. The technology policy advice relying on attracting foreign firms will also be questioned. In order to shed light on how technological capability is accumulated in the Turkish manufacturing industry; and to understand the role that MNCs play in this process, we will answer the following questions:

(i) What is the static effect of MNCs' activities in the Turkish manufacturing industry?

(ii) What is the dynamic effect of MNCs?

(iii) What factors determine innovativeness of, and the technology transfer by the firms in Turkey, and what is the role of MNCs in this context?

(iv) Are there any differences between the small and large firms;

(v) Does ownership (private versus public; and foreign versus domestic) matter?

(vi) Does technological level of domestic firms play a role in the in this respect?

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[5] We use the term technological capability instead of technological change. Because, the concept of technological change might remind one a changing technology at the frontier; and the frontier may not be fully experienced in backward countries.

[6] MNCs may play a role in developing innovative capability of domestic firms by participating in innovation networks (see also, Reger, 1998; Smith, 1995). Innovation capability is important for the international competitiveness of developing countries (Özçelik and Taymaz, 2004).

These questions will be answered by the analyses of vertical and horizontal spillovers arising from MNCs activities, and from the labor transfer to domestic industries in Turkey. The main contribution is to set out spillover effects of MNCs in Turkey. To our best knowledge, the investigation of the effects of labor movement from MNCs to domestic firms is the first attempt to analyze the MNCs' spillover through labor turnover mechanism in a host economy. The analysis of dynamic impact; and the classification of firms by size can be regarded as original contributions. The previous literature has emphasized the need for the investigation for dynamic effect (Aitken and Harrison, 1999). Haddad and Harrison (1993) investigated dynamic effects of the spillovers for the Moroccan manufacturing; but found no significant evidence. Our analysis takes into account not only dynamic effects of the spillovers from MNCs within a different methodology. The vertical spillover analysis can also be acknowledged as an original contribution since the analysis of vertical spillover in the previous literature is limited to only the effects of vertical relations of MNCs on entry and exit dynamics of domestic firms for the case of Irish manufacturing industry (see, Gorg and Ruane, 2001). Our analysis of vertical spillovers is not limited to effects on the entry and exit dynamics but on the technological development in Turkey in general. The attempt to structure the spillover analysis regarding size distributions is also one of the few contributions in the literature[7]. Acs, et al (1994) analyzed R&D spillovers with respect to size of the recipient firms. Aitken and Harrison (1999) analyzed the horizontal spillovers for the Uruguay manufacturing industry by dividing the sample of the firms regarding their size separately. Our analysis is a broader one since it investigates both horizontal and vertical spillovers for the whole sample of the firms with the appropriate modeling.

The outline of the dissertation is as follows: The Chapter 1 is devoted to drawing the theoretical framework benefiting from a plenty of stream of lines in the literature. The main axis of the discussion in Chapter 1 benefits largely from the contributions of *evolutionary theory.* The literature on MNCs was also exploited to a great extent. The second chapter is a descriptive analysis of the technological capability of the Turkish manufacturing industry inspired by the theoretical insights

[7] The size of firms is important for technological development. At first glance, large firms are expected to be more productive. However, recent new technologies increased the importance of small and medium sized firms in developing countries. Computerized manufacturing weakened the link between automation and scale (Taymaz, 1997).

derived from the discussion in the first chapter. The third chapter analyzes the quantitatively the technological capability of the Turkish manufacturing industry. The last chapter summarizes what has been done in this thesis and figures out some conclusions and policy recommendations.

CHAPTER 2

THEORETICAL FRAMEWORK

This chapter reviews the theoretical background of the discussions on the issue of technological change in developing countries. The first section dwells on the popular ideas of the 60s, -developmentalist/modernist perspective on the technological development inspired by convergence approach. We also review the literature on theoretical and empirical evidence on the MNCs and their effects on the host economies. The discussion on the complementarity/substitutibility discussion about the foreign technologies and indigenous technological effort will be followed by linking dynamic capabilities argument to the notion of national innovation systems.

2.1 Developmentalism/Modernism

The neoclassical representation of economic growth is basically a capital accumulation model in which it is assumed that countries can best use the existing technology; and in the end, all countries would have the same rate of steady state economic growth rate. Thus, there will be no difference between the levels of income across countries since any disparity would be cleared out as they converge to a steady state level. One rationale behind the convergence idea is that the rate of return to capital would be higher in developing countries compared to developed ones since the capital stock in the former economies are limited. The only factor the developing countries should do is to invest enough; -depending upon their backwardness, and to acquire the new technologies mostly embodied in capital goods. Obviously, in this model it is hardly possible to find a concern for technological change since it arrives as exogenous shocks. When a technology arrives -to wherever in the world, it can efficiently be used in production because it is perfectly available to any country without any institutional impediment. If the new technology is lacking in any country, they can simply transfer those technologies without any sacrifice from the efficiency in usage.

Therefore, the scholars who were convinced with the insights of the Solowian type of neoclassical economic growth models studied the technology diffusion issue by focusing on accumulation rather than problems arising from the transfer of technologies. For example, Findlay (1978) formalized the rate of technical change in a “backward region” as a function of the extent to which domestic economy is exposed to foreign capital. In fact, this study models the diffusion through a tax mechanism collected from foreign entrepreneurs, which is the contribution to the capital formation in a domestic economy. Capital formation process is financed by the tax imposed on the profits of MNC obtained in the domestic economy. So, domestic capital formation is an increasing function of; *inter alia,* the tax accrued to domestic economy from the activities of foreign firms. Apparently, in this model the spillover to domestic economy is a by-product process of the presence of foreign capital and new capital added to domestic stock equally possesses ‘new’ technology embodied in foreign capital. In addition, there is no cost of transferring technology and learning of domestic firms. Most early models share these common features.

In turn, in 1960s a developmentalist/modernist approach to the problems of the developing countries stimulated by the convergence hypothesis dominated economic development agenda as the most widely accepted policy. The motto, ‘There is no need to reinvent the wheel’, can best summarize the discussion about the technological development in relatively developing countries. Under the convergence hypothesis, relative backwardness has been taken for granted as an advantage since, unlike the developed ones, these countries do not need to make equal efforts as the former ones to gain access to new technologies. They can benefit new technologies without incurring the cost of innovation. Newer technologies are already there, and developing countries have free access to this open source that Bell (1989) calls “book of blueprints”. These new technologies have public good and non-rivalry nature, and therefore, can be acquired by developing countries, worrying tacitness at neither generation, nor adaptation phases (Lall, 1992), with some license, foreign direct investment, labor turnover at much lower cost than that of developed countries (Freeman, 2002). Therefore, these advantages would be attributed to the backwardness of the former (Bell, 1989; Radosevic, 1999). Furthermore, these countries would enjoy economies of scale because of expanded market by developed countries. The only thing that developing countries have to sacrifice is the relatively high cost of production which would be driven down by learning-by-doing effect as function of accumulated output in the course of time. By time, these countries will catch up with developed ones. One can conjecture here that that this explanation can theoretically be grounded on the Solowian type of neoclassical model in which convergence of the income level of countries is necessary logical implication.

A plenty of issues can be raised and discussed here concerning the technology issues and policies in developing countries: First, technology here is characterized as the capital goods used in production. Therefore, it is assumed that technologies can be transferred to developing countries without facing any institutional/local barrier; and domestic productive forces can upgrade their existing technological level automatically as they import new machines. However, as Bell and Pavitt (1997) stated, technological diffusion is more than the acquisition of new machinery or product design, and mastering the related knowledge. The students of technological activity in developing countries emphasize that there is a need for adaptation of new technologies to local conditions (Lall, 1992; Bell and Pavitt, 1997). Because the technology, in essence, is a solution for a variety of problems faced in different locations and the same technology can function in totally different manner in different context; so, the same technology can act and result in surprisingly different outcomes.

Second, related to the first, since technology here is viewed as a pure public good and assumed that it can be fully transferred in blueprints; and no emphasis was made on the tacit nature of technologies and related knowledge. An automatic and instantaneous capability building takes place for the domestic productive forces. The drawback of this characterization is well discussed and criticized in evolutionary theories of technical change (Nelson and Winter, 1982; Bell and Pavitt, 1997; Dosi, 2000b). However, evolutionary theorists of technological change elaborated that knowledge has also a ‘tacit’ character as well as a codified character; neither can be codified in blueprints, nor be transferred easily to recipients (Nelson and Winter, 1982; Dosi, 1988; Pack and Saggi, 1997). They can only be transferred in "rules of thumbs". Transferees can only get full access to those technologies by experience and learning depending on their capabilities. Therefore, the knowledge and skills required for technologies can only be accumulated by the course of time.

Third, in this model technologies can be transferred without incurring any cost of producing the new technologies. As it was mentioned in the above paragraph; there is no cost of adaptation of the transferring technology and learning of domestic firms. Even if there are lower cost of technologies elsewhere produced, due to the necessary investment regarding the uncertainty of technologies and market creation have already been made, those technologies cannot be transferred (Teece , 1977), or imitated (Mansfield, et. al., 1981) at zero cost. In addition, technology transfer is not a costless process. Teece (1977) has shown that the cost of technology transfer accounts for approximately 20 % of total investment, which can reach, sometimes to 60% depending on the capabilities of the parties.

Fourth, the dynamic core, driving technological change, lies outside the national system under this setting. Developing countries do not necessarily commit themselves into the basic research in science. They can transfer new technologies produced in developed areas. Therefore, technology in developing countries changes in response to exogenous shocks as it is transferred by various mechanisms, and remains the same until a new shock arrives. Thus, in essence, this model is a static model. Wylie (1990) found a rigid dependence on transferred technology and suppressed adaptation and innovation in 1900-1929 period because of technological domination for the Canadian manufacturing industry, lacking a capital goods sector. As this example poses, in some cases even absorption and adaptation can be unsuccessful, let alone innovation.

Fifth, the developmentalist/modernist approach give rise to linear process of *technological capability* building. The technological capability, in the literature mainly drawing on the works of Dahlman, Ross-Larsson and Westphal (1987) and Lall (1992), *inter alia*, was defined as the ability to identify, acquire, absorb, adapt into local conditions, and finally improve it. The building process of technological capability in a country, or in a firm, was deemed to follow these linear sequential steps. The switch in the successive steps is governed by a learning by doing effect which is a linear function of output produced. Given the complexity of diffusion, the corresponding linear characterization of capability building literature is now tended to be driven by dynamic capability considerations. Recent studies in this issue points out to the invalidity of linear capability building, and instead emphasizes the nonlinear and complex nature of technological learning (see, i.e. Chen and Qu, 2003, for the Chinese case).

Sixth, this developmentalist/modernist approach can explain only lagging behind, and catching-up but not forging ahead dynamics. However, this approach cannot explain why, for example, Japan have outperformed the other countries formerly at the technological frontier?

Finally, an implicitly expressed idea of this strategy is, as dependency theorists criticized (Palma, 1989), that developing countries should follow the *same pattern* that developed countries have followed. So, this strategy is based on purely a replication approach. In a static world, this replication approach is not bothersome, however, in a fast changing environment the replication approach poses some problems which can be caricaturized as ‘carrot and stick’ metaphor. While you try to replicate the same success, world changes, and you can never reach to the frontier. Because, the efforts made will be limited only to mastering transferred technologies, since in a fast changing technological environment, improving upon old technologies would not be meaningful. The performance of the countries that could catch-up with the UK and the USA had not been a *simple replication* of the latter countries (Maddison, 1982).

I would like to argue and make explicit here that the *backwardness* is not an advantage but it is a real *disadvantage*. This can be better understood by the excellent explanation of Bell and Pavitt (1997). They contrast the developed and developing countries regarding technology diffusion that allows us to contrast the matter of backwardness in industrialized and developing countries. The authors state that “[i]n the industrialized countries, the adopters and users of technology will typically already possess the particular kinds of knowledge and skills needed to play … technological creative role. In developing countries, however, these capabilities will usually have to be accumulated before the full, dynamic benefits from technology can be realized (Bell and Pavitt, 1997). The firms, acquired new technologies from their rivals, might be in an advantageous position since they did not commit themselves to painstaking and costly process of producing that technology. They have the required knowledge and skills, -in varying degrees, to master and efficiently use it already. On the other hand, a firm in a developing country cannot be said that it is in an advantageous position just because of it is backward. One can mention here that the problems arising from the lack of knowledge and skills would be compensated by the indigenous technological effort, but this still cannot justify the central argument of modernism/developmentalism that is the opportunity to acquire new technologies without incurring the cost of innovation. The firms in industrialized countries obviously in a better position compared to the ones in developing countries. We can elaborate more on this point concerning the appropriability regime. As Dosi (2000c) stated, a high technological opportunity may act as a powerful incentive to innovate for a firm near the technological frontier, whereas it may act as a disincentive for a firm with low technological capability. In other words, technological gaps encourage technical change but this technical change does not work in favor of laggard firms, but forward ones. In brief, catch-up argument can be useful a framework for the diffusion of new technologies within an entity which can be characterized with parameters whose values are close, but when great differences between these parameters exist, it functions no more as an incentive.

To sum up, developmentalist/modernist perspective for the technology problems of developing countries is greatly problematic. The problems are two folded: First, there are problems characterized as the unrealistic perceptions of technology and related issues in these countries. These problems invalidate the logical conclusion such that relative backwardness might work positively for a laggard country, and the passive absorber role attributed to developing countries. Developing countries, or firms in these countries, cannot be considered in an advantageous position, just because they are lagged, without setting any requirement regarding indigenous technological effort on their side. On the other hand, the other group of problems arises because of the appropriateness of the technology policies at the strategy level as raised by dependence school.

The discussion above implies that there is a cost related to knowledge and skills to fully benefit from the imported technologies, and therefore, developing countries should make some effort in this context. In the following section, I shall elaborate more on the passive absorber role of developing countries in the context of a specific and most favored mode of technology transfer, -that is, MNCs.

2.2 Multinational Corporations and Technology Diffusion

There are various mechanism for technology transfer; but the race among developing countries today in attracting the foreign direct investment reveals that these countries rely on MNCs as the most favorite and reliable tool for their technological development. However, the discussion in the previous section makes the role of indigenous technological effort and capability[8] in a technology transfer process in general. I shall go one step further and ask the question of the effects of MNCs activity on the purely domestic side of host economies. In this section, I examine theoretical models and empirical evidence of the studies about the effects of MNCs on host economies. The effect of technology transfer through MNCs on purely domestic side of the industry seems to be more relevant for a sustainable technological development. So, I will focus only on the works below whose focus is directly the spillover effects of MNC which are directly involved in a host economy as an external source of technology for indigenous firms. The objective of this section is to examine the theoretical arguments for the role of MNCs as the creator and diffuser of new technologies.

2.2.1 Theoretical Models of Spillovers

The literature on the effects of MNCs goes back to the early 1960s; and the mentioned effect was first emphasized by Hymer in a Ph.D thesis (Findlay, 1978). Since then, there is a view shared by some scholars MNCs as the dominant agents of international technology diffusion (Findlay, 1978; Mansfield, 1994; Cantwell, 1994; Pack and Saggi, 1997) due to their transnational activities, -not only their direct investment but some other forms of activities (Helleiner, 1989). In addition to this, the large share of global R&D undertaken by MNC (Cantwell, 1994) also give rise to the main role attributed to these firms as being the creator of new technologies.

[8] The level of human capital stock is also emphasized in this respect (Borensztein, et al., 1995; and Noorbaksh, et al., 2001).

The focus of the early literature on the effects of MNCs was cost and benefits analysis of foreign direct investments in general. As Blomstrom and Kokko (1998) stated, this literature did not explicitly address the question of spillover effects but contributed to our knowledge by proposing that MNCs may improve allocative efficiency through the effects on market structure in host country, and technical efficiency through their effects on competition in host markets and demonstration of their new vintage technologies. The later studies made use these two points and elaborated them in formal models. Formal modeling is very scarce in this early literature and the contributions by formal modeling accelerated by the end of 1970s (Blomstrom and Kokko, 1998). However, the focus of the later literature, what I shall label as "spillovers literature", is on the phenomenon of generating positive contribution as a result of each activity directly involved in host economies, -production, R&D licensing, backward and forward linkages, etc. The positive spillover effects on domestic firms in all of these works are the main presumption even though they do not explicitly address that point.

The most important dynamic observed in a technology transfer process is the reaction of the other side, which is also considered to be the trigger of a spillover mechanism for a domestic economy. This kind of transfer induces local technological effort and domestic firms might become more competitive. This peculiar characteristic of technology transfer was underlined in a model developed by Wang and Blomstrom (1992). In their model, the cost of technology transfer process was taken into account unlike the former models with neoclassical precepts. This cost is also shared by local firms due to the nature of technology absorption efforts. The authors argue that the effects of technology transfer process will be less lethargic depending on, among the others, the efficiency of learning activities of domestic productive agents. MNCs respond to domestic competition by introducing newer technologies in order to keep their technological leadership in domestic markets. Nonetheless, the important implication for developing countries appears in the age of technologies. Wang and Blomstrom (1992) propose that MNCs transfer their older technologies to their subsidiaries in developing countries compared to developed ones they transfer to their subsidiaries in developed ones. This of course, raises some doubts about the attributed role for MNCs as the diffuser of new technologies for developing country case.

The model implies that domestic side of technology transfer process has to pay a cost in the form of domestic technological effort. Yet, as Dosi (2000b) elaborated, an important part of technologies and knowledge is embedded in human skills and in their tacit capabilities; and the circulation of labor across firms. Therefore, the transfer of human capital constitutes in some cases a way of knowledge diffusion without any cost, if firms are not paying a premium over their current level of average wage to employ such individuals in their firms, and if they do not commit themselves to a costly process of gathering information about such personnel. But, generally this is not the case. MNCs tend to pay higher wages to their workers to prevent labor transfer to other firms, and thus, Saggi (2002: 212) discusses that the wage premiums paid by MNCs can provide a rough estimate of the value it places on the knowledge it transfers to its workers. In line with this, all models of technological spillovers through labor circulation assume that MNCs try to prevent such spillovers by offering higher wages to their workers. For example, in a simulation model Kauffman (1997) proposed that MNCs' activity can either generate, or "frustrate" spillover for domestic economy depending on relationship of wage level in MNCs and the technological capabilities of domestic firms. Clearly, higher wages paid by MNCs (and lower domestic technological capability) prevent the generation of spillovers in a domestic economy. An important result that this model provides is that even though MNCs attempt to prevent spillover effects for domestic firms, they cannot prevent them entirely.

This wage differential generally tends to be larger in developing countries (Glass and Saggi, 2002). Fosfuri, et al. (2000) propose that this differential is mainly based on the cost of training. Since MNCs train their workers, they contribute to the human capital and attempt to prevent the leakage of this human capital. Because, in their model Fosfuri, et al. (2000) assume that the superior technology of a MNC is applicable only after training the workers. There is also an empirical support to this view provided by Ballot, et al. (2002). In a study of French and Swedish firms, the authors found that workers benefit from the training activities of the firms. However, what is more interesting is that workers benefit not only from training activities; but also from R&D activities. Both activities increase the wage level. Therefore, it is reasonable to expect MNCs to pay higher wages to their workers to keep them in the firm. Glass and Saggi (2002) argue that this wage differential is purely directed to control technology diffusion[9]. An interesting point that Glass and Saggi (2002)'s model generate is that when there is no technology transfer, in an oligopolistic market structure, production costs will be higher for both the MNC and domestic firms compared to the existence of technology transfer. Despite this fact, a wage premium paid by MNCs can increase the MNCs' profits by preventing the cost reduction for the host firm and increase MNC's profits. Therefore, wage premiums paid by MNCs are aimed at preventing labor turnover, and thus controlling technology diffusion. The ability of MNC to control diffusion will be more as the demand of host firm for labor that is informed about the superior technology of MNC increase. In brief, technological spillover models through labor circulation reach more or less same conclusions. A lower domestic capability[10], and higher wages, in MNCs prevent the generation of technological spillover through labor circulation.

Fosfuri, et al. (2000) adds to the above conditions that a low competition in the market is required. They state that MNCs and domestic firms must operate in different sectors not to be direct competitors to ever generate technological spillovers. This excludes the competition effect resulting in positive spillover. So, the mechanism here is other than competition effect. The other aspect of technology transfer was also modeled in the spillover literature. For example, Rodriguez-Clare (1996) analyzes the effects of MNCs on host country in a two-country framework with a particular emphasis on creating linkages with domestic economy. This study shows that as long as MNCs are involved in an interaction with host economy, we could expect positive spillovers from MNCs activities. To this end, for example, high communication costs between headquarters and production plants are required in order to achieve favorable effects from MNC for host country. Because, only in this way, these firms interact with domestic firms, that is, buy their inputs from domestic firms. Second, the gap between host and home countries should be acceptable, in the sense that, the markets in host country must be deep enough to provide an incentive for procurement of inputs domestically, which is also an emphasis to domestic

[9] However, Glass and Saggi (2002) assume an instantaneous absorption of knowledge of MNC technology, and therefore, there is no room for training in their model.

[10] The measure the extent to which technology is easily transferable, in Fosfuri, et al. (2000) model, and the completeness of transfer, in Glass and Saggi (2002) model, which is related to the demand for informed labor from MNC, shown by θ, in domestic firm point to similar concepts. Both can be interpreted as an inverse indicator for domestic technological capability.

technological capability condition for any potential of spillover[11]. Similarly, Markusen and Venables (1997) also focus on interaction between firms to produce spillovers effects. In their model, activities of MNCs in host economy affect domestic firms through backward and forward linkages. The entry of an MNC, may increase the demand for intermediate goods industry, thus increase the output of that industry. As in the Rodriguez-Clare (1996) model, the effect depends on the extent to which MNC is intensive user of domestically produced intermediate goods.

Pack and Saggi (2001: 400) argues that in a fully owned subsidiary by a MNC in a developing country case, subsidiaries would be more averse to technology diffusion than the case of non-FDI form of technology transfer. However, in an outsourcing context, there is a possibility such that vertical technology transfer causes an increased competition in the market in developing countries. The outsourcing considered by the authors is such that a firm in a developing country is offered to produce the final good under the technology and by inputs provided by the firm in a developed country (without direct involvement of MNCs in host economy). In this context, new firms in developing country would enter the market due to the presence of technology diffusion. Because, diffusion let the marginal costs of potential entrant firms to be lower. Therefore, market becomes more competitive. The spillover effect works through knowledge diffusion and competition. This model does not favor MNCs to be directly involved in the host economy but indirect involvement since the latter increases the domestic technological effort.

We can derive a crucial implication from the models discussed above since they generally emphasize that technological capability and effort made in host country matter in order to reap benefits from MNCs. These appear as the precondition in the process of increasing domestic performance of industries in host countries. The spillovers for host economies are materialized through a variety of mechanisms that are outlined and discussed in Blomstrom and Kokko (1998). The mechanisms to produce productivity spillovers for domestic industries can be summarized as follows: *demonstration effect, competition effect, labor circulation, linkage effects*. First, the set of available technologies and products is enhanced by

[11] However, the condition this model postulates contrasts with the incentives to invest in those countries in which communication costs are higher. This is not to deny, there is no MNC in countries with high communication costs, but the share of foreign firms there will be limited, so the spillovers generated via linkages.

the existence of MNC. Domestic incumbent firms can adopt these technologies either by reverse engineering, or simply imitate the products introduced by MNC. Or, new firms can enter to market by inspiring the technologies brought by MNCs. These effects are called *demonstration- contagion effect*. Second, by competition increased in marketplace, MNCs can either foster, or suppress the domestic productive forces. Domestic firms compete with the superior technologies, or with the products of MNC, and therefore, indigenous efforts might increase. In this case, we can mention about a 'positive spillover' since MNC force domestic firms to be more competitive. However, this 'competition effect' can be negative, too. When markets are populated by inefficient domestic firms, and therefore foreign entry to market would sweep out these inefficient firms from market, one can mention a competition effect. Even though this might seem to be an undesirable effect; since it increases the domestic productivity level, it can be considered as a positive spillover. However, if MNCs increases the entry barrier to domestic markets for domestic firms, then this obviously a negative spillover effect due to the competition of MNCs[12]. But if MNCs lead to an increase in the entry rate of domestic firms, this is also considered to be a positive spillover. These two spillover effects, demonstration and competition, are horizontal ones. It is also observed vertical spillovers for the firms operating in different industries. These spillovers are mediated through backward and forward linkages. The vertical linkages idea can be traced back to the Hirschman's 'forward and backward linkages' argument. MNC transfer some of their technology, or of their knowledge, to other firms they interact. But, such kind of spillovers are realized as long as MNCs integrate to domestic economies, in other words, participate to a network. Finally, the circulation of the labor force enables some original knowledge embedded in the labor to be transferred to other firms, resulting *spillovers through labor circulation.*

2.2.2 Empirical Evidence

There is no consensus on the direction of spillover effects of MNCs in empirical studies. Some studies are extremely optimistic on the role of MNCs for the

[12]Saggi (2002) replaces the competition effect by 'vertical linkages', arguing the effects mediated by market structure should be taken as 'pecuniary externalities', and spillovers should cover only 'pure externalities'.

performance of domestic firms whereas some other studies are quite skeptical about it. As Kokko, et al. (1996) and Gorg and Strobl (2001) noted, these studies inevitably uses different econometric models because of different approaches to the issue as well as the use of data in different periods for different countries. Moreover, the qualities of data used in these studies are questionable. Haddad and Harrision (1993), for example, make an extra effort in order to control such kind of heterogeneity, in their study, which reported negative spillovers for Moroccan manufacturing industry. They replicate their analysis based on the same approach of some studies reporting positive spillover effects, -i.e. with the same specification in econometric model; but they could not produce positive spillovers. This means that this kind of heterogeneity is of limited scope regarding the inference. Therefore, even though methodological approaches have something to do with it; we think that such kind of differences can be explained better on the basis of another factors rather than the approaches studies take. In what follows, we will try to do it when we are discussing the results reported in the earlier empirical investigations[13] with a particular emphasis on technological capability.

2.2.2.1 Evidence on Developed Countries

We can distinguish empirical evidence on spillovers for host countries on the basis of the relative development level of these countries. Some of the empirical studies investigate the spillover effects from MNCs for developed countries as beneficiary host countries. These studies generally reach to evidence in favor of positive spillovers. For example, Globerman (1979) found that labor productivity differences in Canadian manufacturing industry are positively correlated with various measures of FDI, *inter alia*, i.e. capital intensity, size, etc. Globerman (1979) states that those spillovers were even underestimated in his study. A more recent study for the UK covering 1973-92 period by Haskel, Pereira and Slaughter (2001) reports that the Total Factor Productivity (henceforth, TFP) level of domestic plants are significantly correlated with the share of foreign firm's employment in that industry. Keller and Yeaple (2003) also take the employment share in total employment as a

[13] This literature was exhaustively reviewed in Blomstrom and Kokko (1998). The survey is by no means exhaustive here.

measure of foreign industrial activity in their study for the US owned manufacturing industries in the 1987-96 period. Their analysis includes import as well as foreign direct investment as the channel of such spillovers and lends support for positive spillover effects for domestic firms. In addition, they found that FDI related spillovers are much stronger than imports related ones, and accounts for almost 14% of the variation in the performance of domestic firms. Keller and Yeaple (2003) propose that technological spillovers from FDI are much related to the relatively high technology industries compared to lower technology industries. It is implicitly assumed in the above empirical studies that the proxy for the presence of foreign firms in an industry would capture all types of spillover effects. However, Gorg and Ruane (2001) focused only on the linkage effects as a channel for spillover mechanism in the Irish manufacturing industry and found positive spillover effects from this channel for the Irish owned firms. Gorg and Strobl (2002) also focuses on the linkage effects of MNCs and reports a positive correlation between linkages with foreign firms and the incidence of the entry of domestic firms to the Irish manufacturing industry. However, in another empirical study for the US focusing only on the effects of MNCs on labor skills, Bloningen and Slaughter (1999) are skeptical about the contribution of MNCs to host economies. They state that MNCs did not contributed to the skill upgrading in the US, and actually, inward FDI is associated with less skilled intensive industries.

If we leave aside this one exception, all of these studies reporting positive spillovers from MNCs are not very surprising given the implication of the theoretical models reviewed above. US can be taken as the leader country in this sample, and the relative positions of the others are not far behind from the leader. Therefore, the overall domestic sector of manufacturing industries in these countries benefited various types of spillover effects from MNCs. Some of the remarks made by the authors lead us not to discard the importance of technological capability in generating positive spillovers even in these countries, albeit the well accumulated capability background. For example, Gorg and Ruane (2001) mention the lack of necessary scale of indigenous suppliers to provide appropriate quantity and quality of inputs to the large electronics MNCs in Ireland, and therefore large MNCs do not establish backward linkages with local firms. This remark is in line with the condition that Rodriguez-Clare (1996) set. However, Haskel, Pereira and Slaughter

(2001) found positive spillover effects for the less well performing large firms in the UK manufacturing industry. But this not really contrasts with the former evidence since the latter captures the all types of spillovers, not only linkages.

2.2.2.2 Evidence on Developing Countries

The empirical studies focusing on developing countries directly, or indirectly, point out to the crucial role of technological capabilities in the process of generating positive spillovers in a much more explicit way. Admittedly, technological capabilities in these countries are lower in comparison to those of developed countries. So, empirical evidence for these countries is expected to be, *per se,* negative. Despite that, some studies provided mixed results: Some of them found positive, while some others found negative effects. Some other group of empirical studies displays both positive and negative spillover effects working for same host country. For example, Liu (2002) in his study of Chinese manufacturing industries for the period 1993-98 found a positive external effect on domestic industries from FDI. The empirical results refer to the importance of ownership structure to benefit from FDI in Chinese manufacturing industry. For example, state owned sector and joined owned gets positive spillovers to a great extent from FDI whereas it is detrimental for collective owned sector. An interesting result Liu (2002) reports is that foreign sector does not benefit from other foreign investments. In Mexico, Blomstrom (1986) suggested that industries with higher share of foreign activities were more efficient than the others. This positive contribution of foreign firms was considered to work through the increased competition in the market since the analysis in this study revealed a positive correlation between Herfhindahl index and increased efficiency of the manufacturing industry. However, the analysis does not support the proposition as to any increase in technology transfer to Mexico. In addition to this result, this study found that, in overall, productivity change is positively correlated with foreign entry, but this correlation disappears for the less efficient firms. This last point is of importance regarding the message we are trying to emphasize from earlier studies, that technological capability is important determinant in the generation of positive spillovers.

Similar evidence supporting the technological capability argument is related to the Uruguayan manufacturing industry. In their cross section analysis in 1988, Kokko, et al. (1996) found no evidence in favor of positive spillover effects for the whole sample of manufacturing industry in this country. However, this result turns out to be positive spillover for the firms whose technological capability is not very behind the foreign owned firms. The, insignificant spillover effects for the firms with larger technology gaps are permanent, though.

Another attempt to disentangle the potential contradicting effects at work in a whole sample by investigating those effects in subsamples was made by Aitken and Harrison (1999). In their panel data analysis of more than 4000 Venezuelan firms for 1976-89 period, they found that increases in foreign ownership has large negative effects on the wholly domestically owned firms. However, the sign of spillover effects from foreign ownership turns out to be positive for the firms with less than 50 employees. Another interesting result this study produced is the confirmation of the existence of benefits from foreign investment. But, these benefits seemed to accrue to joint ventures in the same economy. We interpret this result as one of supporting technological capability argument, assuming that firms with foreign equity perform better regarding technological capabilities compared to the firms wholly domestically owned.

Costa and de Queiroz (2002) also provide suggestive evidence in favor of technological capability argument given the difference between Brazilian and foreign firms in the generation of complex capability. The authors argue that foreign firms score slightly better than domestic firms, but these firms have no particular role for the learning system in Brazil. Another example, partially supporting the technological capability argument is delivered by Haddad and Harrison (1993). In their study, the authors divide the sample into high-tech and low-tech industries and interpret the result they found as to “the influence of foreign investment in reducing the dispersion of productivity was greatest in the low technology sectors” (Haddad and Harrison, 1993: 64) as spillovers are materialized if productivity gap between domestic and foreign firms is moderate. However, they do not find such a relation for the productivity growth of domestic firms, instead of the dispersion of it, which is negatively affected by the foreign presence in the sector after even after controlling the technology gap differences. Obviously, this last evidence does not support technology capability gap argument whereas the previous one provided by the authors is clearly in favor of it. Kinoshita (1999) provides evidence in favor of "catch-up" argument. In the cross section analysis of Parente-Prescott investment equation, Kinoshita (1999) found that productivity growth of a firm increases just because its productivity level lags behind the leader firm in Chinese manufacturing industry. Recall that the evidence of Haskel, Pereira and Slaughter (2001) as to positive spillovers is larger for the less efficient firm stands by the latter evidence for developing countries. In another study, on the other hand, Kinoshita (2000) proposes that the indirect effect of R&D via developing domestic absorptive capacity is more important in productivity growth, for the role for intraindustry spillovers. This remark is in favor of technological capability argument whereas the one in the previous study obviously is not. Foreign presence in the industry has no contribution in the form of spillover effects for the Czech manufacturing industry in the 1995-98 period. However, when R&D (both for domestic and foreign) is allowed to interact with foreign variables the analysis delivers significant and positive results (Kinoshita, 2000).

Another group of studies points out to the role of indigenous technological efforts undertaken by local firms, -a relevant issue for the technological capability, in order to benefit from MNCs. For example, Pack and Saggi (1997) emphasize the extraordinary complementarity between international technology transfer and domestic technological efforts. Basant and Fikkert (1996) stated that technology efforts of domestic firms are clearly complementary to the purchase of technologies. They report a positive and significant coefficient for the variable constructed by allowing the interaction of the two measurements on the Indian manufacturing output. Aw and Batra (1998) also provide empirical support to this issue. Domestic technological effort is more important in improving the efficiency whereas the presence of foreign capital is generally not significantly correlated with technical efficiency in of Taiwanese manufacturing industry. Kathuria (2000, 2002) states that spillovers are not a by-product result of foreign firms referring the relation between own level of R&D investment and spillovers. In the analysis of spillovers for Indian manufacturing industry for the 1989-90 period, Kathuria (2000) reports a negative spillover effects for the sectors which foreign firms are close to technological frontier. However, foreign capital in these sectors has a positive impact. Kathuria

(2000) states that the firms actively engaged in R&D benefits from the knowledge spillover because of positive and significant contribution of the interaction term in the regression. For the firms without R&D there is no evidence for knowledge spillover, though. Kathuria (2002) replicates the exercise for the firms with and without R&D for the 1989-90 period and reaches the same conclusion that the spillover effects only for the firms who are actively engaged in R&D. The productivity of the firms without R&D investment have depressed in the same period.

These studies emphasize the domestic efforts to benefit from spillovers rather than staying in a passive absorber position. Blomstrom and Sjoholm (1999) focus on the role of active participation in order to examine the same issue from a different point of view. They analyze whether majority versus minority ownership of foreign firms makes a significant contribution to the performance of Indonesian manufacturing industry. They report positive spillovers from foreign firms flowing to domestic ones but they found no evidence for the degree of ownership as a determinant factor in producing these spillovers. On the contrary, Djankov and Hoekman (2000) provide fully contrasting evidence for the Czech Republic for the 1992-96 period. The authors found negative spillover effects for the domestic industry due to foreign firms, and in addition, they conclude that this negative spillover arises mainly from joint ventures because for the wholly foreign owned firms, this negative spillover effect is smaller and insignificant.

On the other hand, some studies investigated the role of FDI at a more aggregate level. Borenzstein, De Gregorio, and Lee (1998), for example, focused on the role of FDI in the process of economic growth. These authors report little evidence favoring the role of FDI in economic growth. Alfaro, et al. (2002) points to the role of financial markets for the positive contribution of FDI to economic growth. This study states that countries with better functioning financial markets can benefit from FDI.

Most of the empirical studies aforementioned employ a variable in the analysis, i.e. foreign employment, share of ownership in the sector, etc expecting that variable would capture all kind of spillover effects. Some other groups of studies focus either only one, or more than one possible channel of spillovers. In this way those studies distinguish various types of spillover channels. Of them, Kinoshita

(1999), for example, reached an interesting result by taking such an approach. As we noted earlier, in the analysis of Parente-Prescott type of investment equation, Kinoshita (1999) found a catch-up effect, which can be interpreted as a positive spillover. However, as the effects of foreign joint venture, foreign linkages, and foreign stock in the industry were distinguished, this result changes. Kinoshita (1999) states that after various types of foreign activity is considered, traditional measure of FDI (catch-up effects here) turns out to be insignificant. The estimation results in this study reports no significant contribution from foreign variables. Besides, for the whole sample Kinoshita (1999) found very marginal contribution of training activities. Kinoshita (1999) argues that domestic firms trained their workers more than foreign firms did, therefore, it appears that foreign firms has no share even in this marginal contribution.

Similarly, Damijan, et al., (2003) allow determining various avenues for spillover effects through linkages in their analysis for the manufacturing industries of ten transition economies in the 1995-99 period. They report that horizontal (competition and demonstration effects) are positive and significant for domestic firms in Czech Republic, Poland, Romania, and Slovakia. Of these countries, only three, except Romania, benefits from spillovers working through backward linkage effects. In Bulgaria, only foreign affiliates benefit from both kind of spillovers. But, Lithuania and Latvia face with negative spillovers from vertical linkages. Damijan, et al., (2003) argues that vertical spillovers are more important than horizontal spillovers for these countries. Spillovers from linkage effects were also analyzed by Castellani and Zanfei (2002) for electronics industry in a set of countries including both developing and developed. They provide positive effects on the electronics industries due to MNCs linkages.

Li, et al. (2001) found in their cross section analysis for 1995 that there is spillover for state owned enterprises due to increased competition, whereas private and collectively owned (with state) firms benefit from spillovers through demonstration and contagion effects. Another interesting result this study yielded is reported as market oriented MNCs have increased the competition and thus seem to produce spillover effects whereas export oriented MNCs have not induced any increase in the competition. Liu (2002) also investigate the spillover effects of MNCs in Chinese manufacturing industry for the 1993-98 period for the intra and interindustry types of spillovers.

