FOREIGN DIRECT INVESTMENT (FDI) AS A CHANNEL OF TECHNOLOGY DIFFUSION: THE CASE OF SAUDI ARABIA

by

SHAKER ALMAHASNA

A thesis submitted in partial fulfillment of the requirements for the degree of

Doctorate of Business Administration

Newcastle University

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Shaker H. AlMahasna

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ABSTRACT

Foreign Direct Investment (FDI) as a Channel of Technology Diffusion: The Case of Saudi Arabia

SHAKER HASSAN ALMAHASNA

Countries' economies should be diversified as much as possible to avoid economic slumps. Saudi Arabia's economy is highly dependent on oil as a major source of financial resources. However, diversification of economic activities requires improvement in the technological infrastructure of the country. FDI is considered a major source of technology diffusion. When foreign investors move some of their activities to a host country, they create externalities known as Spillovers. Spillovers are created with support of four major channels or effects, which are Demonstration-Imitation, Linkage, Competition and Workers' Mobility.

The aim of this research, hence, is to study the effects of FDI on technology diffusion in Saudi Arabia. It investigates the above mentioned four effects as channels of productivity growth and tries to analyze the spillovers resulting from foreign firms' operations in the country. Moreover, the study tries to discover the mechanism through which FDI promotes the technology diffusion. This is done by the utilization of the Total Factor Productivity (TFP) analysis. The TFP has been utilized by previous researchers as an indicator of technology flow and separation across cities and countries. The second objective of this research is to study the local investors' expectation of the future effects of FDI on the technology diffusion in the country. This is done by analyzing interaction between Competition and Linkages. It continues by analyzing the interaction between Training and workers' Mobility. The third objective of this study is to provide recommendations to the Saudi Arabian General Investment Authority (SAGIA), pertinent to the development of the technology diffusion in Saudi Arabia.

To achieve the above mentioned objectives a survey, composed of two parts, was developed. The first part of the survey targeted both foreign and local investors in four major geographical areas of Saudi Arabia. Those areas are the Eastern Province, Riyadh, Qassim and Hail. The second part of the survey targeted the local investors in the same geographical areas. To conduct the data analysis of the first part of the survey, a model is developed based on the

Parente and Prescott equation. The data analysis of this portion is conducted using Ordinary Least Square (OLS) regression. The second part of the study is analyzed using the two way Analysis of Variance. In addition, the results of part two analysis were supported by descriptive data analysis.

In the first part of study, intra- and inter-industry analyses are performed. In the Inter-Industry level; the study results reveal that there is very limited technology diffusion via the four channels and this result applies without adding control variables related to Size, Age, Location and Type of industry. If those variables are added, our variables of interest lose strength. On the Intra-Industry level, there are two (Chemical and machinery) of seven major business sectors that are not benefiting from FDI existence when it comes to advantages related to technology diffusion. None of the other five sectors, however, is fully benefiting from all the effects. In the analysis, different control variables are added to the analysis to investigate their effects. This includes the Size, Age, Location and the industrial Classification.

The results of the second part of the study reveals that interaction between Linkage and Competition is not expected to cause any productivity increase in Saudi Arabia. Moreover, the interaction between Training and workers' Mobility is not expected to lead to technology diffusion. These results are derived based on local investors' opinion polls. The result is also supported by extensive descriptive data analysis in which comparison with previous researchers' results is conducted. In addition, these results are supported by Chi-Square analysis for the sake of accuracy of the hypothesis testing.

The research is concluded with recommendations pertinent to the development of the technology diffusion in the country. The actions that are being taken are described, based on the results of this study, Also recommendations for future studies are given at the end of the research.

ACKNOWLEDGMENTS

I would like to dedicate this work to my dear Professor and Advisor, Dr. Francois Therin (University of Newcastle Upon-Tyne and Grenoble Ecole de Management) my late beloved father, my mother, my brothers and sisters, my beloved wife and children and all my friends.

At the outset, the author wishes to express sincere appreciation to Professor Francois Therin for his assistance in the preparation of this manuscript. I would like to thank Professors Francois Therin and Dimo Dimov for their constant advice and guidance to keep me on right track within the scope of this thesis for its successful completion.

I would like to thank my late father, my mother and my in-laws who brought me to this world to share my life-long learning for the benefit of others on the same path to higher life. Most importantly, I dedicate this work to my grandfather and grandmother, who were the first ones to encourage and support me in my childhood in understanding the importance of education and what it is like without education. I would like to thank my brothers and sisters for their help and support in this project. I would like to thank my dear wife and children who actually suffered most for not giving them enough time in the family during my study, but were always available to provide me with unlimited care, understanding and support in this project. I sincerely acknowledge and thank all my friends and colleagues for their help and support in editing and reviewing the text for the thesis.

I would like to express my thanks and appreciation to the Director-General of the Energy Sector at SAGIA, the Secretary General at Gulf Petrochemicals and Chemicals Association (GPCA) and all the Saudi Arabian companies who contributed their information for the research study.

