Chapter 2
Multinational Companies, Knowledge and Technology Transfer: Theoretical Framework

In this chapter, we review mainly the theoretical and empirical literature on FDI with an emphasis on the technology spillovers and transfer realized by multinationals. In the first section, definitions of the basic concepts used in the study are explained briefly. Next, in the second and third sections, technology diffusion through FDI, growth and the relationship between spillovers and multinationals are presented. Then, the fourth section is devoted to the analysis of main spillover channels identified in the literature. We then examine the determinants of the spillovers in the section five. Theoretical and empirical evidence on the technology spillovers and their effects on the host economies are presented in the sixth section. Review of the related literature on spillovers for Turkey constitutes an important part of the study. The last section summarizes the theoretical framework for the case-study research on both intra- and inter-firm technology transfers in Turkish automotive industry, and reviews the literature on similar case-studies conducted on both foreign countries and Turkey.

2.1 Definitions of Basic Concepts

2.1.1 Types of Technology

We will use the term "technology" here with a broad meaning to include product and production process technology as well as knowledge and skills including management, marketing, organization, know-how, international markets, and global production networks. Some authors need to narrow the scope of the technology and grouped it into two types, namely, "hardware" and "software" technology (Techakanont, 2002, pp. 12–13). The authors call the technology embodied in physical goods as "hardware technology" (such as machinery, equipment, blueprints, and technical specifications), while they call the knowledge embodied in workers' experience and skills in terms of product and production process as

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"software technology" (Cantwell, 1993; Kim, 2001; Teece, 1977). Moreover, some authors differentiate these technologies as "explicit" and "tacit knowledge". "Explicit knowledge" is defined as a codified and transmittable knowledge; sources (multinationals) provide this kind of knowledge to recipients (such as their affiliates or suppliers in host countries) through machinery, blueprints, technical manuals, training handouts, technical specifications, and quality control methods (Kim, 2001). On the other hand, "tacit knowledge", introduced firstly by Polanyi (1962), is defined as knowledge related to "practical knowledge", and it cannot be easily expressed, solved, transferred or declared openly to another person. It is also described as "know-how" or "embodied knowledge", and the sentence *we can know more than we can tell* best describes the notion of "tacit knowledge". In sum, the term "technology" includes both explicit and tacit knowledge here. However, in our study, we prefer to use the term "knowledge transfer" for the transfer of "tacit knowledge", and "technology" for the transfer of "explicit knowledge" in order to examine in detail both types of the technology.

2.1.2 Externalities, Spillovers and Linkages

It is necessary to point out the distinctions between "externalities", "spillovers" and "linkages" here by using the definitions of Narula and Driffield (2012). "Externalities", which are simply the positive or negative benefits from presence of multinationals or from their actions, affect local firms or host economies at no cost. On the other hand, "spillovers" are the indirect effects of multinationals on host countries. In other words, they are externalities that accrue from one firm (source) to another (recipient) through formal or informal relationships between the firms. Recipient firms must put a learning effort to benefit from such spillovers. Also, all "spillovers" are externalities, but all externalities are not spillovers. By the way, "linkages" imply transactional associations between source and recipient firms, and these may not give rise to spillovers. In other words, all spillovers are linkages, but all linkages are not spillovers. The term "spillover" has been generally used in "aggregate empirical analyses" on "production function", while the term "linkages" is preferred in studies on individual firms or multinationals as the unit of analysis (see Narula & Driffield, 2012, pp. 2–3 for further details).

2.1.3 Horizontal and Vertical Technology Spillovers

In the last few decades, FDI flows have played an important role in achieving economic growth and development especially for developing economies. FDI may affect host country economies directly through increased employment, foreign exchange earnings, capital accumulation, and also the usage of more advanced equipment and technology. However, especially in the last decade, it has been

considered that the most important channel through which FDI affects developing economies is situated on the technology front/side. Indeed, the most important contribution of FDI to a developing economy consists in fostering technology transfer by bringing and diffusing new technologies, knowledge, and skills to the recipient country. Transfer of these intangible technology-related elements unintentionally from foreign to local firms is called *technology spillovers* based on FDI. In other words, spillovers are referred to the indirect effects of FDI on domestic firms in host country. These can be horizontal (intra-industry) or vertical spillovers (inter-industry) depending on whether they are disseminated within or outside the sector of activity of foreign firms that trigger these spillovers. In other words, horizontal spillovers occur from foreign firms to local firms operating in the same industry, while vertical spillovers occur from foreign firms to local firms operating in vertically linked (backward or forward) industries (see Sect. 2.4 for details). Vertical spillovers emerge from interaction of the multinationals with the suppliers and customers in the local market. The multinationals could provide technical assistance to the suppliers in the local market in order to ensure the quality of the intermediate inputs they use, could train the employees, and could help in purchasing the raw materials. We could assume that there exist the backward spillovers here. The forward spillovers, on the other hand, emerge from the local manufacturers' purchasing the intermediate or capital goods from the foreign suppliers. Since the products of the foreign suppliers are technologically more superior than the products of the local suppliers, the multinationals could provide the local firms with knowledge to ensure that these inputs are used efficiently by the manufacturers. The econometric studies analyzing the both horizontal and vertical spillovers together are very limited, and they have generally revealed significant positive vertical spillovers than horizontal ones (Pamukçu & Taymaz, 2009, p. 9).

2.1.4 Technology Transfer and Diffusion

What is meant by the "technology transfer" here is the process through which technology is intentionally transmitted between countries or firms. In other words, we define "technology transfer" as the direct type of the spillovers that occurs voluntarily from technology source (such as multinationals or foreign firms) to recipient (such as local firms, affiliate of multinational or suppliers in host country) by way of embodied in the equipment supplied (such as machinery, manual, and equipment) or disembodied in the forms of software, patents, knowledge, or know-how and skills provided by training and education activities (see Bennett, 2002; Radosevic, 1999 for further details on *technology* and *technology transfer*). In this process, there are three factors that play an important role in technology transfer; the source, the recipient, and "the technology itself" (Techakanont, 2002). On the other hand, "technology diffusion" is generally used to refer to the unintentional transfer of technology that may occur as a result of reverse engineering or imitation (Rath, 1994). This type of technology transfer is also called "technology spillover"

as a positive externality effect in the literature and occurs through horizontal and vertical linkages by means of various channels (see Sect. 2.4).

Technology transfers via FDI have been through multinationals in a host country. MNCs operating in host country may transfer some of its technology in terms of product, production process, and organization to recipient firms, which are generally affiliates or the local suppliers of multinationals. However, today attracting multinational is not the only way to obtain technology transfers; they can also be transferred in two ways. The first one is contractual agreements between source and recipient for the transfer of specific technologies that include licensing and management arrangements, technological assistance agreements, purchase of machinery-equipment-assembly apparatus, recruitment of the foreign specialists, patents, and brands. The second one is the transfer of skills, experiences, and knowledge through technical assistance, know-how agreements, labor mobility, turnkey projects, service, and engineering agreements (UNCTC, 1994).

2.1.5 Knowledge and Technology Transfer

"Knowledge transfer" and "technology transfer" concepts are used interchangeably in innovation and development literature. Nevertheless, while "technology transfer" involves rather the transfer of capital goods such as machinery and equipment, "knowledge transfer" includes mostly transfer of tacit knowledge such as know-how, management, and technical skills. Knowledge transfers seem to be more important than technology transfers since they ensure learning of new information, technical and organizational skills (UNCTAD, 1997). Knowledge transfers are realized from one company to another; and its potential benefits depend on the long-term relationships between the companies concerned, the level of the knowledge transferred, and the abilities of the recipient company. The technology transfer process—this term will hereinafter be used in a way to cover the transfer of both the explicit and tacit knowledge—involves acquisition of the technology, absorption of the technology, adaptation of it to local conditions, improving and developing it, its spillover to other companies (Eden, Levitas, & Martinez, 1996; Tung, 1994). Business literature generally refers to three kinds of technology transfer (Grosse, 1996): Product (knowledge used in order to produce any product), process (knowledge used in order to organize the inputs and operate the machinery during production), and transfer of the management skills (knowledge used in order to operate an enterprise). Techakanont and Terdudomtham (2004) clearly explain the concept of technology transfer and its process in the following excerpt:

> The term of technology transfer in its broadest sense defines the process of creation of the knowledge, skills and experience by the recipient of the technology, as a direct result of the contributions of the sources from where the technology is provided. It could be said that the transferring process mentioned above has been completed upon understanding the transferred technology well, absorbing it, adapting it to the local conditions, ensuring its maintenance, sustainment and effective use, by the recipient of the technology. In other

> words, the technology transfer process is the process of internalization or learning of the transferred technology-related knowledge and experience by the recipient. Effective realization of the transfer process depends on two important factors: (i) that the technology recipient has a certain basis of knowledge, and (ii) the intensity of the effort to develop the existing knowledge base. These factors are vitally important in that they determine how fast and how successfully the transferred technologies are internalized by the local suppliers. Especially intensity of effort to develop the existing knowledge base is more important than the existing knowledge base itself because the former creates that latter, but not vice versa (Techakanont & Terdudomtham, 2004, pp. 156–160).

The "efforts" emphasized in the last sentence of the citation above ensure that the recipient company understand, implement, absorb and evaluate the new technologies better, and develop the accumulation of knowledge about them. Therefore, such efforts ensure success of the technology transfer. A successful technology transfer would result in advancement of the technological capabilities of the recipient company personnel playing a role in the transfer, and also in increased productivity of the company's production process.

Recipients can assimilate the transferred "explicit knowledge" into products and production processes by using their "tacit knowledge" (see Kim, 1997; Lall, 1996; McKelvey, 1998; Nelson & Winter, 1982 on discussions about tacit knowledge). Therefore, it is necessary for the recipients to have a certain level of "knowledge base" (tacit knowledge) to benefit from the transferred technology. In other words, acquiring of the external knowledge by recipients requires experienced and skilled human capital. Developing of the "knowledge base" can be possible through specific ways such as extensive personnel contacts and regular interactions with the personnel of foreign firms in host or home countries, mutual trust between source and recipient firms, social networks, regular visits to the plants of foreign customers in order to get on-the-job or off-the-job training activities provided by foreign firms, various assistances of foreign firms in terms of quality control systems, production process, and distribution. For instance, in certain periods, MNCs invite production and management personnel of the local firms in host countries to visit their plants or headquarters in home or host country. They show them how production systems, lines, and organization work by off-the-job training activities, and give them various on-the-job training activities. Moreover, MNCs can send their own expert personnel to assist their local suppliers in solving the technical problems encountered in the application of MNC's production and engineering systems (a kind of tacit knowledge). Consequently, "knowledge base" is based on experience and know-how of the personnel, and this can be accumulated and acquired in many years through training, research, and practice (see Ernst & Kim, 2002 for further details). The creation of new technology and knowledge could also be possible by interaction of the explicit and tacit knowledge categories (Collins, 2001; Goffin & Koners, 2011; Wagner & Sternberg, 1985).

2.1.6 Technological Capability and Learning

According to Kim (2001), *technological capability* can be defined as an ability to make efficient use of technological knowledge, which is gained from either internal or external sources, in manufacturing, production process, R&D, design, engineering, and innovation. It is expected that firms with higher technological capability can acquire, assimilate, and improve new technologies more easily, and also they can deal with creating new technologies. On the other hand, *technological learning* is the process through which technological capability is improved, accumulated and formed. Such ability may be developed through "learning by research" in developed countries, or through imitative "learning by doing" process in developing countries (Kim, 2001, p. 297).

Technological capability of a firm can be considered as a continuous process to acquire, absorb, internalize the knowledge and adapt into local conditions, and improve it. It is also determined by accumulation of skills and knowledge, and by efforts to improve this. The firm-level capabilities can be categorized as "investment capabilities" (the skills needed to obtain new technologies for design, construction, equipment), "process and production capabilities" (quality control, operation, monitoring, controlling, maintenance, research, design, and innovation), and "linkage capabilities" (the skills needed to transmit knowledge and technology to and receive them from various institutions, suppliers, customers) (Lall, 1992, p. 168). The complexity degree of these capabilities can be assessed by activities from which these capabilities arise such as "experience", "search", and "research". Firms must improve and develop their capabilities in order to internalize and get a new technology into production. The factors that have impact on the activities of the firms in developing their capabilities can be summarized as the size of the firm; ability of the technologies from the market; dealing with R&D and innovation activities; cooperation activities with other firms in terms of design, product development, etc.; high-quality human capital; "organizational and managerial skills"; "ability to change structures to absorb new technologies"; "access to appropriate embodied technology"; and "access to external technical knowledge" from various sources (such as foreign firms, MNCs, local firms, special engineering and consultancy firms, laboratories, testing facilities, and standards institutions) (see Lall, 1992 for further details).

2.1.7 Global Production Networks and Global Supply Chain

Globalization process has changed all world economies. One of the most important effects of globalization has occurred in the choices of firms in their location choices for production, R&D, and innovation activities through "international foreign trade", development of "information and communication technologies", and liberalization policies of the host countries to attract high FDI flows (Narula & Dunning,

2000). In this process, the global production networks (GPN) have emerged due to increase in international competition and the need for "the organization of international trade". These networks have been established by multinationals to integrate their supply, technology, R&D, innovation, and production centers into GPN. They consist of hierarchical layers (such as "independent suppliers and subcontractors", "joint-ventures", "affiliates", "R&D alliances", and "subsidiaries"), and they have increased the knowledge diffusion among such actors. Local suppliers in host countries of multinationals (lower-tier suppliers) are at the bottom of these hierarchical layers. "Global supply chain" is also established as a result of these networks in order to provide integrated intermediate goods and services to the firms in GPN (based on Narula & Dunning, 2000).

These networks have played an important role in fostering the advanced technology and knowledge diffusion across countries and firms in two ways:

- By increasing their capabilities; multinationals demand high quality products at low cost and to be delivered on-time. In other words, their working standards and technical specifications are very high and these may put high pressures on local suppliers, especially in developing countries. If local suppliers could not fulfill the demands of multinationals in terms of quality, cost, delivery, durability, and reliability, they may face the threat of expulsion from the production and supply networks of multinationals. Therefore multinationals are endeavoring to upgrade their suppliers' capabilities and productivity.
- Multinationals as the final-user of the products supplied have provided new opportunities for local firms to benefit from the knowledge diffusion. Multinationals may provide financial and technical assistance, knowledge and technology transfers (including engineering, product and production process, on-the-job and/or off-the-job training activities, various blueprints, machinery, raw material, managerial systems, etc.) to the local suppliers in the GPN in order to raise their technical capabilities in terms of production and process because multinationals must be sure about the quality of the products to be supplied (see Ernst & Kim, 2002; Narula & Dunning, 2000 for further details).

2.2 Technology Diffusion Through FDI and Growth

Developing countries consider that FDI by multinationals give rise to technology diffusion and it is a major channel for gaining access to advanced technologies and knowledge of developed countries (Borensztein, Gregorio, & Lee, 1998). In their study, Borensztein et al. (1998) and Xu (2000) verify this by showing that FDI is the most important source of economic growth for developing countries, and they reveal that FDI flows from developed countries are an important channel through which technology transfers have been provided to local firms of developing countries. Moreover, they show that technology transfer through FDI has a more positive effect on economic growth than domestic investment when host countries have a

sufficient level of human capital. They suggest that the stock of human capital plays an important role in the absorptive capacity by emphasizing the role of the education level in order to get benefit from FDI. In a similar study, Blomström and Kokko (1997) also show that there is a positive relationship between the benefits of FDI and technological capability level of domestic firms. In addition, Romer (1986, 1990) in his "endogenous growth theory" emphasized the role of human capital in order to acquire the foreign technologies and to benefit from FDI in host countries by suggesting that human capital would lead to economic growth by using new technologies and efficient production techniques.