2.3 Complementary Foreign Technologies

The discussion in the previous section posits that the other side of process in technology transfer efforts is also important. In fact, Pack and Saggi (1997) argue that international technology transfer and indigenous technological effort are strictly complementary to each other. Therefore, the recent tendency as to finding evidence accommodating complementarity between foreign technological activities and in-house technological effort remains totally unsurprising (Lall, 1980; Braga and Willmore, 1991; Katrak, 1997; Veugelers, 1997; Veugelers and Cassiman, 1999, Radosevic, 1999; *inter alia*). The upsurge of the studies proposing this complementary relation between foreign sources of knowledge and indigenous technological effort appears to be the manifestation of a victory against the protagonists of substitutability relation between foreign technologies and domestic effort. So, this discussion seems to have come to an end. The complementarity-substitutability discussion flourished in the center of protectionist ideas in developing countries. Any evidence confirming complementarity between foreign technology and in-house effort can be taken as counter evidence to this protectionist view. If we extend the insight provided by Rosenberg (1982) about technical change, which cannot be limited to the boundaries of a single firm, to country level; we can easily understand that developing countries should exploit some foreign knowledge sources. Otherwise, without this exploitation, the contribution of purely domestic technological activity would be crude, or primitive, that one can label as "reinventing the wheel". In that sense, foreign knowledge sources complement the domestic activity. So, today there is a consensus about the complementarity of foreign technologies and indigenous technological efforts.

However, I consider that, in the context of the discussion above, the complementarity issue should be dealt with a more detailed scrutiny. I would like to ask here the following questions: How insightful is this complementary proposition? What does it imply for catch up process? It is obvious that it is a necessary condition for the technological development in developing countries; but, is it a sufficient condition for a catch up process? I shall argue here that the increased indigenous technological effort recently in developing countries is not necessarily a reflection that these countries are in the catch up process with developed countries.

Mohnen and Roller (2003) describe the complementarity between a set of variables as the increases in marginal returns to one variable in the level of any other, or as the positive cross partial derivates of the payoff function. This means that any external source of technology is supposed to lead an increase in the level of domestic technological activity if a complementary relation between the two holds. One example to the indigenous technological activity is the R&D undertaken by the domestic agents. This would be acknowledged by many economists in an affirmative way without further considering the qualitative aspect of the problem. But, as Cohen and Levinthal (1989) proposed; there are two faces of R&D. The first one is the conventional perception about R&D as these activities generate new information. In addition to this conventional perspective, R&D has a function of enhancing the acquisition, assimilation and exploitation of existing information. To produce new information is more difficult than to master the existing technologies imported from elsewhere. I think that there is a perfect complementary relation between the activities manifested by latter aspect of R&D. This is true for the firms in developed countries. And there is no reason to suspect that this relation holds for the firms in developing countries. So, a critical distinction appears in the nature of domestic activity in a complementary relation. The domestic technological effort can be quite weak in the face of foreign one; all it does might only to master and to adapt it to local conditions, without any improvement capability, despite the two activities can still be complementary. Here, these activities can be called as "absorbing domestic effort" which can be explained in the developmentalist/modernist approach, since it can hardly go beyond the mastering foreign knowledge sources. In this case, we can regard it a purely know-how transfer in which know-why content of domestic effort is marginal. By 'purely know-how transfer', we mean that a purely codified knowledge transfer. As we, elaborate below, "know-why" element (Teece, 1994) in the activity, which is associated with the tacit character of knowledge, is one of the driving forces for localized technology creation. Know-why content of domestic effort based on a dynamic capability approach should exceed the know-how transfer.

In brief, complementarity analysis does not enhance our knowledge about domestic technological effort without paying due attention to the improvement aspect of it.

In our view, this complementary relation is related to the new division of labor in the world economy. This might be a confirmation of the new trend as reflected by the relocation of industrial activity, -mostly the low technology ones, into relatively developing countries.

The literature on technological capability mentioned above, envisage a linear technological development model. Developing countries are first supposed to gain the capability of investment and production; and then they are supposed to proceed to the step of producing new technologies. Given the reported complementary relations, it seems that these countries are in the stage of enhancing their production capability. However, possible policies derived from this mentioned literature would never change the hierarchy between the developing and developed countries. Chen and Qu (2003) put forward that this linear model is not a suitable framework for the successful cases of technological development. They suggest that a successful learning follow a nonlinear process. The insights provided by the technological capability literature might be very useful in the sense that without the knowledge of how to produce; it is hardly possible to acquire the knowledge of how to innovate. However, as Bell and Pavitt (1997) suggested, there is a tension between the *production capacity* and the *innovation capability*, which totally discarded in this discussion. The relocation process of industrial activity from industrialized countries to developing countries has already eliminated this tension in favor of the former countries. Developed countries do not have to worry about the production of manufacturing goods thanks to the shift of industrial activity to the developing countries enabled by the activities of MNCs in these countries. Now, developed countries seem to be more engaged to the innovative activities. But it is obvious that, if this tension really exists, it created new problems for the development of innovation capability, and probably locked those countries into a technological pattern which is based on only the assimilation and mastering the technologies elsewhere produced but not producing new technologies.

In brief, this state of affairs explicitly reveals that the reaping full benefits from the technological development at the frontier is extremely limited. So, the complementary relations between foreign technologies and domestic technological efforts very often reported in the recent studies, does not necessarily mean that the gain of any core dynamics of technological activity, or it does not mean that the ability to produce new technologies.

2.4 Dynamic Capabilities and National Innovation Systems

Recently, a comprehensive effort in describing and understanding the technological change made in the theoretical conceptualization of the process as a system view at the aggregated level. The idea in this perspective is that innovation process is of a nonlinear character such that each stage of the process is deeply affected by the interaction of the institutions at work, which altogether constitute a system (Freeman, 1987, 1988 and 2002; Lundvall, 1988 and 1992; Nelson 1988 and 1993; Nelson and Rosenberg, 1993). This approach, so-called National Innovation Systems[14], is defined by Freeman who first introduced the concept into the theoretical discussion, as the network of institutions, both public and private, which produce, import, adapt and diffuse new technologies by their activities and interactions (Taymaz, 2001). The main focus in this literature is the institutions; -let these institutions be R&D laboratories, universities, administrative government bodies, financial intermediaries, and firms, etc. Institutional change; or flexibility and rigidity, is also under the focus as a unit of analysis for a better explanation of catching-up, lagging behind, or forging ahead dynamics, with special references to Britain and Japan (see, Dosi, et al, 1988). Technology policy can be used to achieve a greater connectivity between these mentioned institutions in a number of ways, -i.e., collaborative programs and schemes to promote the mobility of scientists and engineers; and only with a greater connectivity between institutions innovation possibility frontier can be pushed further ahead (Metcalfe, 1994). This system view of technical change is also used as an analytical tool to understand the experience of developing countries concerning technological development (see, i.e. Nelson, 1993).

[14] The systems of innovation are called sectoral (Malerba, 2002) and regional (Cooke, 2001) depending on the focus and accepted unit of analysis.

It is true that there is no need to reinvent the wheel but there is a need to improve it. Developmentalist/modernist perspective and associated linear characterization of the process of technological capability building, as acquisition, absorption and adaptation, and innovation is far from registering the ability to improve the existing technologies sufficiently. Taymaz and Ballot (1997) have shown that innovators fare better than imitators, not only because of the gains from innovation, but also because of the competence base, facilitating learning from others.

Dosi (1999) notes the need for linking system level analysis to some micro foundations. In what follows, we will outline the dynamic capability view of the organizations (Dosi and Marengo, 2000)[15] with some specific references to the system level counterparts. In other words, we will extend, and apply some of the insights provided by this argument to the organization and coordination of production and innovation at the economy wide, characterizing and defining the economies as 'learning economies'. While doing this, we will try to show that national innovation systems based on a firm level 'dynamic capability' argument should complement the catch-up argument driven by theoretically developmentalist/modernist considerations, based on growth models of neoclassical type, and compensate its well-known limitations and fallaciousness[16].

2.4.1 Dynamic Capability

The salient feature of dynamic capability approach, distinguishing from developmentalism/modernism, is the recognition of the changing environment[17]. Teece (2000) emphasizes the problem with the conventional view which is inherently *static*. The major concern is how to optimize the activity; however, the development of a more dynamic approach is necessary for a successful technological policy and the concern should shift towards how to grow. This can only be achieved by a

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[15] We interpret the dynamic capability concept raised by Teece, et al. (2000) and Teece (2000) and 'dynamic competence' approaches perfectly correspond to each other. Therefore, we use the two terms interchangeably.

[16] As vividly portrayed by evolutionary theorists concerning technical change.

[17] 'Environment' for a firm and for a country is not the same but certainly overlaps to a great extent. We mean by the term, the outer domain of nations, in developmentalist approach, where this domain also includes outer domain of firms within the same nation, for capability explanation.

continuous adaptation. We can rephrase the dynamic capability, drawing on Dosi and Marengo (2000); Teece, et. al., (2000) and Teece (2000), the ability of an organization to adapt its activity; and thus renew its competence as required by changing environment, in which the very organization operates through the *interaction* with a set of agents. Obviously, this is not a static optimization problem but the formation and successfully application of idiosyncratic problem solving procedures[18]. In the static framework, given the capital endowments of firms, *problem solving procedures are* governed by a maximization exercise under the assumption of perfect information, and thus, as Dosi and Marengo (2000) stated, competence do no matter. The observed differences in the performances in the static approach, therefore, can be reduced to the capital accumulation problem without any learning mechanism.

However, in the dynamic approach these procedures are regarded as the ***emergent properties of interactions*** in a learning process, which in turn, "involves adaptation and *discovery* of [new] problem solving procedures that cannot be automatically derived from the information about *states of the world*" (Dosi and Marengo, 2000; emphases are mine). The information of the state of the world here constitutes the pile of blueprints, or know-how, whereas "adaptation and discovery" represent tacitness. A successful adaptation and discovery of procedures necessarily require the context-specific logic of the information in hand, and possible further directions of it in that context. The 'know-why' element of information is necessary for this adaptation.

In order to get access to the acquisition process of this logic, we should remind ourselves that dynamic capabilities emerge with relation not only to environment, but also to an inner nature. We should pay attention to the cognitive process of organizing certain things, depending on to a great extent to the formation of common codes and languages between the members of an entity since each has a different model of world. In this way, communication and coordination is maintained since the interpretation of the state of world is brought on a common ground. However, the diversity of the knowledge shared by the members also enhances the scope for learning, these two dimensions of the internal learning process work in the

[18] The following discussion benefits from Dosi and Marengo (2000) to a great extent.

reverse direction, posing a trade-off for a successful learning. Put it differently, coordination deriving from the common interpretation of information facilitates learning; on the other hand, the learning process is also fed by diverse knowledge bases which make the coordination more difficult. The coevolution of individual and organizational knowledge bases on the ground of mutual adaptation should be underlined here.

The mentioned trade-off between commonality and diversity is central for the discussion for exploitation and exploration in organizational learning. The members of an organization mutually learn from each other. Therefore, common codes and languages favor the use of existing knowledge. The exploration of new possibilities would be facilitated by diverse knowledge bases and interpretation of knowledge. The achievement of commonality sometimes works on a continuous flow of messages from a higher level agent (or institution) who interprets the surrounding world and send his/her/its interpretation to other members[19], even though they still continue to receive messages from the environment, and process the latter by their own, to a great extent varying, cognitive process. This kind of coordination increases the common knowledge among the members. The mentioned trade-off is tackled in a way with reference to the changing environmental conditions. Simulations, referred in Dosi and Marengo (2000), show that slowly changing environments necessitate differentiation in learning process (diversification of knowledge bases); whereas unpredictably changing (within predictable limits) commonality in the understanding and interpretation of knowledge becomes a must. The former case is termed decentralization while the latter is centralization. So, firms must possess both kinds of structures in their body. Notice that, in this approach both exploitation and exploration of environment are mentioned whose management depends on the dynamic environmental conditions.

Now let us translate some of the features of the approach summarized above into the language of national innovation systems to support our conjecture that the existence of compatibility, and complementarity with the innovation systems[20]. First,

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[19] Varying translations and interpretations of these messages by different individuals within the organization still persist, but at least there is coordination in this case.

[20] We are very well aware of that localized technical change at the firm level and technical change at the more aggregated level, national systems here, have different characteristics. This parallelization is

the dynamic nature of the environment is acknowledged in both approaches. The concern, as in evolutionary technology policy, is to push forward the innovation frontier possibilities of firms by achieving a greater connectivity between institutions (see, Metcalfe, 1994). This can also be found in the exploration element in dynamic capability argument which is driven by common knowledge basis of individual members of an organization. Secondly, the importance of construction of a common code and language is one of the major concerns in both approaches (see, Freeman, 2002, for innovation systems). At the firm level, as we discussed, this common language facilitates coordination through the communication between agents and increase the common understanding of events which might be sometimes quite unclear to some agents. At the system level, this common codes and language between institutions can harmonize the activities of the very institutions directed to reach a predetermined common target, as also emphasized by Metcalfe (1994). Third, since the definition of dynamic capability also includes both internal and external interaction, which can be translated to the system level, interactions between institutions, especially user-producer relations within a system. Fourth, and relating to this last point, both system and firm levels are compatible with a nonlinear representation of technical change of which each stage host a plenty of different interactions.

Now let us turn to the role of manager and her/his probable equivalent in a system. We shall propose the following: the role of a manager as the translator, who observes and gathers the messages from outer environment and translates them into a common language, can be considered as corresponding to the role of an institution functioning in the same way. In the Japanese case, this function was fulfilled by MITI (Freeman, 1988). The vision and the strategy of such an institution are of crucial importance concerning the interpreted messages from environment, the harmonized activities facilitated by better information flow. Besides, this coordination should support the dynamic capability building. In other words, that institution must be a good manager. It should observe the frontier and its movements, send messages to other institutions and affect them in a best way to create technological change. Without any dynamic capability consideration, however, the

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not an attempt to reduce the two into one dimension but it is to note that there is a structural relation between the two.

activities and interactions of institutions would be far away to leading successful innovation system.

In order to further clarify the system based on dynamic capabilities, one can raise the example of Japanese experience. In the Japanese case, the access to foreign technology took the form of 'reverse engineering' (Freeman, 1988). We consider that this kind of transfer best fit with a nonlinear and complex process of technological learning since it registers capabilities both at the production, and the improvement stages, simultaneously. Indeed, in the phase of exploring here, the know-how element of technology is inevitably accompanied by a learning, characterized by know-why. In other words, know-how transfer is an outcome of know-why capability, - the acquisition process of codified knowledge is associated with the organizational heuristics in the exploration of new opportunities, and is greatly outweighed by the latter. Notice that in this transfer mode, a passive absorber role for transferor is impossible. In order to get access to the available knowledge base, an *active engagement* to it is required. This necessitates the shift of the core dynamics of the technological development towards to local productive agents from foreign technologies. However, in the case of other mechanisms of technology transfer, -i.e., MNCs, this simultaneity is not inevitable. Consider the license agreements, where a good deal of codified knowledge purchased, and some necessary information related to adaptation is voluntarily supplied. In this case, the know-how transfer is not a consequence of know-why capability, and therefore, may allow a passive absorption of knowledge. Both cases are the articulations of the "exploitation of the available knowledge", in Dosi and Marengo (2000)'s words. We shall conjecture here that, the elasticity of know-why activity for the "exploration of new opportunities" is greater than that of know-how activity. We ground this conjecture on the distinction Dosi (2000b) made about the strength of uncertainty inherent in technological change process: The conventional view of uncertainty draws on the imperfectness of information about a full list of possible events in a transfer of any technology. Therefore, routines of the firms aimed at correcting this asymmetry in the information can be based on know-how transfer. However, this sort of transfer may not be sufficient for reducing strong uncertainty which defines a case where the full list of possible events is not known. In Dosi (2000b: 77 [1134])'s words, "…technological trajectories are not only the ex-post description of the patterns of technological change, but also … the basis of heuristics asking 'where do we go from here?'". This basis of heuristics can be best developed by the routines focusing on know-why rather than know-how, though both are necessary for a successful exploration.

The existence of a dynamic strategy in a national context may also benefit other forms of transfer. The Korean case, for example, can constitute an example for this last point. When the most advanced and complex technologies concerned, the transfer of technology initially might take the forms other than reverse engineering; however, exploration of new opportunities might take place in a very fast pace. This is the case for Korean system in which very complex technologies were transferred by mechanisms other than reverse engineering. However, since the general strategy of the Korean system can be characterized by one of such a dynamic capability consideration, the extensive reverse engineering activity existent in the system also enabled the *exploitation*, in the license case for example, and absorption process took place very shortly (Kim, 1993 and 2000)[21]. The elements of the innovation system provided necessary knowledge for a later successful reverse engineering for advanced technologies (Kim, 2000).

To recap, deficiencies of catch-up explanation drawing on convergence hypothesis can be compensated by an innovation system approach since the former is characterized by a static developmentalist/modernist approach whereas the latter is characterized in terms of dynamic capabilities. Given the insights provided by the discussion above, system approach to innovation is the appropriate tool to understand the innovation process in developing countries.

[21] Korean case does not perfectly correspond to a case where dynamic capability building. For example, Kim (2000) discuss that Original Equipment Manufacturing enable some Korean firms to gain production capability thanks to the buyers of their product. However, this also created dependence to buyers, when they shifted their purchases to China; Korean firms were lacking marketing capabilities in the international scale.

CHAPTER 3

DESCRIPTIVE ANALYSES

The chapter is devoted to a broad descriptive analysis of the issues related to the technological capability in the manufacturing industry in Turkey. Before this analysis, the recent trend in the FDI flows in the world and the legal framework and historical background of MNCs in Turkey.

This and the following chapter draw on three main data sources, all of which was obtained from State Institute of Statistics (SIS). The first one is a panel data set, called the *Manufacturing Industry Statistics* consists of 28 three digit level industries (according to the classification ISIC, Rev 2) covering the 1983-2000 period. The second data source is the *Innovation Surveys* conducted by the SIS. The surveys, the first one conducted in 1998 covering the period 1995-97, and the second one conducted in 2002 covering the period 1998-2000, adopted a questionnaire compatible with the *Community Innovation Survey* of the European Union, and used the concept of "innovation" as defined in the OECD *Oslo Manual*. The response rates were more than 50 percent in both surveys. The surveys include questions about innovative activities, knowledge sources, interactions, etc. The SIS performed a non-response analysis and estimated sample weights for each respondent. Finally, the third main data sources is the *Input-Output Tables*, indicating the inter and intra industry economic transactions, released by State Planning Organization (SPO) in Turkey, for the years; 1979, 1985, 1990 and 1996.

3.1 Recent Trends in FDI Flow in the World

The figures in the Table 1 show that FDI mostly flowed into developed countries. Developing countries received a relatively limited amount of FDI in the 1997-2001 period. For example, the developed countries included in the table attracted around 379 billion USD in 2001 whereas this figure amounts to almost 121 billion USD. Japan, Brazil and China are the exceptions to these remarks. FDI flow to Japan, a major developed country, exhibited a pattern similar to those of developing countries; whereas the pattern of FDI flow to Brazil and China, displayed a similar pattern to that of developed countries. The table shows an interesting trend in FDI flows such that the highest foreign investment received by the USA. This amount of FDI in this country was around 124 billion USD. The UK, France and Netherlands follow, respectively.

FDI flow in the world economy fluctuated around 22 trillion USD over the 1997-2001 period. In 2001, the total amount of FDI declined, but some countries were able to attract more FDI. Turkey was one of these countries in which FDI increased with respect to previous year. The relative increase in the FDI flow is very impressive in Turkey. The total amount of foreign investment increased to 3.2 billion USD in 2001 from 982 million USD in 2000. This means that total FDI in Turkey had grown more than three times by the end of the period. No such an impressive growth of FDI was observed in any other country in relative terms.

Table 1: FDI Flow into seleceted countries, million USD, 1997-2001

COUNTRY	1997	1998	1999	2000	2001
Developing Countries					
Argentina	9 156.0	6 848.0	24 134.0	11 152.0	3 181.0
Brazil	18 992.9	28 855.7	28 578.4	32 779.2	22 457.4
Chile	5 219.1	4 638.3	9 220.8	3 674.3	5 508.0
China	44 237.0	43751.0	40 319.0	40 772.0	46 846.0
Czech Republic	1 300.4	3 717.9	6 324.0	4 986.3	4 916.2
Hungary	2 173.0	2 036.0	1 944.0	1 643.0	2 414.0
Malaysia	6 324.0	2 714.0	3 895.3	3 787.6	553.9
S. Korea	2 844.2	5 412.3	9 333.4	9 283.4	3 198.0
Poland	4 908.2	6 364.9	7 269.6	9 342.3	8 830.0
Romania	1 215.0	2 031.0	1 041.0	1 025.0	1 137.0
Russia	4 865.0	2 761.3	3 309.0	2 714.0	2 540.0
Singapore	10 746.0	6 389.0	11 803.2	5 406.6	8 608.8
Taiwan	2 248.0	222.0	2 926.0	4 928.0	4 109.0
Turkey	805.0	940.0	783.0	982.0	3 266.0
Venezuela	5 536.0	4 495.0	3 290.0	4 464.0	3 409.0
Developed Countries					
France	23 173.8	30 983.7	47 069.8	42 929.8	52 623.2
Germany	12 244.3	24 592.8	54 753.7	195 122.2	31 833.3
Italy	3 699.9	2 634.6	6 911.4	13 377.3	14 873.4
Japan	3 224.2	3 193.2	12 741.1	8 321.8	6 201.5
Netherlands	11 132.2	36 963.8	41 289.0	52 453.0	50 471.0
Spain	7 696.7	11 796.7	15 758.1	37 523.5	21 780.6
Sweden	10 967.5	19 563.8	60 850.4	23 367.1	12 733.5
Switzerland	6 636.1	8 940.5	11 717.9	16 285.4	9 986.4
UK	33 228.6	74 324.3	87 972.8	116 551.7	53 798.8
USA	103 398.0	174 434.0	283 376.0	300 912.0	124 435.0
World Total	22 205 100.0	23 569 500.0	21 223 800.0	24 644 300.0	18 545 100.0

Source: UNCTAD World Investment Report 2002. Note: The last row indicates the total foreign investnent flow in the world so the columns do not add up to the figures in the last row.

3.2 Legal Framework for Foreign Firms in Turkey

The legal infrastructure for MNCs was established soon after the Second World War in Turkey. The Foreign Capital Law was enacted in 1954 and the related Decree of the Council of Ministers had remained in force since the late 1980s. The Law and the Decree provided a quite liberal framework of general principles designed to create a favorable environment for FDI. However, it is suggested by some researchers that the government institutions, and most importantly the SPO, who were suspicious of foreign capital, had effectively kept inward foreign investment at low levels with various restrictive bureaucratic practices (Erdilek, 1982). Thus, the *cumulative* total of FDI authorized from 1950 to 1980 had reached only 229 million USD (Öniş, 1994).

The import substitution industrialization strategy followed by the Turkish governments in the 1960s and 1970s had to be abandoned as a result of a severe balance of payments crisis in the late 1970s. On January 24, 1980, the Turkish government announced a stabilization program that was fully implemented under the military regime after September 1980. The new program was based on outward-oriented trade strategy and foreign trade, product, and, later, capital markets have been liberalized to a large extent (for a comprehensive overview of the Turkish economy, see Kepenek and Yentürk, 2000).

The administrative system regulating FDI was reorganized in the early 1980s to simplify investment procedures and to eliminate ambiguities arising from the fragmented bureaucratic structure. Moreover, all discriminatory treatment foreign investor were subject to and conditions on local equity participation were gradually eliminated (Erdilek, 1986; Akpınar, 2001). The complete liberalization of capital accounts in 1989 provided an additional impetus for foreign investment. As a result, the number of firms with foreign participation increased from 78 in 1980 to 1,856 in 1990 and to 5,328 in 2000, whereas total value of inflow of FDI reached.

6 billion USD in the 1980-89 period and 11.8 billion USD in the 1990-2000 period.[22] The manufacturing industry alone accounted for 55% of cumulative authorized FDI in the post-1980 period.[23]

The annual FDI has been about one billion USD in the 1990s. The share of foreign firms[24] in total number of private firms in the manufacturing industry was about 1 % in 1983, but it increased continuously up to 2 % in 1999, and 3.5% in 2000 through acquisitions and entry.[25] The share of foreign firms in private manufacturing employment was about 6 % with 50 thousands people employed by foreign firms in 1983. Employment share of foreign firms increased gradually, especially after 1988, and reached 11 % in 2000.

3.3 The Overview of the Turkish Manufacturing Industry

There are various channels for technology transfer to an economy. It was discussed in the previous section that MNCs are regarded as the dominant agent for technology transfer. Though, foreign trade, license agreements, R&D cooperation, etc. are also important mechanisms for knowledge transfer to an industry. Therefore, any broad analysis of technological development of an industry should also consider the other ways of external knowledge flows to an economy as well as foreign direct investment. In this section, in addition to the various characteristics of MNCs in Turkey such as their productivity, market share, backward and forward linkages they

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[22] For the data on inward FDI and the list of all firms with foreign equity participation, see the web site of the Undersecretariat of Treasury (http://www.hazine.gov.tr).

[23] The share of the manufacturing industry in total FDI was about 88% in 1977 (Öniş, 1994: 9).

[24] Following the usual convention, "foreign firms" are defined as those joint ventures where foreign ownership is 10 % or more. If the foreign share is less than 10 %, it is considered to be portfolio investment. Joint ventures with more than 50% foreign ownership are "majority-owned foreign firms".

[25] The data refers to all *private* establishments employing 10 or more people, and all public establishments. The data source is the State Institute of Statistics (SIS) Longitudinal Database that includes all public and private establishments employing 10 or more people. The statistical unit is the "establishment" which is the main decision-making unit. Most of the firms in Turkish manufacturing industries own only one establishment.

created with other firms, etc.; we will also examine foreign trade orientation and technology transfer through license agreements in the Turkish manufacturing industry. Besides, as the previous sections elaborated the technological capability of an industry is an important determinant to benefit knowledge flows mediated by various mechanisms. Thus, we shall also examine the current technological capability of the Turkish manufacturing industry versus the US manufacturing industry[26]. The specific characteristics of industries also matter for the idiosyncratic and cumulative nature of technological development. For example, knowledge necessary for low tech industries is quite different from the knowledge necessary for high tech industries. That is why; the descriptive analysis below will flourish on the basis of such kind of specific breakdown of the manufacturing industry in Turkey.

3.3.1 Productivity in the Turkish Manufacturing Industry

Given the insights provided by the previous literature on MNCs, a better productivity performance for foreign firms is postulated in the process of generating positive productivity spillovers. In this respect, one of the aims of the productivity analysis conducted here is to understand if there is a potential for positive spillovers from their activity in the Turkish manufacturing.

In the figures below, the productivity of the Turkish manufacturing industry is presented. The productivity here was measured as the real value added per employee. The pattern of productivity of both foreign and domestic industries in the 1983-2000 period, had increased, with a slightly stronger positive trend for the foreign firms (Figure 1 below). The labor productivity in the foreign side had increased 12 %, on annual average, over the period. This increase in the domestic side amounts to 7.2 %. The productivity of MNCs had increased especially after 1989; it was registered as a great performance in 1990-1993; and remained, more or less, the same after this period. We observe the same trend for the domestic industries, too; though the jump of domestic productivity after 1989 is a moderate one. Nevertheless, the pattern for labor productivity in the foreign industries is of an

[26] For the purpose of this section we approxiamte to the technological capability as labor productivty.

erratic character, whereas it was more stable for the domestic side. Observe that the declines in the trajectory of the productivity of MNCs followed are sharper than that of domestic industries. Despite these declines, MNCs had always had a higher productivity performance compared to domestic firms. In other words, foreign firms in the Turkish manufacturing industry outperformed their domestic counterparts in terms of labor productivity measured as the real value added per employee in the period. One can observe a huge gap between domestic and foreign firms in the figure that is increasing especially after 1990. The labor productivity of foreign firms was 1.8 times higher than that of domestic firms in the beginning of the period.

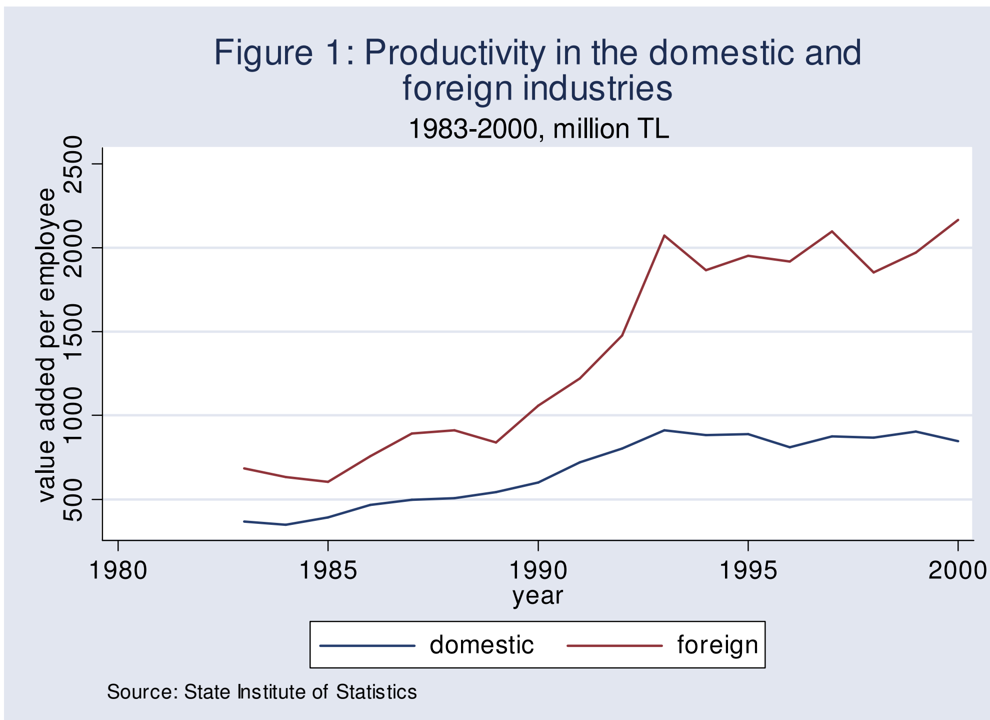
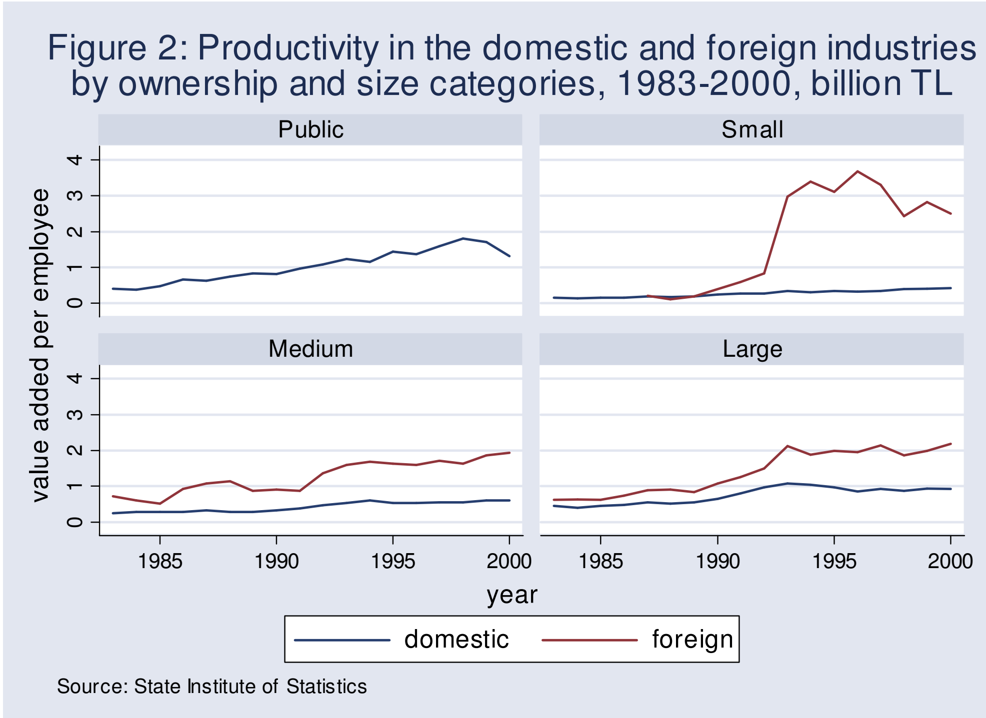


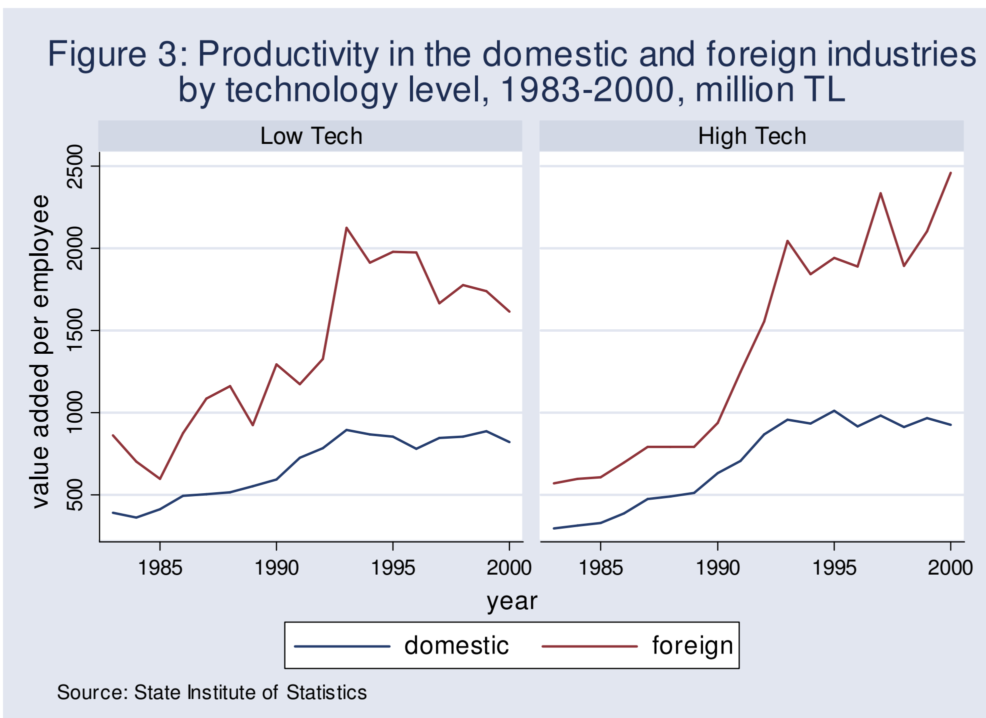
Figure 1: Productivity in the domestic and foreign industries

This ratio jumped to 2.5 in the end of the period. This gap can be interpreted as counter substantiation against positive spillovers. Meanwhile, this gap also reflects the technological opportunities, potentially available, to be exploited by the domestic firms, and therefore; the potential for positive productivity spillovers for the domestic industry. But, as this gap is increasing throughout the period, it can also be a result of competition effect which resulted as negative spillovers due to foreign industrial activity. In brief, we interpret this picture in the following way: there is a technological opportunity for domestic industry, however; since this huge gap between domestic and foreign small industries was increasing, it can be a reflection of suppressed domestic productive forces. In other words, it can be the indication of negative spillovers due to increased competition with foreign firms.

Perhaps, a part of this gap can be attributed to the size distribution of foreign and domestic industries. MNCs are generally tended to be large firms and therefore, this might contribute to the observed superior productivity of foreign industries. However, the Figure 2 below shows that the highest productivity was measured in the whole period in small sized foreign firms. The labor productivity was almost approximately 2.8 billion TL whereas the same figure is only 0.26 billion TL in the domestic small industries, in the whole period. This means that foreign small industries were ten times more productive than domestic ones. Therefore, the superior productivity of foreign firms in Turkey cannot be explained on the basis of the scale of economies which is most likely to be materialized in large scaled manufacturing plants. In other private size categories, foreign industries are also more productive than domestic ones, but the gap is not as striking as in the small ones. However, they are still remarkable. Foreign medium and large sized firms are more than three times, and almost twice, more productive than their domestic counterparts, respectively. On the other hand, the highest productivity was measured in the public industries in the domestic sector[27]. Of the remaining size categories of private industries, large domestic ones have the highest labor productivity which is followed by medium and small industries, respectively. That the gap between the two groups in other size categories are not very dramatic raises the expectations for positive spillovers since it might also be a reflection for domestic technological capability, -that is, precondition for generating positive spillovers from MNCs, discussed in the previous section.

[27] The large scale of public firms might have a role in this performance of domestic public industries. The petrochemical industry which is public owned is a good example here. The foreign industrial activity in public industries is negligible.





Since the differences in production scale cannot explain the whole gap between domestic and foreign industries, some differential still remains to be explained[28]. On account of the idiosyncratic and knowledge specific nature of the manufacturing activity in different industries; another approach to classify the industrial activity can be using the R&D intensity. Figure 3 displays the labor productivity by the R&D intensity of the industries[29] and confirms the productivity gap between domestic and foreign industries. The productivity differentiates across the low tech and high tech groups, neither in domestic, nor foreign industries. But, the productivity of foreign industries is at least twice larger than domestic ones in each category of R&D intensity.

The productivity of foreign high tech industries is slightly above 1.5 billion TL in real terms for the whole period, and it is slightly below 1.5 billion TL in low tech foreign industries. The productivity in low and high tech domestic industries is slightly below 0.7 billion TL. In brief, the R&D intensity characteristics of the industries do not contribute to the explanation of the productivity gap between domestic and foreign industries. Because, the gap between the foreign and domestic low tech industries is almost as large as that of high tech ones. As we noted before, these gaps can be a reflection of a suppressed domestic productive forces in the meantime they also draw a sort of technological opportunities.