DECLARATION

The work presented in this thesis entitled **"Foreign Direct Investment as a Channel of Technology Diffusion: The Case of Saudi Arabia"** is entirely my own and was carried out between October 2004 and May 2011 at University of Newcastle Upon-Tyne and Grenoble Ecole de Management. This material has not been previously submitted to any other institute or university for a degree or qualification.

Chapter 1 Introduction to the Research Model

1.1 Introduction

Countries' economies should be diversified as much as possible to avoid slumps (Nourse: 1968)[1]. To do so, investment should not be concentrated in one field. Diversity in industrial activities, however, does not only require financial resources, but also the technical ability to carry out the industrial activities for the adoption of various technologies (Krugman, 1991; Lucas, 1993; Romer, 1990). For that reason, if a country does not meet such requirements, it has to be one of its primary objectives when attracting Foreign Direct Investment (FDI).

FDI creates what is known as technology spillovers. **Spillovers** may be defined as the externalities resulting from an economic activity upon those who are not directly involved in it (Coe and Helpman, 1995). Those spillovers finally lead to technology diffusion via two major mechanisms:

(a) The direct learning of foreign technological knowledge **(Active spillovers).**
(b) Employing advanced intermediate products resulting from foreign R&D activities **(passive spillovers).**

In addition, FDI carries the spillovers and works as a catalyst in the channel of technology diffusion supported by four major effects, as follows:

a) The **Demonstration-Imitation Effect:** The exposure to superior technology might oblige local suppliers to upgrade their production capabilities. In the absence of FDI this is done only through R&D, which is usually expensive. However, the knowledge transferred from FDI to local companies may allow them to demonstrate the products. According to Connolly (1998), when this process is managed well, it has very strong effects on technology diffusion.

[1] Nourse in his book " Regional economies: A study in the economic structure, stability and growth of regions" argues that as regions become more economically diversified, their economies become less responsive to fluctuations

b) The **Competition:** Marakusen and Venables (1999) argue that when there is a difference in the economies of scale between foreign and the local investors, Competition effect will take place. Local investors will have to be more efficient to survive. However, to be more efficient, they need to use advanced technologies.

c) The **Linkage effect:** It takes place when foreign investors materialize transactions with local suppliers. To achieve the quality standards requested by foreign investors, local suppliers will need to upgrade their technologies and, hence, resulting Backward Linkages will occur. Sometimes, local manufacturers are obliged to buy intermediate goods from foreign investors. This happens due to technical complexity. In this case Forward Linkages will take place (Holland and Pain, 1998).

d) The **Training and Workers' Mobility effect**: It takes place when foreign investors train local workers on new technologies. Upgrading the level of technical knowledge and skills of these workers will create the Workers' Mobility in the local market, which will finally lead to spread-out of technology and increase of productivity (Kinoshita, 1998).

Quantifying the spillovers from FDI, however, is not an easy task. As technology diffusion is an important contributor to productivity growth, several researchers have used the Total Factor Productivity (TFP) as an indicator of technological spillovers. Among those researchers are Coe and Helpman (1995) and Keller (2002). Economists define TFP, as the portion of output that is not caused by input. If all input variables are accounted for, TFP can be taken as a measure of economic progress due to technological advancement changes. Several other researchers used the TFP growth as a measure of the spillovers from FDI. Examples include Benhabib and Spiegel (1994), Kinoshita (1998) and Keller (1998). Similarly, the TFP will be used to measure the spillovers from FDI in Saudi Arabia. The fact that TFP is a good proxy measure for the technological progress is justified by many researchers. The TFP is usually obtained as the difference between output (value added) and production factor inputs multiplied with their coefficients. When the FDI spillovers are regressed against the TFP, they are considered as additional indirect inputs explaining its change. The

significance of this contention is highlighted by Melitz (2003). The source of TFP change due to spillovers could also be practically explained by new technologies that are brought by FDI through joint ventures. Usually, those technologies are not available in local market and their usage leads to TFP growth. Those technologies could also be copied by local competitors either through direct Imitation or through Workers' Mobility. Another, way of productivity is done when local suppliers are employed as suppliers. Local firms might be educated by foreign investors to improve both quality and quantity of their production. The aforementioned tactics are all sources of productivity growth justifying the use of TFP as a proxy for measuring spillovers.

Moreover, a major part of the cost-benefit analysis performed by government to decide on the size of investment incentive offered to a foreign investor should include the size of productivity spillovers. Blomstrom and Kokko (2003) highlighted that in Central and Eastern Europe, countries frequently compete with each other for the same investment. Having an idea about the expected spillovers would help in deciding on the size of the incentives offered to the FDI.

Saudi Arabia has close strategic, political, and commercial ties with most of the financial giants in the world. These relations include European countries, the United States, South East Asian countries (Japan, China, South Korea, etc...). The Saudi Government has been putting efforts to promote FDI in the country. Yet most of the FDI activities in Saudi Arabia are in the Oil and Petrochemical industry. As a result, the economy of the country remains critical, since it is highly dependent on the oil and petrochemical revenues. The diversification of different industrial activities in the country requires the adoption of various technologies. The MNCs' activities develop different types of technology spillovers that may help in achieving such a goal.