The simple models in the neoclassical economic theory assume that technology is freely available across, and within countries, and among all firms. This theory basically assumes that technological knowledge is a public good and non-rivalry, when it is created every person that is willing to pay the price of technology may benefit from it, in other words, it is non-excludable. This view expresses itself best in the motto *free international flows of capital and technology*. According to this view, all firms are considered to be operating on the same production function and they decide how much labor and capital will be used in accordance with their relative factor prices. In this process, developing countries can transfer advanced technologies from developed countries, and adaptation and assimilating of these technologies are not required, and technical efforts by firms in the learning and absorbing of these technologies are not seen as important factors (see Lall, 1992). In other words, knowledge, capability, cost, and tacit nature of technologies are not seen important; it is assumed that they can be easily acquired by developing countries, and there is no need for adaptation of such technologies to local conditions (Bell & Pavitt, 1997). In line with the neoclassical growth theory, Wang (1990) also conducted a model by assuming that increase in "knowledge" used in the production is determined as a function of FDI (Borensztein et al., 1998). Even though neo-classical approach suggest that there is not any obstacle to restrict the spillovers from multinationals to local firms, and that spillovers occur efficiently, findings and evidence on developing countries in the literature show that there are very limited benefits from multinationals, or they have revealed negative spillovers from multinationals (Narula & Marin, 2003).[1]

On the other hand, "unconventional" approaches, inspired by "evolutionary theory"—developed by Nelson and Winter (1982) and explained in Dosi (1988)—propose that "indigenous technological efforts" of the firms in developing countries in adapting, learning, and improving of new technologies from developed ones play a deterministic role by implying that markets are inefficient in the diffusion of technology (Lall, 1992). This approach is mainly based on these assumptions: (i) knowledge and technology are not easily available and fully transferrable across firms since they are created as a result of long R&D and

[1] For instance, Haddad and Harrison (1993) for Morocco; Aitken and Harrison (1999) for Venezuela, Konings (2001) for Bulgaria and Romania, Djankov and Hoekman (2000) for Czech Republic have found negative evidences.

innovation activities at high costs; (ii) they are protected by creators in order to prevent the diffusion of these technologies to other rival firms; (iii) the adaptation of these technologies requires high technological capability and capacity, skilled and experienced human capital, effort, investment, and learning process by the recipient due to tacit character of these technologies. These also explain why there are differences among firms in terms of their technology levels, production processes, and capabilities (based on Lall, 1992; Pack & Saggi, 1997). Therefore, the approach of "the evolutionary theory" seems more realistic than the neoclassical approach.

In the traditional growth theory, the role of the technology was left as an unexplained residual, whereas recent literature on growth revealed that state of the domestic technology relative to that of the rest of the world plays an important role in the process of economic development (Barro & Sala-i-Martin, 1995). According to this theory, economic development of a backward country depends on its absorptive capacity, technological capabilities, infrastructure, and human capital stock. In other words, economic development, and growth are explained by a "catch-up" process in the level of technology and it depends on the extent of absorption, adaptation, acquisition and implementation of new technologies, and knowledge that are already in use in developed countries (Borensztein et al., 1998). Therefore, in modern economic growth theory, stock of knowledge, its intensity and generation play a very important role and determine a country's economic growth (Kuznets, 1966).

Today, technology is seen as a major determinant for industrial development and economic growth. According to Pack and Westphal (1986), *industrial development* is a process through which accumulation of knowledge and technology capabilities are conducted especially by learning and translating them into new product and production process innovations. The studies related to the developed countries revealed that 50% of the long-term economic growth stems from technological developments that improve R&D, innovation, productivity or lead to new products and processes (Grossman & Helpman, 1991). One of the important examples is South Korea, which has achieved to transform its economy from agrarian to industrialized one during the past 4 decades through technology and industrial development. Therefore, many governments in developing countries nowadays have been studying and examining the South Korea experience as a case study to be successful in their own countries by applying science and technology policies or strategies (see Kim, 1998).

Kim (1998) postulates that industrial development process of developing countries consists of three stages: "acquisition", "assimilation", and "improvement" of foreign technologies from developed countries through technology transfers rather than relying entirely on foreign sources. In the first stage, developing countries acquire technologies from advanced countries through "assembly processes", "product specifications", "production know-how", "technical personnel", and/or "components and parts" because of insufficient technological capabilities of local firms. In other words, firms in the developing countries try to imitate foreign technologies and products through reverse engineering; therefore, this stage consists of "assembly production" for "standard products" and requires only an

"engineering" capability. In the second stage of industrialization, "production" and "product design" technologies are quickly improved by "assimilation of foreign technologies". In this stage, firms undertake "creative imitation" and try to produce differentiated products by using their technical capabilities on "engineering" and "development". In the last stage, after the successful assimilation of foreign technology, local firms shift to "original innovation" and they can undertake research, development, and engineering activities by their increased scientific, technological, and engineering capability in order to improve and develop new technologies and products. In these stages, if they are successful, countries accumulate knowledge and technology, and they increase their technological capabilities, and in the end, they may be a candidate to be an advanced country (see Kim, 1998, 2001 for further details).

Developing countries benefit from globalization process through liberalization of capital flows and export oriented policies. These policies also provide them with access to advanced technologies and sophisticated products invented in developed countries, which trigger growth rates, and thus they may have a chance to catch up with the developed countries (Keller, 1996). However, when a small part of the technology can be obtained by these processes (blueprints, manuals, specifications, etc.), they are not sufficient to bring those countries to the level of developed countries successfully without adopting, assimilating, and understanding the knowledge embodied in these technologies. Therefore, it is also necessary to have an efficient absorptive capacity level and a skilled and experienced human capital stock (engineers, workers, and managers) in order to get benefit from these technologies (see Evenson & Westphal, 1995; Grossman & Helpman, 1991; Keller, 1994; Pack, 1992). For instance, in their studies, Borensztein et al. (1998) and Xu (2000) reveal that economic growth is positively affected by FDI in only developing countries with a certain threshold level of absorptive capacity.

In sum, technology spillovers from FDI and the accumulation of knowledge are seen as a key determinant factor for productivity of local firms in and economic growth of developing countries. These can be increased by R&D and innovation activities, or by knowledge diffusion from external sources. It is considered that FDI give rise to inflow of advanced knowledge and technologies into the host countries; hence, today knowledge diffusion from FDI is a very important factor especially for the developing countries to access the latest technologies. FDI can bring technology embodied in goods and services, and knowledge as intangible assets; however, to benefit from them is not an automatic process, and it requires that recipient must have some capabilities to absorb, assimilate, and adopt such technologies (see Kinoshita, 2001 for details).

2.2.1 A Picture of FDI Inflows in Turkey

Although the first law on foreign capital was enacted in 1954, Turkey was a relatively closed market to foreign investment until 1980. After pursuing inward-

oriented economic policies based on an import-substitution development strategy implemented through Five-Year Development Plans since the 1960s, Turkey switched to outward-oriented policies following a severe balance of payment crisis in the early 1980s. In 1989, liberalization of international capital flows occurred. Signing the Customs Union agreement with the European Union in 1995 further contributed to the liberalization of its economy. The policies focused on attracting foreign investment, promoting export activities, and minimizing state intervention. Note that efforts to open the Turkish economy to international markets were not enough to attract more FDI. For instance, from 1950 to 1980 the cumulative authorized FDI had only reached US$229M (Önis, 1994). After the government initiated a stabilization program in 1980 that paved the way to an open economy, the legislative background was also reorganized to eliminate favoritism among foreign investors, local content requirements, minimum export requirements, and restrictions on transfer of capital and profits (Akpınar, 2001; Erdilek, 1986). In addition to changes in the regulatory framework, privatization of state economic enterprises, liberalization of the financial system, elimination of restrictions on foreign exchange, establishment of a stock exchange and heavy investment in telecommunications technology all contributed to the development of a favorable environment for FDI throughout the 1980s. However, in the following decade, two major economic crises in 1994 and 1999 as well as reliance on short term capital flows resulted in a relatively poor FDI performance.[2]

When we look at the 2000s, we see a much more favorable environment for foreign investors with a strongly regulated financial system, a low inflation rate and the establishment of a Coordination Council for the Improvement of the Investment Climate. Following the enactment of the new foreign capital law in June 2003, minimum capital requirements and permits were eliminated; the ownership of property by foreigners without any restrictions, the right to international arbitration and employment of expatriates were granted. Partly as a result of these measures a sharp rise occurred in FDI from 0.56% of GDP in 2003 to 3.8% in 2006 which was followed by a fall after 2006 (see Fig. 2.1).

Policies implemented after the early 1980s to open up Turkish economy were not enough to increase the FDI inflows to Turkey. As can be seen in Fig. 2.2, until the year 2001, annual FDI flows to Turkey were rather low (below US$1B) compared to other emerging economies (see UNCTAD, 2005). Total cumulative net FDI inflows were nearly US$10.7B between 1974 and 2000, corresponding to an annual average of US$400M. Moreover, the place of Turkey was in the 35th rank by US$982M in 2000 in terms of FDI inflows among all countries in the world (see Fig. 2.3). From 2001 onwards there has been an important increase in the FDI flows: total cumulative net FDI inflows reached nearly US$100B between 2001 and 2010

[2] See Kepenek and Yentürk (2003), Önis (1994), Erdilek (1986; 2003), Akpınar (2001), Alıcı and Ucal (2003), Yılmaz (2006), Yılmaz and Barbaros (2005), Taymaz and Yılmaz (2007), Pamukçu and Taymaz (2009) for detailed information on FDI flows in Turkey in terms of historical background, obstacles, structure, discussions and various statistical data.

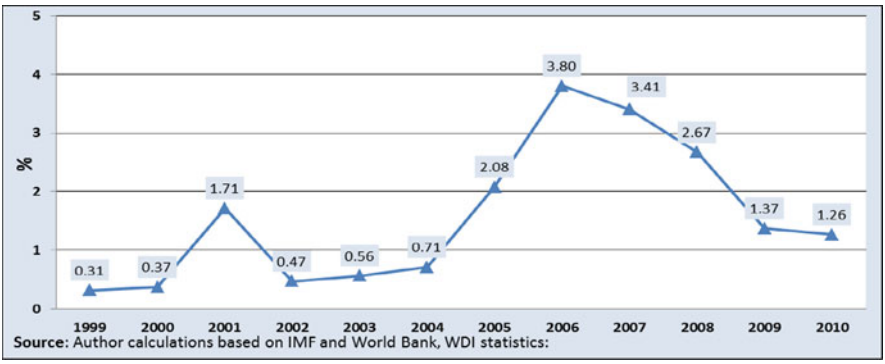

Fig. 2.1 Evolution of the FDI/GDP ratio in Turkey: 1999–2010 (%)

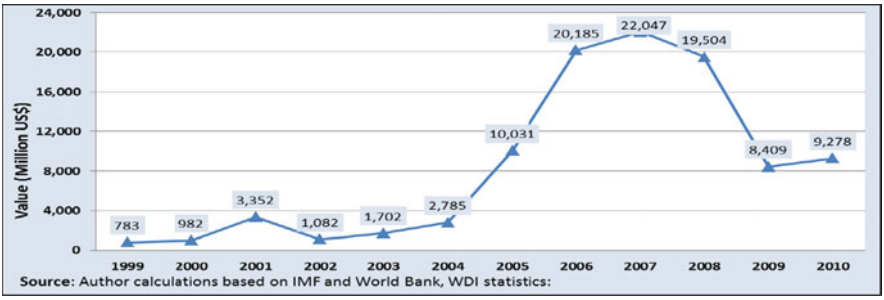

Fig. 2.2 Net FDI inflows in Turkey (BoP Current US$)

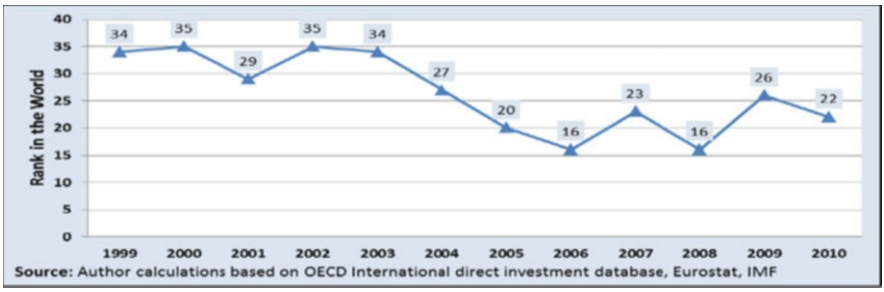

Fig. 2.3 Ranking of Turkey in the world in terms of net FDI inflows

(annual average of US$10B) especially after the Turkish government has started to liberalize its investment policy in 2004 (last stage of privatization program). As illustrated in Fig. 2.2, FDI inflows peaked in 2007 with US$22B. Moreover, as seen from Fig. 2.3, the ranking of Turkey in the world in terms of FDI flows for the period 1999–2010 increased from 35 (in 2000) to 16 (in both 2006 and 2008) for the first time within all countries that attract most FDI flows in the world.

2.3 Multinational Companies and Technology Spillovers

It is known that multinationals are the major players in global production, FDI flows, R&D, and innovation; they are the technology producers of the world. A significant part of the R&D investments in the world are made by these companies (Borensztein et al., 1998). While producing technology, these companies also control the worldwide technology (Eden et al., 1996). Significant information and statistics on the production and technology activities of those companies can be found in various publications and reports, published by OECD and UNCTAD annually (such as main science and technology indicators, and world investment reports). For instance, according to UNCTAD (2011) statistics, the value added generated by multinationals worldwide in 2010 was nearly US$16 trillion, about a quarter of global GDP. Also, total sales/(value added) generated by foreign affiliates of multinationals in the world accounted for US$33 trillion/(US$7 trillion) in 2010. They also conducted exports that are worth more than US$6 trillion, about one-third of global exports. The trade volume of the multinationals' headquarters and their affiliates located in other countries is nearly one-third of the total world trade. Eighty percent of the R&D activities in the OECD countries are performed by the multinational companies who have more than 10,000 employees. Again, 75–80% of the private R&D expenses worldwide are made by the same companies. However, the majority of the technology production and basic R&D activities are realized in the home country of these multinationals. For example, USA-based multinationals conduct only 13% of their R&D research in other countries (UNCTAD, 1997, 2003). More than 65% of the global R&D research total is conducted only in five countries. These countries are the USA (33%), Japan (13%), China (9%), Germany (6%), and France (4%) (OECD, 2009). When we add the next five countries—South Korea, England, Russia, Canada and Italy—, this ratio increases to 80%. This situation reflects that four-fifths of the world's R&D is conducted by just ten countries (OECD, 2009). All these statistics show that multinationals have become the predominant decision-makers in global economic system, technology, innovation, and R&D. For these reasons, multinationals are seen as the creators, major sources, and diffusers of new technologies for the host countries.[3] Therefore, all studies that investigate the technology spillovers have focused on these companies.

Multinational companies invest substantially in R&D, innovation, test facilities, design, and advanced and sophisticated new technological fields, and their products are recognized internationally. These activities are much costly and risky, and require high budgets. Therefore, multinationals owe their dominant position to these activities as the major producers and sources of advanced technologies.

[3] See Lenger (2004) on the discussion of MNCs and for further details.

Moreover, they have established their production, distribution and marketing networks worldwide, by which they can operate in many locations of the world and they can protect their strategic technologies through many ways (intellectual property rights, patents, and other informal ways) (UNCTC, 1994).