3.3.1.1 The Gap between the US and the Turkish Productivity in Manufacturing

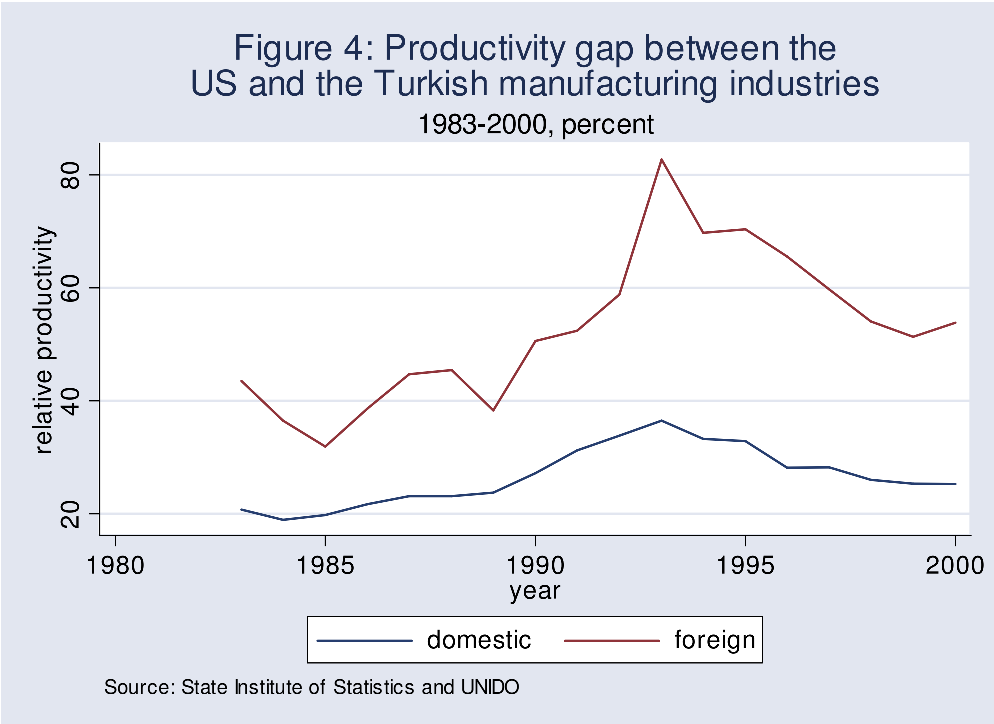
The well-known hypothesis of convergence of income between developing and developed countries by an automatic process also implies a convergence between productivity levels of the very countries. The Figure 4, however, suggests that the productivity level of the Turkish manufacturing industry is far from convergence to the productivity of the US manufacturing industry. This is especially true for the domestic side of the manufacturing industry which was capable of operating at the 26

[28] This differential can be the indication of, *inter alia*, the superior technologies and better managerial capabilities of MNCs implying, on the other hand, a benefit as a positive demonstration spillover. In this sense, limited technological capability of the domestic side of the manufacturing industry would ban to reap the benefits, if any, -in small domestic industries perhaps. Besides, the better practices and superior technologies of MNCs draw a sort of technological capability frontier for the domestic side of the industry. Therefore, we can argue here that the gap between domestic productivity and 'frontier' productivity levels can be regarded as the technological opportunities.

[29] The industries in low tech and high tech were defined according to the OECD classification. Since the relative importance of high tech industries are limited; we merged medium and high tech industries and labeled them high tech.

% as efficient as the US manufacturing industry in 1983-2000 period, on average. The relative productivity of the domestic manufacturing industry could have reached to only 37 % at most. After this peak level in 1993; it started to slow down again. The foreign side of the manufacturing industry, on the other hand, had a better performance compared to the domestic side versus the US manufacturing industry. The relative productivity of foreign industry had reached to slightly above 80 % of the US productivity.

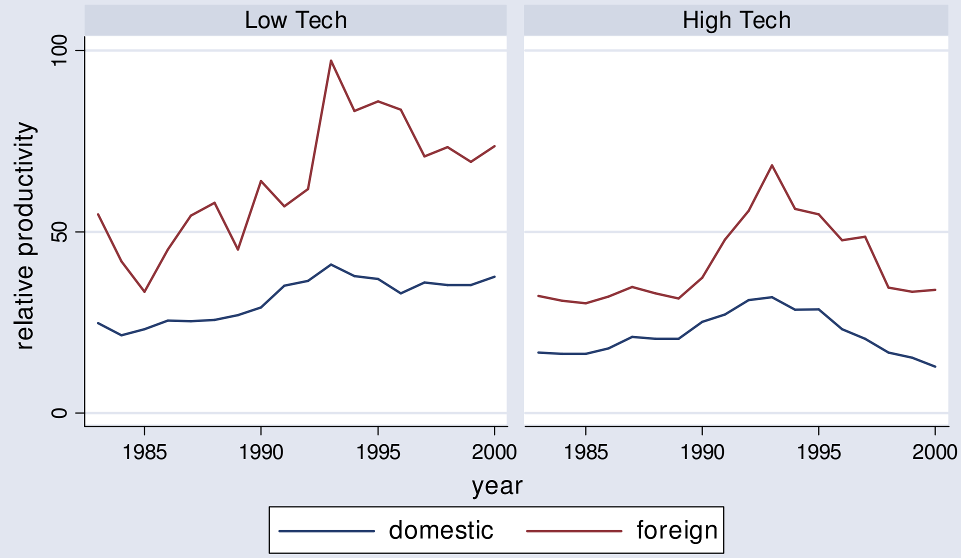
One can understand from the Figure 4, that the macroeconomic conditions were also effective on the trajectory of the relative productivity of the Turkish manufacturing industry. Because, even though there was a gap between the relative productivity of the domestic and foreign sides of the manufacturing industry, the patterns that they had followed were more or less similar to each other. The foreign side was almost capable at the rate of 52% as the US manufacturing industry. This rate climbed to the 83% at most in 1993.



The pattern of relative productivity of the Turkish manufacturing industry exhibits somewhat stability in low tech industries unlike the high tech ones that dropped dramatically after 1993 (Figure 5). The decline in the relative productivity of low tech industries is negligible. Moreover, the relative productivity of low tech industries remained always on a higher path for each corresponding year throughout the period. The relative Turkish productivity in low tech industries differentiated between 25 and 41 % in the 1983-2000 period. However, 16 and 32 % was the range that the relative Turkish productivity in high tech industries.

One can confer here that backwardness that we observe in terms of relative productivity both in low tech and high tech industries may not be an advantage for a successful catch-up. Of course, we can comfortably assert that this pattern of relative productivity of the Turkish manufacturing industry was also affected by some other factors. Of them, macroeconomic instability perhaps is worth mentioning. For example, the Turkish economy experienced an economic crisis that was deeply felt in the manufacturing side of the economy in 1994; just after the peak of the relative Turkish productivity observed in the both figures. Another factor that had exerted its influence upon this pattern of relative productivity of Turkey might be a new regime in foreign trade sphere. Turkey joined to the Customs Union with European Union (EU) in 1995. It is highly likely that the pattern of the Turkish productivity just after 1995 was affected by the change in the trade regime. But this effect, if any, worked in the reverse direction for low tech and high tech industries. We see that there is an increase in the relative productivity of low tech industries and decrease in that of high tech industries.

Figure 5: Productivity gap between the US and the Turkish manufacturing industries, 1983-2000, percent



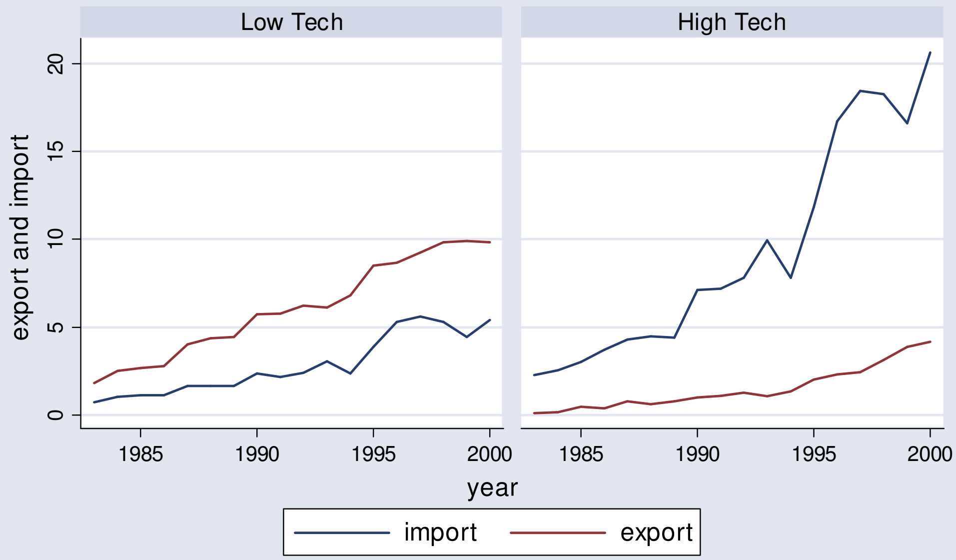
Source: State Institute of Statistics and UNIDO

3.3.1.2 Foreign Trade with EU

The effects of customs union with the EU, of course was mediated by the foreign trade relations. The figure below visualizes the import and export relations of Turkey with EU. The figure suggests that both export and import had increased in low tech industries, and that the export performance of low tech industries in Turkey was higher throughout the period. The integration with EU through customs union had a slight positive effect on the export performance of low tech industries. Both import and export relations with EU increased after 1995, the jump in import figure being more observable. But, the gap between export and import figures is not ver y dramatic. However, this gap between export to and import from EU strikingly increased after 1995 in high tech industries. The export to the EU countries from the Turkish manufacturing industries increased to only 2.3 billion US $ in 1995 from the level of 2 billion US$ in 1994. However, the import from EU countries jumped to 16.7 billion US$ from 11.8 billion US$ after the customs union. By the end of the period, the trade deficit with the EU countries in high tech industries was around 16.5

billion US$. We observe a trade surplus in low tech industries, which was 4.4 billion US$ by 2000.

Figure 6: Foreign trade with EU by technology level 1983-2000, billion US$



Source: State Institute of Statistics

The integration of the Turkish economy with EU by Customs Union fostered the low tech industrial activity; but it discouraged the high tech industrial activity. This rough analysis gives way to the conclusion that a deeper integration of technologically developing and developed countries enforces a traditional specialization pattern in industrial activity. The technologically lower activities are encouraged; whereas the technologically higher activities discouraged. This means that in the long term the convergence hypothesis does not hold since the fostered low value added activities (in low tech industries) probably will not lead to such a convergence. In contrast, one should expect a divergence between the developed and developing countries on account of the suppressed high value added activities (in high tech industries). Kotan and Sayan (2002) reported that EU's import demands for 'textiles and garment' and 'technology intensive products' are elastic, implying that exporters should charge lower prices by reducing their costs. It is obvious low tech products have lower cost compared to high tech ones. The difficulty of lowering costs in high tech products might have a role in the explanation of poor export performance to EU versus import from EU in high tech products.

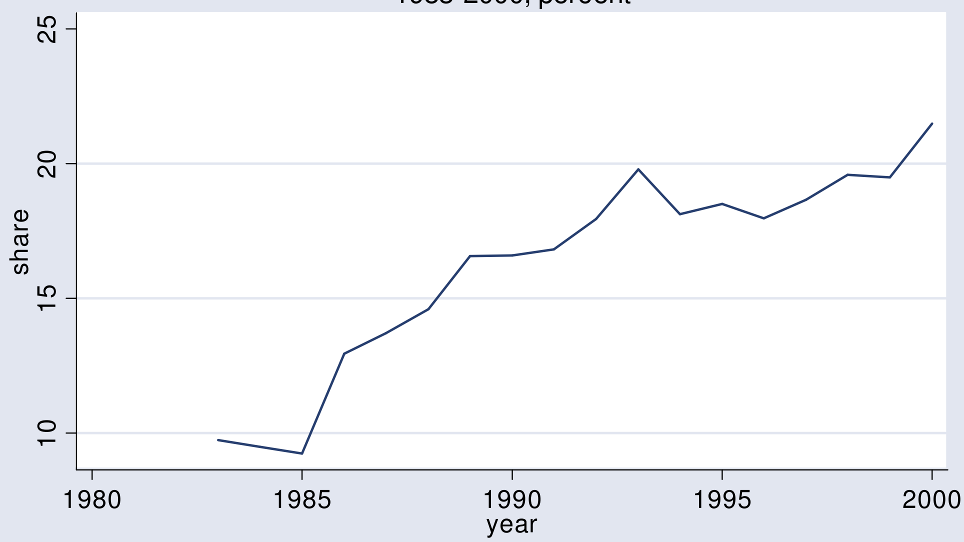
The relative productivity in the Turkish manufacturing industry versus the US productivity has also implications for the spillover effects from MNCs. In order to approach to the technological capability of any country, or industry, the technological capability literature suggests examining the relative position of that country, or industry in comparison with the leader, or with the practice of the state-of-art. The manufacturing practice in the United States of America is considered to be the best practice here. Therefore, we check the current technological capability of the Turkish manufacturing industry in comparison with the US manufacturing industry. We suggest the difference between the labor productivity, measured as the real value added per employee as a proxy for that. The poor performance regarding the relative productivity in Turkey raises doubts about the realization of such kind of spillovers.

3.3.2 Market Share of MNCs in the Turkish Manufacturing Industry

There is another condition for positive spillovers for domestic industries: Foreign firms must occupy an important part of the overall industrial activity. It can be claimed that the weight of foreign industrial activity in the overall Turkish manufacturing industry had reached to such a magnitude. The industrial activity of foreign firms had increased in the Turkish manufacturing industry over the period 1983-2000, and had constituted increasingly an important part. Market share of MNCs over this period clearly lends support to this remark. The Figure 7 exhibits a very strong positive trend for the market share of MNCs in Turkey. This market share had increased from 9.7 % in 1983, to circa 21.5 %, in 2000. This sharp increase emphasizes the high competence of MNCs as well as a probable competition effect that is resulted as negative spillovers even though this increased market share also carries some potential demonstration of product technologies. The net effect of these countervailing influences will be strictly dependent on the response given by domestic side of the manufacturing industry. This implies that those industrial activities of foreign firms had reached to a magnitude large enough to create spillover effects, either positive or negative, for domestic firms.

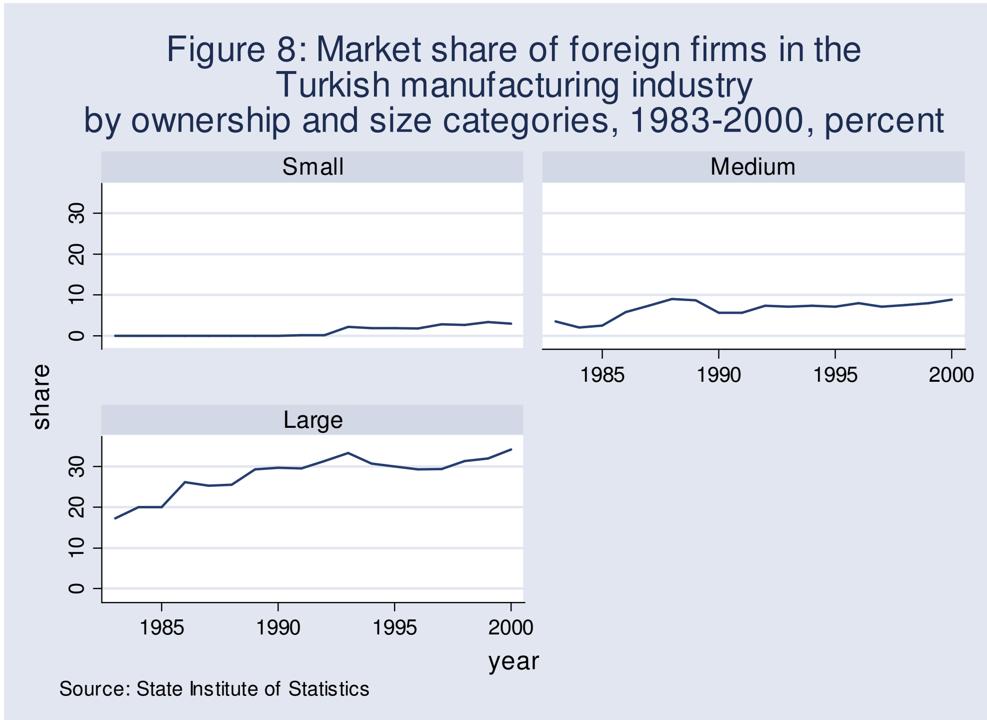
Figure 7: Market share of foreign firms in the Turkish manufacturing industry

1983-2000, percent

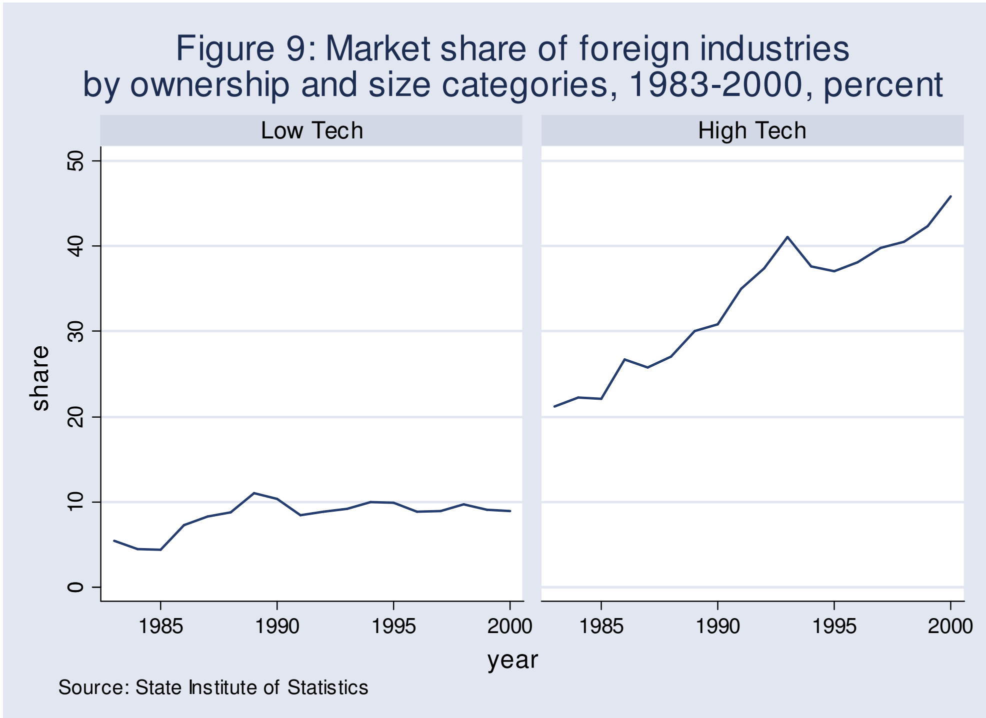


Source: State Institute of Statistics

The greatest part of this increase belongs to the large firms. The market share of large foreign firms is extraordinarily high compared to other size categories in the period of 1983-2000 (Figure 8). The share of these firms had reached to an average of 32 %; whereas the share of medium sized and small foreign firms were 8 % and 2 %, respectively, in the period. The figure makes explicit the interesting feature about the market share of small and medium sized foreign firms. Their shares started to increase only after 1992 and 1985, respectively, although they did not reach to considerable shares by the end of the period. On the other hand, large foreign industries had always had an important part of the market, even in the beginning of the period, and had increased their performance by the end of the period significantly.



We should note here that there is an inverse relation between productivity and market share of foreign firms in various sizes. This relation may be explained on the basis of the population of the firms. The market share of small foreign firms is the lowest among the other size categories, despite their outstanding productivity. When the population of domestic firms concerned, the market share of domestic firms remains no more impressive. The dominance of domestic small firms in the market can be explained by the large number of domestic firms in the market place. In the period considered, there were around 4094 domestic small firms versus 11 foreign small ones, on annual average (Table 2). This figure is 4372 for medium sized domestic firms and 103 for foreign firms. However, the ratio of the number of domestic firms to the foreign ones is relatively smaller in large industries. There were around 930 domestic large firms versus 126 foreign ones, on annual average, in the 1983-2000 period. In brief, this high market share despite the low productivity performance of domestic small and medium sized firms is a result of the high population of the domestic firms. This posits that there is a great potential of growth to be realized by fostering the productivity of small and medium sized domestic firms.



Regarding R&D intensity, high tech foreign firms had the highest market share in the Turkish manufacturing industry (Figure 9). The market share of foreign high tech firms was around 45 % in 2000 whereas it was 21 % in the beginning of the period. This figure had quadrupled that of low tech firms in the period. These observations also give way to the expectations for the potential horizontal spillover effects for medium and high tech industries whereas it limits the expectations for low tech ones. The striking share of foreign firms in high tech industries indicates that high tech markets are dominated by foreign firms. The productivity record of foreign firms by R&D intensity does not vary to a great extent. Though, the market share does. The population of domestic firms has something to do with the explanation in this respect here, too. The number of domestic firms in low tech industries was around 7258, on annual average whereas there were 119 foreign firms in the same category (Table 2). This might be one of the explanations of the lowest market share of foreign firms in these industries. These figures were around 2511 and 123 firms for domestic and foreign sector in high tech industries, respectively. Therefore, even though the productivity gap does not vary to a great extent over various categories of R&D intensity; the market share of foreign firms varies greatly and the numbers of domestic and foreign firms play a role in this respect.

To sum up, foreign firms are much more productive than domestic ones regardless of the classifications we considered here. However, they cannot takeover the whole market likely due to the large population of domestic firms, even though their productivity levels are lower, and thus, technological capability are limited. Domestic firms concentrated mostly in small and medium sized and low tech industries, and especially in small industries these poor performing domestic firms can dominate the market. The existence of inefficient domestic firms versus efficient foreign ones leads one to think about a negative competition effect was generated. This huge gap between domestic and foreign industries might also refer to the existence of potential for positive spillovers that can be materialized in the future. But as the technological capability appears as a condition for positive spillovers here, it is unlikely for small domestic industries to reap benefits without increasing their technological capability. The productivity gap for medium and large industries was relatively small. But foreign market share for large industries was high whereas it was very small for medium sized industries. Therefore, we have no expectations for the medium sized industries; but for large industries we consider that a spillover was produced by MNCs. We have no expectations at this point about the sign of the effect since it can be either positive or negative. It can be positive since the increasing market share forced domestic firms to be more productive; it can be negative because of the high market share might have swept out the inefficient domestic firms from the market. So we need to examine such kind of industrial dynamics to ever have an expectation for the direction of spillovers.

Table 2: Number of Firms by Various Characteristics, 1983-2000

Year	Ownership/Size Categories								Technology Categories			
	Public		Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1983	407	3	4593	0	3387	31	658	61	6432	33	2613	62
1984	379	3	4138	0	3330	34	674	81	6070	44	2451	74
1985	390	2	5680	0	3569	44	709	78	7614	50	2734	74
1986	397	1	4613	0	3701	45	747	95	6883	56	2575	85
1987	408	2	4108	1	3779	49	828	93	6620	63	2503	82
1988	413	3	3848	1	3886	63	888	95	6611	70	2424	92
1989	414	2	3860	1	3946	80	898	115	6786	96	2332	102
1990	409	0	3333	0	3891	99	917	119	6443	111	2107	107
1991	412	0	2894	2	3784	97	853	119	5980	105	1963	113
1992	431	0	5168	3	4389	113	853	125	8237	123	2604	118
1993	413	1	4369	23	4494	121	891	136	7685	147	2482	134
1994	390	1	4122	16	4352	131	848	140	7321	150	2391	138
1995	356	0	3827	18	4657	135	969	151	7435	159	2374	145
1996	329	0	3772	14	4984	151	1074	144	7686	158	2473	151
1997	315	0	3939	21	5396	153	1231	174	8227	182	1654	166
1998	299	0	4197	34	6018	165	1274	187	8804	208	2984	178
1999	289	0	3693	32	5577	169	1177	186	7972	197	2764	190
2000	262	0	3533	25	5552	172	1253	177	7844	181	2756	193
Mean	373	1	4094	11	4372	103	930	126	7528	119	2511	123

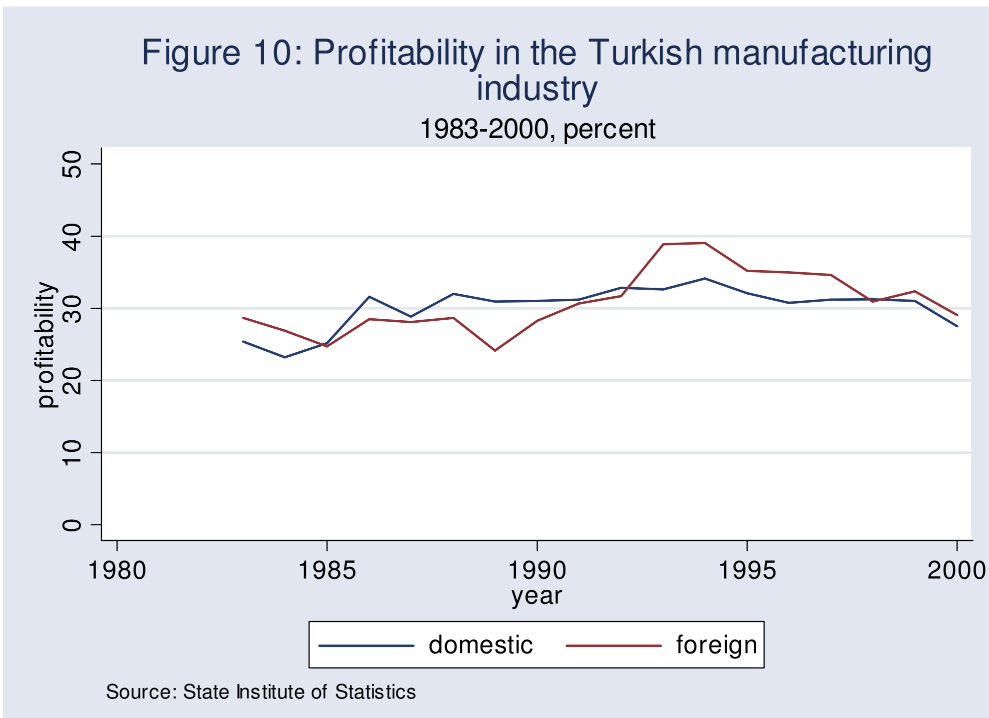
Source: State Institute of Statistics

3.3.3 Profitability in the Turkish Manufacturing Industry

Despite to the low productivity level of the indigenous industrial activity, the domestic firms gained considerable rates of profits[30] and these rates were not very much different than those of foreign firms in the 1983-2000 period (Figure 10). These rates had horizontally fluctuated between the ranges of 23-34% for domestic industries; and between 26-39% for foreign industries throughout the period. The profitability of the foreign side of the manufacturing industry was also very close to that of domestic industries. The foreign profitability rates climbed to a higher path than that of domestic ones 1993 onwards; whereas the average domestic profitability were generally higher previously. Given the poor performance in terms of productivity, the high rate of profits was achieved at the expense of low wage levels for workers in the domestic side of the industry. Nonetheless, foreign industries were able to obtain the same, even higher, profitability rates, though they paid higher

[30] The profitability here was defined as, Л= (Value added-Wages)/Output; that is, the differences between the real output and real wages.

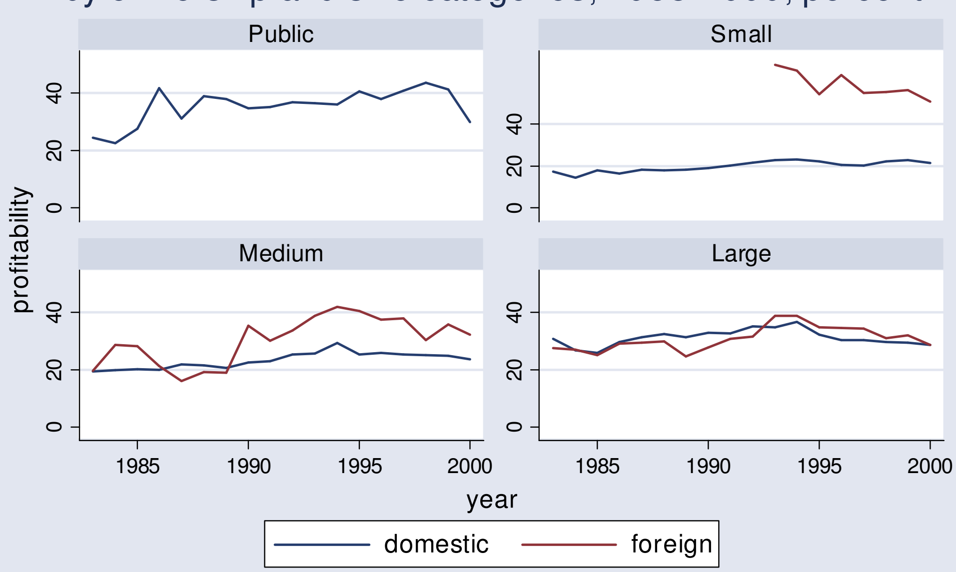
wages compared to domestic firms. The arguments favoring the determination of wages in line with labor productivity would justify this high profitability versus low wages. But, we should remind ourselves that the organizational capabilities of firms and technology are the main effective factors on the labor productivity; and the efforts made by the labor force to increase the productivity cannot solely explain the resulting level of the labor productivity. Therefore, MNCs, with their assumed higher organizational and technological capabilities achieved a better productivity performance, despite the higher foreign wage levels, on the one hand; and the same profitability with domestic firms, on the other.



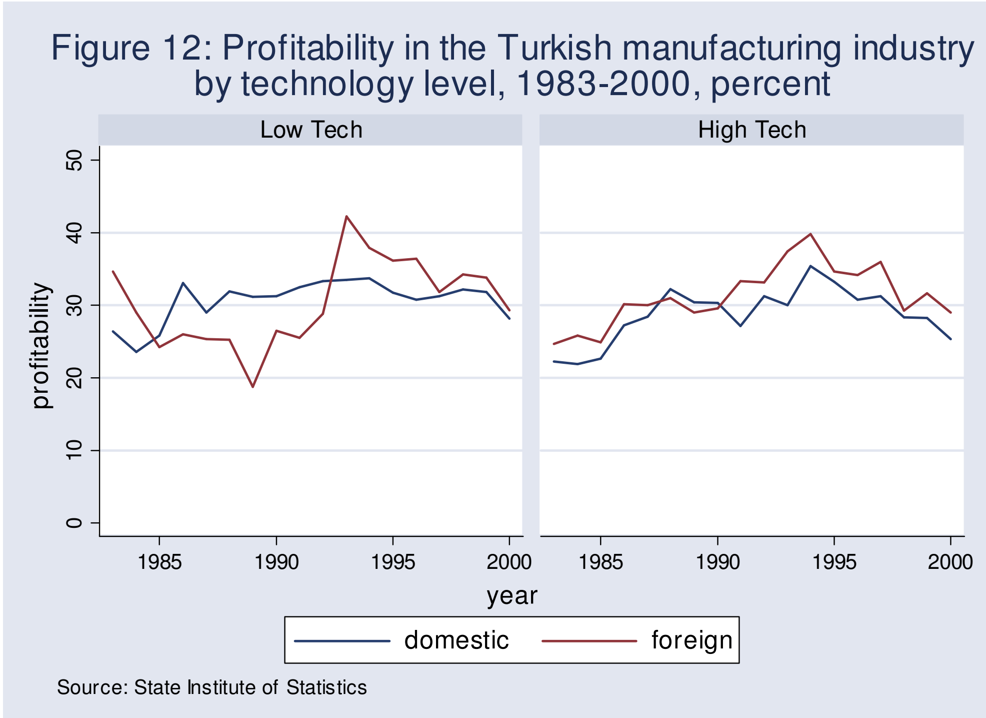
The average profitability of the domestic and foreign industries does not very much differentiated in medium and large scaled industries, regardless of ownership; though the profitability of the latter was slightly higher than the former for domestic industries in the 1983-2000 period (Figure 11). The public profitability was close to that of large industries since the public firms are generally large scaled. However, the average profitability of small foreign industries was higher than any other industries with respect to size and ownership. The profits in these industries had a declining trend; but this declining trend could drop the average profitability gap between domestic and foreign small industries to only 2.4 times by the end of the period from the level of more than 3 times in 1993. Not as much as in the case of small industries, but the profitability of medium sized foreign firms were also higher than that of domestic ones. The profitability difference in the large industries between foreign and domestic firms was negligible, though.

The breakdown of the industries regarding to their technology level shows that the relative positions of domestic and foreign firms changed (Figure 12). This superiority was mainly on account of the average profitability of low tech foreign firms that displayed an erratic character. The average profit in low tech domestic firms was more stable around 30 %. The high tech foreign industries, on the other hand, had a more stable profitability pattern compared to the low tech foreign ones. Profit rates in all categories had declined in the late 1990's.

Figure 11: Profitability in the Turkish manufacturing industry by ownership and size categories, 1983-2000, percent



Source: State Institute of Statistics



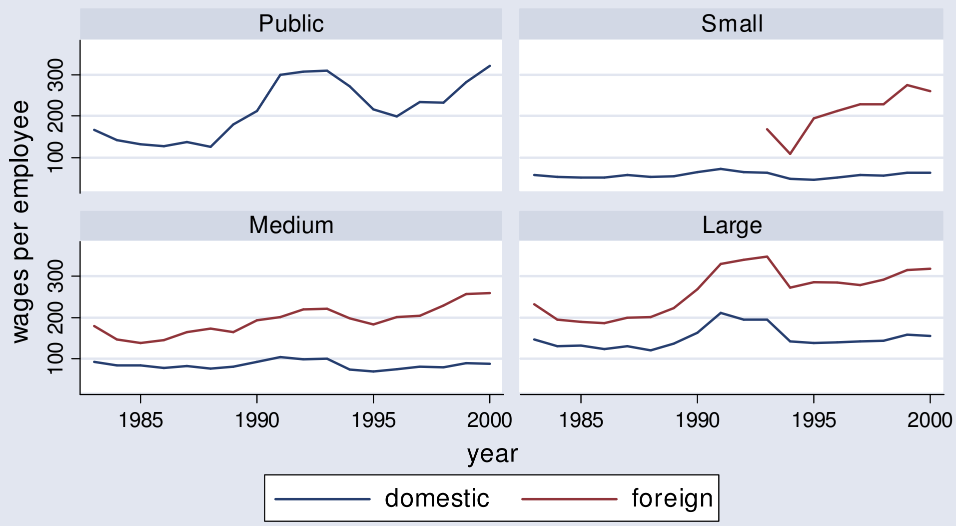
3.3.4 Wage Structure in the Turkish Manufacturing Industry

The literature reviewed previously suggests that, the wage structure in an industry may hint about the value of the knowledge that MNCs brought to the very industry. Because, they would rather to prevent the knowledge leakage through labor circulation in the industry; and therefore, the wage premium above the domestic wage level can be considered as the value of potential knowledge spillover. The figure below shows that MNCs had always paid higher wages to their employees over the whole period; and towards the end of the period, the gap between the domestic and foreign wages had increased. By 2000, MNCs paid to their workers more than twice compared to their domestic counterparts in the Turkish manufacturing industry. This gap was around 1.6 in the beginning of the period.

The wage gap between the domestic and foreign wages differentiates with respect to the size categories (Figure 14). The wage differential between domestic and foreign firms increases in small and medium sized industries. The foreign wages in medium sized industries had tripled the domestic wages towards the end of the period; whereas foreign wages in small industries had quadrupled the domestic wages. This state of affairs in the wage structure, of course, occurs because of the tendency to pay higher wages in the domestic large firms compared to smaller domestic firms. Domestic large firms had paid around 147 millions TL on annual average in real terms over the 1983-2000 period. This figure corresponds to 83 and 54 millions TL in medium and small sized industries, respectively. The annual average of foreign wages, on the other hand, were 261, 198 and 193 millions TL in the period.

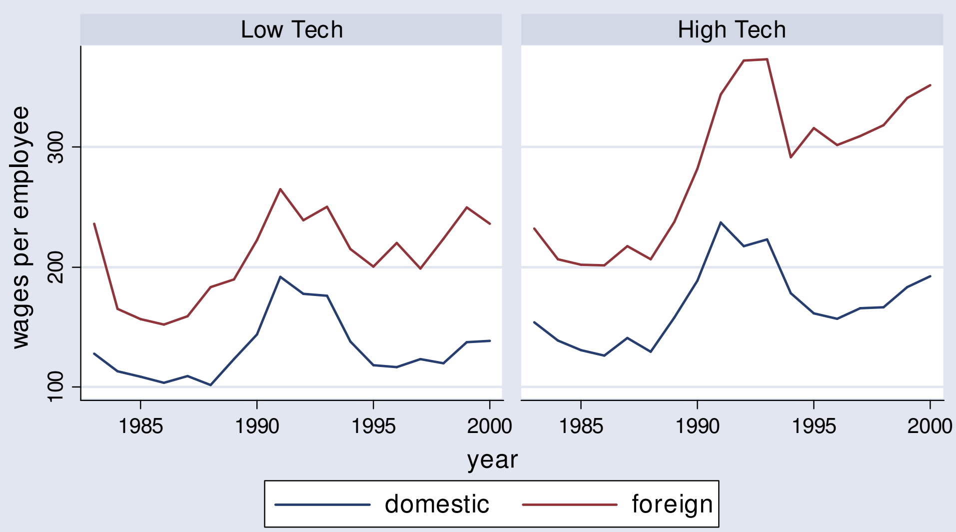
The foreign wages do not very much differentiate across the size categories. The wages are slightly higher in the large industries in both foreign and domestic firms. But the wage premium of the foreign firms over the domestic wages increased over the 1983-2000 period in all size categories implying that domestic wages were eaten up towards the end of the period.

Figure 14: Real wages in the Turkish manufacturing industry by ownership and size categories, 1983-2000, million TL



Source: State Institute of Statistics

Figure 15: Real wages in the Turkish manufacturing industry by technology level, 1983-2000, million TL



Source: State Institute of Statistics

The wage structure also differentiates with respect to the technology level of industries (Figure 15). One would expect lower wages in low tech industries both in domestic and foreign firms. Foreign wages were higher in the high tech industries compared to low tech ones. The wage differential is also more remarkable in the high tech industries. The wages per employee in domestic industries were around 191 and 271 millions TL; whereas the foreign wages were 318 and 509 millions TL, in 1994 prices, by the end of the period.