This research is going to answer the questions related to diversification of foreign activities in the Kingdom of Saudi Arabia (KSA) and the spillovers from those activities to be maximized in the country.

1.2 The Research Objectives

As mentioned in the previous section of this chapter, there are four effects of FDI on technology diffusion. Most of the studies considered a single effect, which does not provide enough evidence for decision makers. Other studies considered a couple of effects. Unless all the effects are considered, simultaneously, studies remain valuable information but not strong evidences. This research aims to cover the gap in literature by considering all the effects, simultaneously.

Furthermore, I could not find any source in literature that discussed the FDI effects and considered Saudi Arabia as a case study with the following four objectives:

- The first objective of this research is to provide a reference study for the Saudi Arabian General Investment Authority (SAGIA) personnel that will help them to make various economic decisions related to the fields of FDI and technology diffusion development.

- The second objective of this research is to provide a reference study that will help decision makers in Saudi Arabia to accept and support selected FDI inflows in the country. The maximized spillovers from FDI in a way will help in the dissemination of technology and achieving the resulting diversification of economic activities. The Saudi government has been putting efforts to support the FDI through the establishment of the SAGIA. This action is supposed to increase Competition and Linkages. Consequently, productivity of local firms should increase.

- The third objective of this study is to provide recommendations to the SAGIA that will eventually lead to technology diffusion. This will be done by finding out the mechanism through which FDI promotes technology diffusion.

- Finally, the Saudi government has been exerting efforts and spending a lot of money on the development of its human resources. This study will analyze and investigate the results of that investment in human resources. I

will study the effect of Training and Workers' Mobility on technology diffusion.

1.3 Justification of the Research

FDI as a channel of technology diffusion is an area that is worth studying. During the past few years, FDI flows have grown at remarkable rates. According to the United Nations Conference on Trade and Development (UNCTAD) in 2007, the FDI inflows to the developing countries have increased by 33 %. The inflows were approximately $1,248 billion. In 2008, that grew at a faster rate to reach 1, 693 billion dollars US.

The first point of justification is that countries would allow and encourage such investment with hope that FDI will foster economic growth **(Figure 1.1).** Since FDI works as a catalyst for such long term economic growth, studying the inflow of resources related to it is considerable. If these studies are supported by results that will help to enhance the four effects of technology diffusion, that will make the justification sound.

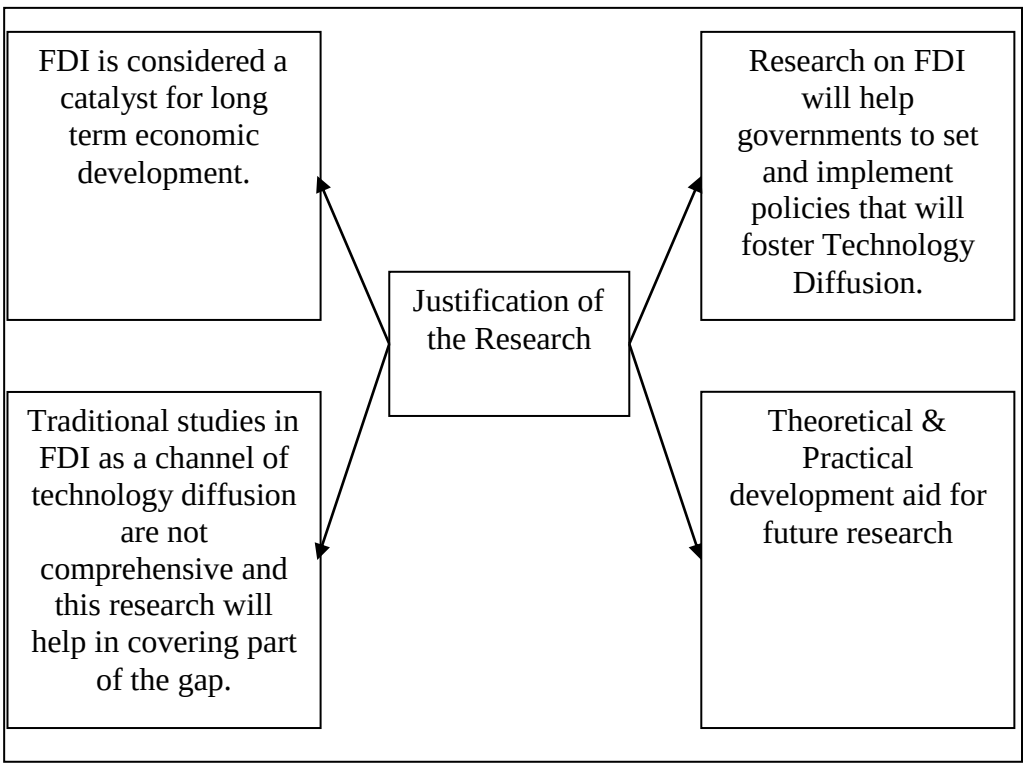

Figure 1.1 *Justification of the Research*

The second point of justification is to study the management of those financial resources that is even more important to achieve the necessary technology diffusion. The results of this research can help the Saudi government to set policies that will eventually lead to the development of new business sectors. That will happen by concentrating and supporting the inflows of FDI in those sectors that require further technological development. This is a strong justification for exerting efforts in this research field, because it will lead to diversification of economic activities.