In the last decades, together with globalization process, FDI accompanied by multinationals is considered a major factor for economic growth and development strategy. Hence, almost all governments, particularly developing countries which do not want to reinvent the wheel, compete with each other in order to attract more FDI flows by liberalizing their FDI regulations, by creating favorable conditions, and by offering incentives in a wide range for multinationals[4] (see Narula & Driffield, 2012; Narula & Dunning, 2000; Narula & Marin, 2003; UN, 1999). Moreover, FDI is also being promoted by international institutions (WTO, OECD, IMF, EU, UN, UNCTAD, Washington consensus,[5] etc.) that help countries to attract more multinationals by giving them advice, training, and various assistances (Narula & Driffield, 2012). Because of these reasons, the relationships of the governments with MNCs have gained impetus, and the role of the MNCs in developing countries has significantly increased in their economies (UNCTAD, 1997, 1998). Accordingly, FDI flows by MNCs have increased significantly and it is seen as the most important external source of technology for developing countries (UNCTAD, 2000). In sum, developing countries rely on MNCs for their technological development and for transferring of the advanced technologies.

According to the general view, it is considered that MNCs associated with FDI will bring with them superior technologies (which includes modern and advanced technologies in terms of product, production process, marketing, and distribution), know-how, skills (in terms of organization/management/marketing), export contacts, well established and designed systems for relationships with suppliers and customers on top of the inflow of physical capital (Aitken & Harrison, 1999; Blomström & Kokko, 1998; Caves, 1971; Hymer, 1960; Kokko, 1996). Host countries hope that they will have a chance to gain access to the technology by inviting foreign investment, and they hope that they will acquire these in the end. It is also considered that FDI will result in benefits for national income, employment, capital formation, productivity, foreign trade, and technology structure of the host country. All of these will increase the technological capability and productivity level of the host country firms through their interactions with MNCs. That means they rely on FDI as a source of technology and capital (Lall, 1997; UNCTAD, 1998). These kinds of benefits arise through externalities discussed above with the

[4] These incentives are usually in the form of special tax concessions, lower income taxes, exemptions from import duties, extension of tax holidays, subsidies for infrastructure and direct subsidies.

[5] The term was firstly used by the economist John Williamson in 1989. It refers to ten recommendations of three institutions (the World Bank, the IMF and the US Treasury department) for developing countries based on neo-classical economic theory to establish a more market oriented economy.

terms *FDI productivity spillovers* (external effects) or *technology spillovers*,[6] and it is considered as the most important benefit from FDI (see Blomström & Kokko, 1998 for further details).

In the literature, technology spillovers are associated with the direct or indirect benefits of MNCs, and they generally occur when the entry of MNCs lead to productivity increases in the local firms of host country. Direct benefits can be summarized as increases in physical capital, employment, and usage of advanced machinery and equipment. On the other hand, indirect benefits are the various technology spillovers from MNCs to local firms. According to this view, technologies of MNCs is in the nature of public good to some extent and generate positive externalities because they cannot be fully internalized by MNCs and local firms of host country may benefit from these externalities. In other words, technology spillovers are thus a matter of externalities being provided by foreign firms in host country to local ones (see Blomström, 1986). These are considered as one of the most significant channels for the diffusion of modern technology across countries, rather than formal technology transfer arrangements (Romer, 1990).

Spillovers from MNCs impact also positively on human capital level in host country by direct and indirect ways. Entry of a multinational into domestic market is expected to directly increase the employment level and capability level of the domestic human capital by providing on-the-job or off-the-job training and education, by "learning by doing" activities, and by transferring their "technological knowledge" to their domestic workers (engineers, R&D, production, and management personnel). These education and training activities are expected to increase the quality and tacit knowledge level of the workers in host country. In addition, local firms increase their own employment because of "increased economic activity", and it is expected that MNCs provide training and technical assistance to their direct suppliers in host country. Direct suppliers of MNCs gain access to more productive human capital stock: their staff are employed and trained by MNCs, or they hire workers who already have the knowledge and technology of MNCs (see Narula & Marin, 2003 for further details).

MNCs invest generally in overseas countries in the expectation of acquiring higher profits by using their firm-specific advantages. These advantages of MNCs are associated with technology (including economies of scale, patent, capital intensity, human capital, innovation, R&D, etc.), "managerial ability", "organizational skills", "the ability to coordinate resources or supply chains", international distribution and production networks, "access to finance", and "the knowledge of markets" (Dunning, 1979; Narula & Driffield, 2012). Dunning (1993) explains potential sources of these advantages within "OLI model" (which stands for ownership, location, and internalization advantages) that may have impact on a firm's decision to become a MNC. According to this, "ownership advantages" (O) of MNCs allow them to compete successfully in host countries due to their firm-specific advantages such as better marketing techniques, export contacts,

[6] We will use the terms "productivity spillovers" and "technology spillovers" interchangeably throughout the study to refer to the same concept.

reputation, superior managerial, production, and technological capabilities, and so on. Dunning uses "location advantages" (L) term in order to refer to the benefits offered by host country to attract the MNC (investment and tax incentives, special tariffs, etc.) and the access to good infrastructure and production factors of host country at low cost. Lastly, "internalization advantages" (I) refers to advantages of MNCs to invest in a country rather than exporting, licensing, or joint venture. In short, according to Dunning, determinants of MNCs' activity abroad are influenced by these three factors.

MNCs generally establish an affiliate in overseas countries in order to produce and sell goods. These affiliates use local inputs of capital, labor, and intermediate products. Moreover, these affiliates provide new technologies to host countries by both development through R&D activities in host country and importing from its parent company in home country (Hines, 1995). According to the 'industrial organization' approach, affiliates of MNCs can compete with local firms in host country because of their firm-specific intangible assets[7] (see Caves, 1996). These assets are in the form of explicit technology (machinery, tools, equipment) and tacit knowledge (capabilities, experience, know-how) about "organizational governance" based on intra-firm hierarchies and on "the advantages of common governance" (Lall & Narula, 2004). Due to less costly and easily transferable/transferred specifications of these assets, MNCs prefer direct investment in host country rather than licensing these assets to local firms, and they protect their advantages by this way (Aitken, Harrison, & Lipsey, 1996). On the other hand, some studies that analyzed why MNCs invest in the host countries rather than directly exporting or giving license of their products/technologies revealed that one of the reasons is to protect these advantages due to market failures and non-existence of proprietary rights (see Caves, 1996; Görg & Greenaway, 2004; Markusen, 1995). Therefore, even if explicit technology can be acquired by local firms, tacit knowledge cannot be easily gained by such firms. The only way that local firms can profit from external benefits of MNCs is the technology transfers from MNCs, but MNCs will not easily transfer the source of their advantages to the local firms in host country.

Due to globalization process, MNCs have a dominant role in the technology transfers, and they play an important role in the transfer of advanced technologies across countries. Technology transfer from developed countries through MNCs may provide increases in knowledge base and technological capabilities, and may serve as a vehicle for technological change and learning; however, experiences reveal that relying on fully-owned or joint-venture MNCs are not necessarily an effective way to acquire foreign technologies. These firms may transfer production technology, but they do not transfer their engineering, innovation capabilities, and

[7] Such as trademarks, technology, knowledge, organizational, marketing and managing skills, export experiences and contacts worldwide, production methods and marketing advantages, coordinated strategic relationships with suppliers and/or customers, distribution networks established worldwide, and reputation.

their tacit knowledge when parent company used FDI to exploit the local market. Therefore, these kinds of FDI as a means of technology transfer may lead to foreign dependency (see Kim, 1998 for further details).

Technology spillovers depend on many factors. One of them is "the scope and competence" of the MNC affiliate. According to this view, MNC affiliates with complex production systems and advanced technology need high level of local capabilities, skilled human capital, strong clusters, service firms, government incentives, substitutions, and institutions. That is one of the important reasons of why MNCs generally prefer to establish and to conduct their basic R&D and design activities in their home countries. If countries can provide these, then MNCs will establish high-tech affiliates in host country, and high quality of spillovers from these affiliates can be expected (Lall & Narula, 2004). In their study, Wang and Blomström (1992) developed a model to analyze the international technology transfer, and they revealed that these were resulting from the strategic interactions between affiliates of MNCs and local firms in host country. They also point out that learning efforts of local firms have positive impact on such technology transfers provided by MNCs. On the other hand, establishment structure of the affiliates also determines the quality of spillovers. For instance, spillovers from an affiliate in the structure of sales office are limited than that of manufacturing plants.

Consequently, in the last decades, there has been a significant change in developing countries in terms of openness and attracting more FDI flows. The main reasons for this change can be summarized as globalized production networks, easy access to international markets and production networks of MNCs, and need of acquiring advanced technologies of MNCs. In this process, the role of MNCs as the creators of high technologies has grown in all countries and they have become the leader of technology transfers. They are seen as the only source of the technology creation and as dominant actors in international technology diffusion. However, the MNCs that use high-technology generally prefer to invest in developing countries with high level capabilities in terms of human capital, better infrastructure, and production. That is, liberalizing FDI policies is seen as a necessary condition for developing countries, but not sufficient to attract more MNC with high technology and to benefit from it. Besides, it requires strong local technological capabilities that MNCs need (Lall, 1997; Lall & Narula, 2004). In other words, there is no any reason to believe that FDI flows through MNCs lead to an increase in exports, competition, capacity, and productivity of local firms and result in technology spillovers to local firms, which ultimately determine economic growth in the long run. Conversely, it is necessary to have a certain "knowledge base", "intensity of effort", and "technological capacity" in order to benefit from spillovers acquired through MNC activities (Lall & Narula, 2004).

2.4 Channels of Technology Spillovers

This section discusses in detail the major channels that earlier literature identified through which the spillovers from foreign firms to local firms can occur. There are a number of spillover channels identified in the literature, but we categorized these as FDI, horizontal and vertical (backward and forward) linkages with foreign firms, "demonstration/imitation", "labor turnover" (skill acquisition), "competition", and "exports" (see Blomström & Kokko, 1998; Görg & Greenaway, 2004; Kinoshita, 1999; Kokko, 1992; Wang & Blomström, 1992). In the literature, three of these channels—demonstration, labor turnover, and competition—are referred as horizontal ones.

Via FDI: It is known that FDI is generally the most important channel through which superior technologies (equipment, machines, skills, knowledge, etc.) can be transferred from developed countries to developing ones. Developing countries, where local technologies and capabilities are very low, hope that MNCs, by establishing plants in host country, may provide technology transfers to their suppliers and sub-contractors, and they may also allow these firms to access their international networks. By this way, these countries may upgrade their technologies and conduct high-tech activities, and local firms may enhance their productivity (Glass & Saggi, 2002). Hence, FDI is seen as the largest source of external financing of the development and growth for less developed countries. For this aim, many governments have followed policies to ease restrictions on FDI and offered special incentives to MNCs such as tax exemptions, areas for establishing plants free of charge, and subsidies for infrastructure to attract foreign investment. The basic idea behind these policies as discussed before is to benefit from the spillovers occurring from FDI through technology spillover (Aitken & Harrison, 1999).

Via Vertical Linkages: Another important channel through which technology spillovers occur is vertical linkages (backward and forward), the relationship between foreign and local firms. The importance of this channel for host countries to benefit from FDI was introduced to the literature by Lall (1980) and Mead (1984), and developed further by Markusen and Venables (1999), Blomström and Kokko (1999), Pack and Saggi (2001). The spillovers that occur through these linkages are also referred as vertical spillovers (or inter-industry spillovers). These spillovers occur through forward and backward linkages of MNCs with local firms who become their suppliers and customers. According to general view, spillovers associated with vertical linkages with foreign firms give rise to more advanced, better quality and specific transfers to local firms, and more improvement in the productivity since MNCs voluntarily share their firm-specific technologies only with their closer local suppliers (backward linkages) and customers (forward linkages) for strategic reasons. Moreover, foreign firms may need to assist their local suppliers or customers to raise the quality of products supplied, and by this way local firms also improve their productivity.

- ***Backward Linkages***: In the case of backward linkages (selling output to foreign customers), the entry of MNCs may impact local suppliers positively by increasing the demand for local inputs. Moreover, local firms as suppliers or sub-contractors of MNCs may be forced to produce output with higher quality standards and technical specifications, and by using more efficient technologies. Therefore, MNCs may provide technical assistance or introduce new technologies for their suppliers in order to raise the quality of the intermediate products manufactured according to technical specifications enforced by MNCs (supply side) (Moran, 2001). Furthermore, MNCs may provide on-the-job and/or off-the-job training activities to both management and production personnel of their suppliers to ensure the organizational and management structure, delivery times, and production standards of the goods to be procured. MNCs may help their local suppliers to set up production facilities by providing technical assistance. In addition, MNCs may insist on using the high quality standards and procedures of their own on the production processes, or they may help their suppliers by giving materials-tools, or by providing some incentives or financial assistance to upgrade their technologies (demand-side) (Blomström & Kokko, 1999; Lall, 1980).

The spillovers and technology transfers provided by MNCs to their suppliers through backward linkages discussed in the preceding paragraph are well known practices especially in the global automotive industry. Global automotive manufacturers provide various technologies to their overseas affiliates or joint-ventures in host country in order to develop their production technology, to increase efficiency, and to provide firm-specific benefits. Foreign affiliates as the final users of the products being supplied by local firms assist their local suppliers in various ways as summarized in the preceding paragraph. The strategic relationships between buyers and suppliers in this industry are very strong and depend on mutual trust established in many years. Moreover, there are very close communication and strategic relationships between such firms in every step of the production, and supplier firms have actively participated in the production and design processes of products. These are also the most important reasons why we analyze the Turkish automotive industry as a case study in this book (see Sect. 3.3).

- ***Forward Linkages***: In the case of forward linkages (local firms' purchasing intermediate inputs from foreign suppliers), the most important benefit from MNCs is the supply of higher quality inputs at lower price to local firms (Markusen & Venables, 1999). Furthermore, MNCs may provide various assistances (such as technical services, manuals, training activities, seminars, and courses) to their local customers about using the products supplied by MNCs more efficiently (Görg & Greenaway, 2004). It must be kept in mind that if increases in production quality lead to increases in prices, and if absorptive capacity of the local firms is insufficient to benefit from this upgrade of quality, they will be negatively affected by increased costs (Javorcik, 2004). This situation is called *negative forward spillovers* and it may also help to explain

the negative findings on such spillovers (see Sect. 2.6.4 for other reasons of negative spillovers).

Because of the reasons discussed above, vertical linkages are considered as one of the most important channels to increase the technological capabilities of local firms (see Lall, 1980; Lin & Saggi, 2004; Markusen & Venables, 1999; Navaretti & Venables, 2004; Rodriquez-Clare, 1996). In addition, vertical spillovers are seen as more important than horizontal ones (intra-industry spillovers) in terms of technology spillovers because of direct and close strategic relationships between foreign and local firms (Moran, 2001).

Empirical studies for vertical spillovers have produced mixed results for each country. For instance, Kugler (2001) finds positive horizontal (intra-industry) spillovers but no evidence for vertical spillovers (inter-industry) in Colombia manufacturing industry. Javorcik (2004) in her study for Lithuania and Blalock and Gertler (2003) for Indonesia find positive productivity spillovers through backward linkages but no evidence for forward and horizontal linkages. Moreover, the estimations of Driffield, Munday, and Roberts (2002) for UK show that there are positive spillovers through forward linkages but not significant spillovers through backward linkages. In other studies for UK, Harris and Robinson (2004) find that horizontal spillovers are more important than vertical ones, and there are negative spillovers in many sectors. Girma, Görg, and Pisu (2003) in their study for UK also find that export oriented domestic firms benefit more from vertical linkages than domestic orientated ones.

In sum, firm-specific technology of the foreign firms may spillover to local firms in host country through vertical linkages. With these linkages, local firms are exposed to new products, production and marketing techniques, and to more rigorous quality and working conditions, and they may receive direct technical support and training activities from upstream or downstream foreign firms. Moreover, foreign firms may also act as a stable customer of the local firms for their input demands, and this gives rise to maintaining long-term and mutual trust that is based on strategic relationships with foreign firms. In all these cases, foreign firms would raise the productivity gains for local firms through vertical linkages (see Aitken & Harrison, 1999 for further details).