The wage structure outlined above points out the knowledge embodied in foreign firms, and the bans to prevent any leakage of that knowledge to other firms. However, despite to these efforts, there might be some labor turnover in the industry, leading to some knowledge transfer to other firms. This knowledge transfer via labor transfer, as discussed in the previous section, is a form of spillover.

3.3.5 Forward and Backward Linkages Created by MNCs

As we discussed in the theoretical section above, MNCs are expected to interact with the domestic side of the industry to ever generate any beneficiary effect for the latter. In this respect, backward and forward linkages created by the MNCs are crucial since this is a mechanism for knowledge flow to an industry. We approximated these linkages by making use of the following formula.

$$forward_{it} = \Sigma \omega_{ijt} s_{jt}$$
$$backward_{it} = \Sigma \acute{\omega}_{itj} s_{jt}$$

where $i = 1,\ldots,m;\ j = 0,\ldots,m;\ t = 1,\ldots,T;$ s_j is the market share of foreign firms in market j, ω_{ij} the j^{th} sector's share in inputs used by the i^{th} sector, and $\acute{\omega}_{ij}$ the share of j^{th} sector in the use of i^{th} sector's output. Thus, in a sense, *forward* measures the proportion of firm's inputs produced by foreign firms, and *backward* measures the proportion of firm's output used by foreign firms. ω and $\acute{\omega}$ variables are calculated from the Input-Output Tables[31].

Figure 16 shows that the vertical interactions between domestic and foreign industries had increased continuously in the 1983-2000 period with a very strong positive trend for both backward and forward linkages. Backward linkages, -that is, the proportion of input purchases in total input sales by foreign firms from other industries, was around 8 % in 1983; and it was estimated as 17 % by the end of the period. Forward linkages, -that is, output sales to other industries seems slightly more important. The estimated share, that was 10 % in 1983, climbed to 21 %.

These linkages display a great differentiation with respect to low and high tech industries (Figure 17). Backward linkages created by low tech foreign firms were higher than forward linkages in the 1983-2000 period. The reverse is valid for high tech foreign firms. The proportion of input purchases of low tech foreign firms had reached to around 14 % in the end of the period from 6 % in 1983. Forward linkages by low tech foreign firms were also duplicated. It was around 5 % in 1983 whereas it had reached to almost 10 % in 2000. On the other hand, backward linkages created by high tech foreign firms were much higher. This foreign share in total input purchases in the Turkish manufacturing industry climbed to 23 %, from almost 13 %, by the end of the period. The magnitude of forward linkages is much more remarkable. The output sales of foreign firms to industries were around 23 % in the beginning of the period and it had reached to 43 % by the end of the period.

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[31] Input-output tables were obtained from State Planning Organization of Turkey. These tables were released in 1979, 1985, 1990 and 1996. The coefficients necessary for the calculation of the backward and forward linkages were assumed to be the same as 1996. The remaining coefficients used in the calculations were interpolated.

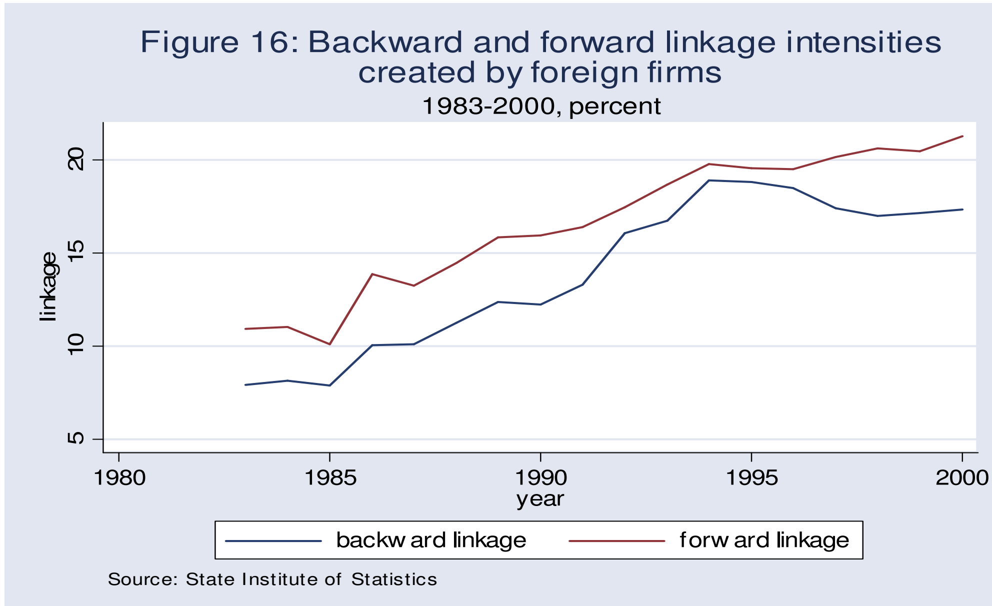


Figure 16: Backward and forward linkage intensities
created by foreign firms
1983-2000, percent
linkage
5
10
15
20
1980
1985
1990
1995
2000
year
backw ard linkage
forw ard linkage
Source: State Institute of Statistics

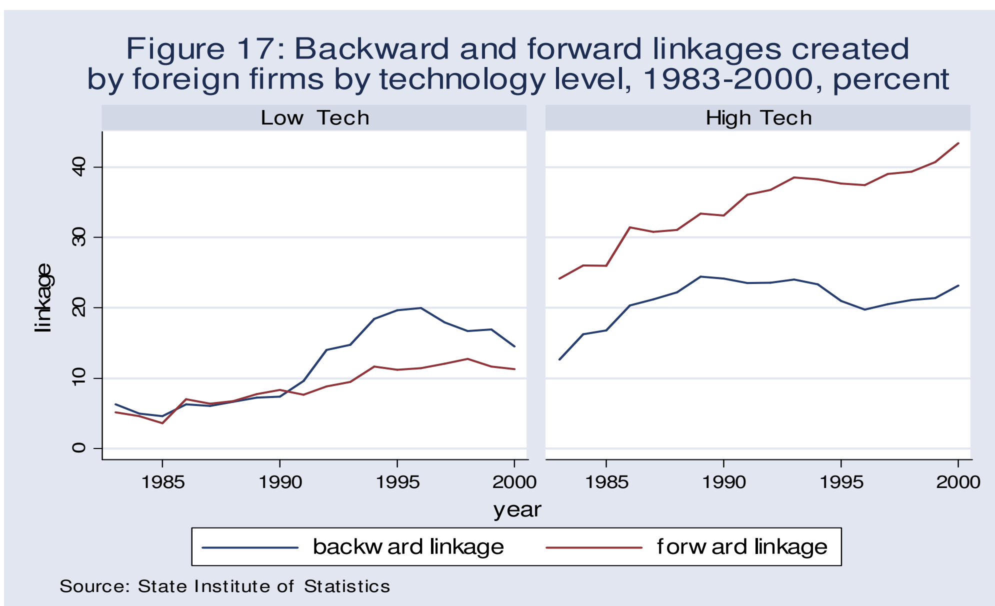


Figure 17: Backward and forward linkages created
by foreign firms by technology level, 1983-2000, percent
Low Tech
High Tech
linkage
0
10
20
30
40
1985
1990
1995
2000
1985
1990
1995
2000
year
backw ard linkage
forw ard linkage
Source: State Institute of Statistics

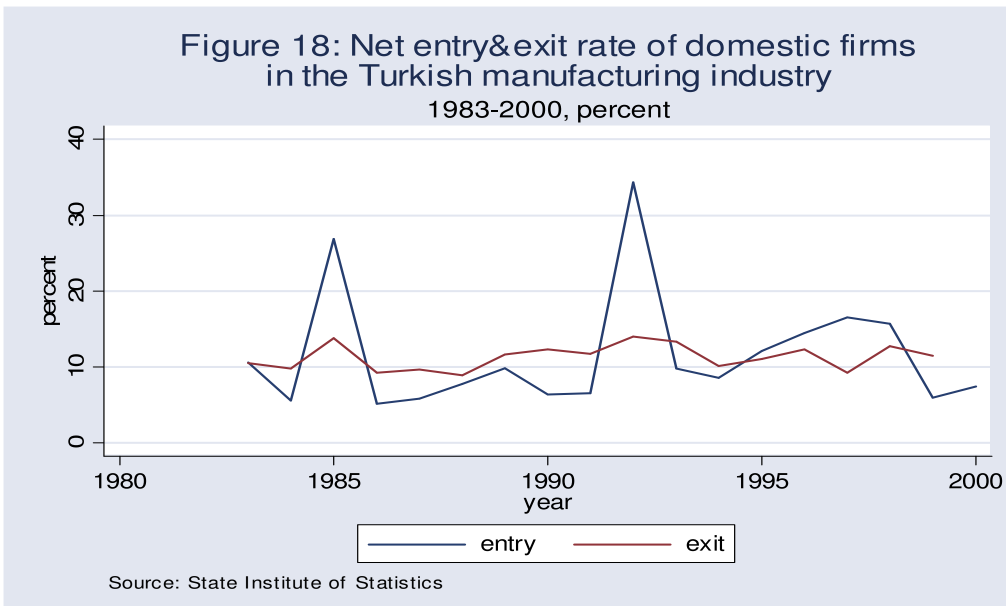
To sum, forward linkages outweigh the backward linkages in the Turkish manufacturing industry. This means that this interaction between domestic and foreign firms is likely to serve to MNCs rather than domestic firms. This might have the following logical conclusion: The vertical spillovers created by MNCs in the Turkish manufacturing industry seem to be materialized, if any, more in a way by knowledge spillover in the input sales of foreign firms rather than input purchases of the very firms. In other words, the vertical spillovers that are generated by a channel that is directly increasing the demand on the output of foreign firms in other industries, and the importance of backward linkages remained limited in the 1983-2000 period. It is also true there might be some knowledge spillovers through backward linkages since foreign firms may set some technical specifications and quality assurance for their input purchases from other industries. But since the direct effects on the demand for the products manufactured by the domestic industries is relatively limited; vertical spillovers are tended to appear in the form of knowledge spillovers mediated by output sales of MNCs to the firms in other industries.

These two pictures provided by the Figures 16 and 17, pose the intuition that, even if the technological capability had been increasing in the Turkish manufacturing industry, that the forward linkages outweigh the backward linkages, the mentioned capability is still behind the capability of foreign firms, since it is a reflection of the trust on the foreign goods is wider than the one on the domestic goods. While this interpretation still holds for the high tech industries; the reverse is true for low tech industries. In other words, the relative technological capability, regardless of the level, was accumulated mostly in low tech industries.

3.3.6 Entry and Exit of Domestic Firms in the Turkish Manufacturing Industry

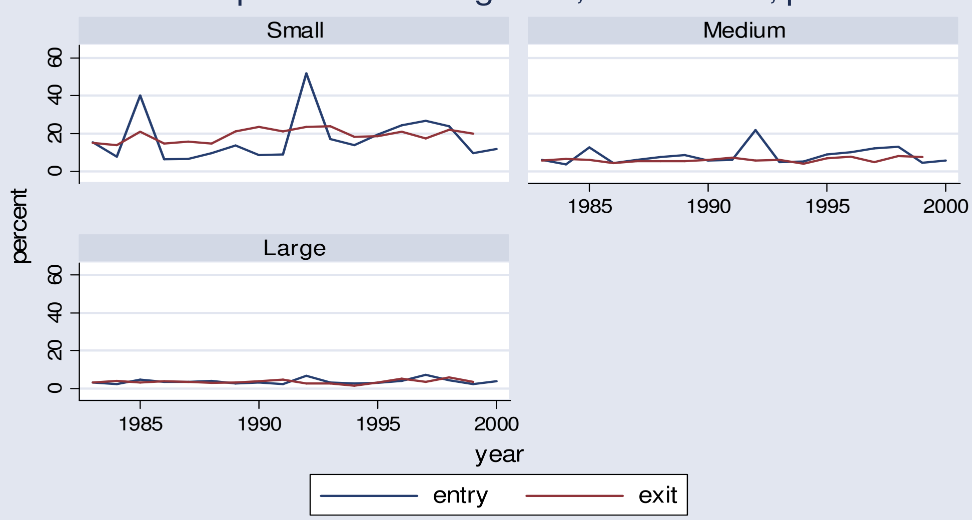
As we noted in the theoretical discussion, one of the arguments favoring the MNCs is the demonstration of their assumingly superior technologies and products.

It is argued that, as well as incumbent firms, the other potential firms that are not currently in the marketplace might benefit from such an effect and can enter the market. On the other hand, increased competition can drive out some of the inefficient firms from the market. The figures 18 and 19 show the entry and exit dynamics of the domestic manufacturing industry on the basis of ownership and size categories for the 1983-2000 period. We do not specifically examine the public industries in this section, since entry and exit dynamics of public industries are not determined by the market mediated decisions.



The Figure 7 and the Figure 18 should be evaluated together, in order to understand the effects of foreign market share on the entry and exit dynamics. We see that the market share of MNCs and the entry and exit patterns of the domestic manufacturing industry display secular trends. Therefore, it is hardly possible to mention any spillover effect working through entry and exit dynamics by the examination of these figures. However, the Figures 8 and 19 give a better picture in order to comment on the potential spillovers. There seems to be a demonstration effect generated in all of the categories, that is, for small, medium and large sized firms. The entry rate of small domestic firms started to increase; and the exit rate started to decrease from 1992 onwards. Similar increasing pattern is also observed in the figure for the market share of foreign firms starting from 1992. Recall that, as the spillover literature discusses, MNCs can lead to an increase in the entry rate of domestic firms. Then, both series of foreign market share and entry rate have a positive; and the series of exit rate has a negative trend giving rise to the expectation for a demonstration effect. The reverse signs of the correlation coefficients would have confirmed a negative competition effect regarding entry and exit dynamics of the industry. In medium sized industries, however, the series of domestic entry rate and foreign market share seem to move together. There seems to be no interdependence between the entry rate of large domestic firms and foreign market share of large firms.

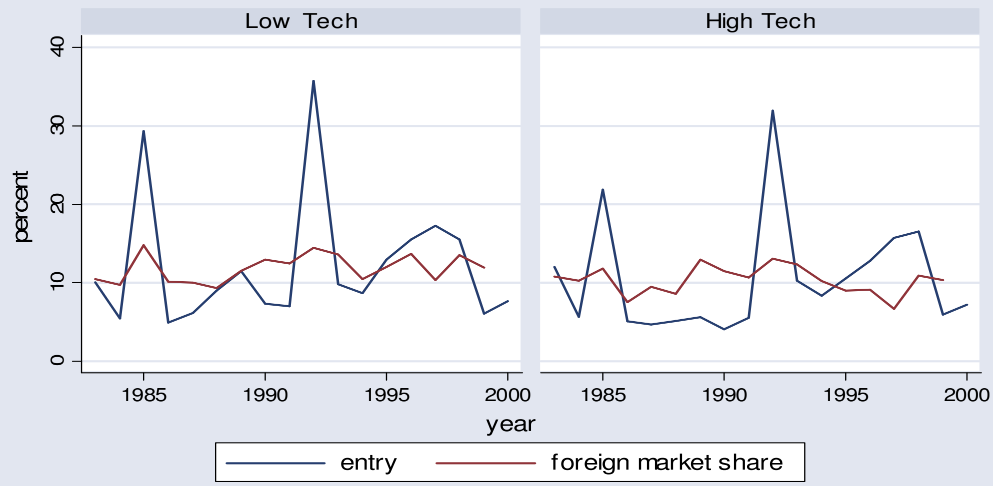
Figure 19: Net entry and exit rate of domestic firms by ownership and size categories, 1983-2000, percent



Source: State Institute of Statistics

Therefore, one would expect negative spillovers from MNCs if there is a positive relationship between the exit rate and foreign market share for the small and medium sized firms. The Figure 8 and 19 show that there seems to be a relation between the mentioned variables in the reverse direction for the medium sized domestic firms; but this reverse relation seems quite weak for the small firms. It appears that no relation exists between the exit rate of large domestic firms and market share of large foreign firms. Therefore, one could expect positive spillover especially for the medium sized industries; and would have no idea about the positive demonstration effect for the large industries which might be generated in the years when the entry rate and foreign market share are increasing. The calculated correlation coefficients, suggest a positive relation between foreign market share and the entry; and a negative one between foreign market share and exit rate in small and medium industries. But there is a positive correlation for both entry and exit rate for the large firms. This rough analysis raises the expectations for demonstration effect especially for small and medium industries.

Figure 20: Net entry and exit rate of domestic firms by technology level, 1983-2000, percent



Source: State Institute of Statistics

The entry rate of domestic low tech firms seems to be weakly correlated by the foreign market share in low tech industries (Figure 20). In most of the years in the period, a positive correlation between the two variables can be mentioned. But, there are some exceptions, of course, in some years in which a negative relation is observed. We calculated positive correlations between entry rates of domestic firms and the foreign market share in both high tech and low tech industries, which the former almost duplicates the latter one (Table 3). The calculated coefficients for high tech industries for the entry rate and market share of foreign firms are 0,13 and -0.28, respectively.

The exit rate of domestic firms in the 1983-2000 period seems to be positively correlated by the foreign market share in low tech industries and negatively correlated in the high tech industries (Figure 20). The Table 4 shows that the calculated correlation between domestic exit rate and the foreign market share in low tech industries is quite weak, which is almost 0.04 (The negative correlation is stronger than the previous one in absolute terms in high tech industries, which is -0.28). The market share of foreign firms is positively correlated with the net exit rate of medium and large firms, though the correlation is weak for the former. So, one can expect negative spillovers for the medium and large firms; and for low tech firms whose net exit rate is also positively correlated with the foreign market share [32].

Table 3: Correlations between foreign market share and net entry and exit rate of domestic firms

	Categories	Net entry rate	Net exit rate
Foreign Market share	Small	0.06	-0.20
	Medium	0.11	0.07
	Large	0.19	0.30
	Low Tech	-0.16	0.04
	High Tech	0.13	-0.28

However, even though we have an expectation for positive spillover effects in some of the categories of industries; we can not precisely infer that the causality is running from the foreign market share to the entry and exit rate because of the simultaneity problem we noted in the theoretical discussion above. In other words, as it might be reflected by the domestic entrance to the market, the markets for manufacturing goods of small industries might have become more attractive because of some reasons other than foreign industrial activity, and therefore, foreign market share might have increased, but not the other way around. One cannot be so precise

[32] In fact, the sign of the correlation between the exit rate of domestic firms and the foreign market share does not provide a clear-cut expectation about the direction of the potential spillover. As it was discussed previously, some of the authors interpret negative competition effect mediated by the exit of inefficient domestic firms as positive spillover. (Of course, market stealing effect of foreign firms is always considered to be negative spillover for the domestic industries.) For example, MNCs can sweep out inefficient domestic firms, and therefore, contribute positively to the average productivity of domestic industries. On the other hand, if the market share of foreign firms stops the exit of domestic firms, then these firms might be benefiting from the demonstration effect of MNCs, as in the case of high tech industries here probably.

about the causality of this relationship, even though there is a probability of positive demonstration effect included in the relation.

3.3.7 Research and Development in the Turkish Manufacturing Industry

The indigenous technological effort is an important determinant in reaping the benefits from the activities of MNCs as well as in the process of technological development. The R&D activities of domestic firms can be accepted as a proxy for this effort. The share of R&D of the domestic and foreign industries, measured as the proportion of the R&D expenditures in the total sales, to approximate the technological effort[33]. The share of R&D in the Turkish manufacturing industry is extremely low (Figure 21). This share was 0.1 % in 1992 and had reached to only 0.12 % in domestic firms. Foreign firms seem to have invested in R&D expenditures more than domestic ones. Their share in 1992 was 0.16 % and had reached to 0.30 % in 2000. The Figure 22 shows an interesting feature about the share in small foreign firms. The R&D share of these firms had continuously decreased throughout the 1992-2000 period from around 0.2 % to 0.015 %. The share in the domestic small firms is higher than foreign ones and they seem to have grasped the importance of R&D since the domestic R&D share started to increase in the end of the period. However, this figure in small domestic firms was still extremely low and it was 0.12 % in 2000. The strategies of medium and large foreign firms are more likely to rely on R&D expenditures. Their share was always higher than that of domestic firms. One can observe in the figure that medium sized domestic firms could have reached to the share of medium sized foreign firms in some years in the period; but they could never have exceeded it. In the last years of the period, both medium and large foreign firms have increased their R&D share. Despite this increase, by the end of the period this share could reached only to 0.16 % in the medium foreign firms. It was relatively more satisfactory in the large foreign firms. Their shares had reached to 0.74 % in 2000. These figures were 0.09 % and 0.25 % for the domestic medium and large firms, respectively by the end of the period.

[33] However, the R&D data before 1992 is unavailable; thus, we are able to present here R&D share of firms only after 1992.

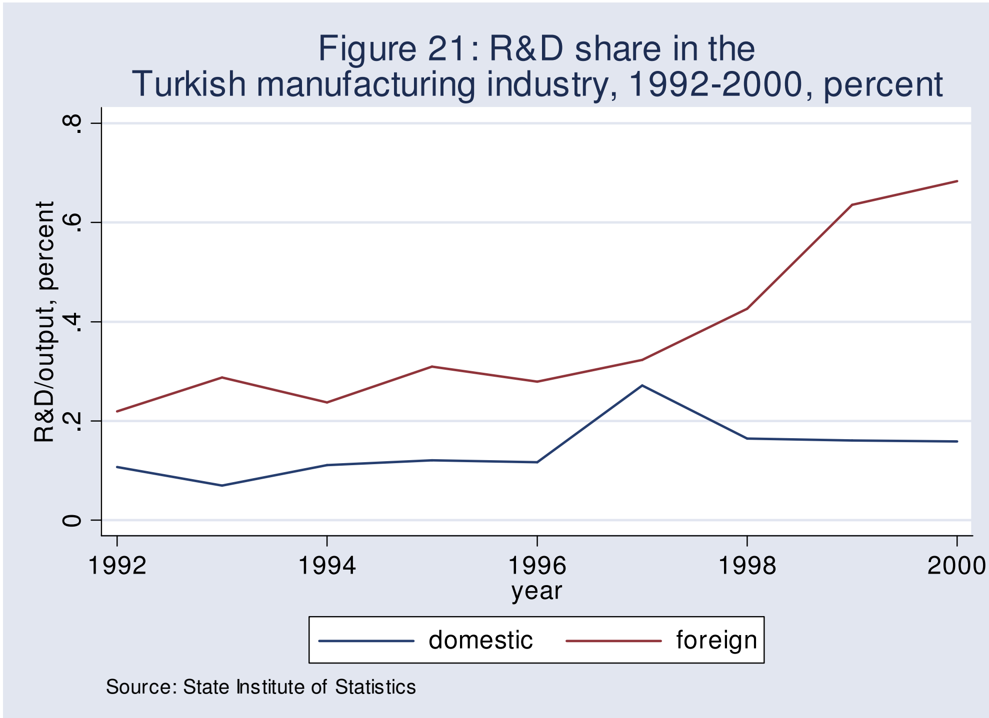


Figure 21: R&D share in the
Turkish manufacturing industry, 1992-2000, percent
R&D/output, percent
0
.2
.4
.6
.8
1992
1994
1996
1998
2000
year
domestic
foreign
Source: State Institute of Statistics

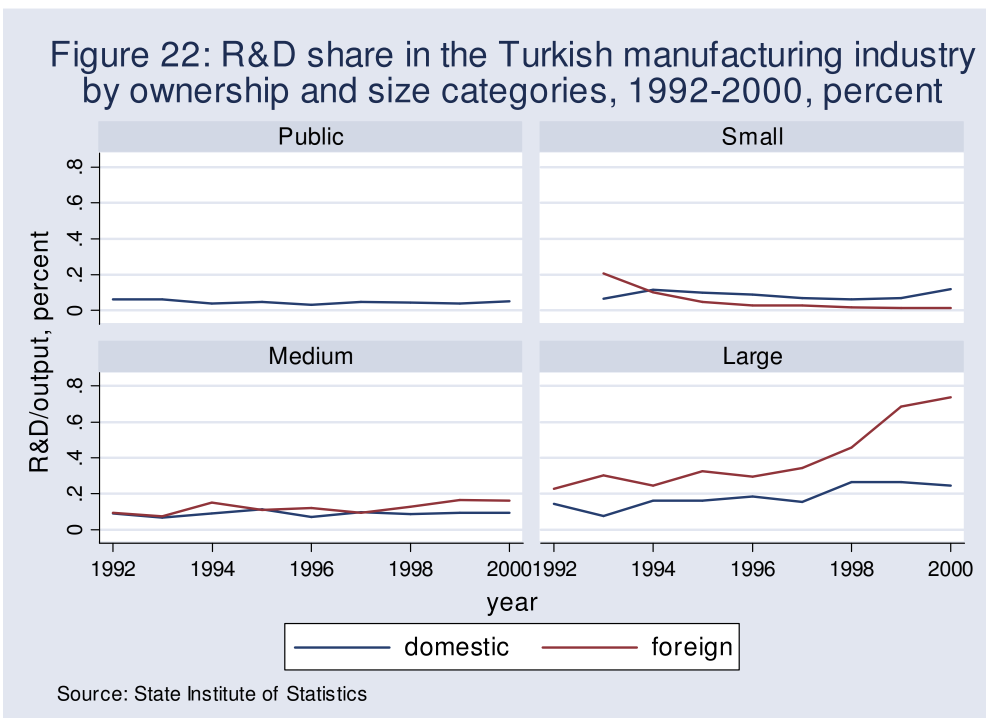
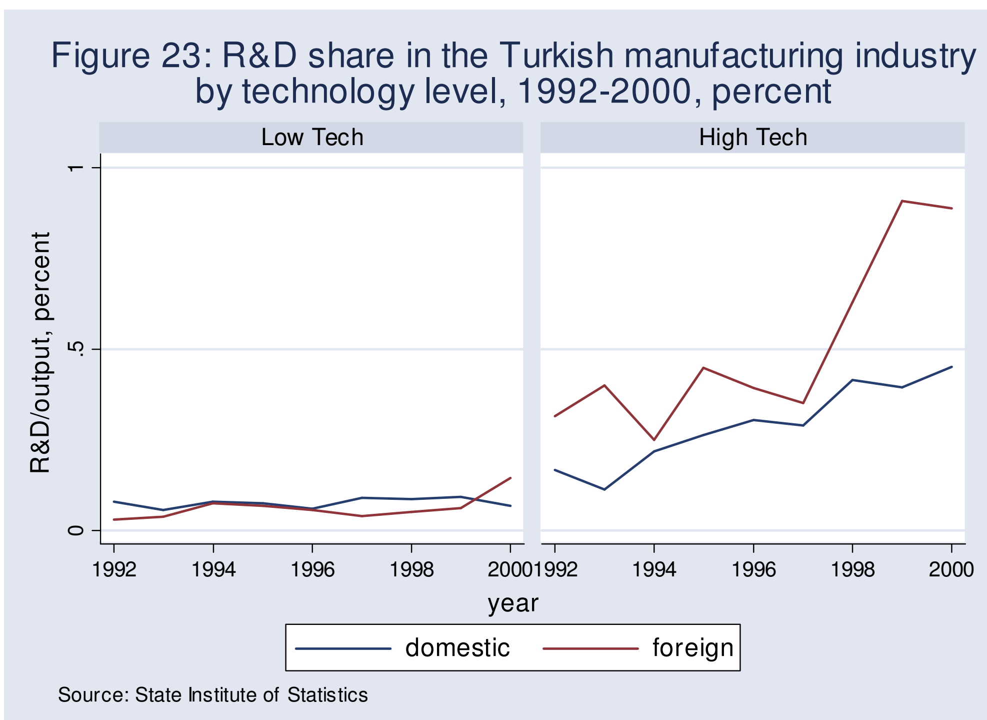


Figure 22: R&D share in the Turkish manufacturing industry
by ownership and size categories, 1992-2000, percent
Public
Small
Medium
Large
R&D/output, percent
0
.2
.4
.6
.8
1992
1994
1996
1998
2000
year
domestic
foreign
Source: State Institute of Statistics

The Figure 23 draws a similar picture. The R&D share of domestic firms in low tech industries was higher than that of foreign firms; and vice versa in high tech firms. In 1999, the share had reached around to 0.09 % in domestic firms; in 2000 and to 0.15 % and foreign firms in low tech industries. But the share in foreign firms was always below the share of domestic firms before 2000. High tech foreign firms have followed a strategy relying on R&D. They had increased their R&D share in the period; it was around 0.9 % by the end of the period. Domestic high tech firms had also increased their share in the whole period, but the share for these firms was relatively modest; it was around 0.45 % by the end of the period.

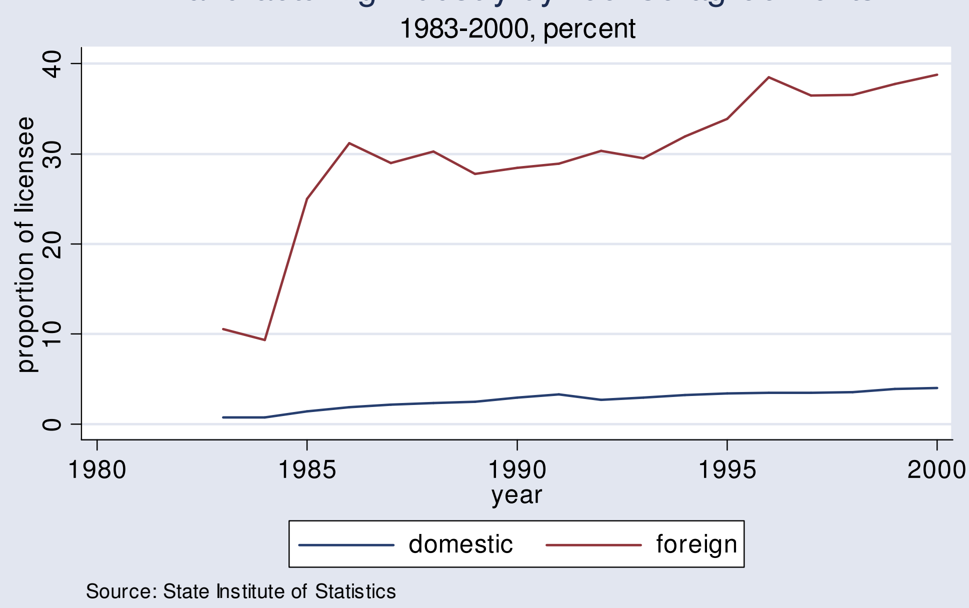
Note that these remarks are based on the shares rather than total expenditures in absolute figures. Of course, the total R&D expenditures in domestic industries were much higher than those of foreign industries. In the whole period of 1992-2000, the cumulative total expenditures invested in R&D in domestic industries was almost 28 000 billion TL in fixed 1994 prices. It was around 18 200 billion TL in foreign firms.



3.3.8 Technology Transfer through License, Technology Agreements

The technology transfer to the Turkish manufacturing industry was dominantly undertaken by foreign firms in the 1983-2000 period. The technology transfer is defined here as the license, know-how and other technology agreements. The percentage seen in the figure below is the proportion of firms with such kind of agreements. This proportion for foreign firms jumped to 25 % in 1985, from a level around 10 %, and had always increased until the end of the period. By 2000, the proportion of the foreign firms with technology transfer had reached to almost 39 %. Despite to the domination of the market in terms of the number of the domestic firms, this proportion of the domestic firms was extremely low and recorded a very modest increase over the period. The proportion of domestic firms technology transfer could reach to only 4 % by the end of the period, and never exceeded this percentage in the previous years.

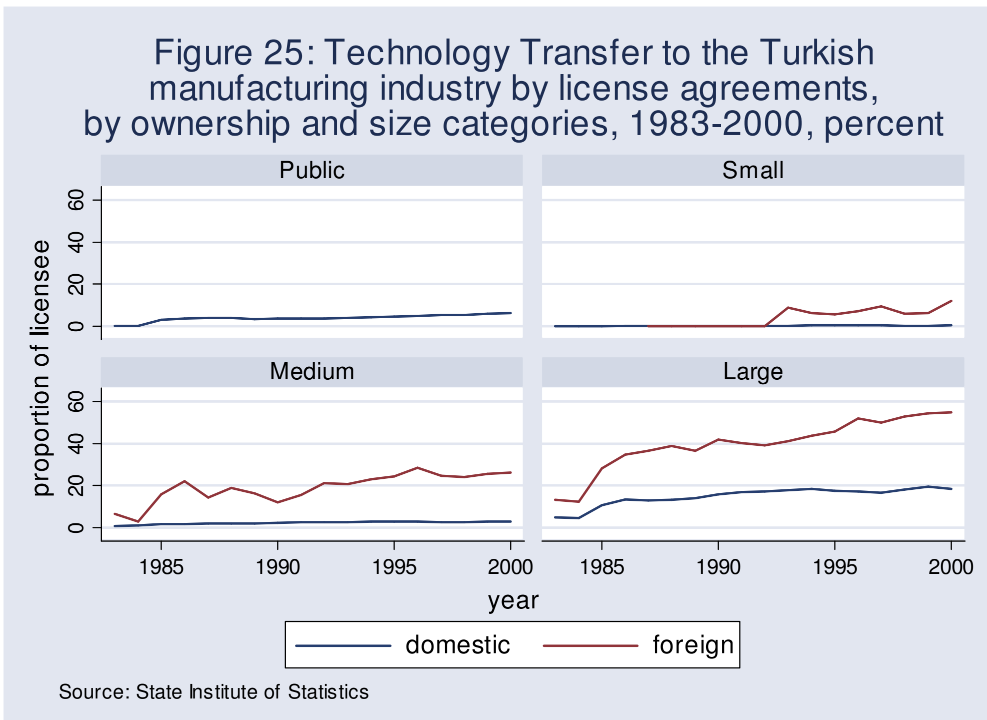
Figure 24: Technology Transfer to the Turkish manufacturing industry by license agreements



The Figure 25 shows that the domestic public owned; and small and medium sized firms had the greatest role in this poor figure for the technology transfer. The proportion in small firms is particularly remarkable since it is very close to zero. The highest figure recorded for small firms was 0.46 % in 1997. The proportion of medium sized domestic firms climbed to 3 % from almost 1 % by the end of the period. However, large domestic firms had a more active role in technology transfer process via such kind of agreements compared to the other categories of firms. In 1983 only 5 % of the domestic large firms had these agreements; this figure steadily climbed to around 20 % by the end of the period. The role of small foreign firms is very limited in the high figure of technology transfer to the foreign side of the industry. These firms started to transfer technology through these kinds of agreements after 1993. In 1993, the share of foreign small firms was 9 %; and in 2000, it was recorded as 12 %. Foreign medium sized firms have more contribution to technology transfer to the Turkish manufacturing industry. In 1983 the share of foreign medium sized firms with these agreements was around 6.5 % and had increased to the level of 26 % by the end of the period. The highest contribution to the technology transfer process to the Turkish manufacturing industry came from large foreign firms. In 1983, 13 % of the large foreign firms had these kinds of agreements; and this figure had reached to 55 %.

The examination of the proportion of the firms with technology transfer by their technology level yields that domestic firms in low tech industries had almost no contribution to the technology transfer process; and despite the role of foreign firms that is much more important compared to the former, it was still limited compared to high tech foreign firms (Figure 26). The share of the low tech foreign firms with technology transfer had reached to almost 27 %, from 6 % in the 1983-2000 period. It corresponds to 0.3 % in 1983 and 2.4 % in 2000 for low tech domestic firms. High tech domestic firms had a more important role than the low tech ones in the technology transfer process. The share of high tech domestic firms was 1.7 % in 1983 and had climbed to 8.7 % by the end of the period. The main agent in the technology transfer process appears to be the high tech foreign firms. The share of these firms with technology transfer in 1983 was around 16 %; it was measured as 50.3 % by 2000.

The nature of the industrial activity in different size and technology categories has something to do with the explanation of this picture. By definition, high tech industrial activity necessitates a greater amount of knowledge and related technology. On the other hand, as the size of firms increase, the required the technology also increases. Therefore, the higher proportions of the firms, both domestic and foreign, in large sized and high tech industries are not very surprising. However, what one can find out from this exercise is that the extremely limited role of domestic firms versus foreign firms in the technology transfer process of the Turkish manufacturing industry.