The third justification of this research is that most of the studies of FDI and technology diffusion focused on a single or two effects of the FDI. More comprehensive studies are needed. These studies must consider all the effects of FDI on technology diffusion. In addition, previous studies did not touch on the practical side of FDI and technology diffusion. Most of them are based on statistical data that were driven from different databases available in government institutions. On the contrary, this thesis will consider actual information based on data collected directly from the local industries.

The fourth justification of this thesis is that its findings will provide substantial research benefits in the fields of FDI and technology diffusion. It will make significant contribution to the knowledge in the areas of technological developments with particular contributions being:

1. Unique in its geographical locations
2. A study of FDI attraction in a wealthy country that has no problems related to financing different projects.

1.4 Scope of the Research

This study aims to investigate the FDI as a channel of technology diffusion. The four effects of FDI on technology diffusion are considered, simultaneously. In the previous studies, most of the researchers measured a couple of effects only.

Even those researchers, who considered two effects, used one effect only while holding the other effect constant.

In this research, I will measure the impact of the four effects together. I will utilize the equation proposed by the empirical work done by Parente and Prescott (1994). The survey conducted in this regard was at the firm level.

This study will handle the subject quantitatively. A survey was developed to serve this purpose. However, due to lack of information about the FDI in Saudi Arabia, some data was collected from SAGIA database. Other data was collected from the Ministry of Commerce (MOC). The data collected from those two organizations will help in identifying the scope of this research.

The research is going to assess, in general, the FDI in the Kingdom of Saudi Arabia. The data collected from the MOC database reveal that there are 4048 factories owned by local Saudis. The industrial activities are concentrated in the Eastern, Western and Central Provinces of Saudi Arabia. Yet, most of the medium-to large industries are concentrated in the Eastern and Central provinces. In addition, the Eastern and Central Provinces are geographically attached, which make the flow of spillovers between the two provinces easier. The Eastern Province is considered the source of oil revolution in the country and many investors set this proximity as a target. Natural sentiments could lead to a hypothetical assumption that the Eastern Province has the source of technology in the country while Riyadh, which is the Capital of Saudi Arabia, has the treasury and the major financial transactions take place there.

The Western, Northern and Southern Provinces are excluded due to the fact that they solely depend on the two major sources to cover their financials. The first is the money that comes from the Eastern Province and the tourism due to the existence of the two holly cities, namely, Makah and Madinah in the Western Province. The Northern and Southern part of Saudi Arabia are considered rural areas and most of the people from those areas migrate to the east for working and living. Moreover, adding those three provinces to the sample would have increased the number of local investors by 1448 and the foreign investors by 821 leading to an unachievable and unrealistic target of respondents. SAGIA had its

own input on the sample and the management recommended doing the research in the Eastern and Central Provinces only.

Province	EAST	WEST		CENTRAL			SOUTH				NORTH		
City		Makah	Madinah	Riyadh	Qassim	Hail	Jazan	Najran	Aseer	Al-Baha	Al-Jouf	Tabouk	Boarders
Food	120	180	42	194	43	9	10	3	14	4	14	12	2
Non-Metallic	146	133	33	221	23	6	21	10	43	4	4	9	5
Textile	29	67	8	89	3	0	1	0	1	0	0	0	0
Wood	22	16	3	11	1	0	0	0	0	0	0	0	0
Chemical	95	116	12	147	12	1	1	0	6	0	1	3	0
Machinery	41	51	3	105	11	0	0	0	1	0	0	0	0
Others	451	500	50	748	57	15	4	7	31	7	4	10	2
Total (By City)	904	1063	151	1515	150	31	37	20	96	15	23	34	9
Total (By Province)	904	1214		1696			168				66		

Table 1.1 *Local Factories distributed by City and Province*[2]

[2] Statistical Reference Data collected directly from the Saudi Ministry of Trade to be compared with sample data from different industries

The distribution of these factories over the cities and provinces of Saudi Arabia is presented in **Table 1.1**. Furthermore, the data extracted from SAGIA database reveals that it has issued around 2109 industrial licenses for foreign direct investors during the past eight years. Those industries are concentrated in Eastern, Western and Central Provinces. The geographical distribution of those factories is depicted in **Table 1.2**. The medium-large industries are also concentrated in the Eastern and Central Provinces for two reasons.

First, Eastern Province is an oil rich area and most of the foreign investors would like to be close to the giant oil and petrochemical companies. The other reason is that Riyadh is located in the Central Province and the Saudi government has spent huge amounts of money to develop the infrastructure of the industrial cities located there. This thesis is going to tackle those two regions for the aforementioned reasons. One more reason for this scope is that Eastern and Central provinces are geographically attached, which will make the technology diffusion faster.

Three hypotheses are developed to investigate the effects of FDI on technology diffusion. All of those are handled quantitatively. Yet, the quantitative analysis is mixed with descriptive analysis. This is due to the fact that a lot of effort was exerted to collect data not related to the distributed survey. This obliged me to meet many employees in charge of FDI in Saudi Arabia and that added to my experience in the subject. This experience will add to the quality of this research.