Via Demonstration/Imitation: *Demonstration* by MNCs or *imitation* by local firms is probably the most evident spillover channel. Foreign technology embodied in FDI can be acquired by observing foreign firms or by imitating some technologies used by MNCs. Local firms, by these ways, can improve their productivity and efficiency. For instance, when a new MNC enters a market, it introduces new technologies in terms of production, process, quality control, distribution systems, and organization into market, and local firms may improve their capabilities and production methods by adopting and copying these through imitation or reverse engineering. These externalities are also called as "contagion" effects (see Blomström & Kokko, 1998; Cantwell, 1989; Das, 1987; Kokko, 1996; Wang & Blomström, 1992 for details). These are generally observed among firms operating in the same industries, so these are also referred as horizontal spillovers. A number

of case studies have identified the presence of spillovers through demonstration in various countries (see Blomström & Kokko, 1997).

Via Labor Turnover (Skill Acquisition): One of the channels through which spillovers occur to local firms is labor turnover. Training of the employees at the MNCs and recruitment of this trained workforce by the local firms could enable the local firms, though indirectly, to access the production and management skills of the MNCs. According to this, workers employed by MNCs acquire knowledge of its technology by training activities and experiences, and this knowledge may move to local firms by labor turnovers. Role of labor turnover as a channel of technology spillover was examined by Glass and Saggi (2002). It is expected that labor turnover mostly occur among firms within same industries, so it is also referred as horizontal spillovers.

It is agreed that, as a result of having firm-specific intangible assets, MNCs demand highly skilled and experienced workers from labor market. Moreover, when a worker joins the firm, they invest a lot in regular training activities, and they train their employees continuously in order to provide the latest technologies. Therefore, skills and knowledge of the domestic workers employed and trained by MNCs may spillover to local firms when they set up their own firms or when they are hired by local firms in host country (Kokko, 1996). Moreover, hiring workers who have acquired knowledge and advanced technologies of MNCs is seen as one of the important channels for the transfer of tacit knowledge in terms of management, quality control, distribution, and marketing systems. On the other hand, it should be noted that this channel also has a negative impact on local firms as MNCs may attract the skilled workers away from domestic firms by offering higher salaries (Girma & Wakelin, 2001). For theoretical discussion for the role of labor turnover in the technology transfers from MNCs see Glass and Saggi (2002).

It is very difficult to measure and analyze the spillovers that occur through this channel because it is not possible to track employees, worked for MNCs and hired by local firms, and their effects on local firms (Glass & Saggi, 2002). One of the methods to measure the spillovers through labor turnover is "wage spillovers". As a result of higher training investment expenditures, it is expected that MNCs should put upward pressure on wages and often pay higher wages to prevent the labor turnover, because marginal productivity of workers in the plants are very high (Lipsey & Sjöholm, 2004). On the other hand, if local firms want to attract skilled workers who have tacit knowledge of MNCs have to pay also higher wages and give more incentives than MNCs. As a result of these, if they compete on the same labor market, higher wages in foreign firms spillover to local firms, and this could be an indicator for technology spillovers associated with higher "wage spillovers" to local firms. Therefore, some studies which examine the impact of FDI on domestic wages hypothesized that rises in equilibrium wages in response to increases in FDI may represent an evidence for technology spillovers through labor turnover. In other words, high wage differentials may present the lack of technology spillovers between foreign and local firms (see Aitken et al., 1996; Girma, Greenaway, & Wakelin, 2001; Görg, Strobl, & Walsh, 2003; Lipsey & Sjöholm, 2001 for further details and testing of wage spillovers). The studies that

examine wage spillovers are very limited[8] and they generally have adopted a regression framework as in the case of productivity spillovers: wages paid in local firms are used as the dependent variable and some proxies for foreign presence at both firm- or sector-level are added. Moreover, firm-specific (age, firm size, exports and capital intensity, share of skilled employees in the workforce, R&D expenditures, and so on) and sector-specific control variables are added as explanatory variables (see Pamukçu & Taymaz, 2009 for further details).

Via Competition: Presence of MNCs increases competition in host countries and this is seen as one of the major channels of spillovers. Entries of MNCs into domestic market should bring newer and advanced technologies; these force domestic firms (receivers) to use their available technology more efficiently, to improve or upgrade their technology in order to be competitive and to get much benefit from these technologies. Moreover, this situation also forces other local firms to use their existing technologies and sources more efficiently in order to cope with the "competition", to survive and to protect their market shares. In addition, they have to seek new technologies to use in the production process and to increase their productivity levels. As a result of competition effect, acquiring and adaptation process of new technologies will also be accelerated (see Aitken & Harrison, 1997; Blomström & Sjöholm, 1999; Dunning, 1993; Glass & Saggi, 1998, 2002; Markusen & Venables, 1999; Wang & Blomström, 1992). Due to the nature of competition within intra- and inter-industries, this channel affects both horizontal and vertical spillovers. However, it should be noted that this channel may also affect the productivity of local firms negatively. If foreign firms enter into domestic manufacturing market at a lower marginal cost than local firms, they may steal some market share from local firms, and they may force them to manufacture on a less efficient scale. These give rise to higher average costs for local firms and their productivity will be lower (Aitken & Harrison, 1999, p. 607).

Via Exports: The last important channel through which spillovers occur is the exports (export access). In other words, the spillovers occur when local firms have gain to access to foreign markets because of the presence of export oriented MNCs (Aitken, Hanson, & Harrison, 1997; Blomström & Kokko, 1998; Greenaway, Sousa, & Wakelin, 2004). Local firms can benefit from the MNCs' knowledge on global markets by observing their production, management, and exporting activities and techniques (*demonstration effects*). MNCs may share their information on foreign markets and may enable local suppliers to use their distribution networks in foreign countries. In other words, local firms can increase their export shares by learning from export oriented MNCs and using their distribution networks since MNCs have superior experience and knowledge on entering world markets, international marketing, production, exporting, and they have strong networks in various countries. Therefore, the collaboration between local firms and export oriented MNCs may provide international marketing channels for local firms. Furthermore, export competition with MNCs at host country and in foreign markets may lead to

[8] See, Görg and Strobl (2001, 2003) for details.

productivity increases for local firms. In sum, as a result of these effects, local firms may improve their export capabilities and may be successful exporters, and they can compete more successfully in export markets (Görg & Greenaway, 2004, p. 194).

Several studies have revealed the positive impact of MNCs on the export capacity of local firms (Aitken et al., 1997; Kokko, Zejan, & Tansini, 2001; Rhee, 1990). In addition, the local firms that have linkages with MNCs may easily access foreign markets or may reduce the entry costs into foreign market by benefiting from the knowledge and distribution networks of MNCs (through imitation or collaboration). For instance, the backward linkages with MNCs may provide knowledge about product and process technologies, foreign market conditions and arrangements, and tastes of foreign consumers in terms of design, product quality, and packaging (see Aitken et al., 1997; Barrios, Görg, & Strobl, 2003; Blomström & Kokko, 1998; Greenaway et al., 2004). For the empirical studies about the effects of exporting access on spillovers, see Aitken et al. (1997); Kokko et al. (2001); Greenaway et al. (2004); Banga (2003); Barrios et al. (2003).

Consequently, all of the above channels are seen important because they are complex and interconnected (Kinoshita, 2001). However, it is clear that how much the local firms can benefit from these spillovers is dependent on their efforts and technology capabilities.

2.5 Determinants of Technology Spillovers

This section briefly discusses the determinants of technology spillovers that occur MNCs to local firms in host country. In the light of literature, key determinants can be categorized under four headings: Absorptive capacity and technological gap, MNC, host country, and firm characteristics.

2.5.1 Absorptive Capacity and Technological Gap

One of the most important factors that affect technology spillovers is the absorptive capacity of both host country and local firms. Although absorptive capacity is evaluated as firm specific, it can be also associated with a country or location. For instance, the success of a firm to absorb and to internalize efficiently transferred technology depends also on "the institutional and organizational framework", "infrastructure", "the processes that create and distribute scientific knowledge", "cultural, political and financial structure of the host country" (Lorentzen, 2005; Narula & Driffield, 2012).

Absorptive capacity is defined as an ability to internalize technology created by foreign firms and "modifying it to fit their own specific applications, processes, and routines" (Narula & Marin, 2003, p. 23). The results of the studies show that

technology diffusion does not automatically occur; it requires the recipient to have a certain "knowledge base" and "technological capability" to collaborate successfully with source so that it can absorb and adopt such technologies (Kinoshita, 2001; Wang & Blomström, 1992). In the literature, it is agreed that "existing knowledge base" and "intensity of effort" are two important elements of absorptive capacity in order to internalize and to assimilate new knowledge. Today, firms learn new technologies by their "existing knowledge base", and this also influences their learning processes and their knowledge in the future. "Intensity of effort", on the other hand, refers to the activities of local firms to solve technical problems encountered in production, and represents a firm's physical energy and intellectual entrepreneurship to internalize and to convert foreign technology (Cohen & Levinthal, 1990). Moreover, absorptive capacity of the local firms determines the speed and duration of the internalization process of the transferred technology. In the literature, "knowledge base" is considered less important than the "the intensity of effort" because the latter creates the former, but not vice versa (Techakanont & Terdudomtham, 2004; Ullrich, 1998).

"Technology gap" term is used to refer to the absorptive capacity and it is simply defined as the distance between source (home country or foreign firms) and recipient (host country or local firms) in terms of technological competence and development level (Borensztein, et al., 1998; Xu, 2000). It can be measured in many ways, such as the difference between the productivity of local firms and the average productivity of foreign firms in the sector, or the ratio between the labor productivity of a firm and average productivity of the sector. Furthermore, it signals to MNCs about the recipient's absorptive capacity related to human capital, institutions, infrastructure, R&D capacity, distribution networks, and technology capabilities.

In the literature, there are two contradictory views about the effects of technology gap on spillovers. Findlay (1978), in his pioneering contribution, introduced the role of *relative backwardness* on technology spillovers. He proposed that the greater the technology gap between two countries/(two firms) in terms of technological capability or development level, the greater the opportunities for less developed country/(less developed firm). He also suggested that higher technological gap accelerates the technology spillovers due to greater pressure for change and more rapid adaptation of new technologies (see Castellani & Zanfei, 2002; Sjöholm, 1999b). In other words, technology gap will facilitate the technology transfer processes through relationships between those who have the advanced technology and knowledge (such as developed country or MNCs) and those who wish to acquire, assimilate, and absorb them (such as host country or local firms) (Narula & Driffield, 2012). However, it is necessary to point out that Findlay does not completely ignore the role of technological capability to benefit from spillovers by suggesting that the gap must not be too wide, or a threshold level of capability in terms of scientific and technical knowledge is necessary in order to use and acquire technologies. In contrast to this view, some studies (Cantwell, 1989; Glass & Saggi, 1998; Kathuria, 1996; Kokko, 1994; Kokko, Tansini, & Zejan, 1996; Liu, Siler, Wang, & Wei, 2000; Perez, 1997; Wang & Blomström, 1992) reveal that there is a

negative relationship between technology gap and technology spillovers; the greater technology gap means lower qualities of technology transferred and lower potential gains for spillovers. This line of thought assumes that it is necessary to have only a reasonable technological gap with MNCs for the recipient to benefit from technology spillovers associated with MNCs. It is suggested that if the technology gap is higher for the local firms with low-tech level, technology spillovers may be lower for these firms because of their lack of "absorptive capacity" (Kokko, 1996). In other words, a large technology gap is a signal to MNCs about low absorptive capacity of domestic firms, and it decreases the gains from spillovers by domestic firms.

The findings of the studies support the second claim above. For instance, in their study for Tanzania, Portelli and Narula (2004) find that larger technology gaps between local and foreign firms give rise to fewer backward linkages and to lower quality technological spillovers. Narula (2004) also shows that countries with high absorptive capacity receive FDI flows that include advanced and high level technologies. In another study, Borensztein et al. (1998) revealed that higher productivity growth from FDI depends on the level of absorptive capacity. In a similar vein, Narula and Marin (2003) confirm that only firms with high absorptive capacity are to benefit from FDI spillovers. Moreover, Xu (2000) shows that skilled human capital stock of the host country plays an important role in reaping benefits from technology transfers. Therefore, the second claim may be more rational than Findlay's claim because one of the conditions to benefit from spillovers is that local firms must have certain technological capabilities relative to their foreign counterparts. Meanwhile, it can be claimed that the absorptive capacity of host country firms is more important than being able to access the technologies of MNCs, and this capacity determines whether or not they benefit from FDI (Görg & Strobl, 2003). Therefore, backwardness is not seen as an advantage for the countries; actually, it could be a disadvantage (Bell & Pavitt, 1997).

In sum, absorptive capacity is seen by researchers as an important factor in order to internalize the benefits resulted from MNCs at both the firm and the host country level. Moreover, according to FDI-assisted development view, local firms as collaborators and suppliers of MNCs must have a certain level of technological capability to usefully internalize spillovers, and to learn from MNCs, and to undertake specific duties assigned by MNCs. Therefore, a specific threshold level of absorptive capacity required to benefit from spillovers is seen as a key determinant on spillovers (Narula & Driffield, 2012).

2.5.2 MNC Characteristics

This section deals with the characteristics of the MNCs that impact on spillovers.

Motives of MNCs: According to Narula and Dunning (2000), the main motives of FDI through MNCs whether to invest or not in a country (especially in developing countries) are summarized in four ways: "resource seeking", "market

seeking", "efficiency seeking (to restructure existing foreign production through rationalization)" and "strategic asset seeking" motives. They define these motives as follows:

- "Resource seeking" motive is the motive to obtain resources and production factors at lower costs.[9]
- Motive for the "market seeking" is to invest in a country to supply goods to host country or other neighbor countries. In other words, MNCs may invest in a country in order to access host country market,[10] to protect and to expand their market shares by expanding their production bases.
- "Efficiency seeking" motive for the MNCs is to invest in a country in order to increase efficiency by using different production factors, market structures, experienced and skilled domestic workers in host country, policies, customer preferences, etc.
- Lastly, "strategic asset seeking" is the motive to acquire and to benefit from the strategic assets of host country such as "marketing", "technology", "marketing", "infrastructure", investment policies, and human capital stock (see Narula & Dunning, 2000, pp. 150–152 for further details).

It is stated that, MNCs aim to generate economic rent by using their advanced production techniques in the first three motives, while they move and invest in a country to acquire new assets that protect or enhance existing assets in the last motive. In general, MNCs have generally moved with these four motives discussed above to make an investment decision in a country: using natural resources in host country; using cheap labor stock; entering new markets and expanding their market; improving production technologies; developing new technologies; and obtaining "new strategic assets" (Narula & Dunning, 2000, pp. 150–152). Until a few decades ago, the majority of the MNCs engaged in the first two motives and invested in host countries; therefore, developing countries received most of their FDI owing to these motives. In other words, developing countries have generally attracted MNCs which try to generate economic rent by using their "firm-specific intangible assets" (Lall & Narula, 2004, p. 451). Today, however, we see that MNCs have changed their motives, and the majority of them have engaged in the last two motives to manage and integrate their activities across borders, and to maximize their cross-border efficiencies. These motives also have a prominent role in the transfers and spillovers since they are also interrelated with strategies of MNCs (Narula & Driffield, 2012; Narula & Marin, 2003). Henceforth, the main motives of MNCs may affect the extent and quality of spillovers, and linkages with local firms.

The Entry Mode of MNCs: The other important factor that affects the occurrence of spillovers is the entry mode of MNCs into host country. MNCs may enter into domestic market either through a "merger or acquisition" (M&A), entering into

[9] These could be in the form of natural or human resource-seeking.