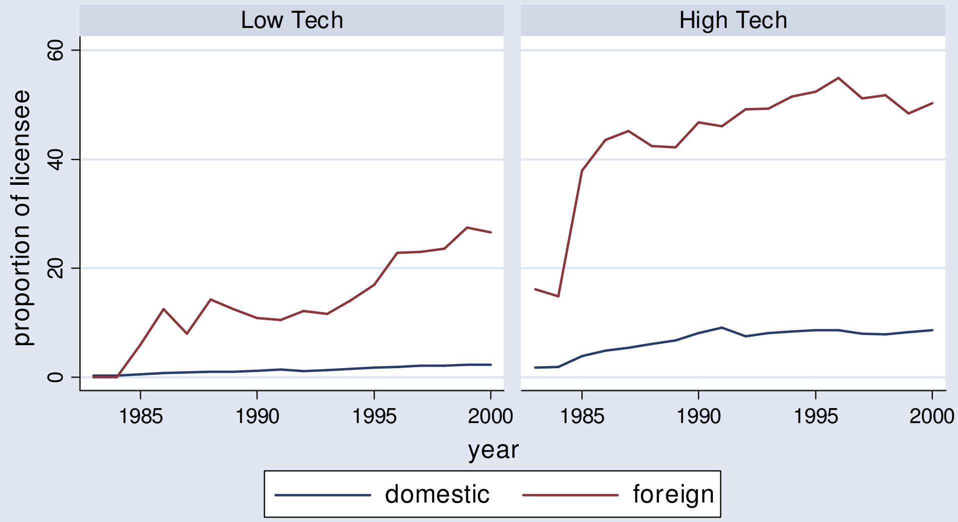


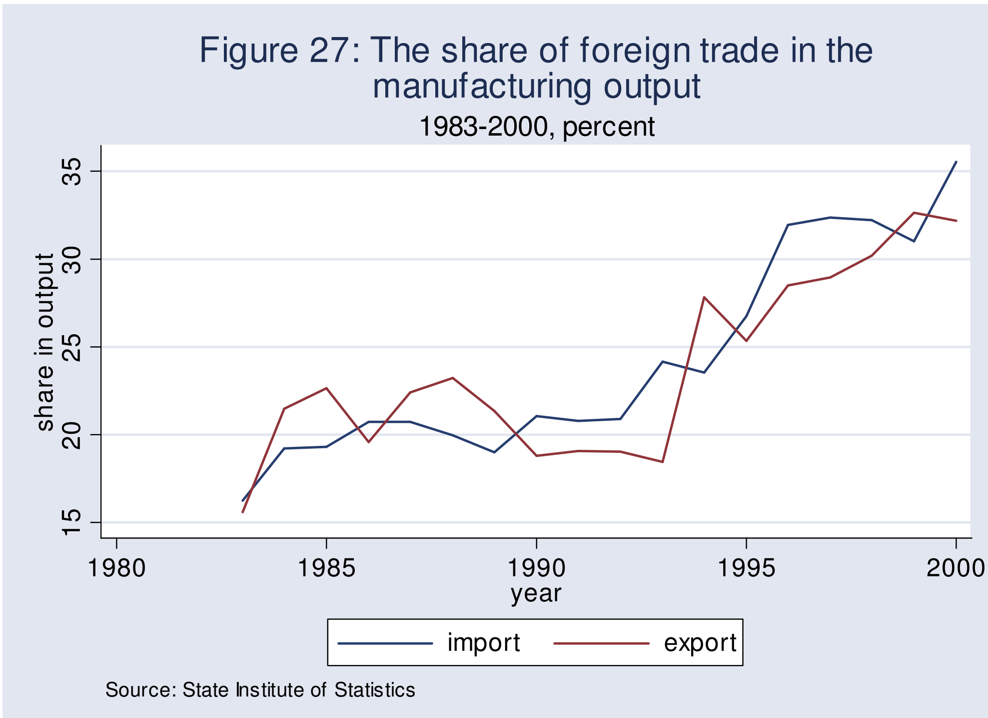
Figure 26: Technology Transfer to the Turkish manufacturing industry by license agreements, by technology level, 1983-2000, percent

Source: State Institute of Statistics

3.3.9 Foreign Trade Orientation of the Turkish Manufacturing Industry

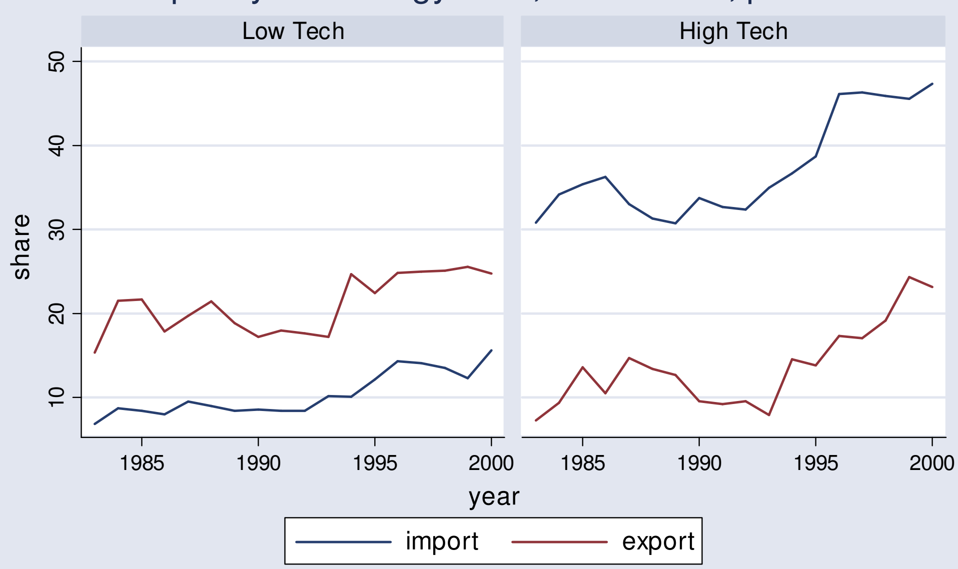
The export orientation and the success in the global markets can also be taken as a proxy for technological capability as the literature in this specific issue suggests. Besides, as known, foreign trade is regarded as a channel for knowledge transfer to an economy. So, the evaluation from the foreign trade standpoint may hint about the technological development of the manufacturing industry.

The share of export in the manufacturing output in Turkey was around 25 % in 2000. The Figure 27 ramifies a certain technological development; because it was 14% in the beginning of the period. The share of import displays a similar pattern. The share of import in 1983 was 15% and it had reached to 30% by the end of the period. This picture is still in need of further interpretation. The beginning of the period in the picture covering the years 1983-1989, -except 1986, appears as the period where the export share exceeds the import share in the manufacturing industry. Another year in which the export share exceeded the import share was 1994. The second trade surplus period is not very surprising since the Turkish economy experienced an economic crisis in that year; and, the exchange rates jumped dramatically compared to the previous year. So, the hierarchy between export and import share should be attributed to the strong relation between exchange rate and import and export exerted its influence in 1994 rather than to the development of technological capability. In the rest of the period, the import share was always higher than the export share except 1998.



The export and import shares are different for low tech and high tech industries (Figure 28). The low tech industries in the Turkish manufacturing industry are importing less than they export in relative terms. The export share in low tech industries had reached to 25 % in 2000 from its level of 17 % in 1983. The import share in low tech industries had increased from 7 %, to almost 16 %. This reflects the traditional strength of the Turkish manufacturing industry in low tech industries that can be characterized as labor intensive. The hierarchy in high tech industries between import and export shares is totally the reverse. The import share in high tech industries is remarkably high reflecting the boundaries of the technological capabilities in the very industries. The share was 48 % in 2000. It was 16 % in the beginning of the period, which is still a high percentage. However, the performance in export by high tech industries is remarkable. It was around 8 % in 1983 and had climbed to circa 25 %. This high import share also reflects the dependence on imported goods in high tech industries. Even though the high import share marks the lack of technological capability in these industries; there is an improvement in technological capability because of the increased export performance. It is especially impressive in high tech exports. These industries had reached the same exporting figures with low tech exports but the initial level of export was quite low. Put it differently, the export share in these industries reflects an accumulated technological capability, though it is still limited when the high dependence on imported goods concerned.

Figure 28: The share of foreign trade in the manufacturing output by technology level, 1983-2000, percent



Source: State Institute of Statistics

In brief, the export share of the Turkish manufacturing industry had increased in the 1983-2000 period, so had the import share. The foreign trade shares reveal the high competence of the Turkey in labor intensive industries with low value added. This is not very surprising as Turkey is already traditionally strong in these industries. On the other hand, foreign trade share in high tech industries that are capital intensive and high value added, reflects the dependence on the imported goods, but in the same time a considerable amount of technological capability have been accumulated, though it is still less than enough.

Of course, the validity of this rough analysis undertaken here, so the inference drawn from it, should be limited since there might be many other factors effective as well as the performance in foreign trade. For example, the political and macroeconomic stability issues are ignored here, which might change the interpretations about the technological capability to a certain level of extent. But this does not invalidate the rough inference about the technological capability we made. The points we made here give us a general idea about the pattern of technological capability in the manufacturing industry.

The figures related to foreign trade can also be interpreted in a different way: The different exposition to import in high and low tech industries might also be a result of the knowledge requirement embodied in the imported goods. The high import share in high tech industries is expected to carry some knowledge necessary for the high tech industries raising the expectation of positive spillovers from foreign trade.

3.3.10 The Evolution of the Turkish Manufacturing Industry

The entry and exit dynamics of domestic firms were analyzed above in order to examine the potential spillover from the industrial activity of foreign firms. The entrant firms to a market are the main sources of evolution of an industry; and thus, the specific characteristics of these firms are of importance in terms of the long term development of the very industry. These characteristics provide information about the evolutionary pattern of industries. So, now, the reader can find the analysis of some specific characteristics of the entrant firms categorized according to domestic and foreign firms.

The Table 5 below display the mean of the number of entrant firms for various categories for various subperiods. The entry of domestic firms was most often observed in small sized firms. On average, 404 small domestic firms entered to the Turkish manufacturing industry in the 1983-2000 period. The years 1985 and

1992 are especially remarkable since 1036 and 1239 firms entered to the market in these years, respectively. The medium sized domestic firms follow the small domestic firms. In the period studied, on average, 303 medium sized domestic firms entered to the Turkish manufacturing industry. The highest number of medium sized firms entering to the market was observed in 1992, by 819 firms; in 1997, by 542 firms; and in 1998 by 647 firms. The expansion of the large industries was often observed in the same years as in the medium sized industries by 55, 75 and 52 large domestic firms. The average of the entrant large domestic firms was 30 in the whole period. The table shows that the incidence of the entry by public firms decreased especially towards to the end of the period suggesting the changing structure of the Turkish economy in favor of the private enterprises. This is of course took place as an outcome of changed preferences in economic policy. The number of entrant public firms dropped to 1 by the end of period from its average level of 14 in the early 1980's.

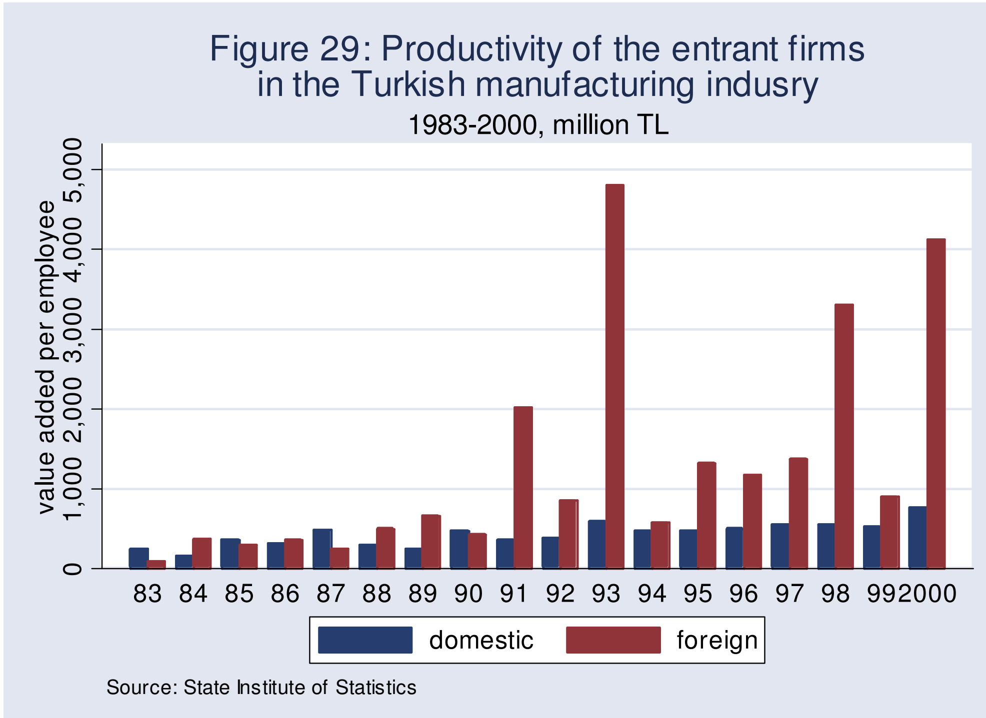
The taxonomy in the entry incidence to the industry by domestic firms is different from that of foreign one. The incidence of entry by foreign firms was mostly observed in medium sized industries. In the 1983-2000 period, 11 foreign firms entered to the medium scaled industries. The large and small foreign firms take the remaining positions in the incidence of foreign entry to the Turkish manufacturing industry. Recall that the average number of firms in the large industries outweighs that of medium sized industries. Thus, the high incidence of foreign entry to the medium sized industries should have changed the weight of these firms in the size distribution of the foreign firms in the Turkish manufacturing industry.

As expected, given the average number of incumbent firms, the highest number of entrance of domestic firms was observed in low tech industries. The average number of entry to low tech industries was 559 by domestic firms. This figure is 187 for high tech firms. The average of foreign entry to low tech and high tech industries are very close to each other; which is 8 and 10, respectively.

The outstanding rise in the productivity of small foreign firms after the 1990's was fed by the foreign entrance to the industry especially between 1995 and 2000. In fact there is also a high entry rate in 1993 by foreign firms. The productivity of small foreign firms jumped to high path and persisted around that level (see the

Figure 2). In the remaining years no foreign entrance to the market was observed. Thus, the extraordinary increase in the productivity of small foreign firms was achieved by the entrance to the industry especially after 1993; the high entry to the small industry by outstandingly productive firms was unable to prevent the decrease in the productivity of small foreign industry. This means that there were some declines in the productivity of the incumbent firms.

These remarks are also valid, to some extent, for the medium and large sized industries. We observed a foreign entry to these industries by extremely productive firms in 1992 ands 1993, respectively. The high number of medium and foreign entrants carried the productivity pattern of the medium foreign industries to higher path (see the Figure 2). The high foreign entrance by productive firms did not cause a great jump in the productivity of the medium foreign industries. The high entry rate of outstandingly productive firms helped to increase the average productivity in large foreign industries after 1992. But the high number of entrant firms in 1998 and 2000 that are extremely productive did not lead to an increase in the average productivity, as in the case of medium sized foreign industries. This means that the productivity of the incumbent firms tended to decline especially in the late 1990's.



The productivity in the domestic side of the manufacturing industry has a different picture. The productivity of domestic entrant firms was not very noticeable. Though, one can observe some productive entrance in 1993 and 2000 in the Figure 29. But the productivity of entrant firms was generally below the average productivity in the industry both at the aggregated level, and different size categories. The Figure 1, on the other hand, indicates that the average productivity of the industry had increased after 1993 and remained stable in that level. This means that the modest increase in the productivity of domestic industries in the late 1990s had been achieved by the productivity increases in incumbent domestic firms in 1993; and nothing changed in the productivity pattern of domestic industry after that year. That is, neither the productivity increases in the incumbent firms, nor the more productive entrants were observed after 1993 in the domestic side of the industry.

The highest productive entrants in foreign high tech industries were observed in 1991, 2000, and 1995, respectively. The productivity of the entrant firms was above the industry average. These productive entrants affected the pattern of the productivity in foreign high tech industries in these years as the Figure 3 reflects above. However, the productivity increase in 1997 was the result of the performance of the incumbent firms since the productivity of the entrant firms in 1997 was below the industry average.

The entry to foreign low tech industries by the outstanding productive firms in 1993, 1998 and 2000, on the other hand, had different effects on the trajectory of the foreign productivity in low tech. This trajectory was noticeably affected only in 1993 as one can observe in the Figure 3 above. The entrance in 1998 had a limited effect on the industrial productivity. The entrant firms into low tech foreign industries had not been able to prevent the decline in the average productivity 2000.

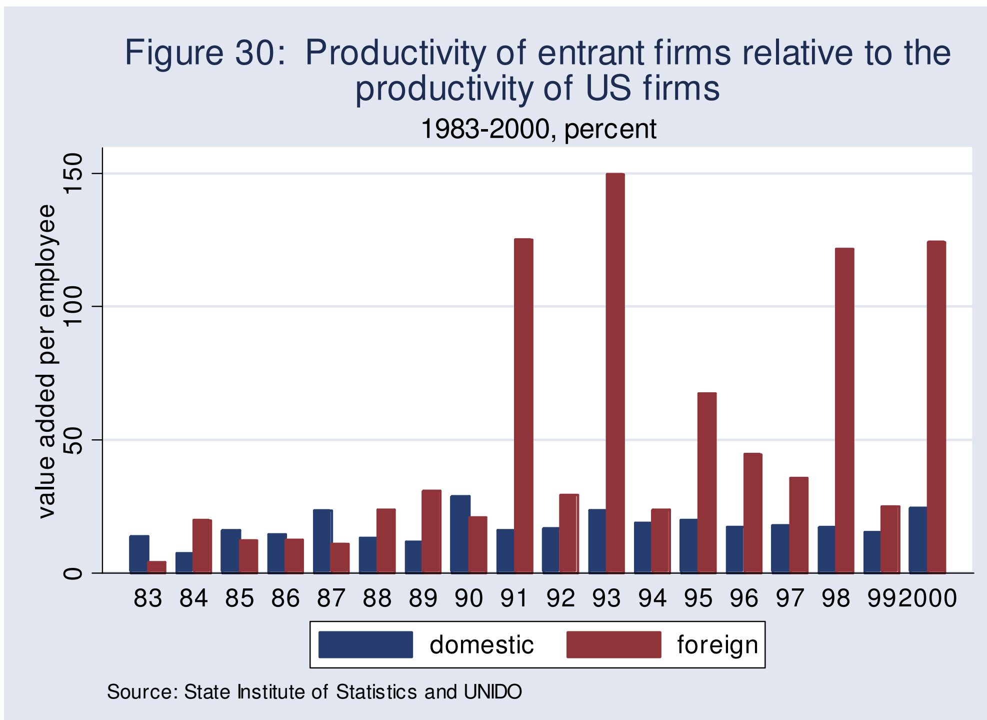
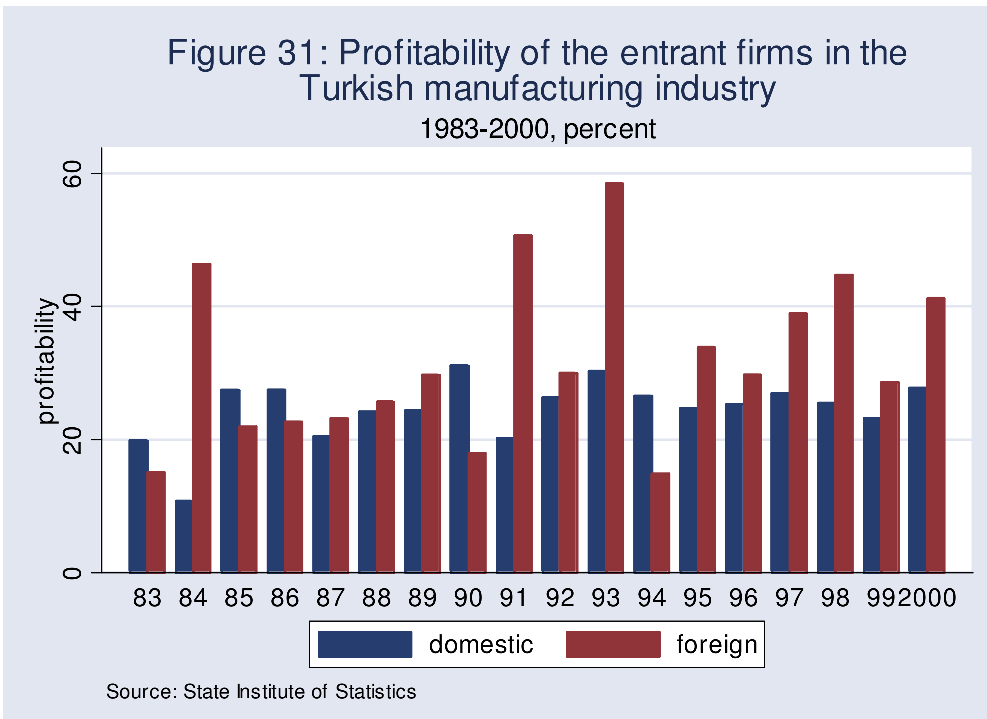


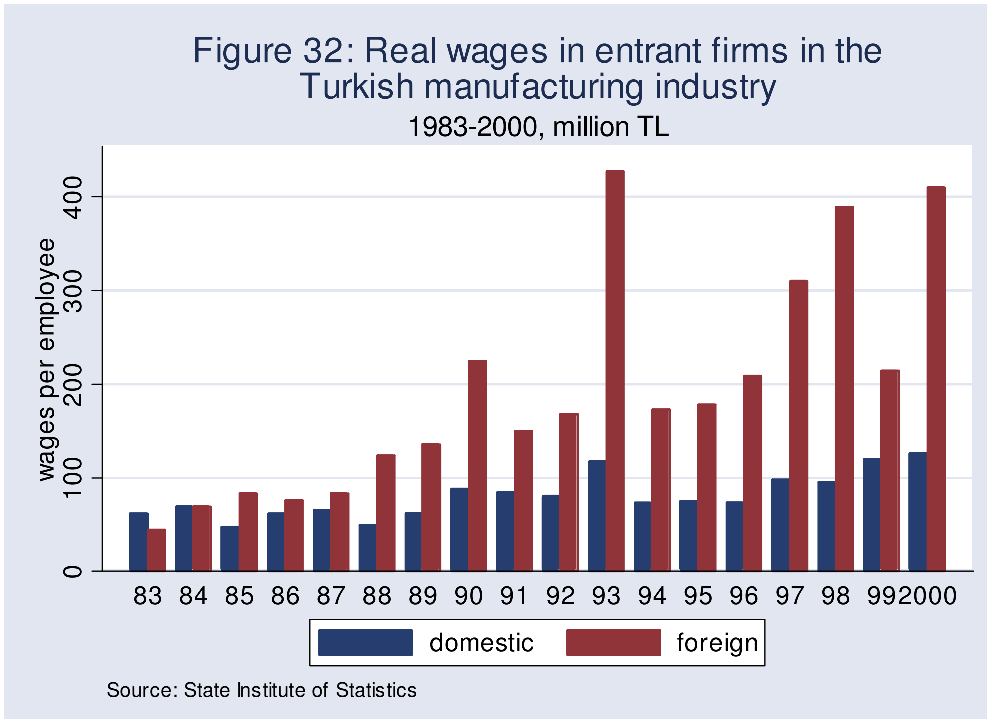
Figure 30: Productivity of entrant firms relative to the productivity of US firms

The discussion about the entrant firms above made clear that there were outstandingly productive foreign entries to the Turkish manufacturing industry. The Figure 30 indicates that the foreign entries in 1991, 1993, 1998, and 2000 were great contributions in terms of productivity since the productivity of those entrant firms were even beyond the average US manufacturing industries. This superiority of the entrants in 1993 reached to the extent that they were technologically more capable than the average US corresponding industries by 50 %.

The productivity of the entrant firms varies to a great extent but the profitability of the entrant firms almost fixed at the rates above 90 %. These high rates of profitability enable the firms with low productivity levels to survive in the market. In other words, high opportunities in terms of profitability on account of, to a great extent, by the low wage levels; allow the existence in, and the entry to the industry.



But these remarks are applicable to only the domestic side of the industry since the wages in foreign entrants are not at the modest levels (Figure 33). In parallel with the productivity of the foreign entrants 1993, 1998, 2000, except 1991; the wages are also considerably higher compared both, to other years, and to the wages in domestic entrants. As it was discussed above, the wages in the foreign firms are regarded as a proxy for the value of the knowledge brought by the very firms. Therefore, these high wages paid by the new foreign firms are supposed to indicate the contributions to the knowledge stock of the Turkish manufacturing industry, raising the expectation for positive spillovers. The wages are lower in the medium sized foreign entrant firms compared to small and large firms. This peculiar characteristic of foreign wages breaks the classical taxonomy of foreign firms across the size categories; -that is, large, medium and small firms with respect to all characteristics.



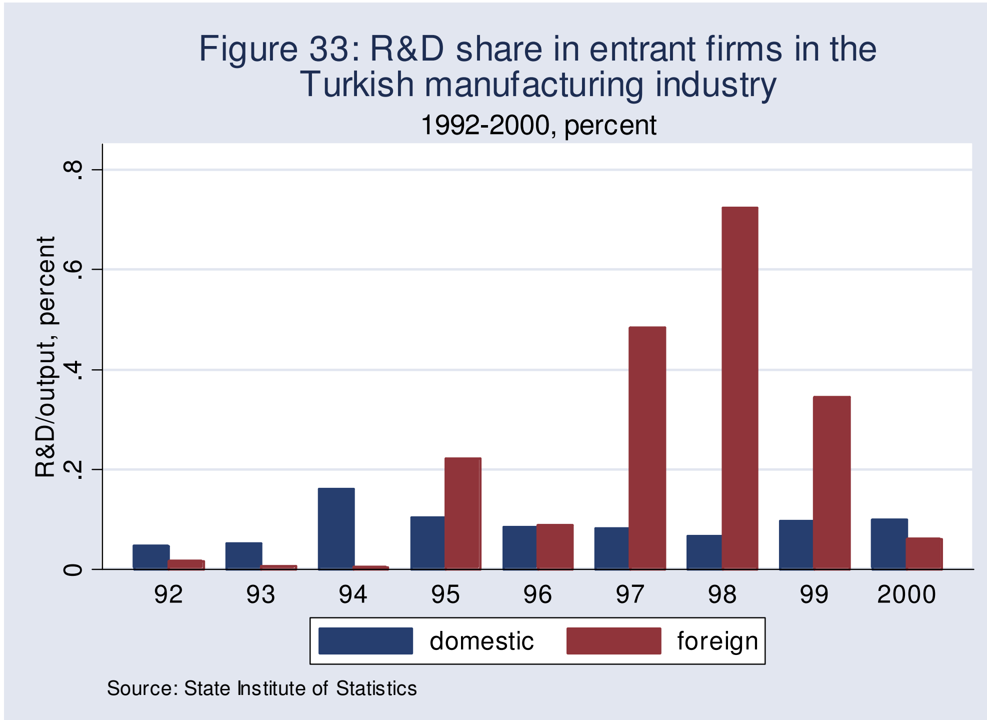


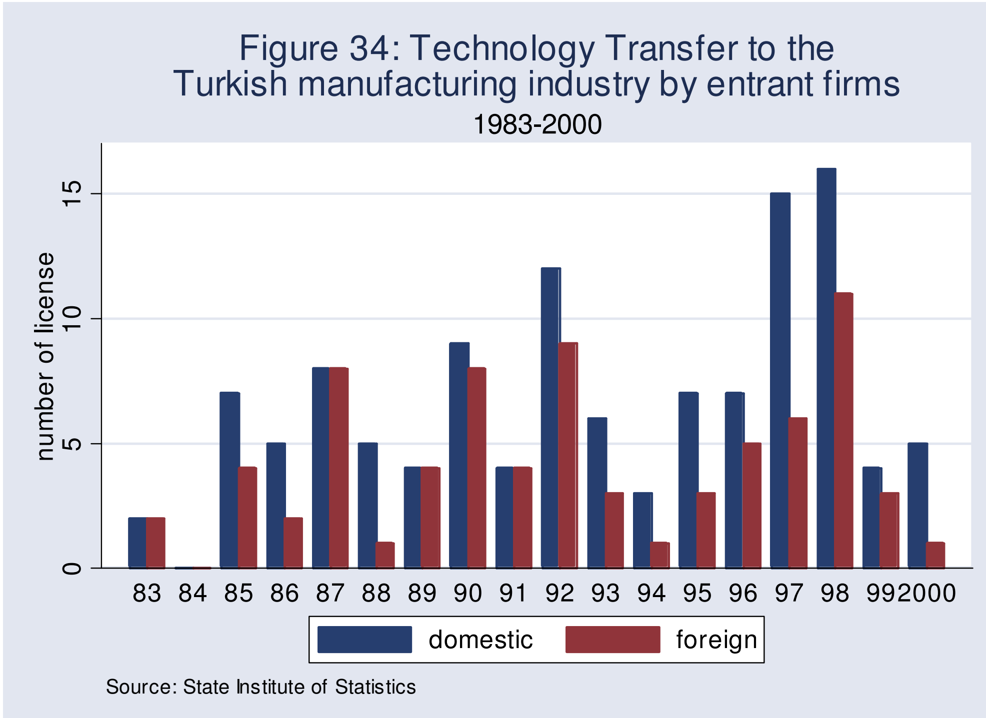
Figure 33: R&D share in entrant firms in the Turkish manufacturing industry

Even though the wages are considerably high in the new foreign firms, the share of R&D expenditures in output remains at the very modest levels (Figure 33). For example, this share in the foreign entrants in 1993 was close to zero. However, we observe some entries with relatively high R&D share between 1997 and 1999. But the foreign entries with high R&D share had not a persisting trend since the foreign entrants in 2000 had a very low share of R&D in their total sales. The greatest part of this foreign entry with high R&D share belonged to the large foreign entrant firms. The entrants in 1997 and 1998 had a R&D share above 0.6 % that helped the R&D share of large foreign firms to climb over 0.4 %. However, the increase in the rest of the period was achieved by the increase in the R&D expenditure of the incumbent large firms. The increase in the R&D share of the medium sized industries in the years 1994, 1996 and 1998 seen in the Figure 22 have different sources. The increase in 1994 was mainly due to the increase in the R&D share of incumbent medium sized foreign firms. However, the increases in 1996, and especially 1998, were owed to entrants. Even though the new foreign firms in medium sized industries had relatively considerable R&D shares in the last two years, they were unable to raise the average R&D share, most likely due to decreases in those of incumbents. The small foreign entries in 1996 and 2000 by the firms with relatively higher R&D share in the Turkish manufacturing industry could not prevent the continuous convergence of average R&D share in small foreign industries to zero.

The R&D share of large domestic firms followed a stable pattern in the 1992-2000 period. Therefore, one can hardly talk about the contribution of the new firms to this share. The only increase recorded in 1998 for the large domestic firms in R&D share was achieved by the increases in the existing firms' R&D shares. The increases in the R&D share of medium sized industries in 1995 and 1997 were achieved by the increases in the R&D share of existing firms. After 1997, the average R&D share in medium sized domestic industry remained around the same level since the existing firms did not increase their R&D expenditures; and no contribution made by the new firms. In the domestic side of the small industry, the increases observed in 1994 and 2000 were driven by new firms with high R&D share. In the remaining part of the period neither domestic entrance with high R&D; nor increase in the R&D share of incumbent domestic firms took place.

The extremely high R&D share of the entrants to the foreign high tech industries boosted the average R&D share in this category, to a great extent; however, it was the effort of the existing firms leading to the peak of the trajectory of the average R&D share in foreign high tech industries in 1999. The foreign entry to the high tech industries by the firms with the R&D share above 0.5 %, somewhat pushed the average share up in 1995; but had no effect in 1997 likely due to the decrease in the incumbents' share.

There were some entries to the low tech industries by foreign firms with relatively high R&D in 1997 and 1999. However, as it can be seen in the Figure 21, only the effect of the entry was felt in 1999. In 1997, on contrary, there was a decline in the average share of the foreign low tech R&D. The increase in 1994 was on account of the increased share of the existing firms. The increase in the R&D share over the period, on the other hand, had arisen from the increasing efforts of the existing high tech domestic firms rather than the entrants.



As it was discussed above the technology transfer activities, which is at the very modest levels, in the Turkish manufacturing industry was mainly undertaken by foreign firms. The technology transfers process by foreign firms relied on the incumbent firms rather than entrant firms to the market. As shown in the Figure 25 the highest share of the firms with the technology transfer agreements was in the large foreign industries whose share of technology transfer climbed from around 10 % to almost 60 %. The increase in this share was mainly owed to the increase in the efforts of the incumbent large foreign firms. The pattern of the foreign entrants with technology transfer activity followed a very erratic character over the whole period. The highest number of foreign entry with technology transfer agreements was recorded in 1994 with four entries out of 8; on the other hand, no such firms existed in 2000 among the seven foreign firms entered into the large industries.

The relatively modest increase in the share of medium sized foreign firms with these agreements was also originated from the efforts by the incumbent firms. Such kind foreign entries had no positive effect in increasing the share of the medium sized firms with technology transfer. Since the number of small foreign firms was very low; even one entry of this kind into the small foreign industries was felt in the trajectory of the share of the firms with technology transfer in the Figure 25. The same remarks made apply to the cases of the foreign firms with technology transfer regarding the technology level of classification of industries. The increase in the share was fed by the technology agreements committed by the incumbent firms.

The share of the domestic firms with technology transfer was very limited and the modest increases observed in the relevant figures above were also achieved by the efforts of incumbent firms.

3.3.11 Innovativeness of the Turkish Manufacturing Industry

The Table 6 below summarizes the data on the innovativeness of domestic and foreign firms in the periods 1995-1997 and 1998-2000 for low-tech and medium- and high-tech industries.[34] It is interesting to observe that there is almost no difference in terms of product innovations between domestic and foreign firms in low-tech industries. For example, only 11.2 % of domestic firms introduced any product innovation in the period 1995-1997, whereas the proportion of foreign firms who introduced product innovations in the same period is even lower (9.1 %). The proportion of innovative firms has increased in the second time period (1998-2000), but the difference between domestic and foreign firms is not significant. Foreign firms in low-tech industries seem to become more successful in process innovations than their domestic counterparts in the second time period.

Firms operating in the high-tech industries are almost two times more innovative than firms operating in low-tech industries, and foreign firms in these industries are undoubtedly superior to domestic firms in innovativeness. The data provides strong evidence supporting the argument that domestic firms are technologically weaker than foreign firms in high-tech industries.

[34] We use OECD's definition of low-, medium- and high-tech industries. Since the number of firms operating in high-tech industries is small, medium- and high-tech industries are grouped together, and defined as "high-tech".

The relative importance of product and process innovations differs in low-tech and high-tech industries, and the ownership of the firm matters for the type of innovation. Product/process innovators ratio is much lower in low-tech industries than in high-tech industries. In other words, process innovations are more common than product innovations in low-tech industries. Moreover, MNCs put more emphasis on process innovations than domestic firms do. Since low-tech industries tend to have "mature" product technologies, process innovations are likely to play more important role for competitiveness, where foreign firms seem to have a competitive advantage over domestic firms.

Product/process innovators ratio is much higher in high-tech industries than in low-tech industries, and foreign firms have even higher ratio of product-to-process innovators. This finding supports the perception that high-tech industries play a leading role in developing new products.

The Table 7 displays the expenditures of firms including the ones for innovation. The greatest part of the innovative expenditures of the firms in Turkey directed to the purchase of machinery and equipment regardless of the ownership structure, the technology level of the firms, in the first period. In the second period, the share of capital goods decreased in high tech firms, both foreign and domestic; but, in low tech firms this share raised. Surprisingly, the share of the expenditures for machinery and equipment in high tech firms are lower than those of low tech ones. These refer to that the technology transfer for low tech firms in the Turkish manufacturing industry takes the forms of embodied technology transfer in capital goods. Since the share of in-house R&D doubled in the second period; these firms can also be regarded as important channels for technology transfer to the system as well as the embodied technology for high tech firms.

The distribution of innovation expenditures over various categories of activities provides additional evidence on the differences in technological activities between domestic and foreign firms. The major difference is observed in the case of in-house R&D activities: Domestic firms in low-tech industries spend relatively more on in-house R&D activities than foreign firms do, though the innovative expenditures are still very little. In other words, building technological capabilities on the basis of in-house R&D seem to be more important for domestic firms in low-tech industries. Moreover, technology embodied in machinery and equipment and learning-by-doing (production process) have higher shares in domestic firms, whereas marketing-related activities account for almost one quarter of innovative activities in foreign firms.

As may be expected, in-house R&D has a much higher share in innovation expenditures in high-tech industries, especially in foreign firms: it accounts for exactly half of innovation expenditures in foreign firms, and almost one third in domestic firms in the period 1998-2000. Domestic firms allocate somewhat higher proportions of expenditures for technology embodied in machinery and equipment and learning-by-doing activities. It is interesting that marketing-related activities have almost the same share in domestic and foreign firms in high-tech industries.

The Table 8 below indicates the R&D cooperation of the firms with users, consultants, suppliers and universities and other public institutions by ownership structure. The R&D cooperation is a very common practice neither for foreign, nor for domestic firms in the Turkish manufacturing industry. The share of the firms for each category of interaction listed in the table generally remains at the very modest levels. More than half of innovative domestic firms are not involved in any type of co-operation in R&D activities. Furthermore, the firms in the Turkish manufacturing industry generally favor domestic institutions to interact rather than the foreign ones. This is especially true for the domestic firms. Co-operation with foreign organizations is even less likely for domestic firms (about 10 %) of innovative firms. There are, of course, exceptions to this generalization. For example, foreign firms mostly interact with their own group of home countries. Irrespective of the sector they operate in, foreign firms have more intensive contacts with other organizations in R&D activities. The most important partner for foreign firms is their sister companies belonging to the same business group. In fact, the highest figures one can observe in the table consist of this specific interaction form of foreign firms.

The table suggests that, in general, medium and high tech domestic firms commit themselves to cooperation with other actors more often than the low tech ones in the most of the categories of interaction in the 1995-97 period. For example, interaction with own group, users suppliers, and universities/non-profit research institutions are markedly higher in the medium and high tech firms. Though, the rest of the interaction categories display similar proportions of the low tech and high tech firms. However, in the second period, low tech firms have higher interaction. Low tech domestic firms in this period registered a higher score for each category of interaction except the consultants. This refers to a shift in the links to domestic sister companies, users, suppliers and university/non profit institutions from the consultants. The links with domestic users in high tech domestic firms between the periods were the only category of registered increase. Leaving aside this increase, the loosening links of high tech firms with other institutions in the system in the second period is worth noting. For example, low tech domestic firms had tightening links with universities/non profit institutions whereas almost half of the high tech domestic firms lost this sort of interaction in the second period. In fact, none of the agents listed in the table for the R&D cooperation were able to increase their cooperation with high tech domestic firms. This raises the pessimistic expectations about the performance of the high tech domestic firms.

The foreign firms, on the other hand, had tighter links in the both period. However, concerning the domestic bodies of interaction; low tech foreign firms gave the weight of their R&D cooperation to consultants, supplier and universities/non profit institutions; and decreased their interaction with their own group and users. The table also shows that the interaction of low tech foreign firms became less intensive with the foreign consultants, suppliers, and sister companies abroad. These remarks point out to an increasing importance of the role of the foreign firms in the innovation system in Turkey as well as a deeper integration with elements embodied in the system. The increased number of firms might have a role in this structural change. The integration of high tech foreign firms stayed in a limited extent. Even though the high tech foreign firms in Turkey had remarkably increased their R&D interaction with domestic users and suppliers, they still relied on their sister companies abroad, and intensified their links with foreign users. This is not, of course, very surprising in the face of limited capabilities, both in the knowledge creation process and productive activities in high tech industrial activity by the domestic agents.