Province / Year	EAST	WEST	CENTRAL	SOUTH	NORTH	Total No. of FDI Per Year
2001	9	12	21	0	0	42
2002	44	106	168	3	1	322
2003	42	120	206	2	2	372
2004	28	69	70	2	1	170
2005	30	67	67	2	0	166
2006	42	50	73	1	0	166
2007	70	137	187	3	0	397
2008	68	230	163	13	0	474
Total	**333**	**791**	**955**	**26**	**4**	**2109**

Table 1.2 *Number of FDI Licenses by Province*[3]

[3] Statistical Reference Data Collected directly from the Saudi General Investment Authority database to be compared with sample data

1.5 Structure of the Research

The title of the thesis is “FDI as a Channel of Technology Diffusion: The Case of Saudi Arabia”. The thesis studies the effects of FDI on the technology diffusion concentrating on the Eastern and Central Provinces of the country. The structure of the thesis is presented in **Figure 1.2**.

There are seven chapters in this research. The first chapter is an introduction, which provides a summary statement of the research project and its purpose. It also explains the objectives of the research and the research justification. It provides a brief explanation of the research methodology and the scope of the research.

A comprehensive literature review is presented in Chapter 2. It sets a base for the conceptual framework for the research project by putting the different subjects related to the study in a structured sequence. The FDI relation with the economic growth is highlighted. Then, the way countries attract foreign direct investors is discussed in detail. Chapter 2 also investigates the reasons that make foreign investors go abroad. The second part of this chapter handles the relation between FDI and technology diffusion. It handles the channels of technology diffusion. It explains all of those channels that are highlighted in previous studies. This part concludes with the explanation of the FDI effects on the diffusion of technology. The third part of the literature review provides empirical evidences on the spillovers from FDI. This includes both inter- and Intra-Industry evidences. The last part of the literature review touches on the FDI experiences in Saudi Arabia. This section is included because Saudi Arabia is the location where the survey is conducted.

Chapter 3 presents the conceptual framework of this study. It discusses the the hypothesis and the testing method of each. It also presents the model formulation in detail.