[10] Especially they invest in host countries where import substitution policies have restricted import from the foreign markets in developed countries.

market by purchasing an existing domestic firm or by joint venture with one, or through "greenfield investment", entering a market by building a new firm. It is suggested that new technologies have been introduced to the market slowly in the case of M&A, while they are instantaneous in greenfield investment mode. According to this view, MNCs established in the form of M&A integrate into the domestic market and sources more locally than those established through greenfield investment. M&A entry mode creates more linkages with local firms, and thus it may give rise to more spillovers. On the other hand, in greenfield investment mode, because MNCs rely on their own technologies and systems that differ from host country, and they import such inputs heavily from their home country, the spillovers may be restricted (based on Crespo & Fontoura, 2007, p. 414). Moreover, affiliates of MNCs established in the form of greenfield investment are expected to have weak linkages with local firms than those established in the form of M&A investment (Narula & Driffield, 2012; UNCTAD, 2000). Therefore, it is expected that MNCs established through M&A will result in greater vertical spillovers than those established through greenfield investment.

Foreign Ownership Structure: Although evidences from studies have produced mixed results, another factor that may affect spillovers is "the ownership structure of the MNC affiliates" established in host country. There are two contradictory views about the role of foreign ownership in the literature (based on Blomström & Sjöholm, 1999). According to one view, MNC affiliates with minority foreign ownership reduces the spillovers to local firms because parent company may hesitate to transfer more advanced technology, know-how, and systems to its affiliate in host country due to its reduced control over the affiliate. In other words, there is a positive relationship between technology spillovers and the degree of foreign ownership. When the MNCs have the majority of the shares, it would bring along its much newer technologies and its managerial skill along with it, since they would have a control over the profit and the firm. Newer and more technology could mean more spillover (Ramachandran, 1993). The contrary view suggests that minority ownership MNC affiliates may have more positive impact on benefiting from spillovers than those with majority ownership because it is expected that MNC affiliates with minority foreign ownership need to create more linkages with their partners and local firms in host country by transferring more advanced technologies in order to increase their advantages over domestic market and to get high profits. These are expected to lead to more knowledge and technology diffusion to local firms in host country. In other words, larger domestic ownership in MNC affiliates is better to access foreign technology because it may create more linkages with the local firms and the parent firm cannot prevent leakage of technologies. For this reason, some of the developing countries press on the foreign investors to make them establish joint ventures with the local firms (Blomström & Sjöholm, 1999).

The Market Orientation Strategy of MNCs: It is one of the most important factors that matter in spillovers. Export-oriented MNCs are expected to conduct less frequent linkages with local firms since they purchase less locally than domestic oriented ones in order to produce goods with higher quality requirements and technical specifications for export markets. Moreover, if intermediate products

are used intensively, and if costs of communication are high between parent and affiliate, and if intermediate goods that are produced in home and host country are similar, it is expected that more linkages are created by MNCs (Görg & Strobl, 2003; Lall & Narula, 2004; Narula & Driffield, 2012).

The Origin of MNC: It is another factor that may also generate different spillovers to local firms because of their different nationalities, cultures, technologies, different modes of transfers, working conditions, and systems (see Crespo & Fontoura, 2007 for details).

2.5.3 Host Country Characteristics

The literature on the determinants of technology spillovers reveals that the host country characteristics play an important role in the decisions of MNCs about whether to invest or not in that country, and impact on both the technology spillovers and the adaptation of new technologies by local firms. The major characteristics identified by econometric analyses and case studies in the literature are summarized under four headings: (i) economic development level, (ii) knowledge base or available skilled human capital stock, (iii) infrastructure, and (iv) technological capability level of the host country. These also determine the composition and quality of technology spillovers and the level of benefiting from it. Furthermore, foreign trade policy, foreign investment policy, intellectual property rights, market size, competition level, investment incentives, policy stability, or overall macroeconomic outlook of the host country are other host country characteristics that may determine the linkages with MNCs (based on Blomström & Kokko, 1997; Görg & Greenaway, 2004). For instance, countries with larger market size, with larger capacity, with better skilled human capital stock, and higher technological capability are expected to attract MNCs with advanced production technologies and knowledge, often with R&D and design departments. Moreover, it is agreed that there is a positive relationship between the quality of linkages created with MNCs and average technology level of the local firms in host country.

Economic Development Level: Empirical findings related to developed and developing countries show that there is a positive correlation between development level of host country and benefiting from spillovers (Blomström, Lipsey, & Zejan, 1994). The studies on developed countries provide consistent results on positive spillovers, while studies on developing countries produce mixed results (positive, negative, or insignificant results). These studies support above argument by suggesting that developed countries have better infrastructure, advanced financial institutions, advanced technological equipment, high competitive sectors, local firms which have high technological capability, skilled human capital, better inter and intra-sectoral linkages, and these give rise to more positive spillovers and to more benefits from these.

Supply and Quality of the Human Capital Stock: It is the other most important factor and used as a proxy for knowledge base because advanced technologies need skilled and educated workers. MNCs may decide to invest at a location if there is enough educated and skilled human capital. Findings show that MNCs with high technology invest only in countries with higher skilled human capital stock. Therefore, it is necessary to have certain qualified human capital stock in order to get benefit from advanced technologies and to host advanced foreign technology (see Keller, 1996, 2004). The quality of human capital may be generated by host countries through formal education, formal training, on-the-job and off-the-job training activities.

Infrastructure and Incentives: Spillovers may also depend on the infrastructure of the host country (such as communication, and logistics) and incentives given by host country for R&D, innovation, and investment. In a similar way to human capital stock, MNCs with highly-intensive technological manufacturing need high-tech and developed infrastructure. Incentives by government to attract more FDI, to develop infrastructure, and to increase absorptive capacity of the local firms play an important role in promoting the spillovers. Although individual firms are responsible to benefit from spillovers, it is clear that entire economic system and infrastructure are very crucial to successfully absorb technologies, and they positively affect individual firms (see Narula & Marin, 2003).

Technological Capability Level: The possibility of attracting MNCs with high-tech production systems and advanced technologies, in order to acquire skill and technology from them, is higher for the countries with higher technological capabilities. However, these MNCs seek incentive public policies and special investment promotions conducted by host countries, so these are the other factors that positively impact spillovers (Lall & Narula, 2004). The major factors that impact the host country capabilities can be grouped as "physical and human capital", "infrastructure", "technological effort", FDI policies, incentives for FDI, trade regimes, institutions, and financial markets (Lall, 1992).

Foreign Trade Policy: According to this argument, trade regime of the host country has an impact on spillovers; however, the direction of the relationship is not certain and varies according to countries and host country policies. Yet, the general view suggests that export-oriented strategy is to attract more FDI flows than import substituting strategy. According to this view, in import substituting strategy, the size of domestic market is so small for foreign firms that they do not need to use their best technologies, marketing, and international distribution networks to produce only for the domestic market (Kokko et al., 2001). It is observed that MNCs prefer to transfer new and advanced technologies to their affiliates in developing countries with export-oriented markets, and these create higher technology diffusion to domestic firms (Dutz, Us, & Yılmaz, 2005). Empirical findings on different countries have produced mixed evidences on this argument. A number of studies find positive spillovers for countries with export-oriented policies, while others find positive evidences for countries with domestic-oriented policy (Kokko et al., 2001).

Intellectual Property Rights (IPR): The policies of the host country in terms of IPR are also affecting the decisions of MNCs whether to invest or not in the host

country, thus the occurrence of spillovers. If there is not any protection about the IPR, MNCs generally prefer not to invest in that country, or they prefer to bring with them only products and production process technologies with low-technological level.

The Foreign Investment Policy: This argument suggests that foreign trade-related investment measures and government policies, such as foreign ownership restrictions, incentives, substitutions, local content requirements, minimum export measures, and duties, impact on FDI inflows, and thus the technology spillovers accompany those inflows (Blomström, Globerman, & Kokko, 2001). With the accelerating globalization wave, government incentives for foreign investment have become much more important to attract FDI and it is considered as one of the important determinants of spillovers (Kokko, 2003).

The Structure of the Financial Sector: It is another key determinant factor. It is expected that host countries with highly developed financial market facilitate the spillovers to local firms. In this case, foreign or local firms who are in need of capital can be established by borrowing from financial markets at relatively lower costs, and firms can focus on engaging in their production activities (Alvaro, Chanda, Kalemli-Ozcan, & Sayek, 2004).

Competition Level: According to the results of some studies, competition level of the host country may be a factor that affects spillovers from MNCs. However, findings could not reach consistent evidences. Some of the authors argue that competition level may negatively affect spillovers due to high costs in order to obtain advanced technologies (Barry, Görg, & Strobl, 2005; Blomström et al., 2001), while others suggest that high competition level encourages MNCs to transfer more advanced technologies and this enhances the spillovers to local firms (Kokko, 1996; Sjöholm, 1999a; Wang & Blomström, 1992).

Location Advantage: Location advantages of host country where investment will be made also determine the decision of a MNC whether to enter a given market or not, and its interaction level with host economy and local firms. Moreover, quality of the FDI flows and firm specific assets that will be brought by MNC depend on these advantages (Narula & Marin, 2003). MNCs generally prefer to invest in countries where there is the opportunity to export to neighboring countries; in other words, they invest in the host country in order to use it as a production base for neighbor countries.

2.5.4 Firm Characteristics

Another important factor that affects the occurrence of spillovers is characteristics of the firms in host country such as export intensity, size, age, human capital, ownership status, R&D capability, and so on.

Export Orientation: It is argued that export-oriented firms benefit less from spillovers associated with foreign firms in host country because they already produce for foreign markets and face significant competition in these markets.

Therefore, it is expected that their capabilities are very high and they do not need to create extensive linkages with MNCs in host country (Blomström & Sjöholm, 1999). According to this view, non-exporting local firms will benefit more from technology spillovers.

Size: It is expected that firms with larger size (in terms of production, turnover, and employment) benefit more from spillovers because small firms do not have enough capacity to compete with MNCs and to imitate technologies and systems used by MNCs. Aitken and Harrison (1999) in their study for Venezuela confirmed this hypothesis. However, in the literature there are studies that find the opposite results. For instance, Girma and Wakelin (2001) and Sinani and Meyer (2004) find that small-sized firms benefit more from FDI spillovers.

Human Capital and R&D Capability: The other factors are the human capital and R&D capability of the local firms. The studies point out those firms with highly educated employees or higher R&D capability benefit more from the presence of foreign firms (see Blalock & Gertler, 2004; Kathuria, 2000; Kinoshita, 2001).

Technological Capability: As proposed in the literature, assimilating knowledge and technology and benefiting from technology spillovers from MNCs depend on both "the complexity of the technology transferred" and on the technological capability of recipient firms, which is measured by the absorptive capacity. Evidence for the absorptive capacity of the firms can be interpreted and measured in many ways. Some of the proxies used to measure "the technology gap" or "absorptive capacity" of the recipient firms can be summarized in this way: the difference between the firm's labor productivity and the average labor productivity of foreign firms in the sector; R&D expenditures; payments on patents; capital intensity; export intensity; number of patents; number of engineers, educated and skilled workers.

The studies on various countries have produced supporting results on positive relationship between technological capability and spillovers. For instance, Kokko (1994), in his study for Mexico, concludes that technology spillovers occur only in sectors in which technology gaps between foreign and local firms are not too large. In another study for Uruguay, Kokko et al. (1996) found that local firms with low technology gap with MNCs could benefit and absorb the knowledge transfers from MNCs. Similarly, Girma, Greenaway, and Wakelin (2001), using firm-level panel data for UK, found evidence for spillovers to local firms with a small gap between their productivity level and the industry productivity level. In another study for Spain, Barrios and Strobl (2002) showed that there were positive spillovers from foreign presence to export-oriented local firms but not to domestic-oriented local firms. In a similar study, Blomström and Sjöholm (1999) also found that technology spillovers were restricted to non-exporting local firms. They proposed that export-oriented firms are using more advanced technologies, and also they are exposed to international competition. Therefore, their technological capabilities are high, and as a result of these, they benefit more from positive spillovers than non-exporters do. Kinoshita (2001), in his study for the Czech Republic, also found evidence of positive spillovers for local firms with high R&D capability. Furthermore, Keller and Yeaple (2003) in their study for the USA showed the evidence of positive FDI

spillovers for the firms operating in high-tech sectors and conducting R&D activities. The studies once more reveal that absorptive capacity matters for spillovers. Therefore, it can be hypothesized that local firms, which have high technological capabilities and skilled human capital, with lower technology gap with MNCs may absorb and assimilate the spillovers more easily from MNCs (for more details, see Görg & Greenaway, 2004).

Geographic Location: Another characteristic that affects the technology spillovers may be the geographic location of the firms. Several studies have investigated the role of geographic dimension in order to benefit from spillovers. These studies hypothesize that spillovers from foreign firms would be received firstly by their neighbor local firms, and then they diffuse to more distant local firms, thus benefiting from spillovers is higher for the firms located nearby MNCs (Aitken & Harrison, 1991, 1999; Audretsch, 1998; Audretsch & Feldman, 1996). In other words, technology spillovers decrease with distance. Some of these studies failed to find evidence of spillovers at the regional level (Sjöholm, 1999a for Indonesia), some found negative spillovers for the same sector in any region of the country (Aitken & Harrison, 1999 for Venezuela), and some found evidence for positive spillovers in the same region and sector (Aitken & Harrison, 1991; Girma & Wakelin, 2001 for UK).

As can be seen from the studies in the literature, the determinants of technology spillovers have produced contrary results, and these make it difficult to reach a definite conclusion about most of the determinant factors. However, the common result among them is the importance of the absorptive capacity of both recipient firms and host country to benefit positively from spillovers (Crespo & Fontoura, 2007, p. 420).

2.6 Empirical Studies on Technology Spillovers and Transfer

2.6.1 General Information

In the literature, a number of surveys review theoretical and empirical studies on spillovers through FDI.[11] These identify potential sources of spillovers, then present findings of available econometric studies and discuss reasons that may explain the positive or negative effects of spillovers on the productivity of local firms in host economies.

In the theoretical literature, the studies on the effects of FDI on the host countries of MNCs date back to the early 1960s. The first authors that systematically

[11] See Blomström and Kokko (1998), Görg and Greenaway (2001; 2004), Saggi (2002), Haskel et al. (2002), Crespo and Fontoura (2007) for detailed literature review and theoretical discussions on technology spillovers.

discussed technology spillovers as a consequence of FDI were MacDougall (1960), Corden (1967), Caves (1971, 1974) for Australia, Globerman (1979) for Canada, Blomström and Persson (1983) for Mexico. In these studies, the authors generally tried to understand the costs and benefits of FDI on host countries by impacting on foreign trade, taxes, or balance of payments, and they analyzed whether the foreign presence has any significant impact on the productivity of domestic firms by using cross-section or panel data. Caves (1974) showed that there is a positive relationship between the foreign share and productivity level of domestic firms by using the share of foreign firms in employment at manufacturing sector level. Globerman (1979) also found positive evidence of spillovers on domestic firms in Canada manufacturing industry by using labor productivity as a dependent variable. In their study, Blomström and Persson (1983), using labor productivity as a measure of efficiency and relating this to capital intensity, labor quality, scale of production, foreign participation, and using different degree of concentration indices (Herfindahl index), provided also support for positive spillovers in Mexican industries by using cross-section data from the 1970 census. In these studies, the authors defined the dependent variable as the total value added per employee in domestic firms, and assumed the key independent variable as foreign share in total employment or value added in order to use as a proxy for spillovers together with other independent variables.

The importance of technology spillovers has emerged with the results of empirical studies rather than theoretical studies.[12] The empirical studies on technology spillovers from FDI that provide important evidence on the presence and pattern of spillover effects can be summarized under three types[13] (Blomström & Kokko, 1998).