As Rosenberg (1982) emphasized both internal and external knowledge sources are important for firms in the technical change process. The Table 9 confirms this proposition; however, it also exhibit that the internal knowledge of firms are still the main sources for knowledge in the innovation process. Regardless of the ownership, and technology levels of firms, or the periods studies; firms rely mostly on the internal knowledge sources for their innovative activities. Domestic firms value their internal knowledge sources in the innovation process less than foreign firms do. But this is not to say that, foreign firms rely on the external knowledge sources less than domestic firms do. Each sources of knowledge were evaluated on a higher value in foreign firms compared to domestic ones both in high tech and low tech industries. This might possibly be interpreted as the indication of the limits of the firms in exploiting the knowledge sources. It can further be interpreted as the reflection of relatively lower capabilities of domestic firms in innovation capability.

Among the external knowledge sources, consultant firms are the dominant channel for innovative knowledge for domestic firms in the both period. This is also true for the foreign firms to some extent. The sister companies are of more importance as the external knowledge sources for foreign firms; but for domestic firms their role is considerably limited. These links between sister companies, of course, are the results of the organization of industrial activity. As it was discussed in the theoretical section, there are vast advantageous for the firms to become multinational in increasing their technological capability. The foreign firms, by definition, are already multinational; but, the multinationality of domestic firms seems to be less developed given the less reliance on own groups. Another indication of limited technological capability of domestic firms possibly lies behind the role of rival firms as the knowledge sources. The domestic firms in the Turkish manufacturing industry are not very good at in exploiting knowledge from their competitors. Rival firms appear to be a more important source of external knowledge for foreign firms. This can be regarded as the capability of foreign firms of exploiting knowledge flowing from the competitors; and also incapability of deriving knowledge spillovers from the market working through demonstration effect, extensively discussed in the theoretical section. Therefore, this remark limits the expectations of horizontal spillovers for domestic firms from the demonstration of superior technologies of the rival foreign firms.

Both foreign and domestic firms seem to benefit from vertical knowledge spillovers since users and suppliers were reported as important knowledge sources. However, the structure of the vertical spillovers differentiates for domestic and foreign firms concerning suppliers. Domestic firms reported that the suppliers of input and software are less important than the supplier of capital goods. For foreign firms, the role of the suppliers of capital goods varied in the both period whilst the role of suppliers of inputs and software was generally important, -except the weakened role of input suppliers for high tech firms in the second period. This might also be taken for granted as the more developed technological capability of foreign firms in comparison with that of domestic ones. Users are also an important source of knowledge for both domestic and foreign firms in both low tech and high tech industries. This is the confirmation of the Von Hippel (1988)'s well known hypothesis for the Turkish manufacturing industry. Therefore, we expect positive spillovers from the forward linkages of vertical knowledge spillovers for both domestic and foreign firms. Although the structure of vertical knowledge spillovers regarding the type of suppliers is different for the foreign and domestic firms; it is still reasonable to expect positive knowledge spillovers from the backward linkages for innovation.

Universities, as one of the most emphasized institution in the system of innovation for the technical change, does not seem to have fulfilled this role in the Turkish innovation system since both foreign and domestic firms reported that the role of these institutions was limited in their innovative activities as a source of knowledge. Nonetheless, foreign firms exploit university slightly more than domestic firms in the first period; but domestic firms started to use university research more intensively in the second period than before. Similarly, the role of nonprofit organizations has a role of more limited scope in the innovation system in Turkey. Firms seem to compensate the limited role of universities in the system by their own efforts to use scientific activities such as professional conferences, meetings and journals; and knowledge networks of computer databases. Technology transfer in the form of license agreements contributes almost as much as supplier of capital goods.

In brief, domestic firms in Turkey conduct their innovative activities based on internal knowledge combined with consultants, technology transfer, vertical relations, especially the kind of embodied technology transfer, as the sources of innovation. The importance of these sources outweighs the others in the innovation process of domestic firms. The other role of institutions in the system in the creation of new technologies is very limited, though scientific activities and knowledge networks of computer databases. Given the extremely high share of expenditures for capital goods depicted in the Table 6, especially domestic firms seem to be dependent on the technologies imported from elsewhere for their innovative activities. Therefore, the system of innovation in Turkey seems to be far behind of the one that would register dynamic capabilities. This is not to deny the role of mentioned knowledge sources most often benefited for the innovation process. However, the unimportant role of other sources, -in particular, universities and other R&D institutions, raises the suspects about domestic firms and the system, in general, to establish dynamic capabilities.

3.3.12 Labor Mobility in the Turkish Manufacturing Industry

As it was discussed in the theoretical framework, labor mobility also provides some opportunities for domestic firms. By transferring laborforce previously employed by MNCs, domestic firms can accelerate the process of tacit knowledge creation in their manufacturing activities. We approximate the labor transfer from MNCs by the following equation.

$$FL_{js}=\Sigma_{i\neq j} lfire_{is} fdi_{is}/\Sigma l_{is}$$

where *lfire* is the number of separations (quits, fires); *l* is the number of employees; *fdi* is a dummy for foreign firms, *i, j* stand for firm; *s* is sector at 4-digit level.

The Table 4 depicts that, on average, around 15 % of the labor previously employed by foreign firms was transferred to other firms in 1993-2000 period. This share is around 11 %. This share over the period varied to a great extent in high tech industries, but never fell below 9 % in low tech ones. Therefore, despite to the high wages, there is a possibility for the leakage of the knowledge brought by foreign firms. However, this opportunity is relatively smaller in high tech industries for which the knowledge occupies a greater and more important part of the industrial activity.

Table 4: The labor flow to other firms from foreign firms, 1993-2000, labor separation/foreign employment, percent

Year	Low tech	High Tech
1993	11.12	6.80
1994	10	18.87
1995	9.12	7.17
1996	16.86	8.57
1997	21.88	10.24
1998	15.44	12.15
1999	18.22	12.92
2000	20.12	9.90
Mean	15.34	10.83

Source: State Institute of Statistics

The table 5 below shows that labor mobility in food and agriculture industries, textile and garment industries, wood and wood products, paper and printing industries had diminished in the 1998-2000 period compared to 1995-97 period. However, the reverse is true for petrochemical and chemical industries, stone based industries, iron and steel based industries; and non-ferrous metal industries. The highest mobility in the first period was observed in food and agriculture, and wood and wood products in the first period. The mobility in these industries was 2.37 and 2.07 %, respectively. In the second period, non-ferrous metal industries was the leader regarding the highest labor mobility with a ratio of 2.08. Labor mobility was higher in high tech industries compared to low tech ones in the both period. This raises the expectations as to spillovers from MNCs through labor mobility, if any, would be stronger in high tech industries.

Table 5: The share of laborforce separated from foreign firms, 1995-1997 and 1998-2000, percent

Industries	1995-1997	1998-2000
Food & Agriculture Industries	2.37	1.5
Textile and Garment Industries	0.27	0.24
Wood &Wood Products	2.07	0.44
Paper & Printing Industries	0.36	0.34
Petrochemical&Chemical Industries	1.08	1.7
Stone Based Industries	0.25	0.46
Iron & Steel based Industries	0.13	0.27
Non-Ferrous Metal Industries	1.7	2.08
Other Manufacturing Industries	1.5	1.24
Low tech Industries	0.85	1.1
High tech Industries	1.56	2.00
Mean	0.87	0.93

Source: State Institute of Statistics, Innovation Surveys, 1998 and 2000.

Table 6. Innovativeness of domestic and foreign firms, 1995-1997 and 1998-2000, proportion of innovative firms

	1995-1997		**1998-2000**	
	Domestic Firms	**Foreign Firms**	**Domestic Firms**	**Foreign Firms**
Product innovations				
Low-tech	0.112	0.091	0.143	0.162
Medium- and high-tech	0.278	0.526	0.325	0.601
Process innovations				
Low-tech	0.159	0.163	0.193	0.387
Medium- and high-tech	0.280	0.453	0.279	0.483
Innovative (product and/or process innovations)				
Low-tech	0.191	0.169	0.250	0.425
Medium- and high-tech	0.378	0.563	0.419	0.680
Product/process innovators ratio				
Low-tech	0.704	0.558	0.741	0.419
Medium- and high-tech	0.993	1.161	1.165	1.244
N				
Low-tech	1301	68	1391	83
Medium- and high-tech	646	79	770	94

Source: SIS, *Innovation Surveys*, 1998 and 2002.

Table 7. Distribution of expenditures for innovation, 1995-1997 and 1998-2000

	1995-1997 Domestic Firms	Foreign Firms	Majority-owned foreign firms	**1998-2000** Domestic Firms	Foreign Firms	Majority- owned foreign firms
Low-tech industries						
In-house R&D	0.118	0.036	0.032	0.147	0.050	0.048
Contract R&D	0.035	0.077	0.112	0.016	0.006	0.007
Machinery & equipment	0.617	0.587	0.486	0.698	0.606	0.608
Technology transfer	0.026	0.035	0.020	0.020	0.101	0.106
Production process	0.061	0.035	0.029	0.041	0.004	0.004
Training	0.022	0.037	0.056	0.027	0.005	0.006
Marketing	0.121	0.193	0.265	0.051	0.227	0.221
N	301	26	18	223	19	17
Medium- and high-tech industries						
In-house R&D	0.187	0.283	0.227	0.297	0.503	0.502
Contract R&D	0.057	0.038	0.030	0.020	0.010	0.011
Machinery & equipment	0.529	0.477	0.596	0.443	0.352	0.340
Technology transfer	0.018	0.046	0.051	0.034	0.019	0.021
Production process	0.105	0.044	0.017	0.087	0.028	0.033
Training	0.034	0.016	0.018	0.021	0.023	0.027
Marketing	0.070	0.096	0.061	0.098	0.065	0.066
N	264	51	27	228	40	29

Source: SIS, *Innovation Surveys*, 1998 and 2002.

Table 8. R&D co-operation by ownership, 1995-1997 and 1998-2000, proportion of R&D co-operations

Partner		**1995-1997**		**1998-2000**	
Low-tech industries		Domestic	Foreign	Domestic	Foreign
Domestic	Own group	0.033	0.134	0.060	0.050
	Users	0.027	0.178	0.060	0.074
	Consultants	0.090	0.112	0.041	0.213
	Suppliers	0.035	0.156	0.087	0.243
	Universities/non-profit	0.085	0.195	0.151	0.252
Foreign	Own group	0.012	0.325	0.007	0.194
	Users	0.023	0.000	0.003	0.089
	Consultants	0.025	0.140	0.070	0.031
	Suppliers	0.037	0.202	0.037	0.088
	Universities/non-profit	0.009	0.018	0.003	0.010
N		443	37	470	49
Medium- and high-tech industries					
Domestic	Own group	0.081	0.171	0.051	0.038
	Users	0.119	0.159	0.102	0.451
	Consultants	0.089	0.070	0.042	0.297
	Suppliers	0.098	0.106	0.074	0.176
	Universities/non-profit	0.183	0.279	0.094	0.216
Foreign	Own group	0.028	0.180	0.002	0.594
	Users	0.043	0.079	0.041	0.137
	Consultants	0.047	0.020	0.023	0.086
	Suppliers	0.087	0.177	0.039	0.132
	Universities/non-profit	0.010	0.000	0.008	0.023
N		321	62	402	71

Source: SIS, *Innovation Surveys*, 1998 and 2002. *Note:* The total may exceed one because a firm can co-operate with more than one type of organization.

Table 9: Knowledge Sources for innovation*, 1995-97 and 1998-2000

	1995-97		**1998-2000**	
Low-tech industries	Domestic	Foreign	Domestic	Foreign
Internal	2.00	2.52	2.03	2.32
Own group	0.59	1.63	0.76	2.10
Rival firms	1.68	2.11	1.75	2.02
Users	1.46	1.50	1.33	1.70
Consultants	1.80	2.34	1.66	2.11
Suppliers of capital goods	1.08	0.86	1.02	1.56
Suppliers of inputs	0.96	1.47	0.70	1.15
Suppliers of software	0.85	1.40	0.77	1.21
University	0.51	1.00	0.55	0.48
Non profit institutions	0.36	0.61	0.33	0.75
Technology Transfer	1.08	1.36	1.00	1.35
Scientific activities	1.63	1.36	1.73	1.44
Knowledge networks	1.06	1.08	0.10	1.09
Medium- and high-tech industries				
Internal	1.91	2.61	2.32	2.64
Own group	0.60	1.98	0.53	2.44
Rival firms	1.24	1.55	1.55	1.80
Users	1.44	1.47	1.66	1.58
Consultants	1.71	2.30	1.84	1.68
Suppliers of capital goods	1.12	1.32	1.22	0.86
Suppliers of inputs	0.85	1.28	0.60	0.85
Suppliers of software	0.74	1.62	0.84	1.40
University	0.70	0.92	0.50	0.54
Non profit institutions	0.52	0.88	0.48	0.29
Technology Transfer	0.98	1.38	1.02	0.94
Scientific activities	1.52	1.58	1.82	1.10
Knowledge networks	0.98	1.41	1.41	0.74

Source: SIS, *Innovation Surveys*, 1998 and 2002.

CHAPTER 4

THE ECONOMETRIC ANALYSES

This chapter consists of the quantitative analyses of the Turkish innovation system. The first section below draws on the panel data set of the Turkish manufacturing industry at three digit level of 28 industries for the 1983-2000 period. By utilizing this data set, the effects of MNCs on purely domestically owned manufacturing industries, or spillover effects, will be quantitatively analyzed. This analysis in the first section will be based on the horizontal and vertical spillovers from MNCs separately. In other words, the effects of MNCs for the firms in the same industries, -horizontal spillovers; will be distinguished from those arising from the input purchases and output sales of MNCs, -vertical spillovers. The analysis will also take into consideration the size and technological characteristics.

The second section will focus on the national innovation system in Turkey, in general. The Innovation Surveys will be utilized for the analysis in the second section. The *Innovation Surveys* are available for two time periods, 1995-1997 and 1998-2000. While analyzing the innovation system in Turkey, the role of MNCs will be given special emphasis. Therefore, the role of spillovers, both vertical and horizontal, will be analyzed in the process of technological change in Turkey.

4.1 The Effects of Multinational Corporations on the Domestic Manufacturing Industries

This section is devoted to the industry level analysis of horizontal and vertical spillovers, and their differentiation with respect to the ownership and size categories of the Turkish manufacturing industry. The role of indigenous technological capability and technological effort in the process of exploiting the spillovers; and the role of trade orientation of the Turkish manufacturing industry in the process of technological development will also be analyzed.

4.1.1 Empirical Model

The following production function is assumed for the analysis of the spillover effects arising from foreign industrial activity:

$$Q = A\, f\,(K, L, E, M) \qquad [1]$$

where Q is real value added, K, L, E, M is real capital, labor, energy consumption, input respectively; and A is the baseline productivity level. The equation below will automatically follow from [1] if there are constant returns to scale:

$$ln(Q_{ijt}/L_{ijt}) = lnA_{ijt} + \beta_1 ln(K_{ijt}/L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) + \varepsilon_{ijt}\,;$$

$$i = 1,\ldots,m;\; j = 0,\ldots,n;\; t = 1,\ldots,T \qquad [2]$$

where i stands for 3-digit industries, j stands for ownership and size categories; and t for time[35]. We can raise a plenty of other factors that are effective on the

[35] Note that β_2 will be statistically 0 if there are constant returns to scale.

productivity of industries which can be introduced to this model simply by using a baseline productivity term, as Haddad and Harrison (1993) and Kinoshita (1999) did for their own models:

$$ln(A_{ijt}) = \beta_0 ln(Q_{ijt-1}/L_{ijt-1}) + \sum_p \delta_{(p+1)} ln(MS_{ijt-p}) + \sum_j \sum_p \delta_{4(p+1)j} ln(DMS_j)_{it-p} + \delta_{4[(p+1)+1]} ln(W_{ijt}/L_{ijt});$$

$$p = 0, \ldots, T-1 \qquad [3]$$

where W/L is wages per employee, MS is market share of foreign firms, and DMS is the variable to capture the effects of foreign market share on the different ownership and size categories that was defined as

$$(DMS_j)_{it} = (MS)_{ijt} \text{ if } j=n; \; 0 \text{ otherwise}; \qquad j = 0, \ldots, n.$$

If we combine [2] and [3], we obtain the following that will serve us in analyzing spillover effects in the Turkish manufacturing industry due to foreign firms.

$$ln(Q_{ijt}/L_{ijt}) = \beta_0 ln(Q_{ijt-1}/L_{ijt-1}) + \beta_1 ln(K_{ijt}/L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) + \sum_p \delta_{(p+1)} lnMS_{ijt-p} + \sum_j \sum_p \delta_{(p+1)j} ln(DMS_j)_{it-p} + \delta_3 ln(W_{ijt}/L_{ijt}) + \varepsilon_{ijt} \qquad [4]$$

This equation is our general model and will be made use of to analyze spillover effects of MNCs in the Turkish manufacturing industry. We use capital, labor, energy, and input used in production to control the variation of the productivity of the industries. We have already mentioned the relevance of wages in this context; therefore, wages are likely to serve in the explanation of the labor productivity of industries. We are concerned with the rest of the variables. We also use the one period lagged value of foreign market share following the suggestion raised by Aitken and Harrison (1999). The dynamic analysis of spillovers might be relevant because of learning effects of firms and other factors that create delays to materialize the positive spillovers. The possible different spillover effect of foreign firms on the various size categories is due to Acs, et al (1994).

4.1.2 Estimation Results

The model above was estimated for the manufacturing industries broken down according to the technology levels, separately; as well as for the whole manufacturing industry in the 1983-2000 period. The system GMM estimation procedure, which is the improved version of Arellano-Bond type of GMM (Arellano and Bond, 1991), was followed for the econometric analysis. This procedure was developed by Arellano and Bover (1995) and Blundell and Bond (1998). The model has a semilog form, that is, the dependent variable and other control variables were defined in the natural logarithmic form, but the market share of MNCs is not defined in the *ln* form. The results are exhibited in the Table 10, 11 and 12; respectively.

4.1.2.1 Horizontal Spillovers

The Table 15 below shows that there is no evidence for horizontal spillovers from the market share of MNCs on the domestic side of the manufacturing industry. The coefficient of *MS*, supposed to represent the horizontal spillover effects, amounts to -0.05, but it is insignificant. There is no evidence for negative or positive spillovers for low tech and high tech subcategories, either.

Since we consider that the spillover effects of MNCs positive horizontal spillover effect may be materialized in the long run, the lagged value of the market share of foreign firms was added to the model as an independent variable. In this way, the dynamic effects of MNCs, as it was forwarded by Aitken and Harrison (1993) are supposed to be captured. In order to see if there is any dynamic effect, only the coefficient of lagged market share was estimated in the first attempt. This dynamic effect of MNCs was estimated as 0.19 for the whole sample, at the 5 % significance level (Table 10). This dynamic effect for the low tech domestic industries was estimated a bit weaker as 0.06 but the coefficient is statistically insignificant (Table 11). The dynamic spillovers for the high tech domestic industries were also estimated positive as 0.09, but this coefficient is insignificant, either (Table 12). So, there are dynamic effects for the domestic manufacturing industries in Turkey, materialized in the lagged period; but this effect was not observed for the subsample of the manufacturing industries according to the classification of their technology levels. This dynamic effect arises most likely due to on the learning effects. If the results presented above are not statistical artifacts; then, we can confer that the realization of these effects is possible only from a larger set of MNCs, since low tech domestic firms, for example, can also benefit from the high tech foreign firms. The insignificant coefficients were obtained from the separate estimation of industries by their technology level.

In the next step, the net effect of from the market share of foreign firms on the domestic manufacturing industries was investigated. It is considered that the real net effects upon the domestic industries can be captured by the inclusion of both current and lagged values of market share as independent variable into the model. The model III in the tables displaying the estimation results was estimated for the all categories of sample[36] (Tables 10, 11, and 12). The current horizontal spillover from the MNCs'market share was estimated as -1.17, and the lagged horizontal spillover was estimated as 1.23 (Table 10). These estimated coefficients were significant at the 1 % level. The coefficients of the current and the lagged values of market share of foreign firms in low tech industries were estimated as -0.92 and 0.92, respectively, both coefficients are significant at the 1 % level. The corresponding estimations for high tech domestic industries are -1.30 and 1.47, respectively, but current effects is insignificant and lagged effect is significant at 10 % level.

In order to find out the impact of the dynamic spillover effects on the overall domestic industries (net effect), joint hypothesis test was conducted. No attempt was made to test the dynamic impact for the high tech sample of industries because the coefficient for current effect was already estimated insignificant. However, since both current and lagged coefficients are significant for the overall and low tech domestic industries, the investigation for the impact of spillovers would be relevant. The null hypothesis is stated as

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[36] The second lagged value of the market share of foreign firms was also added to the model. However, we found generally insignificant, or negative results from the estimation of the second lagged coefficient. Therefore, in rder to avoid further complication of the discussion here, we did not report these estimates in the tables.

$$H_0 : \Delta\delta_{MS} + \Delta\delta_{MS\_1} = 0$$

The $\chi^2(1)$ of this hypothesis was calculated as 0.50, which exceeds the critical value. Therefore, the null hypothesis stating that the current and the lagged effect of the market share of foreign firms are jointly statistically equal to zero is accepted. This means that the spillover from the lagged values of market share of MNCs is unable to register a net positive spillover in the long run. The statistic was calculated as 0 for low tech domestic industries which makes the comments for the overall domestic industries also relevant for low tech domestic industries.

4.1.2.2 Horizontal Spillovers with respect to size of domestic firms

Another contribution of this work, drawing mainly inspiration from Aitken and Harrison (1994) and Acs, et al. (1994), is that the spillover effects may differentiate with respect to the size of domestic firms. We estimated the Model IV in the tables that include the variables supposed to capture the size aspects of horizontal spillovers. These variables are designated in a way that they take the value of market share of the foreign firms in the related size and the remaining values take the value of zero for the size categories other than the scale of firms for which we are trying to capture spillover effects. For example, the variable supposed to capture the effects on small firms take the value of market share of small firms; and takes zero for the other size categories.

The estimation results (Model IV) show that there are negative spillovers for all categories of sizes, and public firms (Tables 10, 11, and 12). However, the estimated coefficients of the current market share of MNCs are statistically significant only for the medium sized low tech firms. So, there is no evidence for spillovers, negative or positive, from the MNCs activity for the firms in other size/ownership categories in the Turkish manufacturing industry.

The separate estimation result for industries of different technology levels in the Table 11 and 12 suggest that there is negative spillover for the public high tech firms but not for the firms in other categories both in low tech and high tech domestic industries. The coefficient for market share of foreign firms was estimated as -0.49, which is significant at the 5 % level, for low tech domestic medium sized firms. For the rest of the industries there is no evidence in favor of, negative or positive, spillovers. Therefore, it can be inferred here that the spillover effects varies with respect to size distribution of domestic firms. Because, as the estimated coefficients suggest, there is evidence for the negative spillover for the medium sized domestic firms whereas no evidence was found for the firms in other categories.

The combination of the two inspirations (differentiation of spillovers with respect size and dynamic spillovers) allows the further analysis of the dynamic spillover effects for different sizes. The model V and VI in the tables depict the results of such analysis. In this way we are able to see for which size of industries the lagged positive spillover was generated. The estimation results of the Model V show that the lagged positive spillovers were generated only for the large sized firms. The lagged spillover for the large firms was estimated as 0.22, (significant at the 5 % level) for the whole sample of manufacturing firms. This coefficient of dynamic spillover was significantly estimated as 0.30, at the 5 % level for the low tech domestic large firms. However, the estimation of the Model V for high tech firms shows that there is evidence in favor of positive dynamic spillover.

As in the previous analysis, we tried to find out the dynamic spillover impact of the various size categories. To this end, the Model VI was estimated. The estimation results of the Model VI show that the spillover effects for both current and lagged values of market share is significant for the firms other than public ones (Table 10). The coefficient of lagged spillover exceeds the current one for small and large firms but medium firms. So, if the joint significance test happens to be rejected, then we will be able to infer that the dynamic impact of spillovers is positive for the domestic small and large firms. The joint significance test was conducted on the basis of the following null hypothesis

$$H_0 : \Delta\delta_{DMSj} + \Delta\delta_{DMSj\_1} = 0; \quad j=1, 2, 3$$

The calculated $\chi^2(1)$ for this hypothesis test for small and medium firms is 0.22 and 0.17, and therefore, we accept the null hypotheses. In other words, there is no evidence in favor of dynamic impact of spillovers for the small and medium sized domestic firms. The corresponding statistic for large domestic firms is equal to 3.24 and rejects the null hypothesis at the 10 % level. Therefore, we conclude that there are net positive spillovers for the large domestic firms in the Turkish manufacturing industry.

The corresponding estimations of the Model VI for low tech industries provided similar result as to large firms (Table 11). The only significant estimation result for both lagged and current value of the market share of MNCs was obtained for the large firms in low tech industries. The magnitude of the estimated coefficient of the lagged market share also exceeded that of current market share. So, the rejection of the null hypothesis of a joint significance test, would lead inference in favor of the net positive spillovers for the large firms in low tech industries in the long run. The null hypothesis formulated as in the case of the whole sample of industries above was rejected since the calculated $\chi^2(1)$, which is 3.18, exceeding the critical value at the 10 % level. We were able to obtain the significant estimates for both current and lagged spillovers from foreign market share in none of the ownership/size categories (Table 12).

4.1.2.3 Vertical Spillovers

Vertical spillovers, defined as the spillovers due to forward and backward linkages created by the foreign firms, was also attempted to be analyzed in this study for the domestic firms in the Turkish manufacturing industry for the 1983-2000 period. The variants of the model [5] below were utilized to this end. The estimation of the model including the vertical relations can be depicted as

$$ln(Q_{ijt}/L_{ijt}) = \beta_0 ln(Q_{ijt-1}/L_{ijt-1}) + \beta_1 ln(K_{ijt}/L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) +$$

$$\sum_p \delta_{(p+1)} BW_{it-p} + \sum_p \delta_{(p+1)} FW_{it-p} + \sum_j \sum_p \delta_{(p+1)j} (DBW_j)_{it-p} + \sum_j \sum_p \delta_{(p+1)j} (DFW_j)_{it-p} +$$

$$\delta_3 ln(W_{ijt}/L_{ijt}) + \varepsilon_{ijt} \qquad [5].$$

The *BW* stands for backward linkages; whereas *FW* stands for forward linkages. The effects of vertical linkages on the various ownership and size categories will be captured by the *DBW* and *DFW* terms. These terms are defined as

$$(DBW_j)_{it} = (BW)_{it} \text{ if } _{j=n;} \ 0 \text{ otherwise}$$

and

$$(DFW_j)_{it} = (FW)_{it} \text{ if } _{j=n;} \ 0 \text{ otherwise}; \qquad j = 0,\ldots,n.$$

The variable standing for the market share of foreign firms in the model including backward and forward linkages was dropped in order to avoid multicollinearity problem since the calculation of these linkages already includes foreign market share[37]. The rest of the variables, which were explained above, are the control variables supposedly effective on the productivity variation for the domestic labor productivity.

The estimation results for this investigation were presented in the Table 13; 14 and 15 for the whole sample of manufacturing industries, low tech, and high tech industries respectively. The estimation of the Model I suggests that there is no evidence for the spillover from the vertical linkages of MNCs in the Turkish manufacturing industry for the 1983-2000 period. The spillovers due to vertical linkages were found statistically insignificant (Model I).

The possible dynamic nature of vertical spillovers was also taken into account here; and thus the effects of possible lagged effects were investigated. However, when dynamic investigation was attempted, no significant evidence was found in favor of lagged vertical spillover (Model II). Thus, the vertical relations

[37] The calculation of these linkages was explained in the previous section.

with the foreign firms have no effect on the domestic firms in the Turkish manufacturing industry.

In order to find out the dynamic impact of vertical spillovers upon the domestic side of the Turkish manufacturing industries, as in the horizontal spillovers case, the effects of both currents and lagged spillovers were estimated. But these estimates were also found to be insignificant (Model III). Therefore; it can be inferred that there is no dynamic positive impact of backward linkages of MNCs in the Turkish manufacturing industry.

The estimation of the Model III analyzing dynamic impacts of vertical linkages shows that there is no significant lagged spillover from the forward linkages of foreign firms in the Turkish manufacturing industry, neither a positive dynamic impact.

4.1.2.4 Vertical Spillovers with respect to size of domestic firms

The idea as spillover effects might diversify with respect to the size of the recipient firms was also credited here; and the possible diversification of vertical spillovers of this kind was investigated.

The related tables lend some support to the mentioned idea. The estimations show that the negative and significant spillovers from the backward linkages of foreign firms were found for the public domestic firms. The model IV in the table 13 shows that estimated coefficients are -0.47 (significant at the 1 % level). The rest of the size categories showed no significant spillovers. There is no evidence for negative spillovers for none of the other size/ownership categories from the forward linkages, either. The estimation for low tech industries is in line with these results to a great extent. The table 14, however, exhibits an additional significant coefficient of backward linkages of foreign firms in medium scaled domestic firms. This coefficient for the spillover effects due to backward linkages of MNCs was estimated as 0.45 for medium sized domestic low tech firms.

No evidence of vertical spillovers from MNCs' forward linkages on different sizes of domestic industries was found.

The lagged effects of vertical linkages on various ownership and size categories were presented in the relevant tables, as well (Model IV). The results suggest that the lagged effects of linkages of MNCs appear to be positive and significant in large scaled domestic industries. This significant evidence was obtained from the whole sample of the firms and low tech firms. In other words, there is no evidence in favor of lagged vertical spillovers for high tech firms. The mentioned coefficients were estimated, respectively as 0.62 and 0.48, both are significant at the 5 % and 10 % levels (The model V in the table 13).

In order to see the dynamic impact of these lagged positive spillovers on the various sizes of Turkish manufacturing industry, the model including the current and lagged effects was estimated as previously was done. The estimation of the Model VI suggests that there is no evidence for spillovers from the vertical linkages in the long run. Even though we obtained significant coefficient estimates for the medium sized high tech firms; the joint significance test did not rejected the null hypothesis as their joint significance equals to zero which was formulated as.

$$H_0 : \Delta\delta_{BW2} + \Delta\delta_{BW2\_1} = 0$$

Therefore, it can be conferred here that there are no dynamic impacts of the lagged positive spillovers from the backward and forward linkages of MNCs.

4.1.2.5 Indigenous Technological Capability and Spillovers

It was discussed elsewhere in this work many times that, the process of generation of spillovers arising from MNCs is not by-product process. Indigenous technological capability and technological effort are required in order to reap benefits from the spillovers. To test this hypothesis, a variable was added supposedly capturing the interaction between foreign market share, and technological capability;

and domestic technological effort. The technological capability was approximated in this study as the relative productivity of the domestic manufacturing industries with respect to the productivity of the US manufacturing industries. The technological effort, on the other hand, will be measured as the R&D shares of domestic industries in output. Therefore, the variables standing for the interaction with the foreign market share will be added to the analysis So, equation [2] is modified as

$$ln(Q_{ijt} / L_{ijt}) = \beta_0 ln(Q_{ijt-1}/L_{ijt-1}) + \beta_1 ln(K_{ijt} / L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) + \delta_3 ln(W_{ijt}/L_{ijt}) + \delta_4 CAP\_1 + \varepsilon_{ijt} \qquad [6].$$

where

$$CAP = (MS_{ijt})*ln[(Q_{it}/L_{it})_T/(Q_{it}/L_{it})_{US}].$$

The final explanatory variable consists of the relative productivity of the domestic firms with respect to the productivity of US manufacturing industries. This term is considered to be a good proxy for the technological capability of the domestic side of the manufacturing industry. So, the parameter shown as δ_4 supposed to capture the effect of indigenous technological capability in reaping benefits the spillovers from MNCs' activities. We included the lagged value of the *CAP* variable as In order to avoid any endogeneity problem. Because, since the calculation of this variable consists of the productivity of the domestic firms which is our independent variable. A positive sign for this parameter would imply that capabilities of domestic firms are important precondition for the positive spillovers, as the previous literature proposed.

The estimation of the equation [6], however, does not support any endorsement to the theoretical expectation about the role of technological capabilities of domestic firms in the process of generating positive spillovers. The coefficient capturing that mentioned effect was estimated as -0.10, which statistically significant at the 5 % level (Table 16). The estimations for low tech and high tech industries show that there is a weak evidence in favor of the role of domestic capabilities in low tech firms (the estimated coefficient is significant at the 10 %

level). The estimated coefficient for high tech industries is -0.02 but it is found to be insignificant. The negative estimated coefficient implies that the arguments raised by the spillover literature as technological capability is an important factor in the generation of the positive spillover is not valid for the Turkish manufacturing industry.

4.1.2.6 Indigenous Technological Efforts and Spillovers

The previous literature suggests that technological efforts made by the domestic firms are also an important precondition for positive spillovers from MNCs activities. It is considered that indigenous technological effort can be approximated by the R&D share in the output of domestic manufacturing firms. Therefore, a term was plugged into the basic model (equation [2]) to capture the interaction between domestic effort and foreign market share. The model in order to investigate the effect of domestic effort becomes

$$ln(Q_{ijt}/L_{ijt}) = \beta_0 ln(Q_{ijt-1}/L_{ijt-1}) + \beta_1 ln(K_{ijt}/L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) + \delta_3 ln(W_{ijt}/L_{ijt}) + \delta_4 RD_{ijt-1} + \varepsilon_{ijt} \qquad [7]$$

where *RD* stands for the share of R&D expenditures in the total output. The one period lagged value of R&D was included in the estimated model since the calculation of domestic R&D share includes the total output which is highly correlated with the dependent variable. The rest of the variables were already defined above.

The estimation of the above equation suggests a very striking fact that there is no contribution of domestic R&D to the domestic productivity of the Manufacturing firms in Turkey. The coefficient of R&D share is insignificant for the all estimation exercises of different sample of the firms in manufacturing industries. This might most likely due to the low share of domestic R&D (Table 17).

4.1.2.7 Trade as a Knowledge Flow Mechanism

MNCs are one of the mechanisms of technology diffusion. On the other hand, trade can also be accredited as a knowledge transfer mechanism. Because, high competition in the global markets enforces domestic firms to be more competitive; and to be able to survive in the export markets, firms have to export the products fulfilling high standards required by the customers. In order to do that, there has to be a knowledge flow to domestic firms. That is, export orientation of the firms can be regarded as the proxy for the technological effort made by the very firms. On the other hand, import can also be taken as a mechanism for exploiting knowledge since the imported goods embodies a considerable amount of knowledge that can be exploited by the reverse engineering practice. So, it seems reasonable to check the possible effects of the trade orientation of domestic firms in the Turkish manufacturing industry in the process of technological capability.

For this exercise the following model will be utilized.

$$ln(Q_{ijt}/L_{ijt}) = \beta_1 ln(K_{ijt}/L_{ijt}) + \beta_2 lnL_{ijt} + \beta_3 ln(E_{ijt}/L_{ijt}) + \beta_4 ln(M_{ijt}/L_{ijt}) + \delta_3 ln(W_{ijt}/L_{ijt}) + \delta_4 + XO_{it} + \delta_5 MO_{it} + \varepsilon_{ijt} \quad [8].$$

where XO and MO stand for the export share and import orientation in the output of the domestic industries. These variables were defined as

$$XO_{it} = (X_{it} / Q_{it}),$$

$$MO_{it} = [M_{it}/(M_{it} + Q_{it})].$$

The estimation of the above equation does not support the expected positive contribution of trade openness as a knowledge transfer model. The estimated coefficients for the export and import share were statistically insignificant (Table 18). Trade openness might have different effects on the industries in different technology level. Therefore, the estimation of the above model was replicated for low tech and high tech industries in the Turkish manufacturing industry. However, no significant evidence in favor of the proposition that trade might facilitate knowledge transfer.

4.2 The National Innovation System and the Multinational Corporations

The descriptive statistics show that there are substantial differences both in terms of innovativeness, and the way innovative activities are performed in domestic and foreign firms. In this section, we will test the impact of foreign ownership and the existence of foreign firms on technological activities. The analysis is focused on two sources of technologies, in-house innovative activities and technology transfer (from abroad).

4.2.1 Empirical Model

We assume that technologies acquired through innovative activities or transfer processes improve the productivity of the firm as follows:

$$Q = A\, f(K, L, E, M) \qquad [1]$$

$$A = A_0 e^{\delta\, INNO + \gamma\, TECHNO} \qquad [1']$$

where Q is (real) output, K, L, E and M are (real) capital, labor, energy and material inputs. A_0 is the base-line productivity level, and δ and γ are the effects of innovative and transferred technologies, respectively, on productivity. The choice to be innovative and to transfer technology depends on a number of firm- and sector-specific factors as follows:

$$INNO_i = \alpha_0 + \Sigma\alpha_{ij}x_{ij} + \Sigma\alpha_{ij}z_{ij} \quad [9]$$

$$TECHNOit = \beta_0 + \Sigma\beta_{ij}x_{ij} + \Sigma\beta_{ij}z_{ij} \quad [10]$$

$$i = 1, \ldots, n, j = 1, \ldots, k, k+1, \ldots, m$$

where x's are k firm-specific variables and z's are m-k sector-specific variables. INNO and TECHNO are dummy variables that take the value 1 if the firm is innovative[38] and transferred a technology through license or know how agreement, respectively. Since the innovation and technology transfer variables are endogenous in the output model (equation 1), we first estimate equations 9 and 10, and then estimate the output equation by adding the inverse-Mills ratios (obtained from the estimation of equations 9 and 10) to have unbiased estimation.[39]

The following variables are included in the innovation and technology transfer equations: *FDI* is a dummy variable that takes the value 1 for joint ventures where foreign ownership is 10 % or more. This dummy variable is used to test if foreign firms are more innovative and/or if foreign firms are more likely to transfer technology from abroad, possibly from their parents.