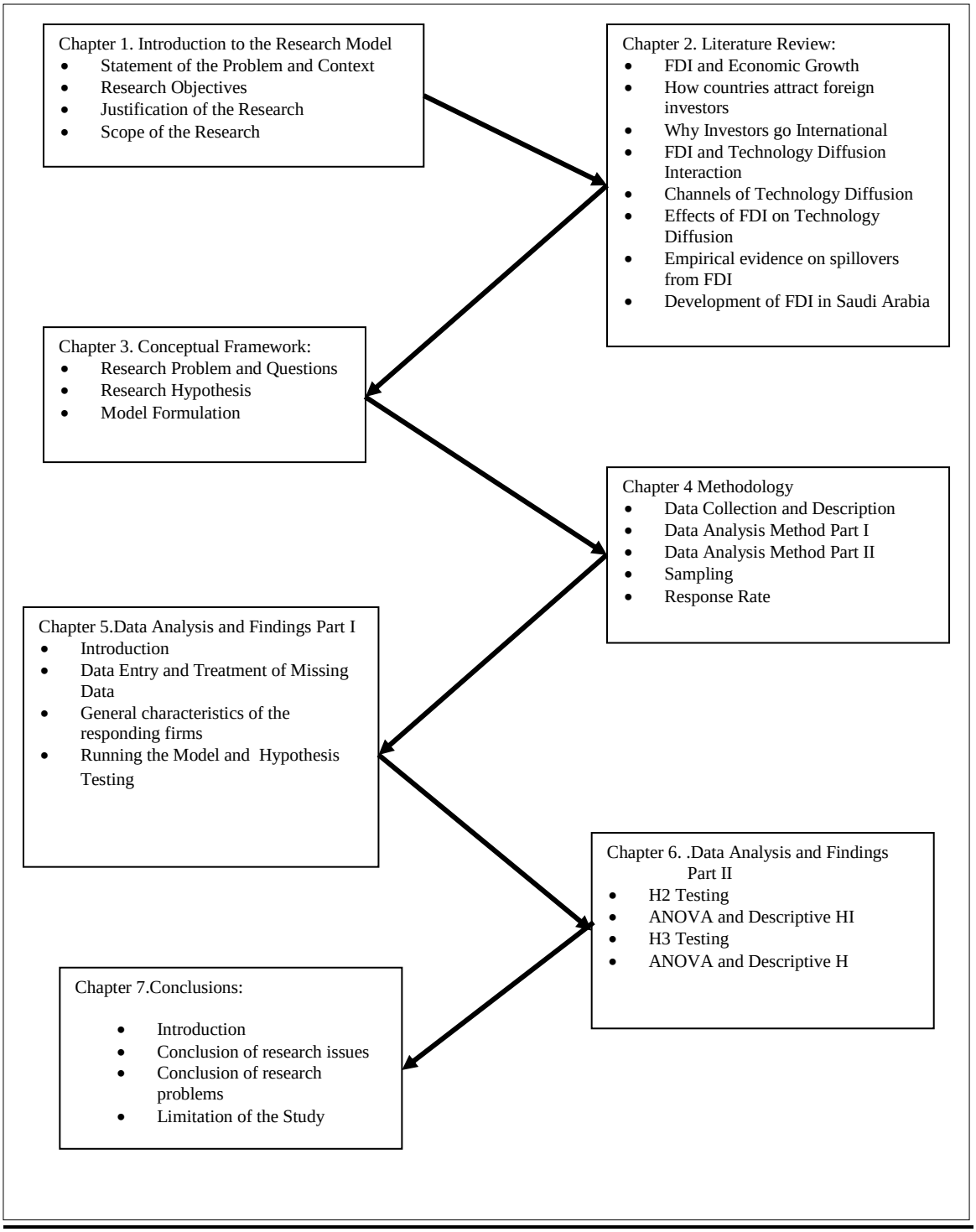

Figure 1.2 *Structure of the Thesis*

Chapter 4 is dedicated for the methodology of the research. It explains the nature of the data and the data collection method. The data analysis methods of both parts one and two are highlighted in this chapter. Sampling strategy and response rate are also enlightened here.

Chapter 5 is titled Data Analysis and Findings – Part I. it starts by describing the relative performance of foreign firms relative to local investors. The detailed analysis of the part I is explained and around 16 different control variables are introduced in this part. It provides the results of the data analysis and the run out tests for the hypotheses.

Chapter 6 is titled Data Analysis and Findings – Part II. It aims to test both Hypotheses (H2 and H3). Two way “Analysis Of Variance” method is used to analyze both hypotheses, quantitatively, with extensive descriptive analysis.

Chapter 7 concludes the thesis by providing a brief analysis of the main issues rising from the research and key contribution to the fields of FDI and technology diffusion. It provides recommendations for future direction of research and possible concentrations.

1.6 Summary and Conclusion

This introductory chapter lays the foundation of the thesis. The research objectives and questions are briefly introduced with justification structure. The goal is to investigate the effects of FDI on the diffusion of technology. The four major effects - Demonstration-Imitation, Competition, Linkages and the Workers’ Mobility are measured. The survey is conducted in the Eastern and Central provinces of Saudi Arabia. Although the quantitative approach is used in this study, it is mixed with qualitative approach to reflect the data and information collected from different organizations operating in Saudi Arabia.

The next chapter provides an insight on the previous studies related to this subject.

Chapter 2 Literature Review

2.1 FDI and Economic Growth

There is a general definition of FDI in literature, yet different countries and organizations have their own special regulations that make FDI interpretation diverse. The Organization for Economic Co-operation and Development OECD) defines FDI as "investment by a resident entity in one economy that reflects the objective of obtaining a lasting interest in an enterprise resident in another economy. The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the direct investor on the management of the enterprise. The ownership of at least 10% of the voting power, representing the influence by the investor, is the basic criterion used". Researchers in this field have a more general definition of FDI. Romer (1990) defined FDI as the process whereby residents of one country (the source country) acquire ownership of assets for the purpose of controlling the production, distribution and other activities of a firm in another country (The host country).

Whatever the mechanism, a country uses to promote FDI its eventual objective is to achieve a certain level of economic growth. The basic presumption that is found in literature is that FDI raises income and social welfare in the host country unless the optimum conditions are distorted significantly by protection, monopoly and externalities. Choi (1997) asserts that FDI transfers both financial resources and different factors of production such as technology and management Know-How to the host country. In addition, it helps the host country to build and expand various business networks such as marketing. According to Moosa (2002), the effects of FDI on the economics of the host country include the implications for economic variables, such as output, balance of payments and market structure. Moreover, using panel data across Provinces of China, Sun Huihuang and Su Jirong (2009) analyze the relationship between FDI and economic growth. The results indicate that FDI has significant positive effects on economic growth of China. Those effects may be classified into macro and micro effects. The macro effects may be treated as a rise in foreign borrowing. If there is unemployment

and shortage of capital, such borrowing leads to rise in output and income in the host country. This situation is typical in the developing countries under those conditions where FDI has a positive effect on the balance of payments but unknown effect on trade. The unknown effect depends on whether the impact of increased output falls on the substitutes of imports or exports. Fosu et al (2007) analyze the long-term impact of FDI and trade on economic growth in Ghana. He finds that FDI effect on economic growth is negative while its effect on trade is positive. The micro effects, however, pertain to individual firms and industries, specifically, those closely exposed to FDI. Markusen and Venables (1997) argue that FDI effects on the host country may take place through many channels including product market Competition and Linkage effects. This enables FDI to alleviate the process of leading to the development of local industry. Pertinent to employment, Hijzen et al. (2011) analyze the manufacturing and service sectors in France between 1987 and 1999. They verify that Market-seeking FDI in manufacturing is associated with significant scale effects, resulting in job creation. They also find out that FDI in service sectors is associated with significant positive employment effects, presumably, reflecting the importance of the market-seeking motive in these sectors.