- The first type is the studies at micro level by analyzing the impact of spillovers on firm productivity.
- The studies in second type are at the macro level and analyze the effects of spillovers on the economic growth of host country.
- The third type studies are in the form of case studies specific to an industry and these studies are conducted to obtain information and to reveal unknown details of the issues that cannot be captured by empirical studies (see Temenggung, 2006).[14]

The first two type of studies discussed above are generally in the form of econometrical analysis about the relation between foreign presence and productivity of local firms, or about the effects of foreign presence on the host country. These

[12] For theoretical studies, see Findlay (1978), Das (1987), Wang (1990), Wang and Blomström (1992). For some early empirical studies, see Dunning (1958), Safarian (1966), and Gabriel (1967).

[13] See Görg and Strobl (2001) and Blomström and Kokko (1998) for the details on this literature.

[14] These studies are generally employed by using interviews and mailing questionnaires. For instance, see Hobday (1995) and Kim (1997).

studies generally estimate a production function and focus on a productivity dependent variable such as labor productivity or value-added of local firms and regress this on a range of explanatory variables (concentration ratio, factor inputs, skilled human capital, scale of the firm, foreign ownership, etc.) by using cross-section or panel data while controlling for other potentially important factors. In the literature, the studies that use panel data are seen more appropriate, reliable, and informative than those using cross-section data due to firm- and sector-specific factors, and time effects, and because it is expected that spillovers can be detected in the long-term due to its dynamic nature (Aitken & Harrison, 1999; Görg & Strobl, 2001; Haddad & Harrison, 1993). In other words, it is difficult to control for industry- and firm-specific factors in studies "using cross-section data where the time dimension is absent". For example, MNCs may invest in most productive sectors to benefit from high productivity levels, and this may produce positive productivity spillover effect although "foreign presence is the result, not the cause of high productivity levels observed in the sector". Therefore, the findings of the econometric studies using cross-section data are hardly reliable (Pamukçu & Taymaz, 2009, p. 8). In addition, a set of proxy variables are calculated to analyze the effects of spillovers from MNCs such as share of foreign firms in total output, in total sales, or in employment in a given sector. The evidences from literature also show that factors affecting the spillovers depend on the characteristics of host country, sector, and firm.

As can be seen in Table 2.1 and in Sect. 2.6.2, according to the literature available, the empirical studies on the importance of technology spillovers through FDI between MNCs and local firms have produced mixed results. Some studies found positive spillovers, which mean that foreign presence impacts positively on the productivity of local firms, while some reveal that spillover effects on domestic productivity from FDI did not produce significant results or found negative spillovers. For instance, Haddad and Harrison (1993) for Morocco is insignificant; Aitken and Harrison (1999) for Venezuela is negative; Djankov and Hoekman (1998, 2000) for Czech Republic is negative; Okamoto (1999) for Japan is ambiguous; Kathuria (2000) for India is ambiguous; Konings (2001) for Bulgaria and Romania is negative and for Poland is ambiguous; Li, Liu, and Parker (2001) for China is ambiguous.

The last type is the case studies focusing directly on spillovers that analyze linkages between MNCs and their local suppliers by focusing on technology transfers (see Hanson, 2001; Larrain, Lopez-Calva, & Rodriquez-Clare, 2000). The first case studies that produced evidence on technology spillovers to local firms are Germidis (1977), Mansfield and Romeo (1980), Rhee and Belot (1989), and Mody, Sanders, Suri, Rao, and Contreras (1991). Case studies show that presence of MNCs may give rise to *technology diffusion* to local firms by direct knowledge and technology transfers. For instance, according to Blomström and Kokko (1998):

- MNCs may transfer their techniques, quality systems, standardization procedures to their local suppliers in order to upgrade their capabilities and to be sure about the quality of the products

- They force local suppliers to increase their managerial capabilities and to adopt marketing techniques used by MNCs
- They may provide know-how by demonstrating new technologies and by training workers of local suppliers
- They increase the efficiency and productivity of local firms by forcing them in a competition with other potential suppliers and by demanding lower prices for the products supplied

These case studies have given some important clues about spillovers from MNCs; however, they say little about how these spillovers occur, what their intensity is; their channels and determinants; and how important they are in general. To analyze these questions, an ideal study of technology spillovers from MNCs would require a large number of detailed micro data at firm level, both quantitative and qualitative, and would have to cover several years since spillovers do not occur instantaneously so that it would be possible to make significant conclusions (Blomström & Kokko, 1998). To the best of our knowledge, a few comprehensive analyses of such studies have been made (see, Keller, 2004; Larrain et al., 2000; Moran, 2001). Therefore, we focus on this type of study in this book and we believe that future research should focus on this type of studies.

2.6.2 Evidence on Developed and Developing Countries

It is seen that the empirical studies on developed countries generally have provided consistent results that foreign presence positively affects the productivity of local firms; in other words, they find positive spillovers (for instance, Caves (1974) for Australia; Globerman (1979) for Canada; Nadiri (1991) for France, UK, Japan, and Germany; Griffith (1999), Liu et al. (2000), Driffield (2001), Haskel, Pereira, and Slaughter (2002), Harris and Robinson (2003) for UK; Barrios and Strobl (2002) for Spain; Görg and Strobl (2003) for Ireland; Keller and Yeaple (2003) for USA). On the other hand, the studies on developing countries have not produced consistent results; while a number of studies find positive spillovers, some find negative or insignificant (ambiguous) results on spillovers (see Görg & Greenaway, 2004 for further details on productivity spillovers in developing and developed economies as well as the ones in transition).

Table 2.1 based on information provided in Görg and Greenaway (2004) displays the results of some empirical studies on spillovers conducted by various authors at firm or industry level in manufacturing industries of developing countries in terms of country, period covered, type of dataset used (cross-section or panel data), aggregation level (industry or micro-level data), and the results obtained. For instance, Haddad and Harrison (1993) could not find any evidence of technology spillovers for Morocco at micro or industry level by using 5-year panel data for the period 1985–1989, while Blomström and Sjöholm (1999) find positive spillovers at micro level for Indonesia by using cross-sectional data on 1991. Djankov and

Table 2.1 Empirical studies on spillovers in developing countries

Author	Country	Period	Data	Aggregation level	Result
Blomström and Persson (1983)	Mexico	1970	Cross-sectional	Industry	+
Blomström (1986)	Mexico	1970–1975	Cross-sectional	Industry	+
Haddad and Harrison (1993)	Morocco	1985/1989	Panel	Micro and industry	?
Blomström and Wolff (1994)	Mexico	1970–1975	Cross-sectional	Industry	+
Kokko (1994)	Mexico	1970	Cross-sectional	Industry	+
Kokko (1996)	Mexico	1970	Cross-sectional	Industry	+
Kokko et al. (1996)	Uruguay	1990	Cross-sectional	Micro	?
Blomström and Sjöholm (1999)	Indonesia	1991	Cross-sectional	Micro	+
Sjöholm (1999a)	Indonesia	1980–1991	Cross-sectional	Micro	+
Sjöholm (1999b)	Indonesia	1980–1991	Cross-sectional	Micro	+
Chuang and Lin (1999)	Taiwan	1991	Cross-sectional	Micro	+
Aitken and Harrison (1999)	Venezuela	1976/1989	Panel	Micro	–
Djankov and Hoekman (2000)	Czech Republic	1993/1996	Panel	Micro	–
Kathuria (2000)	India	1976/1989	Panel	Micro	?
Kokko et al. (2001)	Uruguay	1988	Cross-sectional	Micro	?
Zukowska-Gagelmann (2000)	Poland	1993/1997	Panel	Micro	–
Kugler (2001)	Colombia	1974/1998	Panel	Industry	?
Kinoshita (2001)	Czech Republic	1995/1998	Panel	Micro	?
Bosco (2001)	Hungary	1993/1997	Panel	Micro	?
Konings (2001)	Bulgaria	1993/1997	Panel	Micro	–
	Poland	1994/1997			?
	Romania	1993/1997			–
Damijan, Majcen, Knell, and Rojec (2001)	Bulgaria Czech Republic Hungary, Poland Romania, Estonia Slovakia, Slovenia	1994/1998	Panel	Micro	? Or – + only for Romania

(continued)

Table 2.1 (continued)

Author	Country	Period	Data	Aggregation level	Result
Li et al. (2001)	China	1995	Cross-sectional	Industry	+
Lopez-Cordova (2002)	Mexico	1993/1999	panel	Micro	−, ?
Görg and Strobl (2002)	Ghana	1991/1997	Panel	Micro	+
Javorcik (2004)	Lithuania	1996/2000	Panel	Micro	?

Source: Extracted from Görg and Greenaway (2004, pp. 177–178)
Note: Micro data may be firm-, establishment- or plant-level data

Hoekman (1998, 2000) find negative spillovers at micro level for Czech Republic by using 4-year panel data for the period 1993–1996. Moreover, Aitken and Harrison (1999) show that there are negative effects of foreign investment at micro level on domestically owned plants in the Venezuelan manufacturing sector by using 14-year panel data for the period 1976–1989. Kokko (1994, 1996) studied Mexico at industry level by using cross-sectional manufacturing data for the period 1970. He finds evidence for positive spillovers and suggests that the effects of technology spillovers on local firms are conditional on the technology level of local firms. Kokko created three independent variables in order to test spillovers, which are average patent payments per employee, average capital intensity of foreign firms, and labor productivity gap between local and foreign firms at industry level.

As can be seen in Table 2.1, the effects of spillovers among countries are different. In these studies, the same econometric models and estimation techniques have been used; especially a proxy variable of productivity as a dependent variable—labor, gross output, or total factor productivity—is regressed on an indicator of foreign presence at the sector level (foreign share in total employment, in output, in sales, etc.), and a number of control variables (share, Herfindahl index, scale, exports, size, age, and so on) are supposed to be correlated with the dependent variable.

2.6.3 Evidence on Turkey

This section reviews some of the empirical studies on spillovers for Turkish manufacturing industry in detail. Empirical studies on spillovers for Turkey which started especially after 2000s are very limited and they all concern the pre-2001 period where annual FDI flows to Turkey were rather low (see Table 2.2). There are various important reasons for the scope and limited number of studies on this issue. One of the important reasons is the unavailability of appropriate data at the sector- or firm-level in order to study spillovers. This situation is still valid. The other reason may be due to fact that FDI flows to Turkey were very low till the end of the 1980s. According to statistics, total FDI inflows to Turkey were nearly US $10.7B between 1974 and 2000, corresponding to an annual average of US$400M

Table 2.2 Empirical studies on spillovers for Turkey

Author	Period	Data	Data source	Aggregation level	Estimation method	Result
Aslanoğlu (2000)	1993	Cross-sectional	ICOC	Micro	OLS	?
Alıcı and Ucal (2003)	1987/2002	Series	TurkStat	Industry	Granger non-causality analysis	No significant effect
Taymaz and Lenger (2004)	1983/2000	Panel	TurkStat	Industry	Arellano-bond type of GMM estimation	−
Ayvaz et al. (2006)	2001	Cross-sectional	ICI	Micro	Regression analysis	+
Lenger and Taymaz (2006)	1995/2000	Panel	TurkStat	Micro	OLS (binary choice model)	No significant effect
Bertinelli et al. (2006)	1983/1994	Panel	TurkStat	Micro	OLS and FE	−
Taymaz and Yılmaz (2008a)	1990/1996	Panel	TurkStat	Micro	Olley and Pakes/OLS	+ Backward spillovers
Aksoy (2008)	1983/2001	Panel	TurkStat	Industry	OLS and FE	+ Horizontal spillovers
Pamukçu and Taymaz (2009)	1983/2001	Panel	TurkStat	Micro	FE and GMM	−
Çetin (2009)	2003–2004	Cross-sectional	TurkStat	Micro	Probit	Firm size, skill level, export, and capital intensity have positive effect on technology transfer
Köymen and Sayek (2010)	1990–2001	Panel	TurkStat	Micro	Levinsohn-Petrin	+ Backward spillovers

Legend: Istanbul Chamber of Commerce (ICOC); Istanbul Chamber of Industry (ICI)

for 26 years. The average annual FDI inflows were nearly US$800M in 1990s, in contrast to US$200M in 1980s. However, FDI flows into the country increased steadily after 2001; total cumulative net FDI inflows reached nearly US$100B for the years 2001–2010 (see Sect. 2.2.1). The last reason may be the globalization polices in 1980s that encouraged all countries to implement liberal policies. Therefore, Turkey also started to liberalize its economy in 1980s by changing its policy to export-promoting industrialization and by opening its doors to foreign investment (see Aslanoğlu, 2000 for details).

Aslanoğlu (2000) is considered as a pioneer in doing the first econometric study analyzing the effects of FDI on Turkish manufacturing industry. He tried to analyze the effects of spillovers by using the cross sectional data for the year 1993 from the survey data of Istanbul Chamber of Commerce (ICOC) on the largest 500 industrial firms of Turkey.[15] He constructed five single equation econometric models. The aim of the first two models is to estimate the effect of foreign presence[16] on the productivity and competitiveness of domestic firms. The results show that foreign presence increases competition in domestic industries, while it has no any significant impact on the productivity of domestic firms. Other two models are constructed to analyze the impact of technology gap between domestic and foreign firms on the productivity and market growth of domestic firms. However, he could not find significant relation between those variables. In final model, the impact of the initial technology gap on the change in technology gap is analyzed, and a significant correlation is found between such variables.

In their study, Alıcı and Ucal (2003) examine the effect of liberalization process on economic growth of Turkey by emphasizing the export led growth (ELG) strategy. The authors aim to find a causal link between exports, FDI, and output by conducting unit root and the Granger non-causality tests from 1987-I to 2002-IV. For this aim, three variables are utilized: export price index, industrial production index, and FDI flows into Turkey. The data for the first two variables come from TurkStat, and those for FDI variable from the Undersecretariat of Treasury. The results neither produced significant positive spillovers from FDI to export nor a kind of FDI-led export growth linkage. In other words, results do not confirm the existence of FDI-growth relationship. They suggest that policies should focus on attracting more FDI in order to gain the spillovers to output and FDI-led export growth.

In their empirical study, Taymaz and Lenger (2004) provide evidence in favor of negative spillovers in Turkish manufacturing industry. The authors examine the productivity spillovers from MNCs by using panel data from TurkStat at industry level over the period 1983–2000. The data consist of 28 industries in three-digit

[15] He uses the 1993 data for the entire analysis; however, the data of the year 1988 is used for creating some independent variables due to lack of data.

[16] Various proxies are used in these models for foreign presence such as the share of foreign firms in total employment, total sales, total value added, and total net assets of an industry (Aslanoğlu, 2000, p. 1122).

level in various categories such as public firms, and private small, medium, and large sized firms in Turkey (Taymaz & Lenger, 2004, p. 2). The study investigates the role of the size of the recipient firms, the intensity of the R&D activities, the ownership structure, and whether spillovers change by time or not. Although the results show that spillovers from MNCs differ with respect to size of the recipient firms and by time, the study reveals the negative spillovers for the domestic sectors.

Lenger and Taymaz (2006) also examine empirically the innovation and technology transfer activities of local and foreign firms in Turkish manufacturing industry. The authors construct a model for estimating the impacts of horizontal, vertical, and labor spillovers on technological activities of firms by taking into account two dummy variables: *in-house innovative activities* and *technology transfer from abroad*. They also test whether foreign firms are more innovative and/or whether they transfer technology mainly from abroad, and whether they have any impact on the technology transfer decisions of local firms. The data used for innovativeness dummy variable come from the two innovation surveys conducted by TurkStat and cover the periods 1995–1997 and 1998–2000. On the other hand, the data for technology transfer dummy variable come from the "Annual Structural Business Statistics" survey conducted by TurkStat for the same periods. In the analysis, several proxies are used for horizontal, vertical, and labor spillovers. The three proxies for horizontal spillovers are the market share of foreign firms, the ratio of foreign firms' R&D expenditures to total output in the province in which the firm operates, and at the industry level. The two variables used as proxies for vertical spillovers are the proportion of firm's inputs produced by foreign firms and the proportion of firm's output used by foreign firms. These proxies measure the weighted average of foreign market share in supplier and user industries, respectively. In the calculation of these proxies, the input (one sector's share in inputs used by another sector) and output (the share of one sector in total consumption of another sector's output) coefficients of the sectors are also calculated by utilizing the 1996 Input-Output Table of Turkish manufacturing industry. The last proxy used for labor turnover is the ratio of the number of separations from foreign firms to the total number of employees in a given sector. The authors find that foreign firms are more innovative than their local counterparts, and transfer technology mostly from their parent firms in overseas. In addition, they show that horizontal spillovers are insignificant, while vertical spillovers are ambiguous. The major finding of the study is that labor turnover is the main channel of spillovers by emphasizing the importance of tacit knowledge. Also, the findings confirm that technology cannot easily be transferred through passive mechanisms such as demonstration effects, and reverse engineering (Lenger & Taymaz, 2006, p. 152).