We use three variables to capture the effects of foreign presence on technological activities of manufacturing firms. The first variable, *MS*, measures the market share[40] of *FDI* firms in the market. If there are sectoral (horizontal) spillovers from foreign firms, other firms in the market may invest in innovative activities to benefit from spillovers. In a similar way, informational spillovers may make technology transfer more likely. The second and third variables, *FW* and *BW*, measure the weighted average of foreign ownership in supplier and user industries, respectively. If vertical relations are used to transfer knowledge from foreign firms, these two variables are expected to have a positive impact on technological

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[38] Since product and process innovations are highly correlated, we use a single innovativeness variable. The INNOV variable takes the value 1 if the firm introduced a product and/or process innovation in the periods under consideration (1995-1997 and 1998-2000).

[39] We use Cobb-Douglas functional form for the production function. Two variables, the proportion of skilled employees and real product wages, are used to control for labor quality.

[40] The "market" is defined at the ISIC 4-digit level (Rev.2).

activities[41]. These kinds of user producer relations are forwarded by many economists as the core of an innovation system. The spillovers arising from the labor transfer from foreign firms will be analyzed by the inclusion of a variable that is labeled as *FLSPILL*.

We think that the innovativeness of the firms is affected by their size. Thus, we include the (log) number of employees *LL* to test the impact of firm size on technological activities.

The main input for innovation process is investment in R&D activities. The R&D intensity *RDINT* (R&D expenditures/sales ratio) is used to determine the effect of R&D activities on innovation. Since there could be a complementarity between in-house R&D and technology transfer, it is also included in the technology transfer model. In addition to the *RDINT,* four variables were used in the analysis in order to capture the R&D spillovers from other firms. These variables are supposed to capture the effects of R&D of other domestic and foreign firms at the sectoral and regional levels. The variables for R&D spillovers from others were labeled as *SECTDRD* and *REGDRD*; and the ones from foreign firms were labeled as *SECTFRD* and *REGFRD* for sectoral and regional levels, respectively.

The effects of subcontracting relations on technological activities are tested by using two variables, *SINPUT* (the share of subcontracted inputs in total inputs) and *SOUTPUT* (the share of output subcontracted by other firms in total output). These variables are used to check if subcontract-receiving *SOUTPUT* and subcontract-offering *SINPUT* firms are more innovative/more likely to transfer technology from abroad.

Finally, there are three additional firm-specific variables: *GROUP* is a dummy variable that takes the value 1 if the firm belongs to a business group. This variable is used to test if membership in a business group yields any benefit for technological

[41] The user-producer relations are important elements of a system of innovation, which enables knowledge flows through the exchange of commodities. But *untraded interdependencies* in a system can take the form of "technological complementarities, synergies, flows of stimuli and constraints" (Dosi, 2000b), not necessarily induced by the flow of commodities, but an informal exchange of knowledge between users and producers (Dosi, 2000b). So, these effects are considered also to be captured by these kinds of user producer linkages.

activities. The variable *INTERNET* is defined by the proportion of employees who have direct access to the internet on the job. If technological activities require extensive exchange of information (and, of course, if the internet provides the basis for information exchange), this variable is expected to have a positive coefficient in both innovation and technology transfer models. The third variable, *LTURN*, is the ratio of the number of employees who left a firm in a year to the average number of employees (average employment *plus* the number of employees who left a firm). This variable is used to measure labor flexibility that is likely to have a negative impact on innovative activities (see Kleinknecht, 1998; Michie and Sheehan, 2003).

The data for these two time periods are pooled together in the regression analysis, and a dummy variable for the second period is used to capture exogenous changes in the dependent variables over time. Moreover, dummy variables for 2-digit industries are added into all models to control for unobserved sector-specific factors.

4.2.2 Estimation Results

We estimated various forms of the model above in order to obtain robust results. The results are presented in the Tables 20 to 35 below. The estimation of the baseline model consisting of the variables in each table suggests that foreign firms are more inclined to transfer technologies via license agreements in both low and high tech industries (Table 20). These firms are more innovative than domestic ones in high tech industries but low tech ones. We have no evidence for the innovativeness of foreign firms in low tech industries. An interesting result is that the innovativeness and tendency for technology transfer of these firms have no contribution to their output in high tech industries. In contrary, even though foreign firms were not found to be innovative (but transferring technologies) foreign ownership contributes to the total output.

The firms employing more skilled labor are more innovative (Table 20). The contribution of skilled labor to the innovativeness is higher in high tech industries as expected. The coefficient of *SKILLED* was estimated 1.25 in high tech industries whereas this coefficient equals to 0.72 in low tech industries. The contribution of

R&D expenditure to the innovativeness is also higher in high tech firms compared to low tech ones. We also found evidence supporting the remark that R&D intensive firms in high tech industries also transfer technologies more than the others. Even though employment of skillful labor has a role for the innovativeness and technology transfer behavior; the estimation of the coefficient of this variable in the nested model suggests no evidence for output. In other words, the size of a firm has no contribution in the explanation of the level of output manufactured by the very firm.

The labor turnovers, *LTURN,* in firms negatively affect the innovativeness in the very firms both in high tech and low tech industries whilst has no effect on the technology transfer behavior. The Table 20 shows that the negative effect of labor flow from firms is more noticeable in high tech firms since the coefficient of labor turnover was estimated around -0.63 (-0.48 in low tech industries). The subcontracted output and input relations seem to have contribution neither to innovativeness, nor to technology transfer process. We were unable to obtain significant coefficients for these variables. The size of the firms, on the other hand, has a role in the explanation of innovativeness and technology transfer behavior. The estimation results for innovativeness of firms suggest that this role is more important in low tech industries. The estimated coefficient of *LL* for the innovativeness model variable is 0.16 in low tech firms (significant at the 1 % level); whereas it is only 0.01 (significant at the 1 % level) in high tech firms (Table 20). On contrary, this role seems more important in technology transfer behavior in high tech industries. The estimated coefficient of size equals to 0.61 for high tech firms whereas it is less than half of it, 0.29, for low tech firms (Table 20). The nested effect of size of the firms in output is also significantly positive for both low tech and high tech industries, being more important for the latter.

The use of more capital, electricity, input is relevant in the explanation of the output level since the estimated coefficients are positive and significant. The role of these factors does not change very much with respect to low tech and high tech firms. However, the role of innovativeness, which also very significantly contributes to the explanation of the output level, differentiates to a certain extent regarding low tech and high tech firms. The estimated coefficient for the contribution of innovativeness of firms to their output level is 0.30 in low tech firms; and 0.38 in high tech firms (Both coefficients are significant at the 1 % level). Therefore, we confer that innovativeness is more important for high tech industries.

On the other hand, there is no evidence for the contribution of the technology transfer behavior of firms in the explanation of the output level. The estimated coefficients of technology transfer are insignificant for in high tech and low tech industries.

4.2.2.1 Determinants of Innovativeness and Technology Transfer

The Table 20 below depicts the estimation results of the models designated for the purpose of finding out the horizontal spillover effects of the market share of foreign firms in Turkey. The table suggests that there is no evidence as to the foreign market share has a positive contribution to the innovativeness. Technology transfer behavior of firms in high tech industries, on the other hand, is affected positively by the foreign market share. The estimated coefficient of this variable is equal to 0.66, significant at the 5 % level. Though, no evidence was obtained for the effects of foreign market share on the technology transfer model for low tech firms.

The products circulating in the market does not very much effective on the other firms; though, the firms' laborforce; formerly employed, and possibly trained in MNCs has a great contribution to the innovativeness of firms in the Turkish manufacturing industry. Our estimation results presented in the Table 21 suggest that this role is much more important in low tech industries. The variable for the spillover effects of labor transfer (*FLSPILL*) was significantly estimated as 11.06 in low tech industries; and 5.01 in high tech ones. This results of the relative importance regarding the technology level, exhibits a contrast with the general expectations and the previous estimation of *SKILL* above. It was estimated that the role of more skilled labor was more important for high tech industries.

The R&D spillover seems to have been materialized in the Turkish manufacturing industry thanks to domestic firms' sectoral R&D. R&D spillovers through foreign firms was not evident in the period. None of the estimated coefficients capturing the spillover effects of foreign firms in sectoral and regional levels were significant in the low tech and high tech firms. The contribution of R&D of domestic firms in the region was not supported by the evidence (Table 22).

On the other hand, backward linkages foreign firms appear to provide benefits for other firms in high tech industries in terms of innovativeness. The Table 23 shows that the coefficient of backward linkages (*BW*) was estimated as 2.36 (significant at the 1 % level). In contrast with the contribution of forward linkages (*FW*) of foreign firms, the backward linkages of the very firms have detrimental effects of the innovativeness of the firms in high tech industries. No influence of these kinds of linkages was found for low tech industries in terms of technology transfer, or innovativeness; neither for technology transfer behavior in high tech firms.

In order to be able to achieve the robustness in the estimation, we estimated the all types of spillovers in a model together. The result of this exercise is presented in the Table 24. The table shows that the discussion above, made on the separate estimations of the different types of spillovers still holds. The only difference of the results this table display from the previous ones is the positive contribution of the total R&D expenditures of the foreign firms at the regional level to the innovativeness of low tech firms. The estimated positive coefficient of this variable is significant in the final model. Though, it has no effect on technology transfer and for the innovativeness of the firms in high tech industries.

To recap, the innovativeness of firms in the Turkish manufacturing industry, both in high tech and low tech, is positively affected by the labor transfer from the MNCs. The domestic R&D expenditures at the sectoral level; and the foreign R&D expenditures at the regional level provide spillovers to low tech firms. Forward linkages of foreign firms favor the innovativeness of high tech firms; on contrary, backward linkages of the very firms deteriorate the innovativeness of high tech firms.

The table 25 shows the estimation results of the innovation and technology transfer models including all types of spillover effects mentioned above. According to the Table, labor transfer from MNCs contributes to the innovativeness of low tech firms and has no effect on the innovativeness of high tech firms. Domestic R&D stock at the sectoral level and foreign R&D at the regional level positively affect the innovativeness of low tech firms in Turkey. On the other hand, forward linkages of foreign firms negatively affect the innovativeness of high tech firms whilst backward linkages affect positively the innovativeness of the very firms.

Table 10. The horizontal spillovers from multinational corporations in Turkish manufacturing industry, 1983-2000

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Q/L_1	0.29 (0.09)***	0.29 (0.08)***	0.41 (0.10)***	0.30 (0.08)***	0.31 (0.08)***	0.41 (0.08)***
K/L	0.13 (0.04)***	0.12 (0.05)***	0.11 (0.04)***	0.12 (0.04)***	0.11 (0.04)***	0.10 (0.04)***
L	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.01)
E/L	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.01)	-0.03 (0.02)	-0.02 (0.02)	-0.02 (0.02)
M/L	0.38 (0.06)***	0.38 (0.05)***	0.32 (0.06)***	0.37 (0.05)***	0.37 (0.06)***	0.32 (0.05)***
W/L	0.37 (0.06)***	0.37 (0.06)***	0.36 (0.06)***	0.35 (0.06)***	0.36 (0.06)***	0.32 (0.05)***
Year	-0.01 (0.10)*	-0.01 (0.06)*	-0.01 (0.00)**	-0.01 (0.00)*	-0.01 (0.00)*	-0.01 (0.01)**
MS	-0.05 (0.10)	.	-1.17 (0.29)***	.	.	.
MS_1	.	0.19 (0.00)**	1.23 (0.32)***	.	.	.
DMS0	.	.	.	-0.77 (0.71)	.	0.45 (1.60)
DMS0_1	.	.	.	.	-0.36 (0.36)	-0.32 (0.74)
DMS1	.	.	.	-0.07 (0.11)	.	-1.15 (0.39)***
DMS1_1	.	.	.	.	-0.10 (0.12)	1.20 (0.38)***
DMS2	.	.	.	-0.20 (0.21)	.	-0.45 (0.24)*
DMS2_1		.	.	.	-0.01 (0.21)	0.35 (0.18)**
DMS3	.	.	.	0.05 (0.11)	.	-1.27 (0.52)**
DMS3_1	.	.	.	.	0.22 (0.10)**	1.43 (0.56)**
Obs	1701	1701	1701	1701	1701	1701
F	192.39 (8, 106)	207.28 (8, 106)	220.51 (9, 106)	158.42 (11, 106)	183.69 (11, 106)	143.54 (15, 106)
Hansen's J	102.60 (1.00)	101.99 (1.00)	101.48 (1.00)	102.88 (1.00)	103.60 (1.00)	99.80 (1.00)
M_1 [AR(1)]	-4.20 (0.00)	-4.28 (0.00)	-4.26 (0.00)	-4.31 (0.00)	-4.29 (0.00)	-4.39 (0.00)
M_2 [AR(2)]	2.22 (0.03)	2.25 (0.03)	2.38 (0.02)	2.27 (0.02)	2.29 (0.02)	2.41 (0.02)
Null $\chi^2(1, 106)$[1]	.	.	0.50 (0.48)	.	.	.
Null $\chi^2(1, 106)$[2]	.	.	.	.	.	.
Null $\chi^2(1, 106)$[3]	.	.	.	.	.	0.22 (0.64)
Null $\chi^2(1, 106)$[4]	.	.	.	.	.	0.17 (0.68)
Null $\chi^2(1, 106)$[5]	.	.	.	.	.	3.24 (0.08)

Notes: Standard errors in brackets (p values in brackets in the last seven rows, and degrees of freedom for F test). (***)(**)(*)significant at 1%, %5, %10. [1] $H_0: \Delta\delta_{MS} + \Delta\delta_{MS\_1} = 0$; [2] $H_0: \Delta\delta_{DMS0} + \Delta\delta_{DMS0\_1} = 0$, [3] $H_0: \Delta\delta_{DMS1} + \Delta\delta_{DMS1\_1} = 0$, [4] $H_0: \Delta\delta_{DMS2} + \Delta\delta_{DMS2\_1} = 0$, [5] $H_0: \Delta\delta_{DMS3} + \Delta\delta_{DMS3\_1} = 0$. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 11. The horizontal spillovers from multinational corporations in the Turkish low tech manufacturing industries, 1983-2000

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Q/L_1	0.27 (0.10)**	0.26 (0.09)***	0.34 (0.10)***	0.27 (0.09)***	0.29 (0.09)***	0.38 (0.08)***
K/L	0.16 (0.06)***	0.15 (0.06)**	0.13 (0.06)**	0.16 (0.06)***	0.15 (0.06)***	0.12 (005)**
L	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.02)	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)
E/L	-0.05 (0.03)*	0.04 (0.03)	-0.04 (0.03)	-0.06 (0.03)	-0.04 (0.03)	-0.05 (0.03)**
M/L	0.41 (0.07)***	0.41 (0.06)***	0.36 (0.06)***	0.40 (0.06)***	0.40 (0.05)***	0.35 (0.06)***
W/L	0.39 (0.08)***	0.40 (0.08)***	0.36 (0.07)***	0.39 (0.08)***	0.38 (0.07)***	0.35 (0.06)***
Year	-0.01 (0.01)**	-0.01 (001)***	-0.01 (0.01)**	-0.01 (0.00)***	-0.01 (0.00)***	-0.01 (0.00)**
MS	-0.18 (0.15)***	.	-0.92 (0.25)***	.	.	.
MS_1	.	0.06 (0.15)	0.92 (0.29)***	.	.	.
DMS0	.	.	.	-0.52 (8.74)	.	-5.03 (15.48)
DMS0_1	.	.	.	.	-0.24 (3.40)	-8.95 (9.73)
DMS1	.	.	.	-0.20 (0.18)	.	-0.61 (0.67)
DMS1_1	.	.	.	.	0.07 (0.36)	0.84 (0.54)
DMS2	.	.	.	-0.49 (0.23)**	.	-0.74 (0.39)*
DMS2_1		.	.	.	-0.29 (0.28)	0.21 (0.39)
DMS3	.	.	.	0.11 (0.13)	.	-1.32 (0.56)**
DMS3_1	.	.	.	.	0.30 (0.13)**	1.65 (0.57)***
Obs	1111	1111	1111	1111	1111	1111
F	131.40 (8, 70)	119.25 (8, 70)	117.51 (9, 70)	123.46 (11, 70)	90.61 (11, 70)	137.39 (15, 70)
Hansen's J	61.54 (1.00)	65.82 (1.00)	64.98 (1.00)	63.69 (1.00)	62.25 (1.00)	59.88 (1.00)
M_1 [AR(1)]	-3.49 (0.00)	-3.57 (0.00)	-3.52 (0.00)	-3.59 (0.00)	-3.67 (0.00)	-3.63 (0.00)
M_2 [AR(2)]	1.59 (0.11)	1.59 (0.11)	1.77 (0.08)	1.62 (0.11)	1.66 (0.10)	2.02 (0.04)
Null $\chi^2(1, 106)^1$	.	.	0.00 (0.98)	.	.	.
Null $\chi^2(1, 106)^5$	.	.	.	.	.	3.18 (0.08)

Notes: Standard errors in brackets. (p values in brackets in the last seven rows, and degrees of freedom for F test). (***)(**)(*) significant at 1%, 5%, 10%. [1] $H_0: \Delta\delta_{MS} + \Delta\delta_{MS\_1} = 0$; [2] $H_0: \Delta\delta_{DMS3} + \Delta\delta_{DMS3\_1} = 0$. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 12. The horizontal spillovers from multinational corporations in the Turkish high tech manufacturing industries, 1983-2000

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Q/L_1	0.56 (0.07)***	0.55 (0.07)***	0.59 (0.06)***	0.58 (0.08)***	0.55 (0.06)***	-0.62 (0.06)***
K/L	0.10 (0.05)*	0.10 (0.06)*	0.09 (0.05)*	0.09 (0.04)**	0.08 (0.04)*	0.08 (0.05)
L	-0.01 (0.02)	-0.01 (0.02)	-0.02 (0.02)	0.02 (0.02)	-0.01 (0.02)	-0.02 (0.04)
E/L	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	-0.02 (0.01)	-0.01 (0.01)	0.00 (0.01)
M/L	0.21 (0.05)***	0.21 (0.05)***	0.24 (0.05)***	0.21 (0.05)***	0.25 (0.05)***	0.16 (0.07)***
W/L	0.25 (0.04)***	0.25 (0.04)***	0.24 (0.04)***	0.27 (0.04)***	0.28 (0.04)***	0.21 (0.06)***
Year	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.01)
MS	0.02 (0.37)	.	-1.30 (0.80)	.	.	.
MS_1	.	0.09 (0.29)	1.47 (0.80)*	.	.	.
DMS0	.	.	.	-1.90 (1.95)	.	-4.81 (1.61)***
DMS0_1	.	.	.	.	0.97 (1.26)	0.99 (1.66)
DMS1	.	.	.	-1.34 (2.41)	.	2.68 (5.29)
DMS1_1	.	.	.	.	-3.78 (7.44)	-10.76 (4.59)**
DMS2	.	.	.	-0.34 (0.85)	.	-2.42 (3.17)
DMS2_1	.	.	.	.	1.41 (1.59)	4.20 (1.89)**
DMS3	.	.	.	-0.22 (0.40)	.	-0.71 (0.50)
DMS3_1	.	.	.	.	-0.38 (0.40)	0.64 (0.36)*
Obs	590	590	590	590	590	590
F	618.10 (8, 35)	641.55 (8, 35)	512.99 (9, 35)	530.88 (11, 35)	639.08 (11, 35)	20.13 (15, 35)
Hansen's J	31.99 (1.000)	31.47 (1.000)	28.45 (1.000)	28.79 (1.000)	26.93 (1.000)	18.45 (1.000)
m_1 [AR(1)]	-3.10 (0.00)	-3.11 (0.00)	-3.15 (0.00)	-3.17 (0.00)	-3.22 (0.00)	-3.38 (0.00)
m_2 [AR(2)]	1.81 (0.07)	1.82 (0.07)	1.86 (0.06)	1.80 (0.07)	1.82 (0.07)	1.59 (0.11)

Notes: Standard errors in brackets. (p values in brackets in the last seven rows, and degrees of freedom for F test). (***)(**)(*) significant at 1%, %5, %10. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 13. The Vertical spillovers from multinational corporations in the Turkish manufacturing industry, 1983-2000

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Q/L_1	0.41 (0.09)***	0.40 (0.09)***	0.45 (0.10)***	0.44 (0.09)***	0.32 (0.08)***	0.48 (0.07)***
K/L	0.12 (0.05)***	0.12 (0.04)***	0.11 (0.04)***	0.10 (0.04)**	0.11 (0.04)**	0.11 (0.04)***
L	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.02)	-0.01 (0.01)
E/L	-0.04 (0.02)**	-0.03 (0.02)**	-0.04 (0.02)**	-0.03 (0.02)*	-0.02 (0.02)	-0.03 (0.02)**
M/L	0.33 (0.05)***	0.34 (0.05)***	0.31 (0.05)***	0.31 (0.05)***	0.36 (0.07)***	0.30 (0.05)***
W/L	0.33 (0.054)***	0.34 (0.04)***	0.32 (0.06)***	0.33 (0.05)***	0.35 (0.06)***	0.30 (0.05)***
Year	-0.01 (0.00)**	-0.01 (0.00)**	-0.01 (0.00)***	-0.01 (0.00)**	-0.01 (0.01)	-0.01 (0.00)***
BW	-0.08 (0.11)		-0.49 (0.16)***	.	.	.
BW_1	.	-0.04 (0.11)	0.40 (0.14)***	.	.	.
FW	0.01 (0.07)	.	-0.28 (0.28)	.	.	.
FW_1	.	0.04 (0.6)	-0.32 (0.27)	.	.	.
DBW0	.	.	.	-0.47 (0.11)***	.	-0.77 (0.36)**
DBW0_1	.	.	.	.	-0.32 (0.22)	0.36 (0.38)
DBW1	.	.	.	-0.05 (0.11)	.	-0.10 (0.37)
DBW1_1	.	.	.	.	0.30 (0.25)	0.10 (0.40)
DBW2	.	.	.	0.08 (0.16)	.	-0.39 (0.26)
DBW2_1	.	.	.	.	0.14 (0.10)	0.25 (0.41)
DBW3	.	.	.	0.34 (0.20)	.	-0.42 (0.63)
DBW3_1	.	.	.	.	0.62 (0.31)**	0.86 (0.77)

Table 13. The Vertical spillovers from multinational corporations in the Turkish manufacturing industry, 1983-2000 (cont'd)

DFW0	.	.	.	0.18 (0.16)	.	0.69 (0.79)
DFW0_1	.	.	.	.	0.14 (0.26)	-0.53 (0.88)
DFW1	.	.	.	-0.20 (0.16)	.	-0.20 (0.41)
DFW1_1	.	.	.	.	-0.54 (0.36)	0.17 (0.58)
DFW2	.	.	.	0.00 (0.31)	.	-0.41 (0.77)
DFW2_1	.	.	.	.	0.15 (0.27)	0.17 (0.58)
DFW3	.	.	.	-0.22 (0.18)	.	-0.82 (0.78)
DFW3_1	.	.	.	.	0.13 (0.23)	0.44 (0.67)
Obs	1701	1701	1701	1701	1701	1701
F	262.73 (9, 106)	257.36 (9, 106)	242.97 (11, 106)	181.68 (15, 106)	122.98 (15, 106)	166.80 (15, 106)
Hansen's J	101.54 (1.00)	101.27 (1.000)	97.51 (1.00)	96.71 (1.000)	100.36 (1.00)	94.61 (1.000)
M_1 [AR(1)]	-4.29 (0.00)	-4.31 (0.00)	-4.24 (0.00)	-4.32 (0.00)	-4.26 (0.00)	-4.59 (0.00)
M_2 [AR(2)]	243 (0.02)	2.43 (0.02)	2.44 (0.02)	2.45 (0.01)	2.33 (0.02)	2.66 (0.08)
Null $\chi^2(1, 106)$[1]	.	.	0.90 (0.35)	.	.	

Notes: Standard errors in brackets. (p values in brackets in the last seven rows, and degrees of freedom for F test). (***)(**)(*) significant at 1%, 5%, 10%. [1] $H_0{:}\Delta\delta_{BW} + \Delta\delta_{BW\_1} = 0$. m_1 and m_2 are Arellano-Bond tests for AR (1) and AR(2) in first differences, respectively.

Table 14. The Vertical spillovers from multinational corporations in the Turkish low tech manufacturing industries, 1983-2000

Explanatory Variables	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**	**Model VI**
Q/L_1	0.41 (0.12)***	0.41 (0.11)***	0.49 (0.11)***	0.52 (0.09)***	0.28 (0.09)***	0.57 (0.07)***
K/L	0.15 (0.05)***	0.15 (0.05)***	0.15 (0.05)***	0.11 (0.05)**	0.15 (0.05)***	0.09 (0.04)***
L	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.02)	-0.12 (0.02)	-0.02 (0.02)	0.00 (0.01)
E/L	-0.05 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)**	-0.04 (0.03)*	-0.04 (0.03)*	-0.04 (0.03)
M/L	0.33 (0.06)***	0.33 (0.05)***	0.29 (0.06)***	0.29 (0.05)***	0.40 (0.05)***	0.25 (0.05)***
W/L	0.34 (0.07)***	0.33 (0.06)***	0.30 (0.06)***	0.29 (0.06)***	0.37 (0.07)***	0.31 (0.05)***
Year	-0.01 (0.00)***	-0.01 (0.00)***	-0.01 (0.00)***	-0.01 (0.00)***	-0.01 (0.00)***	-0.01 (0.00)***
BW	-0.15 (0.12)	.	-0.51 (0.16)***	.	.	.
BW_1	.	-0.12 (0.13)	0.32 (0.14)	.	.	.
FW	-0.05 (0.27)	.	-0.47 (0.41)	.	.	.
FW_1	.	0.00 (0.31)	-0.59 (0.41)	.	.	.
DBW0	.	.	.	-0.60 (0.26)**	.	-0.61 (0.37)
DBW0_1	.	.	.	.	-0.40 (-0.31)	0. 14 (0.39)
DBW1	.	.	.	-0.12 (0.27)	.	-0.43 (0.36)
DBW1_1	.	.	.	.	0.34 (0.33)	0.35 (0.60)
DBW2	.	.	.	-0.07 (0.25)	.	-0.68 (0.53)
DBW2_1	.	.	.	.	0.40 (0.40)	0.71 (0.47)
DBW3	.	.	.	0.45 (0.31)***	.	-0.15 (0.81)
DBW3_1	.	.	.	.	0.48 (0.26)***	0.71 (0.96)

Table 14. The Vertical spillovers from multinational corporations in the Turkish low tech manufacturing industries, 1983-2000 (cont'd)

DFW0	.	.	.	0.22 (0.73)	.	-0.28 (1.03)
DFW0_1	.	.	.	.	0.75 (0.91)	0.25 (1.26)
DFW1	.	.	.	0.08 (0.64)	.	-0.83 (1.30)
DFW1_1	.	.	.	.	-0.40 (0.57)	1.87 (1.74)
DFW2	.	.	.	0.47 (1.06)	.	2.02 (1.78)
DFW2_1	.	.	.	.	-0.84 (0.97)	-1.53 (1.16)
DFW3	.	.	.	-0.59 (0.52)	.	-1.62 (1.43)
DFW3_1		.	.	.	0.17 (0.31)	1.35 (1.16)
Obs	1111	1111	1111	1111	1111	1111
F	145.58 (9, 70)	149.32 (9, 70)	142.38 (11, 70)	593.28	96.23 (15.70)	207.22 (15, 70)
Hansen's J	66.01 (1.00)	63.55 (1.00)	59.56 (1.00)	133.80 (1.00)	52.10 (1.000)	46.13 (1.000)
M_1 [AR(1)]	-3.47 (1.00)	-3.54 (0.00)	-3.51 (0.00)	-3.63 (0.00)	-3.58 (0.00)	-3.84 (0.00)
M_2 [AR(2)]	1.87 (0.06)	1.86 (0.06)	1.98 (0.05)	1.98 (0.05)	1.69 (0.09)	2.04 (0.04)

Notes: Standard errors in brackets. (p values in brackets in the last seven rows, and degrees of freedom for F test). (***)(**)(*) significant at 1%, %5, %10. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 15. The Vertical spillovers from multinational corporations in the Turkish high tech manufacturing industries, 1983-2000

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Q/L_1	0.62 (0.06)***	0.61 (0.06)***	0.65 (0.07)***	0.60 (0.08)***	0.50 (0.13)***	0.43 (0.11)***
K/L	0.09 (0.05)*	0.08 (0.05)	0.07 (0.06)	0.18 (0.09)**	0.08 (0.10)	0.39 (0.17)**
L	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.04)	0.03 (0.07)	-0.03 (0.12)	0.13 (0.16)
E/L	-0.02 (0.02)	0.02 (0.02)	-0.02 (0.03)	-0.02 (0.03)	-0.01 (0.03)	0.21 (0.09)**
M/L	0.19 (0.05)***	0.20 (0.04)***	0.20 (0.04)***	0.21 (0.77)***	0.24 (0.07)***	0.17 (0.10)*
W/L	0.22 (0.04)***	0.24 (0.04)***	0.23 (0.04)***	0.14 (0.10)	0.25 (0.05)***	0.17 (0.12)***
Year	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.00 (0.01)	0.00 (0.01)	-0.03 (0.02)
BW	-0.14 (0.33)	.	-0.59 (0.64)	.	.	.
BW_1	.	0.29 (0.25)	0.74 (0.64)	.	.	.
FW	-0.09 (0.24)	.	-0.05 (0.50)	.	.	.
FW_1	.	-0.08 (0.25)	0.06 (0.49)	.	.	.
DBW0	.	.	.	0.04 (3.69)	.	-13.46 (6.51)**
DBW0_1	.	.	.	.	0.64 (3.59)	-0.18 (4.56)
DBW1	.	.	.	-0.56 (2.57)	.	8.12 (6.75)
DBW1_1	.	.	.	.	-2.85 (7.87)	6.47 (9.39)
DBW2	.	.	.	-0.65 (8.29)	.	-23.74 (10.39)**
DBW2_1	.	.	.	.	1.20 (10.61)	25.84 (10.81)**
DBW3	.	.	.	0.27 (1.30)	.	18.48 (9.39)***
DBW3_1	.	.	.	.	1.97 (6.42)	-16.55 (10.90)

Table 15. The Vertical spillovers from multinational corporations in the Turkish high tech manufacturing industries, 1983-2000 (cont'd)

DFW0	.	.	.	0.43 (1.99)	.	17.66 (7.81)**
DFW0_1	.	.	.	.	-0.24 (2.38)	-9.12 (7.31)
DFW1	.	.	.	1.58 (2.59)	.	0.24 (0.59)
DFW1_1	.	.	.	.	2.02 (5.22)	11.49 (10.17)
DFW2	.	.	.	-0.87 (2.83)	.	0.49 (0.58)
DFW2_1	.	.	.	.	-0.87 (6.53)	9.84 (5.08)***
DFW3	.	.	.	0.70 (2.27)	.	-14.11 (4.01)***
DFW3_1	.	.	.	.	0.46 (3.10)	15.97 (9.71)
Obs	590	590	590	590	658	616
F	626.31 (9, 35)	586.41 (9, 35)	517.67 (11, 39)	15.48 (15, 39)	203.69 (15, 35)	348.78
Hansen's J	30.90 (1.00)	28.37 (1.00)	27.81 (1.00)	33.11 (1.000)	28.18 (1.00)	253.53 (.000)
M_1 [AR(1)]	-3.14 (0.00)	-3.11 (0.00)	-3.08 (0.00)	-3.49 (0.00)	-2.28 (0.02)	-4.59 (0.00)
M_2 [AR(2)]	1.80 (0.07)	1.79 (0.07)	1.72 (0.09)	1.99 (0.05)	1.87 (0.06)	2.66 (0.08)
Null $\chi^2(1)$[1]	.	.	.	.	.	0.11 (0.740)

Notes: Standard errors in brackets (p values in brackets in the last two rows, degrees of freedom for F test). (***)(**)(*) significant at 1%, %5, %10.
[1] H_0: $\Delta\delta_{DBW3} + \Delta\delta_{DBW3\_1} = 0$, respectively. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 16. The role of technological capability in the exploitation of spillovers from multinational corporations in the Turkish manufacturing industries, 1983-2000

Variables	ALL	LOW TECH	HIGH TECH
Q/L_1	0.32 (0.08)***	0. 29 (0.08)***	0.56 (0.07)***
K/L	0.12 (0.04)***	0.13 (0.05)***	0.09 (0.05)
L	-0.01 (0.02)	-0.01 (0.02)	-0.02 (0.02)
E/L	-0.02 (0.02)	-0.05 (0.03)	0.00 (0.01)
M/L	0.38 (0.05)***	0.39 (0.06)***	0.23 (0.05)***
W/L	0.35 (0.06)***	0.38 (0.08)***	0.26 (0.05)***
Year	0.01 (0.01)*	0.00 (0.01)	0.01 (0.00)***
CAP_1	-0.10 (0.05)**	-0.08 (0.05)*	-0.02 (0.13)
Obs	1701	1111	590
F	158.67 (8, 106)	98.39 (8, 70)	487.10 (8, 35)
Hansen's J	104.11 (1.00)	64.38 (1.00)	31.83 (1.00)
m_1 [AR(1)]	-4.29 (0.00)	-3.65 (0.00)	-3.09 (0.00)
m_2 [AR(2)]	2.37 (0.02)	1.76 (0.08)	1.78 (0.08)

Notes: Standard errors in brackets (p values in brackets in the last three rows, degrees of freedom for F test). * (**)(***)significant at 1%, 5%, 10%. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 17. The role of technological effort in the exploitation of spillovers from multinational corporations in the Turkish manufacturing industries, 1993-2000.

Variables	ALL	LOW TECH	HIGH TECH
Q/L_1	0.28 (0.08)***	0.27 (0.10)***	0.53 (0.08)***
K/L	0.14 (0.04)***	0.16 (0.06)***	0.12 (0.05)**
L	-0.02 (0.02)	-0.01 (0.02)	-0.02 (0.02)
E/L	-0.02 (0.02)	-0.05 (0.04)	0.00 (0.01)
M/L	0.39 (0.05)***	0.40 (0.06)***	0.24 (0.05)***
W/L	0.37 (0.06)***	0.39 (0.08)***	0.25 (0.06)***
Year	0.01 (0.00)**	0.00 (0.01)	0.01 (0.01)*
RD_1	1.62(1.05)	2.27 (1.63)	-4.76 (20.70)***
Obs	1769	1111	658
F	184.12 (8, 110)	106.37 (8, 70)	289.97 (8, 39)
Hansen's J	108.83 (0.69)	66.03 (1.00)	37.20 (1.00)
m_1 [AR(1)]	-4.35 (0.00)	-3.60 (0.00)	-3.30 (0.00)
m_2 [AR(2)]	2.31 (0.02)	1.65 (0.10)	1.91 (0.06)

Notes: Standard errors in brackets (p values in brackets in the last three rows, degrees of freedom for F test). (***)(**)(*) significant at 1%, 5%, 10%. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences.

Table 18. The foreign trade orientation and the productivity of domestic manufacturing industries in Turkey, 1983-2000

Variables	**ALL**	**LOW TECH**	**HIGH TECH**
Q/L_1	0.48 (0.09)***	0.44 (0.11)***	0.63 (0.08)***
K/L	0.13 (0.04)***	0.15 (0.06)**	0.09 (0.06)
L	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)
E/L	-0.02 (0.02)	-0.04 (0.03)	-0.01 (0.01)
M/L	0.29 (0.05)***	0.30 (0.06)***	0.22 (0.05)***
W/L	0.28 (0.05)***	0.30 (0.07)***	0.22 (0.05)***
XO_1	0.01 (0.02)	-0.01 (0.03)	0.01 (0.03)
MO_1	-0.03 (0.03)	-0.02 (0.03)	0.07 (0.07)
Obs	1765	1107	658
F	197.43 (8, 110)	109.54 (8, 70)	283.41 (8, 39)
Hansen's J	108.42 (1.00)	64.51 (1.000)	36.54 (1.00)
m_1 [AR(1)]	-4.37 (0.00)	-3.46 (0.00)	-3.39 (0.00)
m_2 [AR(2)]	2.55 (0.01)	1.91 (0.06)	1.93 (0.05)

Notes: Standard errors in brackets (p values in brackets in the last three rows, degrees of freedom for F test). (***)(**)(*) significant at 1%, %5, %10. $m_{1,2}$ are Arellano-Bond tests for AR (1, 2) in first differences. All variables are in natural log form.

Table 19. The innovation and technology transfer in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods

	Low-tech industries									Medium- and high-tech industries								
	Innovativeness			Technology transfer			Production			Innovativeness			Technology transfer			Production		
	Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev	
INTERNET	0.80	0.08	**	0.33	0.45	**				0.95	0.12	**	0.58	0.41				
GROUP	0.01	0,13		0.41	0.48					0.01	0.19		0.58	0.25	**			
FDI	0.04	0.19		1.70	0.43	**	0.10	0.03	**	0.46	0.18	**	1.21	0.24	**	0.04	0.04	
SKILLED	0.71	0.22	*	-0.67	1.69		-0.01	0.02		1.26	0.29	**	0.49	0.67		0.21	0.05	**
RDINT	25.13	8.81	*	6.20	32.72					29.03	5.35	**	8.29	3.09	**			
LTURN	-0.48	0.27		-0.21	2.09					-0.65	0.36		0.64	0.95				
SINPUT	-0.43	0.39		-0.04	2.09					-0.50	0.73		1.68	1.06				
SOUTPUT	0.28	0.19		-4.99	10.95					-0.49	0.67		-0.51	1.86				
LL	0.16	0.03	**	0.30	0.15	**	0.13	0.01	**	0.01	0.05		0.62	0.09	**	0.21	0.01	**
LM							0.68	0.00	**							0.67	0.01	**
LE							0.06	0.00	**							0.04	0.01	**
LK							0.08	0.00	**							0.07	0.01	**
LRW							0.00	0.00	**							0.00	0.00	**
INNOVAT							0.28	0.03	**							0.36	0.05	**
TECHNO							0.05	0.12								0.01	0.07	
λ_{INNO}							-0.14	0.02	**							-0.19	0.03	**
λ_{TECHNO}							-0.04	0.05								-0.03	0.04	
$\rho_{INNO\text{-}TECHNO}$	0.83	0.23								0.05	0.12							
N	1978						1978			1042						1042		
Likelihood	-1031									-777								
Wald test							1786									1356		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. (*) (**) means statistically significant at the 5% and 1 % levels, two-tailed test.