FDI also increases the host country's exchange of earnings through the expansion of exports. Even though critics of Multi-National Corporations (MNCs) argue that inflows of FDI may cripple the efficiency and stifle growth through exploitation and domination. There is general acceptance of the Idea that FDI has positive effects on the overall economic growth. Borensztein et al (1998) test the effects of FDI on economic growth using cross-countries' data of 69 developing countries over a period of 20 years. Borensztein's results reveal that FDI stimulates economic growth. That is achieved either through the flow of physical capital or spillovers from technology. Most of the studies assert that the economic growth resulting from FDI is stronger in developing countries than in the developed countries. Johnson (2005) analyzes cross-countries' panel data to find indications that FDI inflows enhance economic growth in developing economies. He uses data for 90 countries covering the period from 1990 to 2002.

The inflow of FDI generates what is known as technology spillovers, which in turn stimulate the productivity of local firms. Holland and Pain (1998) find evidence

that inward investment advances technical progress, even though, the direct effects of a given change in the stock of inward investment are found to be lower than those obtained for leading economies such as the UK and Germany. Their research data include ten countries from Central and Eastern Europe from 1992 to 1996.

The above introduction results in my conclusion that FDI is a very important channel of economic growth. That is why countries race to attract as many investors as they can. Next section will answer questions related to how those countries achieve that goal.

2.2 How Countries attract Foreign Investors

Countries use different strategies to attract FDI. Those tactics depend on the available resources of the host country. Yet the legislators in those countries have to think from the investor's point of view and study the needs to come up with a successful FDI strategy. In that comprehensive research "Framework for FDI promotion", Henry Loewendahl (1998)[4] proclaims that Image, brand awareness and perceptions are major factors influencing the location of FDI. His research is based on the International Finance Corporation (IFC) work and divided investment promotion into four major areas:

- Strategy and Organization
- Generation Area Leads
- Facilitation
- Investment Services

The **Strategy and Organization** are achieved by the following five major stages:

a) **Setting the national policy context:** Unless the basic policies are set in place, marketing FDI becomes impossible. According to the UNCTAD, those policies include macroeconomic policies, the degree of economic stability,

[4]Lowewenahl is considered as one of the most active researchers in the subject of FDI promotion.

product development policies, regional policies and inward investment policies.

b) **Setting objectives:** The objective of the FDI promotion must be strong and logical. Young et al. (1994) list several issues that have to be taken into consideration when setting the objective of investment promotion. The reason why a government wants to attract inward investment is a major question that influences the size, structure and priorities of the Investment Promotion Agency (IPA). Objectives usually include creating jobs, technology transfer and Competition increase, developing clusters, filling in supply gaps and providing partnering opportunities for local firms. Setting national priorities for sectors is also an issue. IPAs have discrete resources and evidence of best practices shows that effective investment is on certain industry clusters. Objective clarification must also include explanation of the types of projects within a sector or projects that may meet positioning objectives, such as developing an excellence in a particular business activity. In addition, the IPA has to mention whether the investment is in Greenfield or mergers and acquisitions. These technologies are very important sources of energy. As oil is a deplete-able source of energy, the Greenfield types of investments should be given special care by the IPA.

c) **Investment promotions:** This stage varies significantly between countries due to the different objectives in attracting inward investment, size of countries and the differences in the importance of regional agencies. However, there is no perfect structure for a single country. Large countries, such as the UK, usually establish a single entity dedicated to handle FDI and also some small countries like Bulgaria have done the same thing. Those entities and IPAs usually have very strong links with the Ministry of Foreign Affairs (MOFA), which facilitate overseas investment promotions. On the contrary, other countries handle investment promotion at the regional level rather than at the national level. For example, the United States have no national IPA, because of the economic and political weight of Federal States. Similarly, China has no dedicated agency that handles the IPA at a national level. Nevertheless, there is a common success factor in investment

promotion. Henry Loewendahl, et al. (1985) highlight three preconditions for the effective operation of an agency. First of all, the agency has to have a clearly defined role that supports it. Second, operational autonomy is greater if functional responsibilities are assigned for each sector. The third last is the independent access to expertise and information. Therefore, Atkinson and Coleman (1985) support the idea of centralized single agency in a given area, having a greater capacity to regulate and implement FDI policies. The point is, whether operating at the national or regional level, IPAs need to be sufficiently independent from government jurisdictional boundaries. This will give the agency credibility with investors. Also, the ties with both public and private stakeholders should be very strong. Each stakeholder plays an important role in the facilitation process of an investment. For example, universities and training colleges may facilitate that by preparing the necessary manpower infrastructures. Loewendahl (1998) asserts that key government links include the mobility of the government ministers at the highest level to create policy certainty and demonstrate the seriousness with which the projects are viewed. Ministers may also play a role in promoting investment projects through their overseas visits. Another government link is the effective coordination of investment promotions at both national and regional levels. Because regional agencies usually compete for the same investment projects, coordination will avoid wasteful Competition and duplication. Finally, the agency must have enough power to influence decisions that affect individual investments and investment policies.

d) **Competitive positioning:** It is essential for any investment promotion campaign and is applicable for newly established agencies and for more mature agencies. Most of the IPAs conduct such exercise on annual or bi-annual basis. For example, two core elements, Research and Marketing, to competitive positioning are defined by Loewendahl (1998). Research deals with Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of Location relative to different industrial sectors' requirements and key competitors for inward investment in those sectors. Sometimes it includes a SWOT analysis of the IPA itself relative to other competitors as well. Marketing is usually based on the aforementioned analysis. Unique Selling Points (USPs) are developed for key sectors and specific types of projects.