In another study, Ayvaz, Baldemir, and Ürüt (2006) analyze the effects of FDI on both labor productivity and the relationship between capital efficiency and labor productivity by using dummy variables regression model in Turkish manufacturing industry. The data used in the study are obtained from "the largest 500 industrial firms of Turkey" report conducted in 2001 by the Istanbul Chamber of Industry (ICI). The sample consists of 199 firms in total, specifically 19 foreign firms with full ownership, 159 local firm with no foreign ownership, and 21 public firms. The

authors find significant positive spillover of foreign capital on labor productivity, and suggest that local firms should increase their capital and labor resources to compete successfully with foreign firms. However, the study is seen very problematic since it covers a very small sample to conduct this kind of analysis and also actually does not examine spillover effects; only the difference between foreign and local firms in terms of productivity efficiency is tested. Therefore, the findings of this study are not reliable enough (Aksoy, 2008, p. 49).

Another empirical study is the one by Taymaz and Yılmaz (2008a), which analyze the direct and indirect effects of foreign ownership on productivity by using firm-level unbalanced panel data for the period 1990–1996 in the Turkish manufacturing industry. The authors use the Olley-Pakes[17] production function estimates for productivity and OLS regression analyses to test the horizontal and vertical linkages. The sample consists of firms with 25 or more employees due to lack of key variables needed for the study in the 10–24 employee size group, and the sample is limited only to private establishments. In the calculation of linkages, the authors benefit from the sectoral output shares of foreign firms and Input-Output matrix in 1990 to identify linkages across plants. Based on Olley-Pakes approach using total factor productivity, they find that foreign firms are more productive than their local counterparts. Also, majority-owned foreign firms are more productive than minority-owned foreign firms, and fully foreign owned firms are more productive compared to majority foreign owned ones (Taymaz & Yılmaz, 2008a, p. 31). In addition, when industry based measures of linkages are used, they find that productivity spillovers from foreign firms to local firms occur through horizontal and vertical linkages. However, the authors argue that there is a very high correlation between horizontal and vertical linkage measures, so the findings may generate false results with industry based measures. Therefore, they use product-based measures of linkages in order to overcome multicollinearity problem. In this case, the results mostly lose their economic and statistical significance compared to industry based measures of linkages, and they find positive significant spillovers that occur through backward linkages only.

In their paper, Bertinelli, Pamukçu, and Strobl (2006) examine the impact of horizontal FDI spillovers on firms' productivity in Turkish manufacturing industry. Also, the authors test the effect of technology gap, which is measured by the distance between local firms' productivity and that of the industry leader at the four-digit level (relative productivity). The study uses firm-level panel data obtained from the "Annual Surveys of Manufacturing Industry" of TurkStat and covers the period 1983–1994. The authors estimate a productivity equation by using OLS as well as FE methods. An index of total factor productivity in local firms is used as the dependent variable in the productivity equation. Moreover, to analyze productivity spillovers, four different proxies for spillovers based on the extent of foreign presence at the sector level are constructed: the share of foreign enterprises in the number of employees or in gross output at the four-digit sector level, and the

[17] For details, see Olley and Pakes (1996).

indicators of foreign presence for enterprises with foreign equity that is at least 10% of their capital and for those with majority-owned foreign firms (at least 50%). Besides control variables, three firm-specific variables are constructed in the study: the share of skilled labor in total employment (skill level); the ratio of firm sales to total sales of its four-digit sector (market share); the ratio of a firm's gross output to that of sector-level firm average (scale). The authors also introduce two sector level variables in the productivity equation to measure different aspects of the degree of competition: "the share of imports in the domestic demand at the four-digit sector level to domestic demand (import penetration)" and the variables that account for the market structure prevailing at the four-digit sector of the firm by using two alternative indicators, which are the share of the four largest firms in sales at the four-digit sector level (CR4) and the Herfindahl index of concentration of sales (Herfindahl index). The findings show that foreign firms do not generate any spillover that positively impact local firms' productivity levels. Conversely, all four proxies for spillovers produce evidence of negative spillovers on local firms' productivity levels.

Another attempt to investigate the horizontal technology spillovers through FDI in the Turkish manufacturing industry is made by Aksoy (2008). The analysis on spillovers is conducted over the period 1983–2001 at sector level by using the dataset of TurkStat including sectoral level determinants of 89 different sectors. In this analysis, sectoral market shares of the foreign firms are used as proxies for horizontal spillovers. The author also divides the sample into high-tech and low-tech industries in order to test spillovers. In the study, a production function in the form of Cobb-Douglas is estimated by OLS and FE methods. The findings of the study have produced positive evidences on horizontal spillovers at sectoral level.

In a similar study, Pamukçu and Taymaz (2009) examine empirically the existence of FDI-related productivity and wage spillovers in the Turkish manufacturing industry by using the panel dataset of TurkStat over the period 1983–2001. The study is carried out at firm-level, and a production function approach in the form of Cobb-Douglas is adopted in order to assess the impact of horizontal spillovers on firm-level total factor productivity. Firm-level output measured by its gross output is used as dependent variable, while firm's capital stock, labor, raw materials, and energy inputs are used as explanatory variables. Market share of foreign firms at sector level and at the regional level are used as two proxies for horizontal spillovers. Also, firm- and sector-specific variables are added to the equation in order to control for the influence of other determinants of firm-level total factor productivity and to avoid an omitted variable bias. In the estimation of productivity spillovers, FE estimation method is preferred to use in order not to suffer from an omitted variable bias due to unobserved time-invariant firm-specific factors. On the other hand, a dynamic wage bargaining model based on McDonald and Solow (1981) is used in the econometric analysis of wage spillovers. This wage model is empirically tested by using both FE method and Generalized Method of Moments (GMM) a la Arellano-Bond (see Pamukçu & Taymaz, 2009, p. 57). The findings of the study show that FDI-related productivity spillovers exert

a negative effect on the productivity of domestic firms and a significant and positive impact on the wages paid by domestic firms.

Çetin (2009) also investigates the determinants of technology transfer decisions of firms in Turkish manufacturing industries by using probit model. The dataset used in the study is based on the merged data set of both 2003 and 2004 "Structural Business Statistics" survey conducted by TurkStat at enterprise level. The dependent variable is a dummy variable as the firm's decision to transfer technology, and the author uses the "expenditure on licenses, patents, and trademarks" as a proxy for such variable. If the expenditure of a firm on licenses, patents, and trademarks is positive, then it is assumed that technology transfer decision equals to one. The firm-level factors tested are size, skilled labor, capital intensity, expenditure on R&D, and dummy variables for export and import intensity and foreign ownership of the firms. Also, sector level variables are import penetration, Herfindahl index, sectoral license expenditure, share of foreign-owned firms' output, and sector dummies classified according to technology levels. The findings of the study show that firm size, general skill level, export behavior, and capital intensity have significant effect of technology transfer decision of the firm, while foreign ownership does not. The effects of sectoral characteristics are also statistically significant.

The effect of human capital on the productivity spillovers from FDI to domestic firms in Turkish manufacturing industry is investigated by Köymen and Sayek (2010) for the period 1990–2001. In their paper, the role of human capital of local firms is analyzed in order to reveal through which channel of linkages (horizontal, backward or forward) it enhances the local firms' total productivities and acts as an absorptive capacity. In the study, total factor productivity (TFP) of the firms is estimated by using Levinsohn-Petrin (Lev-Pet)[18] methodology based on firm-level unbalanced panel dataset obtained from TurkStat. Then, TFP is regressed on three industry-based linkages (backward, forward, and horizontal) to test the spillovers from FDI. The findings of the study produced evidence on positive productivity spillovers through backward linkages, while there was no evidence on horizontal and forward linkages that play a role in contributing to the productivities of local firms. One of the important result of the study, although it does not take into account the role of the firm characteristics on spillovers, is that such characteristics are important determinants of spillovers from FDI and they should be taken into consideration in the spillover analysis.

Table 2.2 above summarizes the empirical studies on spillovers for Turkish manufacturing industry discussed before. The table provides a comparison of the studies in terms of period covered, data used, aggregation level, estimation method, and the result obtained. As can be seen from the table, the findings of previous studies on FDI-spillovers are pertaining to the pre-2001 period.

Consequently, empirical studies on whether the MNC-based technology spillovers have an effect on the performance of the local firms, and if yes, the direction and dimension of the effect, yield controversial results differing from each other;

[18] For details, see Levinsohn and Petrin (2003).

some provide negative results, while some produce positive results either significant or insignificant. Therefore, we can say that there is no consensus on the effects of spillovers from MNCs. The results vary depending on the different econometric estimation methods adopted, type of the datasets used (cross sectional or panel), aggregation levels at sector or firm level, various methodological problems, different proxies used for spillovers, different foreign share variables, unidentified factors, country concerned, sector specific factors, different time periods analyzed, etc. in the empirical studies. For a comprehensive evaluation of the econometric studies conducted on the effect of the MNC-based technology spillovers on the performance of the firms, see Görg and Greenaway (2004) and Smeets (2008). Although these empirical studies based on published formal data have produced very important results in terms of the positive effects of FDI on host country and existence of positive benefits from FDI, they are not able to provide sufficient information about how these benefits take place, in what forms, and by which channels. Therefore, it is necessary to conduct more detailed case study researches as conducted in this book in order to question and understand the real situations at firm level and in order to clarify the determinants, channels, and dynamics of the KTTs that take place.

2.6.4 Reasons for Failure of Realizing the Technology Spillovers or for Their Negative Effect on Firm Performance

The reasons why there is no technology spillover from the MNCs to the local firms in host country or why they are not adequate could be linked to many factors. The main reasons based on Aitken and Harrison (1999) could be summarized as follows:

- The workforce circulation (labor turnover) among the local and foreign firms is limited (especially due to high salaries in the MNCs)
- There are only a few local firms to render sub-contracting/supply services from MNCs (the MNCs' bringing along their own suppliers with them)
- The local firms do not perform any R&D activities, or their R&D activities are inadequate (this may hinder collaborations to be established with the MNCs)
- Lack of experience of the local firms in the areas of production, manufacturing, quality control, and engineering
- The MNCs are not so inclined favorably towards knowledge spillover to their local rivals. They may apply specific policies in order to protect their advantages and to prevent spillovers to local firms
- The market share of the local firms diminishes or their operation ceases due to their failure to compete with the MNCs

- The local firms do not have the capability to absorb the potential technology spillovers from the MNCs (especially due to the huge difference between the technological capabilities of the local and foreign firms)

2.7 Theoretical Framework for Case-Study Research

2.7.1 General Information

The relevant literature contains a few studies conducted on the technology transfers. These could be grouped under three main topics in terms of the method employed. The first one is the case studies that are didactic and illuminating in that they provide highly valuable, embedded information even if there is a lack of data and information on the subject being studied. The second one is the econometric studies conducted based on various data at the industry and firm level. The last one is the studies where the first two types above are used together in a complementary way such as our study.

Recently, there has been a growing interest in the econometric analysis of the technology transfers realized to the firms in the developing countries. When the international literature is reviewed, it is seen that many studies conducted on the econometric estimations of the technology transfers realized to the firms in developing countries are in general based on the observations obtained from the manufacturing industry statistics published regularly or from the annual industry reviews gathering input-output data. In general, the following results have been obtained from these studies: If the local firms in developing countries conduct more activities in the international markets, if the year of foundation of the MNC affiliates in developing countries is recent, if the domestic market of the developing country is larger, and if the share of the foreigners in the affiliation established in developing country is higher; the technology transfers used by the local firms are more important (Grosse, 1996). However, the findings obtained from such econometric studies are less illuminating than the findings obtained from the substantial case studies.

Case studies provide important clues about the firms that will contribute to our understanding of the transfer process deeper and better, and especially help us to extract the deep-buried information on the subject being studied, if there is a lack of econometric data concerning the manufacturing industry, and help us to grasp the sector as the subject of the study better (Pack, 2005). Such kinds of studies where the researchers collect the relevant data by themselves ensure both that the complex subjects are understood better and that more substantial data are generated (Bigsten et al., 2002). When we look at the empirical studies conducted on the technology transfer, we could see that most of the studies on certain sectors have been conducted in the form of case studies, since there is no detailed data at micro level regarding the firms. We also see that many of the micro- and significant data

have been obtained from the substantial case studies conducted on the firms (Pack, 2005). Case studies not only are informative but also present a profound definition of the factors that determine the international technology transfer. For instance, the question whether the FDI made by *Intel* in Costa Rica in 1990s brought along any technology transfer or not was analyzed by Larrain et al. (2000). This study is informative and illuminative in that the authors made interviews with top managers of *Intel* and authorities of Costa Rican government and tried to understand their ideas, concerns, and motivations. Therefore, the information at the firm level that will contribute to understand better the findings on the details and processes of the technology transfer are obtained by means of case studies. However, it is apparent that supporting the studies conducted in the form of case studies—as is the case with *Intel*—with econometric studies is important (Keller, 2004). In general, it could be said that the econometric and case studies complement each other.

2.7.2 Technology Transfers at Intra- and Inter-Firm Level

In the literature, many channels through which domestic firms may benefit from technology transfers from MNCs are discussed. Some studies point out the two main channels of international technology transfer: (i) joint venture partnership of local firms with foreign firms and (ii) "contractual agreements" signed with foreign firms such as "licensing agreements", "turnkey contracts", "technical, management, or service contracts", and "international subcontracting" (see Sect. 2.1.4) (Pack & Saggi, 2001; Techakanont, 2002, p. 13). Furthermore, some studies specify three other main channels by emphasizing the relationships between source and recipient: (i) "arm's length trade of technology", (ii) intra-firm technology transfer, and (iii) inter-firm technology transfer. Figure 2.4 shows the inter- and intra-firm technology transfer channels that occur between source and recipient.

- The first channel is the "arm's length trade of technology", in which the recipient acquires the technology through agreements signed with the independent technology source, and in return, make royalty payments for such technology (Techakanont, 2002).
- The second one is *the intra-firm technology transfer*, in which there are strategic and interdependent relationships between the source and recipient (see Fig. 2.4). In this case, the source has some equity partnership with the recipient in the form of joint venture, or with foreign affiliate in host country (Techakanont, 2002, p. 19). In other words, some equity of the recipient is owned by the source. In this case, source (MNC, foreign firms, or parent foreign company) provide various technology transfers and training activities to local workers of the foreign affiliate in the host country because the affiliate must be successful in order to get high profits, and this depends on the relationships between such actors and the quality of the transfers provided (Hobday, 1995; Kim, 1997).