Table 20. The horizontal spillovers from multinational corporations in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods

	Low-tech industries									**Medium- and high-tech industries**								
	Innovative			**Technology transfer**			**Production**			**Innovative**			**Technology transfer**			**Production**		
	Coeff	Std dv		Coeff	Std dv		Coeff	Std dv		Coeff	Std dv		Coeff	Std dv		Coeff	Std dv	
INTERNET	0.79	0.08	**	0.35	0.45	**				0.94	0.13	**	0.56	0.41				
GROUP	0.02	0.13		0.38	0.52					0.02	0.19		0.54	0.26	*			
FDI	0.00	0.19		1.77	0.44		0.11	0.03	**	0.48	0.19		1.14	0.25	**	0.05	0.04	
SKILLED	0.72	0.22	*	0.53	1.75	**	-0.01	0.02		1.25	0.29	**	0.63	0.69		0.21	0.02	
RDINT	24.99	8.75	*	6.70	32.06					29.5	5.22	**	8.09	3.47	*			
LTURN	-0.48	0.27		-0.19	2.15					-0.63	0.36		0.53	0.96				
SINPUT	-0.42	0.39		-0.03	2.06					-0.52	0.74		1.91	1.08				
SOUTPUT	0.27	0.19		-5.36	11.46					-0.50	0.68		-0.50	1.88				
LL	0.16	0.03	**	0.29	0.16		0.13	0.01	**	0.02	0.05		0.61	0.09	**	0.22	0.01	**
MS	0.50	0.28		-0.98	1.42					-0.14	0.15		0.66	0.32	*			
LM							0.68	0.00	**							0.67	0.01	**
LE							0.06	0.00	**							0.04	0.01	**
LK							0.08	0.00	**							0.07	0.01	**
LRW							0.00	0.00	**							0.00	0.00	**
INNOVAT							0.30	0.03	**							0.38	0.05	**
TECHNO							-0.02	0.11								-0.06	0.07	
λ_{INNO}							-0.15	0.02								-0.21	0.31	**
λ_{TECHNO}							0.00	0.05								0.02	0.04	
$\rho_{INNO-TECHNO}$	0.83	0.23								0.57	0.12							
N	1978						1978			1042						1042		
Log-likelihood	-1029									-774								
Wald test							1788									1357		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. * (**) means statistically significant at the 5% and 1% levels, two-tailed test.

Table 21. The spillovers of labor transfer from multinational corporations in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods

	Low-tech industries									Medium- and high-tech industries								
	Innovativeness			Technology transfer			Production			Innovativeness			Technology transfer			Production		
	Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev		Coeff	Std dev	
INTERNET	0.83	0.08	**	0.33	0.46					0.94	0.12	**	0.52	0.41				
GROUP	0.74	0.13		0.40	0.49					0.01	0.19		0.59	0.25	*			
FDI	-0.02	0.19		1.75	0.45	**	0.10	0.03	**	0.44	0.18	*	1.18	0.24	**	0.05	0.04	
SKILLED	0.68	0.22	*	-0.68	1.74		-0.01	0.02		1.22	0.29	**	0.43	0.68		0.22	0.05	**
RDINT	24.57	9.32		6.54	31.74					28.8	5.37	**	8.29	3.27	*	-0.02	0. 02	
LTURN	-0.62	0.29	*	-0.08	2.13					-0.66	0.37		0.58	0.97				
SINPUT	-0.56	0.39		0.07	2.08					-0.55	0.75		1.65	1.13				
SOUTPUT	0.29	0.19		-5.04	10.89					-0.53	0.66		-0.56	1.80				
LL	0.16	0.32	**	0.29	0.16		0.13	0.01	**	0.01	0.05		0.62	0.08	**	0.22	0.01	**
FLSPILL	11.06	2.63	**	-9.68	21.45					5.01	2.48	*	7.93	5.13				
LM							0.68	0.00	**							0.67	0.00	**
LE							0.06	0.00	**							0.03	0.01	**
LK							0.08	0.00	**							0.07	0.01	**
LRW							0.00	0.00	**							0.00	0.00	**
INNOVAT							0.29	0.03	**							0.35	0.05	**
TECHNO							0.03	0.11								-0.02	0.07	
λ_{INNO}							-0.15	0.02								-0.19	0.03	**
λ_{TECHNO}							-0.03	0.05								-0.02	0.04	
$\rho_{INNO-TECHNO}$	0.08	0.24								0.04	0.12							
N	1978						1978			1042						1042		
Log-likelihood	-1021									-773								
Wald test							1788									1355		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. * (**) means statistically significant at the 5% and 1% levels, two-tailed test.

Table 22. The R&D spillovers in the Turkish manufacturing industry, 1995-97 and 1998-2000

	Low-tech industries									Medium- and high-tech industries								
	Innovativeness			Technology transfer			Production			Innovativeness			Technology transfer			Production		
	Coeff	Std dv		Coeff	Std d		Coeff	Std d		Coeff	Std d		Coeff	Std d		Coeff	Std d	
INTERNET	0.81	0.08	**	0.34	0.47					0.94	0.13		0.59	0.41				
GROUP	0.04	0.13		0.41	0.55					0.00	0.19		0.56	0.26	*			
FDI	0.10	0.19		1.74	1.45	**	0.11	0.03	**	0.47	0.19	*	1.17	0.24	**	0.04	0.04	
SKILLED	0.70	0.23	**	-0.73	1.77		0.00	0.02		1.16	0.30	**	0.53	0.71		0.15	0.05	*
RDINT	25.68	8.98	**	6.65	34.89					29.6	5.08	**	8.28	3.22	*			
LTURN	-0.49	0.28	*	-0.17	2.47					-0.56	0.37		0.42	1.04				
SINPUT	-0.54	0.41		-0.12	2.14					0.49	0.75		1.80	1.30				
SOUTPUT	0.30	0.19		-5.08	13.29					-0.55	0.66		-0.48	2.02				
LL	0.17	0.03	**	0.30	0.17		0.14	0.01	**	0.03	0.05		0.62	0.09	**	0.22	0.01	**
REGDRD	-42.3	44.0		-334.7	880.8					31.6	50.8		36.6	106				
SECTDRD	543.9	142	**	157.1	689.8					52.6	39.4		-43.8	89.0				
REGFRD	62.85	33.7		65.24	375.0					-53.7	58.1		56.0	142				
SECTFRD	-179	2591		-198	25957					-44.4	33.6		61.0	70.5				
LM							0.68	0.00	**							0.67	0.01	**
LE							0.06	0.03	**							0.04	0.01	**
LK							0.08	0.00	**							0.07	0.01	**
LRW							0.00	0.00	**							0.00	0.00	**
INNOVAT							0.22	0.03								0.49	0.05	**
TECHNO							0.00	0.11								-0.10	0.07	
λ_{INNO}							-0.10	0.02								-0.28	0.03	**
λ_{TECHNO}							-0.09	0.05								0.04	0.04	
$\rho_{INNO\text{-}TECHNO}$	0.07	0.26								0.48	0.13							
N	1978						1978			1042						1042		
Log-likelihood	-1019									-773								
Wald test							1783									1376		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. (**) (*) means statistically significant at the 1% (5%) level, two-tailed test.

Table 23. The vertical spillovers from multinational corporations in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods

	Low-tech industries									Medium- and high-tech industries								
	Innovativeness			Technology transfer			Production			Innovativeness			Technology transfer			Production		
	Coeff	Std		Coeff	Std d		Coeff	Std d		Coeff	Std d		Coeff	Std d		Coeff	Std d	
INTERNET	0.81	0.08	**	0.34	0.45					0.99	0.13	**	0.61	0.41				
GROUP	0.01	0.13		0.40	0.50					-0.01	0.19		0.58	0.26	*			
FDI	0.05	0.19		1.70	0.45	**	0.09	0.03	**	0.50	0.19	**	1.24	0.25	**	0.05	0.04	
SKILLED	0.71	0.22	**	-0.65	1.72		-0.01	0.02		1.19	0.29	**	0.70	0.68		0.26	0.05	**
RDINT	25.22	8.86	**	6.02	33.38					25.1	5.85	**	7.06	3.58	*			
LTURN	-0.48	0.27		-0.21	2.10					-0.49	0.37		0.19	0.99				
SINPUT	-0.42	0.39		-0.10	2.12					-0.70	0.74		1.70	1.10				
SOUTPUT	0.29	0.19		-4.89	11.15					-0.54	0.70		-0.43	1.94				
LL	0.16	0.04	**	0.30	0.16		0.13	0.01	**	0.05	0.05		0.58	0.09	**	0.22	0.01	**
FW	-0.74	0.95		0.41	5.30					-2.11	0.63	**	1.42	1.31				
BW	-0.12	0.87		-1.17	3.75					2.36	0.82	**	3.84	2.58				
LM							0.68	0.00	**							0.68	0.01	**
LE							0.06	0.00	**							0.03	0.01	**
LK							0.08	0.00	**							0.07	0.01	**
LRW							0.00	0.00	**							0.00	0.00	**
INNOVAT							0.29	0.03	**							0.27	0.04	**
TECHNO							0.07	0.12								0.01	0.07	
λ_{INNO}							-0.14	0.02	**							-0.14	0.03	**
λ_{TECHNO}							-0.05	0.05								-0.03	0.04	
$\rho_{INNO\text{-}TECHNO}$	0.82	0.24								0.83	0.12							
N	1978						1978			1042						1042		
Log-likelihood	-1031									-764								
Wald test							1787									1348		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. * (**) means statistically significant at the 5% and 1% levels, two-tailed test.

Table 24. The various types of spillovers in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods

	Low-tech industries									Medium- and high-tech industries								
	Innovativeness			**Tech transfer**			**Production**			**Innovativeness**			**Tech transfer**			**Production**		
	Coeff	S d		Coeff	S dev		Coeff	S dv		Coeff	S dv		Coeff	S dv		Coeff	S dv	
INTERNET	0.84	0.09	**	0.35	0.49					0.99	0.13	**	0.56	0.41				
GROUP	0.04	0.13		0.38	0.60					-0.03	0.20		0.58	0.27	*			
FDI	0.05	0.19		1.81	0.48	**	0.11	0.03	**	0.47	0.19	*	1.17	0.26	**	0.05	0.04	
SKILLED	0.69	0.23	**	-0.61	1.94		0.00	0.02		1.06	0.31	**	0.61	0.77		0.23	0.05	**
RDINT	25.38	9.63	**	6.97	34.72					25.4	5.73	**	7.31	4.06				
LTURN	-0.66	0.30	*	-0.05	2.55					-0.46	0.37		0.27	1.07				
SINPUT	0.64	0.41		-0.08	2.15					-0.67	0.76		1.62	1.42				
SOUTPUT	0.33	0.19		-5.24	13.61					-0.57	0.71		-0.46	2.00				
LL	0.17	0.03	**	0.30	0.18		0.13	0.01	**	0.06	0.05		0.60	0.10	**	0.22	0.01	**
FLSPILL	11.45	2.88	**	-6.91	22.61					7.78	3.22	*	5.55	6.86				
MS	0.22	0.33		-0.89	1.57					-0.09	0.26		0.61	0.52				
REGDRD	-40.0	45.5		-343.9	888.2					52.9	52.5		40.8	114				
SECTDRD	534.8	144.	**	169	716.3					-13.7	49.3		-8.81	110.				
REGFRD	72.77	35.0	*	47.39	378.7					-63.1	59.3		81.7	155				
SECTFRD	2006	2972		-702.9	27559					-14.9	50.5		-43.7	103				
FW	-1.64	1.09		1.98	5.97					-2.33	0.72	**	0.61	1.56				
BW	0.61	0.94		-1.57	4.03					2.19	0.87	*	3.27	2.81				

Table 24. The various types of spillovers in the Turkish manufacturing industry, 1995-97 and 1998-2000 periods (cont'd)

LM			0.68	0.00	**			0.67	0.01	**
LE			0.55	0.00	**			0.03	0.01	**
LK			0.08	0.00	**			0.07	0.01	**
LRW			0.00	0.00	**			0.00	0.00	**
INNOVAT			0.25	0.03	**			0.32	0.04	**
TECHNO			-0.04	0.11				0.00	0.06	
λ_{INNO}			-0.12	0.02	*			-0.17	0.03	**
λ_{TECHNO}			0.01	0.05				-0.02	0.04	
$\rho_{INNO\text{-}TECHNO}$	0.07	0.3				0.07	0.14			
N	1978		1978			1042		1042		
Log-likelihood	-1007					-756				
Wald test			1786					1355		

Note: All models include sector dummies for ISIC 2-digit industries, a dummy for year 2000, and a constant term. (*) (**) means statistically significant at the 5% and 1% levels, two-tailed test.

CHAPTER 5

CONCLUSION AND DISCUSSION

The purpose of this dissertation is to evaluate technological capability of the Turkish manufacturing industry by paying due attention for the role of MNCs in a laggard country; and derive some policy conclusions to foster economic growth. The second chapter descriptively analyzed technological capability of the Turkish manufacturing industry under the lights of the theoretical insights provided by the discussion in the first chapter. The analysis in the first chapter proposed that the recent efforts analyzing the complex process of technical change within a system view have contributed to our understanding of the phenomenon especially within the technological development experience of developing countries. This approach stands as an appropriate framework to explain the dynamics of lagging behind, catching-up and forging ahead observed especially after the Second World War in which the world economy has extensively and increasingly become knowledge intensive. However, even though catch-up argument, theoretically supported by convergence hypothesis of neoclassical growth models, are able to explain the first two dynamics, the phenomenon of forging ahead cannot be explained within that framework. We think that the catch-up argument is an insufficient analytical framework for the observed phenomena in the divergence and convergence dynamics since it is endowed with the developmentalist/modernist precepts. Instead, a better explanation of the most recent technological development of countries and related growth performance can be achieved by resorting to the systems of innovation perspective with a micro notion of ‘dynamic capability’ in its background. Therefore, in this study we tried to elaborate on the proposition of Freeman as to catch-up argument and system approach can be used in a complementary way in the explanation of technological and economic development of laggard countries, by linking national innovation systems to dynamic capabilities. In other words, we think that the well known deficiencies of the convergence approach can be best compensated by the theory of dynamic innovation system.

Since developing countries are thought to be heavily in need of using external knowledge sources, -for their technological and economic development; the agenda of the problems of technological development and the choices of technology policy in the most recent era have been flavored by the neoliberal prescriptions. MNCs have been considered by many economists as an important channel for technology transfer to developing countries. The ready-made advice is currently, therefore, to attract more foreign investment, assumingly having superior technologies and products, to carry the technology that is required for economic growth. It is suggested that modern, advanced technologies introduced by MNCs can also diffuse to domestic firms through spillovers (imitation, demonstration effects, training local labor, vertical technology transfers, etc.). The recent literature on this specific issue put forwarded that, technological development is not a by-product process of accumulation of foreign technologies in a given entity; the transferee was also assigned to a more difficult task than just staying in a passive absorber position. Even though MNCs bring about superior technologies and products to country; the precondition for the firms in that economy appears as making some technological effort and having a certain degree accumulated technological capability. Of course, the question still remains to be answered: If a country; or a firm is expected to have prior technological capability established; then why does the very country need MNCs as the creator and diffuser of new technologies? The answer to this question lies behind the nature of the knowledge generating process that is very well articulated by the scholars of evolutionary theory. For any kind of knowledge generation, external knowledge sources are needed to complement the internal knowledge sources. Otherwise, any autarchic perspective on the issue would risk the whole indigenous technological effort to be made on the 'reinventing the wheel'. One of the main arguments in this work we made is that it is true that there is no need to reinvent the wheel; but there is a need to improve it. Otherwise, all the effort made, even if it is complementary to the external knowledge sources, would not go beyond mastering foreign technologies developed elsewhere. Therefore, the technology policy designated for a developing country should treat that process carefully; and should understand the dynamic and nonlinear nature of it. To this end, we propose that if the analytical tool, developed by the evolutionary economists, the *National Innovation Systems* approach would mean anything for developing countries; it should be based on the dynamic capability approach that is defined roughly as the ability of adapting to the new environmental conditions. In other words, any policy designated for developing countries should have the vision not only the mastering the advanced technologies; but also should pay due attention to the installing the ability for the creating new technologies simultaneously. When indigenous efforts directed to absorbing external knowledge sources and benefiting from them without worrying about the improvement and generation of new technologies; in an environment where technology changes at an extremely fast pace; the resulting hierarchy between developing and developed countries would persist in dynamic terms, even though some technological development is to be recorded in developing countries. That is why any technology policy should identify the sources that possibly best feed the country specific technological development process, as well as the potential weakness in exploiting any kind of knowledge; and design their policy without loosing the vision of dynamic capability.

In line of this discussion, we attempt to analyze technological development of a developing country, Turkey, supposedly possessing an accumulated technological capability to a certain extent. This supposition draws on the fact that the early industrial activity in Turkey can be traced back to the origins of the weaving industry which goes back to almost 150 years. Our analysis focused on the Turkish manufacturing industry by paying due attention to the role of foreign firms in the process of technological change consists of two main aspects: The qualitative analysis identified various sources of technological change and their possible effects on some performance indicators. The second aspect of the analysis is an extensive and detailed quantitative analysis; which also consists of two broad econometric investigations. The first one draws on a panel dataset for the Turkish manufacturing industry broken down to three digit industry level for the 1983-2000 period. The second econometric exercise utilized the *Innovation Surveys* for the 1995-1997 and 1998-2000 period. The both types of analyses took into account of the importance of the size distribution and technological level of the industries and firms.

Our descriptive analysis on the Turkish manufacturing industries showed that foreign firms are expectedly more productive than domestic ones. However, the trajectory of the technological gap between Turkey and USA have displayed that technological development has not been an automatic process by simply exposing to the foreign superior technologies. Because, that analysis showed that being relatively backward did not bring about an automatic technological development towards to the end of the period. This is an obvious challenge to catch-up argument. In addition, the rough analysis about the foreign trade relations within the customs union with EU raises the idea that the deeper integration with a forward economic entity would possibly lock the technological development of Turkey into a traditional pattern. In other words, the deeper integration with EU seems to have encouraged the allocation of technological resources to low value added and low technology areas while suppressing technological activity in high tech industries. This observation poses that when the exposure of a developing country to an environment, in which faster technological change dominates, the required technological development in certain areas, -medium and high tech here, can be suppressed if a good governance of the process is lacking. Another interesting result that qualitative analysis produced is that domestic firms were able to achieve the same profitability rate with foreign firms even though the very firms pay much less wage to their employees. This means that domestic firms can survive by enjoying high profits thanks to low wages; without worrying any technological development for their industrial activity.

Foreign firms are not only more productive than domestic ones, but also definitely more innovative, in particular high tech industries; inclined to transfer technology from abroad (from their sister companies) more; and tend to establish more co-operative relations with domestic organizations than domestic firms, spend more on R&D. Foreign firms also tend to pay higher wages to their employees than their domestic counterparts. Given the theoretical arguments as to knowledge brought by the MNCs can be valued by the wage premium; and all of the above superiorities imply that there are some potential benefits for the domestic side of the manufacturing industry. However, relatively low productivity in comparison with the US manufacturing industry and the huge trade deficit in high tech industries limit the expectations about the generation of positive spillovers from the existence of MNCs, especially, in high tech industries.

Some performance indicators in the Turkish manufacturing industry differentiate with respect to the characteristics considered in this thesis such as size and technology level. For example, the productivity gap between foreign and domestic firms is highest among small firms whereas the gaps for medium and large firms are tolerable. The highest market share of foreign firms was observed in large firms; and in other categories MNCs were unable to achieve a market share more than 10 %. High tech markets are also dominated by foreign firms to a considerable extent. Furthermore, high tech foreign firms create more intensive vertical relations with domestic firms, spend more on R&D, transfer more technology compared to low tech foreign firms. The last two remarks also hold for large foreign firms.

Poor performance of domestic firms in high-tech industries is worth mentioning. Our descriptive analysis showed that domestic firms in high tech industries are more innovative than their counterparts in low tech industries. This can be attributed to the fact that the pace of technological change in high-tech industries is faster than that of low tech ones. However, innovativeness of domestic high-tech firms versus MNCs in the same industry considerably low. The innovative performance of domestic low-tech firms, on the other hand, is not very different than MNCs. We can speculate that, there are paradigmatic differences[42] in high-tech industries between foreign and domestic firms. When there is such discontinuity in technologies, backwardness may not be an advantage for a successful catch-up. When no such differences exist in paradigms, developing countries may be in an advantageous position, as observed in the innovative performance of domestic firms

[42] In Dosi's (2000a) words.

in low tech industries. Therefore, catch-up approach based on developmentalist/modernist ground is inadequate to explain the phenomenon.

In brief, the descriptive analysis shows that there are some potential for spillovers from the alleged superior products and process of MNCs, and refers to the limited capability of the domestic firms in many respects; but left the question whether there are positive or negative spillovers, if any, to be answered by the more advanced analysis.

The econometric analysis of panel data on Turkish manufacturing industry suggests that there is no evidence for spillovers generated by MNCs for domestic firms. However, there are lagged positive spillovers for domestic firms in the long run. This lagged positive spillover was unable to produce net dynamic spillovers to be felt in the current period. Because, the current and lagged parameters, in the analysis, were found to be jointly insignificant. The same result was also derived for low tech and high tech industries separately.

The possible sources of differentiation of horizontal spillovers are investigated for various size categories as well. This analysis suggested large firms benefit from lagged positive spillovers and there is no evidence in favor of spillovers for other categories. This positive spillover persists in long run because the current and lagged effects of foreign market share are jointly significant only for large firms. This last evidence is also valid for low tech firms but not for high tech ones.

There is no evidence suggesting that there are negative or positive vertical spillovers. Unlike the horizontal spillover analysis, we were unable to find evidence for lagged positive vertical spillover. The estimation for different size of the industries suggested that backward linkages produce negative spillovers for public firms; and positive one for large firms due to backward linkages of MNCs. However, there is no evidence in favor of dynamic positive impact of backward linkages.

These results strengthen the doubts about the indigenous technological capability and effort in the Turkish manufacturing industry that have already been traced out in the descriptive analysis. We further investigated the role of these factors in reaping the benefits from the spillovers from MNCs. The analysis provides counter evidence to this proposition. In other words, more capable (more productive ones in relative terms to US) firms appear to benefit less from spillovers generated by foreign market share. Similarly, the indigenous technological effort approximated by R&D share of domestic firms seems to be irrelevant for productivity of manufacturing firms. These results do not provide any support the arguments raised mainly by MNCs literature for the case of Turkish manufacturing industry.

One interesting result that found in our study is that outward orientation has no effect on productivity of the Turkish manufacturing industry. In other words, foreign trade does not function as a knowledge transfer mechanism in the Turkish manufacturing case.

The superior innovative performance of foreign firms was explained by various firm-specific factors (R&D intensity, internet access, labor flexibility, etc.). After controlling for all these variables, we found that foreign ownership matters for the innovativeness only for high tech firms. However, foreign ownership matters for the propensity to transfer technology from abroad. The foreign presence in user industries induces innovation, but the foreign presence in supplier industries is harmful for innovation in high tech industries.

The synergies created by the contributions by foreign firms to the knowledge stock in the region and sector do not seem to produce beneficiary effects. On the other hand, we found significant evidence in favor of the beneficiary effects of this sort that are produced by the domestic firms for the innovativeness of the low tech firms.

But, laborforce that was previously employed, and probably trained by MNCs have significant contributions for the innovativeness of the firms in both industries. We also found evidence in favor of the conclusion that innovativeness of low tech small firms is fed by the spillovers generated through labor flow from MNCs. On the other hand, foreign market share has a detrimental effect on the innovativeness of the firms employing more skilled labor. This poses the argument that foreign firms enforce the trajectory of the technological development in the Turkish manufacturing industry to one of a traditional pattern. In other words, competition from foreign firms tends to lock this pattern into low value added industrial activity. Therefore, even though there are positive spillovers from labor mobility, these positive spillovers are not sufficient to support the innovation system to function in leading the technological development to the frontier.

The fact that there is no evidence suggesting horizontal and vertical spillovers, and no significant effects from the outward orientation supports the idea technological capability is limited in the Turkish manufacturing industry (Of course, there might be many exceptions to these remarks at firm level). The evidence presented in this study suggests that the technological capability at the system level is not very well established. This arises on account of some characteristics of the industrial activity. The industrial activity in the Turkish manufacturing industry can be characterized by the following labels: low technology, low value added, low wage, limited competitiveness in the global markets, limited exploitation and exploration; thus, interaction.

The transfer of tacit capabilities and knowledge embodied in laborforce that was previously employed by a foreign firm has a positive effect on the technological change in the Turkish manufacturing industry. This evidence hints on the possible opportunities for the technological development process. The policies aiming at the acceleration of the accumulation process of technological capability and competitiveness in Turkey should be directed towards creating tacit knowledge and capabilities. Skill upgrading process and on-the-job training will accelerate the accumulation of technological capability. It is obvious that general educational background of the national innovation system also would contribute to the tacit knowledge creation process. Thus, technology policy should encourage, one way or another, the on-the-job training activities in firms in Turkey. Our suggestion on the skill upgrading process is also in line with the evidence provided by earlier studies suggesting that not only workers benefit from training activities; but firms themselves are the main beneficiary of the activities (Ballot, et al., 2002). This raises the point that there is no tension between wages and knowledge accumulation process unlike the traditional conflict between wages and capital accumulation process.

The skill upgrading process supported by the provision of required general education by the innovation system, and by the training activities at the firm level;

would have two folded effect on the industrial activity in Turkey. By this process general wage level would be raised. This might seem to be an unpleasant development for firms since it can be taken as a cost item. However, by skill upgrading process technological activity would be more knowledge intensive, and firms will have to choice a strategy to rely on enhancing their knowledge base instead of gaining competitive strength on the basis of low wages. This would mean a shift in the representation of the industrial activity outlined above. The new terms characterizing the industrial activity might turn out to be high wages (but knowledge intensive), high value added, high technology, higher competitiveness. Adding the term "more interactive" would be achieved by the increasing the connectivity between the elements of the institutions, as suggested by Metcalfe (1994). This process of course, should be supported by the indigenous technological activity. These would further enhance the capability and competitiveness of the national innovation system in Turkey. Such a shift in the terms defining competitive conditions in the Turkish manufacturing industry would also bring about a change in MNC investment decisions in Turkey. Currently, these decisions are mostly motivated by cheap labor advantages. In parallel with the skill upgrading process in Turkey, these decisions would be converted to one of exploiting labor skills, *inter alia*, instead of low cost arguments. This would lead an increase in the technological profile of the foreign industrial activity.

Investment decisions of foreign firms in developed countries are motivated by the exploitation of technological capabilities in host countries. The attributed role of MNCs, the creator and diffuser of new technologies, is most likely to be fulfilled in developed countries where prior technological capability has already been established. The stylized fact about investment flow in the world economy also confirms this trend. The great majority of investment flow into the developed countries. Thus, causality does not seem to run from FDI create technological development but the other way around. In other words, since there is a certain technological development foreign investment flows into developed countries to exploit their technological capability. The analyses suggest that the technology policy that relies mostly on attracting foreign firms should be questioned.

The innovation systems perspective has contributed to our understating of technological change in such a way that this process is basically an interactive process. The firms within a system, and the system itself should use both internal and external knowledge sources. Therefore, technology policy should be directed to accumulate the knowledge stock in domestic industries. The evidence obtained from the analysis suggests that the R&D stock in any industry and R&D share contribute to the innovativeness of firms, and foreign R&D has significant contribution in the creation of synergy neither at the regional, nor industrial level. Therefore, technology policy should also be directed to support R&D activities of domestic firms.

To recap, as Metcalfe (1994) suggested an evolutionary policy should bring greater connectivity between the institutions within a system that is also a requirement for the Turkish case since the elements in the innovation system do not seem to be very interactive. But an appropriate evolutionary technology policy for a developing country such as Turkey should also be targeted on the evolution of industrial and technological activity from the traditional pattern to a more contemporary one in order to compete with both foreign firms in Turkey and the ones in the global markets. The Turkish case suggests that this evolution can be achieved by an endogenous change of the system through skill upgrading and benefiting from labor transfer from foreign firms. Such an effort on skill upgrading is associated with higher wages; higher value added, and higher technology profile. The evolution of industrial and technological activity towards a more dynamic one from the traditional pattern is to be achieved through such a skill upgrading process under the guidance of an appropriately functioning institutional set-up.

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APPENDIX

Table A1: The Technology Level of Industries

Code	Industries	Level
311	Food manufacturing	Low Tech
312	Food manufacturing	Low Tech
313	Beverage industries	Low Tech
314	Tobacco manufactures	Low Tech
321	Manufacture of textiles	Low Tech
322	Manufacture of wearing apparel, exc footwear	Low Tech
323	Manufacture of leather and products of leather, leather substitutes and fur, exc footwear and wearing apparel	Low Tech
324	Manufacture of footwear, exc. volcanized or moduled rubber or plastic footwear	Low Tech
331	Manufacture of wood and wood and cork products, exc. furniture	Low Tech
332	Manufacture of furniture and fixtures	Low Tech
341	Manufacture of paper and paper products	Low Tech
342	Printing, publishing and allied industries	Low Tech
351	Manufacture of industrial chemicals	Medium Tech
352	Manufacture of other chemical products	Medium Tech
353	Petroleum refineries	Low Tech
354	Manufacture of miscellaneous products of petroleum and coal	Low Tech
355	Manufacture of rubber products	Medium Tech
356	Manufacture of plastic products not elsewhere classified	Medium Tech
361	Manufacture of pottery, china and earthenware	Low Tech
362	Manufacture of glass and glass products	Low Tech
369	Manufacture of other non-metallic mineral products	Low Tech
371	Iron and steel basic industries	Low Tech
372	Non-ferrous metal basic industries	Medium Tech
381	Manufacture of fabricated metal products exc. machinery and equipment	Low Tech
382	Manufacture of machinery exc. electrical	Medium Tech
383	Manufacture of electrical machinery apparatus, appliances and supplies	High Tech
384	Manufacture of transport equipments	Medium Tech
385	Manufacture of professional and scientific, and measuring and controlling equipment not elsewhere classified, and of photographic and optical goods	High Tech
390	Other manufacturing industries	Medium Tech

Table A2. Number of Entrant Firms by Various Characteristics, 1983-2000

Year	Ownership / Size Categories						Technology Categories			
	Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1983-87	414	0	189	4	18	2	456	4	166	3
1988-92	413	0	347	15	30	6	647	13	171	8
1993-95	367	2	228	8	245	2	473	8	156	4
1996-00	420	6	420	18	46	5	604	14	244	15
Mean	404	2	303	11	30	4	559	10	187	8

Source: State Institute of Statistics

Table A3. Productivity of Entrant Firms by Various Characteristics, 1983-2000, real value added per employee, million TL

Year	Ownership / Size Categories						Technology Categories			
	Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1983-87	172	0	269	175	375	218.2	389	115	254	338
1988-92	239	0	315	595	533	522.6	357	497	507	1752
1993	361	1343	675	735	975	-	700	5623	669	1039
1994-95	283	121	447	580	484	968	393	847.5	613	1842
1996-00	508	1345	545	1015	728	3032	591	2305	661	2117
Mean	307	1187	401	588	565	1958	448	500	1217	1431

Source: State Institute of Statistics

Table A4. Real Wages in the Entrant Firms to the Turkish Manufacturing Industry, 1983-2000, annual average, million TL

Year	Ownership / Size Categories						Technology Categories			
	Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1983-89	34	-	46	77	75	86	58	74	60	101
1990-95	48	221	71	133	134	278	82	166	99	258
1996-00	71	264	88	238	140	353	97	249	122	368
Mean	49	252	66	140	113	224	77	153	90	228

Source: State Institute of Statistics

Table A5. R&D Share in the Entrant Firms to the Turkish Manufacturing Industry, 1983-2000, percent

Year	Ownership / Size Categories						Technology Categories			
	Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1992-95	0.07	0	0.113	0.023	0.075	0.5678	0.08	0.03	0.135	0.193
1996-00	0.14	0.04	0.093	0.563	0.108	0.405	0.058	0.06	0.203	0.533
Mean	0.1	0.06	0.09	0.26	0.07	0.21	0.06	0.04	0.15	0.48

Source: State Institute of Statistics

Table A6. Licensee Entrant Firms in the Turkish Manufacturing Industry, 1983-2000

Year	Ownership / Size Categories						Technology Categories			
	Small		Medium		Large		Low Tech		High Tech	
	Dom	For	Dom	For	Dom	For	Dom	For	Dom	For
1983-1986	0	0	7	4	5	2	4	3	10	5
1987-1992	0	0	17	13	18	14	16	14	26	20
1993-2000	6	5	33	17	19	6	30	15	25	10
Mean	0	0	3	2	2	1	3	2	3	2

Source: State Institute of Statistics

Table A7. Variable Definitions

Industry Level Analysis		Firm Level Analysis	
Variable	*Description*	*Variable*	*Description*
Q/L	Labor Productivity	LQ	Output
K/L	Capital per labor	LK	Depreciation allowances
L	Labor	LE	Electricity consumption
E/L	Energy per labor	LM	Inputs
M/L	Material per labor	INNOVAT	Innovativeness
W/L	Wage per labor	TECHNO	Technology transfer
Year	Time dummy	FDI	Foreign firms (for. ownership 10%+)
MS	Foreign market share	FDIMAJ	Majority-owned foreign firm
DMS0	Foreign market share in public industries	LL	Employment
DMS1	Foreign market share in small industries	GROUP	Member of a business group
DMS2	Foreign market share in medium industries	INTERNET	Internet intensity
DMS3	Foreign market share in large industries	DRDINT	R&D intensity
BW	Backward Linkages of MNCs	DREGRD	Regional R&D intensity
FW	Forward Linkages of MNCs	DSECTRD	Sectoral R&D intensity
DBW0	Backward Linkages of MNCs in public ind	DSINPUT	Share of subcontracted inputs
DBW1	Backward Linkages of MNCs in small ind	DSOUTPUT	Share of subcontracted outputs
DBW2	Backward Linkages of MNCs in medium ind	DLTURN	Labor turnover ratio
DBW3	Backward Linkages of MNCs in large ind	QFDISH	Market share of foreign firms
DFW0	Forward Linkages of MNCs in public ind	FDISHSUP	Foreign market share in supplier ind
DFW1	Forward Linkages of MNCs in small ind	FDISHBUY	Foreign market share in user ind
DFW2	Forward Linkages of MNCs in medium ind	SKILLED	Proportion of skilled employees
DFW3	Forward Linkages of MNCs in large ind	LRW	Real product wage (log)
CAP	Technological capability	n	Number of observations
RD	Research and Development		
XO	Export Orientation		
MO	Import Orientation		

Table A8. Correlations between the variables employed in the industry level analysis

	Q/L	Q/L_1	K/L	L	E/L	M/L	W/L	MS	MS-1	BW	BW_1	FW	FW_1	CAP_1	RD_1	XO_1	MO_1
Q/L	1																
Q/L_1	0.896	1															
K/L	0.651	0.594	1														
L	0.139	0.115	0.200	1													
E/L	0.448	0.419	0.618	0.303	1												
M/L	0736	0.691	0.581	0.145	0.468	1											
W/L	0.572	0.542	0.473	0.217	0.398	0.300	1										
MS	0.228	0.246	0.257	-0.004	0.016	0.200	0.149	1									
MS_1	0.252	0.218	0.275	0.011	0.039	0.226	0.167	0.921	1								
BW	0.106	0.096	0.101	-0.065	0.044	0.203	0.137	0.279	0.294	1							
BW_1	0.115	0.085	0.110	-0.053	0.059	0.209	0.140	0.255	0.297	0.956	1						
FW	0.034	0.036	0.032	0.108	-0.089	0.009	0.111	0.308	0.300	0.474	0.462	1					
FW_1	0.039	0.030	0.041	0.103	-0.086	0.019	0.116	0.297	0.311	0.483	0.494	0.985	1				
CAP_1	-0.129	-0.065	-0.133	0.096	0.076	-0.111	-0.031	-0.772	-0.859	-0.216	-0.224	-0.207	-0.217	1			
RD_1	0.082	0.101	0.074	0.027	0.030	0.050	0.039	0.030	0.034	0.001	0.004	0.028	0.030	-0.020	1		
XO_1	-0.251	-0.263	-0.118	0.281	-0.013	-0.144	-0.159	-0.068	-0.055	-0.151	-0.100	0.105	0.113	0.072	-0.001	1	
MO_1	0.058	0.046	0.223	0.062	0.236	0.115	0.112	0.021	0.040	0.202	0.219	0.178	0.193	0.023	0.027	0.130	1

Table A9. Summary of Spillover Effects of MNCs on Turkish Manufacturing Industry

	ALL						LOW TECH						HIGH TECH					
	Horizontal		Vertical				Horizontal		Vertical				Horizontal		Vertical			
			Backward		Forward				Backward		Forward				Backward		Forward	
	C	*L*	*C*	*L*	*C*	*L*	*C*	*L*	*C*	*L*	*C*	*L*	*C*	*L*	*C*	*L*	*C*	*L*
All	.	+	.	.	.	.	.	.	--	.	.	.	.	.	.	.	.	.
Public	.	.	--	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Small	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medium	.	.	.	.	.	.	--	.	.	.	.	.	.	.	.	.	.	.
Large	.	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.

Notes: (+) (--) mean positive, negative spillovers; and (.) means no evidence for spillover of any kind.

Table A10. Spillovers from Labor Transfer

	Low tech	High Tech
Innovativeness	+	+
Technology Transfer	.	.

Notes: (+) (--) mean positive, negative spillovers; and (.) means no evidence for spillover of any kind.

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