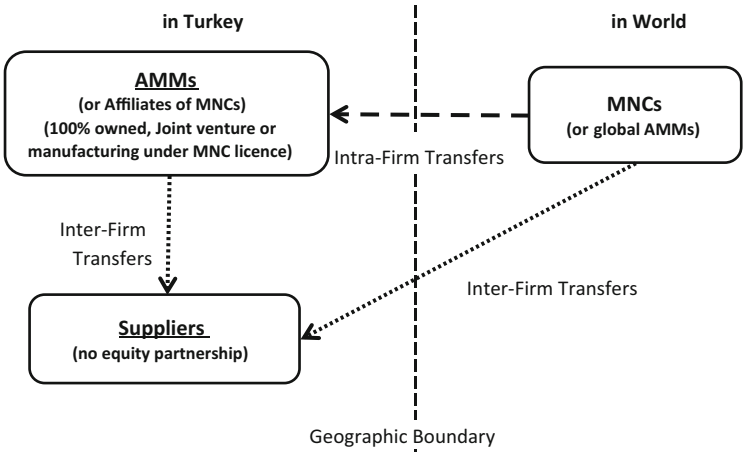

Fig. 2.4 Intra- and inter-firm technology transfers. *Source*: By the author, based on ideas of Techakanont (2002, pp. 19–21). *Note*: The dashed line shows intra-firm linkages between firms, while the dotted lines show inter-firm linkages between such firms

- The third one is *the inter-firm technology transfer*, in which the relationship occurs between the buyer and supplier, and there is not any equity partnership between such independent actors (see Fig. 2.4) (see Lall, 1980). This kind of relationship is also called buyer-supplier relationships. The relationship between such actors starts after the supplier firm is evaluated according to the buyer's own criteria, and if the supplier is selected and approved by the buyer, then an official relationship such as a business contract takes place (Techakanont, 2002, pp. 20–24). To be selected by a buyer, supplier firms should have some technological capabilities and skills in order to produce the demanded products at desired quality and cost level (see Sects. 6.5 and 6.6). In this case, buyers provide various specific technologies to their suppliers without asking for money in order to benefit from products supplied by demanding higher quality standards, improvements, and lower costs. Therefore, local suppliers may gain a chance to access such technologies, and they must upgrade their capabilities according to the specifications of buyers in order to work together continuously.

As discussed above, it is expected that MNCs should provide more technology transfers at *intra-firm level* relative to *inter-firm level*.

2.7.3 Forms of Technology Transfer at Intra- and Inter-Firm Level

Forms of technology transfers can be classified as formal and informal. MNCs actively transfer technology to their suppliers in formal ways to ensure that the

Table 2.3 Forms of technology transfer at intra- and inter-firm level

At intra-firm level		
Technology level	Yamashita (1991)	Kuroda (2001)
Operation	1—Operation	1—Operation
	2—Maintenance	2—Maintenance
	3—Quality control	3—Quality control
	4—Production management	4—Production control
Improvement	5—Improved technology	5—Process improvement (Kaizen)
	6—Molding	6—Development of mold/die/jig
	7—Design	7—Development of equipment
Development	8—Product development	8—New process technology
	9—Equipment development	9—Engineering of new design
		10—R&D of new products

At inter-firm level (Wong, 1991)

- Advice on plant layout, equipment selection and operations planning
- Advice/training on quality management system and other "good manufacturing practices" (GMP)
- On-site audit of plant operation and troubleshooting of specific productivity problems
- Loaning of equipment and machinery, either temporarily or permanently
- Training of supplier staff through formal courses/seminars or informal consultations/visitations
- Product design specification and performance requirements
- Early supplier involvement in prototype development and value engineering stage
- Informal sharing of technical information and ideas among the technical staff of both companies
- Exposure to MNC system of managing and organizing manufacturing activities and observation of MNC
- Provision of a stable source of income to finance the investment
- Sourcing of technical experts to solve specific technical problems encountered by the supplier
- Advanced indications on future quality/performance/features requirements and targets
- Testing and diagnostic feedback on quality and other dimensions of performance of supplier's products

Source: Extracted from Techakanont (2002, pp. 24–26)

products and services supplied meet the technical specifications in terms of quality, cost, durability, and reliability. Formal ways of the transfers can be summarized as FDI, the purchase of foreign machinery and turnkey plants, foreign licenses, consultancies from special engineering firms, technical service/assistance/specifications provided by foreign firms, technical licensing agreements with foreign firms, providing of blueprints, and more generally mergers and acquisitions (M&A) of low or high-tech foreign firms and so on. On the other hand, local suppliers can try to increase their capabilities by using informal mechanisms in order to supply competitive products to MNCs. Major informal forms for technology transfers are OEM arrangements, international literature, labor turnover, observation, reverse engineering, imitation, etc. Although new technologies could be obtained only through formal channels, informal technology transfers are seen most important in the literature for developing the technology capabilities of local firms (see Ernst & Kim, 2002; Kim, 2001 for further details).

Table 2.3 displays the forms of the technology transfers identified through case-studies conducted in automotive, textile, and electrical machinery industries in ASEAN countries at both intra- and inter-firm level (Techakanont, 2002, pp. 22–24). The authors categorized the form of technology transfers into three groups at intra-firm level: "operation technology", "improvement technology", and "development technology (means the creation of new knowledge)". As can be seen in the table, the researchers also classify technology transfers into nine and ten types depending on their observations (Techakanont, 2002, p. 23). The table also shows 13 direct forms of technology transfers, occurring from buyers to suppliers, observed and identified in these studies at inter-firm level. Studies find that suppliers should benefit from such transfers because of having formal relationship with buyers. MNCs send their expert staff to give advice to their suppliers in host country about production, quality control methods, etc., and train the local personnel of their suppliers. By these assistances, suppliers improve their manufacturing technologies, quality control practices, design, R&D, distribution, and delivery methods. These kinds of direct transfers (inter-firm transfers) have occurred between firms and are not commonly observed. One of the aims of this study is to reveal the forms and intensity of the KTTs that are created between such firms in terms of production, production process, and training.

2.7.4 Theoretical Framework

It is pointed out that process of the technology transfer is completed when the recipient learns, transforms, and internalizes the technology transferred by source into their own technology (or knowledge). In other words, it can be seen as the process of "the internalization of knowledge" successfully from the source to their own. As a result of these transfers, positive effects should be expected or observed on the recipient side such as capability increases, performance increases or "productivity improvement" that "can take any form of reduction of defect rate", "delivery time", "average costs", and "cycle time" (Techakanont, 2002, pp. 27–28) (see Sect. 4.9). However, it is not very easy to reveal these relationships at inter-firm-level because they are not easily observable, or formal data or information is not available. This situation justifies our research design and methodology in this field by conducting case-study approach for data collection at firm level. In the context of the case study, we aim to analyze the KTTs and their effects from two perspectives:

- One looks only at the suppliers in Turkish automotive industry as the recipient of the technologies. In other words, we analyze the technology transfers in detail from customers (AMMs in Turkey, MNCs in world, and other firms) to their suppliers at *inter-firm level* (see Fig. 2.4). We conducted face-to-face questionnaire survey with the suppliers in Turkey in order to collect firm-level quantitative data. By this survey, we also want to reveal suppliers' characteristics, technology capabilities, competition structure, cooperated partners, R&D and

innovation activities, etc. There is one caveat to this method; it can reveal technology transfers that occur from other customers, not from a specific customer. This is rational because suppliers have relationships with multiple customers, so they are exposed to technology transfers from many customers. Therefore, it is not possible to analyze the transfers provided by the selected specific customer (at least by this method).

- The second perspective looks at the AMMs (as buyers or customers) operating in Turkish automotive industry as the source of the technologies provided to suppliers at inter-firm level. In this context, we also analyze the technology transfers from MNCs in home country (global automotive manufacturers or parent companies) to their affiliates (AMMs) in Turkey by taking into account the first two types of channels discussed above at both *intra-firm level* (if AMM in Turkey is 100% owned by MNCs, or it is an affiliate of MNCs) and *arm's length trade of technology* (AMMs in Turkey manufacture under MNC license) (see Fig. 2.4). For this aim, we conducted in-depth semi-instructed interview method with the top-executives of AMMs in Turkey to collect qualitative data (see Chaps. 3 and 6). The interview findings are also used for the quantitative survey findings, obtained from recipients and related to inter-firm level technology transfers, in a complementary way.

2.7.5 Studies Conducted for Foreign Countries

A few studies on technology transfer conducted on various countries, which apply the (similar) data collection methods employed in this study, are reviewed below.

Giroud (2003) reviewed in his study on Malaysia whether the foreign main industry companies operating in the electronics sector provide KTTs to the local firms through backward linkages. In this study, both the questionnaire and personal interview methods were used together to collect data at the firm-level. In this study, 320 foreign companies in the sector were approached via mail in 1996, and 95 of them completed a questionnaire survey (a response rate of 30%). Also, in-depth interviews were made with 11 foreign companies operating in the sector, based on their origin (4 American, 3 European, 2 Japanese, 1 Thai, and 1 Singaporean). Unlike the path we have followed in our study, Giroud studied, by means of implementing questionnaire survey via mail only to the foreign companies operating in the sector, what kind of transfers they made to their suppliers on products, production processes, financial support and training, and how often. Under the same scope, he made personal interviews with 11 foreign companies he selected among the surveyed companies. In other words, he studied the KTTs provided by the foreign companies operating in the main sector to the local suppliers only from the viewpoint of the foreign companies realizing those transfers, without contacting any local supplier firms. He tried to examine the questionnaire and interview results first through descriptive analysis; and then, by using logistic regression analysis method, he reviewed the effects of the independent variables (age of the firm,

export rate, size of the firm, purchasing strategy, firm origin) determined based on the data he obtained for 95 firms upon the KTTs. The results of the analysis showed that the foreign companies realized KTTs to the local suppliers via training, but those transfers were inversely proportional to the duration for which the firms had been operating in the sector. In addition, it was discovered that there existed a positive relationship between exports and transfers, and it was determined that the size of the firm, the origin of the foreign companies, and the characteristics of the products manufactured were the most important factors explaining the transfers realized by the foreign companies. These findings are highly consistent with our findings in the case study research for Turkish automotive industry that will be discussed in next chapters.

Other studies—Techakanont (2002); Techakanont and Terdudomtham (2004)—analyzed the evolution of the technology transfer between the main industry companies, and local suppliers in Thailand automotive sector. Also, they attempted to analyze the level of the collaboration between the local firms and the main industry companies and the types of the collaborations which the local firms needed to establish with the main companies so that they developed their technical skills.

Techakanont (2002) used the case study and questionnaire methods in the study. He conducted personal interviews with the top-level managers assigned in the Thai affiliate of a Japanese global automotive manufacturer in 2000. Also, he implemented the questionnaire survey to 26 supplier firms of this Japanese automotive manufacturer that were located in Thailand.

Techakanont and Terdudomtham (2004), on the other hand, attempted to analyze—by using the same research method—what kind of developments occurred in the relationships between the main companies and the suppliers in the Thai automotive sector. To this end, during 2002 and 2003, personal interviews were made with the managers of five companies in automotive main industry that were Japanese in origin and that were located in Thailand. They also applied questionnaire survey to 100 firms that were the suppliers of these five companies interviewed, and answers were obtained from 15 supplier firms. The study found out, as a result of the analyses conducted in the form of case study, that the level of the technology transfers between the firms was quite high both in content and in quality, that the difficulty levels of the transfers were determined by the content of the technologies transferred, and that the success of the transfers was directly proportional to the technological capabilities of the suppliers.

Berger's (2005) study reviewed the effects of the MNCs on the innovation and R&D activities of the firms operating in manufacturing sector of Thailand.[19] The author used the qualitative and quantitative techniques together. The study employed the readily available quantitative data obtained from the researches on R&D and innovation in 2000 and 2002 on the basis of questionnaire surveys conducted—observing the OSLO and Frascati guides of OECD—by the National

[19] The study followed the same method as us in collecting qualitative data and it constituted the basis for us to formulate our questions on innovation and R&D.

Science and Technology Development Agency of Thailand. These surveys were implemented on the firms that were operating in nine different sectors in the manufacturing industry of Thailand and that had a turnover exceeding a certain limit. The survey in 2000 was implemented on 2,166 firms and 1,019 of them responded, while the survey in 2002 was implemented on 3,945 firms and obtained answers from nearly 1,500 firms. The author preferred to focus on the case study method and did not make logistics regression analysis. Semi-structured personal interviews were conducted with the R&D managers, production managers, and general managers of totally 20 companies in the automotive and hard-disk sectors in the year 2003, and the results of the study were analyzed statistically via various variance analyses, and the interviews made with the companies were evaluated by means of case study method.

2.7.6 Studies on Turkish Automotive Industry

The number of the studies concerning Turkey, the main focus being on KTTs, is quite limited in the international literature. However, there exist some studies conducted on the productivity, MNC-based technology spillovers, and automotive industry, using some quantitative and qualitative methods.[20] The number of the studies conducted concerning the relationships between the automotive main and supply industry in Turkey is also few. The available studies are rather based on certain areas of the automotive industry, such as R&D or innovation, and most of the studies review the automotive sector not individually but together with the other sectors. Due to the fact that quality and detailed data cannot be obtained at the firm-level, the analyses are tried to be put forward in the form of case studies. We observe that a large majority of the available studies in Turkey were realized during the last decade. No empirical study examining the technological capabilities of the supply industry firms and reviewing the types, intensity channels, and determinants of the KTTs provided by MNCs to domestic firms at both inter- and intra-firm level qualitatively (case study) and quantitatively (econometrical) in detail together, along with the topics discussed above, has been encountered yet; however, it has been observed that there are studies in the national literature which are similar to our study in terms of method. These could be summarized as follows.

Bedir (1999), in order to collect data, implemented a questionnaire survey on the Turkish automotive main and supply industry firms in his study, where the main and supply industry relationships were reviewed. Under this scope, questionnaire forms were sent to 16 main industry companies and 120 supply industry firms (75 of them being TAYSAD member and 45 being other firms operating in the sector) via SPO in 1996. Twelve of the main industry companies and 79 of the supply industry firms

[20] See Pamukçu (2003), Bertinelli et al. (2006), Lenger and Taymaz (2006), Wasti et al. (2006, 2009), Aksoy (2008), Pamukçu and Taymaz (2009), Dayar and Pamukçu (2011).

responded to the questionnaires. The findings obtained from the study were analyzed only descriptively.

Wasti, Kozan, and Kuman (2006) used the questionnaire survey and personal interview methods in order to collect data. In their study, they attempted to determine the types of the relationships between the buyers and suppliers in the Turkish automotive industry. In the study executed in 2002, 16 main industry companies as the members of OSD and all the supplier firms as the members of TAYSAD were chosen as sampling. Ten main industry companies agreed to participate in the study and a questionnaire survey was implemented by conducting semi-structured personal interviews with 51 purchasing managers of those companies. Seventy-two supplier firms who were TAYSAD members agreed to participate in the study and only the questionnaire survey was applied to those firms. Anova and Scheffe tests were used in analyzing the data.

In another study, Wasti, Kozan, and Çınar (2009) used the same data and attempted to determine the probability of the relation-specific investments made by the main industry to the supply industry in the Turkish automotive sector, by means of the multi-regression analysis method.

Çelikel (2009), on the other hand, employed the case study method in her study, where she reviewed the factors affecting the R&D collaborations between the automotive main companies in Turkey and MNCs as their partners. In this context, case analysis studies were conducted with the affiliates of the three MNCs that were operating in the Turkish automotive main industry (Tofaş, Ford-Otosan, and Hyundai-Assan) and their parent companies abroad, namely Fiat, Ford, and Hyundai, respectively. Çelikel obtained the data she used for the case analyses from the in-depth, face-to-face interviews she conducted with 40 people (R&D managers, engineers, and top-level managers) from those six companies, and put forward her findings descriptively.

Ekmekçi's (2009) study, where the factors determining the knowledge transfer from the FDI flows in the Turkish automotive industry to the local supplier firms are analyzed, is another study which uses a similar case study method with Çelikel (2009). In the study, seven main companies and seven supply industry firms with 100% local capital in Turkey, which sell parts to at least one of these seven main companies, were interviewed face-to face in order to gather data, and a descriptive analysis was performed.

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