The objective of that is to provide project officers with competitive arguments to use when approaching potential investors. To sum up the competitive positioning exercise, it provides an understanding of Location position relative to competitors and sectors at the strategic level. Also, it should provide project officers with information that allows them to promote their areas of responsibility as well as Location for inward investment, more effectively.

e) **Sector targeting strategy:** Due to limited resources available, countries usually move to sectors of the FDI that are most feasible. According to Potter and Moore (2000), this is done by identifying the sectors in which the host country is best positioned to attract investment and which meets inward investment objectives. Several methods are used to evaluate sectors. Evaluation matrices evaluate sectors according to the FDI opportunities, competitive positioning and degree to which they meet FDI objectives. The evaluation is a sophisticated process that requires up-to-date detailed knowledge and reflective analysis of Location and activities. For those reasons, IPAs usually hire independent consultants to conduct such tasks.

The **first stage of Generation Area Leads** of investment promotion is usually achieved through **Marketing**. In order to promote a Location, a recognized brand name is essential. According to a survey conducted by Loewendahl and Ertugal (2000), 60 % of respondents thought Turkey had a poor brand image. This is a major factor that helps in the weakening attraction of FDI. Marketing aims at building up the image of a certain Location. However, it has to be continuous. There are several techniques used to promote investment Location. General Public Relations campaign is one of the most popular techniques. Participating in investment exhibition, IPA and business conferences are very important avenues of generation area leads for investment promotion. Other techniques include investment and trade missions, Direct mail, telephone campaigns and creating an IPA web site.

The **second stage of the Generation** Area **Leads** is the **Company Targeting**. Leading IPAs use sophisticated propositions based on marketing to target different companies with certain business opportunities. This process is long-term

with two main folds; first of which is the identification of potential investors while the second is building up the relationships with the targeted companies.

The **third major area of the FDI promotion** is **Facilitation**. Facilitation is the process of project handling with an objective to convert an investment enquiry into actual investment. There are many issues for consideration while handling an investment project. One of the major issues is nominating a key contact or project manager who makes sure that coordinating the project is effective. One of his main duties is to develop professional respect and personal rapport with the investor. Another issue of the project handling is the full and accurate understanding of the investor's requirements. Example includes the micro-targeted approach where the Costa Rica Investment and Development Board (CINDB) adopted to attract Intel. At that time the CINDB had to conduct a full research on the electronics and semiconductors sector to understand the company's needs according to Spar (1998). Facilitation of investors' visits to the promoted location is very crucial at this stage. Other facilitation issues include information accessibility and range of services that vary from consulting, expediting application and permits processing.

The **fourth area of the FDI promotion is the investment services** where Loewendahl (1998) identifies two stages for this area.

The first stage is the aftercare and product improvement. The objectives of this stage are, as follows:

- Supporting the reinvestment by existing investors.
- Increasing the value of the investment to the host countries through increasing the share of value-added sourced from local firms.
- Helping to embed Transnational Corporations (TNCs) more strongly.
- Generating new leads by reinforcing the quality of location.

The **second stage of the investment services,** the last for the FDI promotion, is monitoring and evaluation of the project development. Monitoring is increasingly recognized for **three major reasons**. The first is to promote knowledge transfer and coordination between project officers and offices. The second is the after-care and product development while the third is for the purpose of accountability.

2.3 Why Investors Would Go International

In the literature of FDI, one may find variety of reasons for MNCs to go abroad. Hymer (1976) is the first author who indicates two motives for FDIs to work abroad. He states that the removal of Competition and the advantages a particular foreign firm possesses in a particular industry are the main reasons for moving abroad. Further, Hymer's concepts demonstrate that a firm would move abroad only if the paybacks of exploiting firm specific advantage would outweigh the relative cost of moving abroad. He further appeals by explaining that MNCs would appear due to market imperfection that would lead to divergence from perfect Competition in the final product market. This important work was followed by an important concept developed by Dunning (1977). He mentions that advantages are of three types. Those types are Ownership, Location and Internationalization.

Ownership advantages include the following:

1. Firm monopoly advantages that may include the utilization of a country's natural resources, patents and trademarks.
2. Access to technology and knowledge that contain innovation activities.
3. Development of economies of learning, economies of scales and access to capital.

The location advantages however, include:

1. Economic quantitative and qualitative advantages related to communication, cost of transportation and market size.
2. Political advantages including government regulations governing FDI inflows.
3. Social advantages including cultural diversity.

Finally, the advantages of internationalization defined by Hymer (1976) are the utilization of firm power to sell its goods and sign service contracts with companies at a different location. The aforementioned theory is known as the Eclectic Paradigm Theory.

Other studies in this field includes Krueger (1995) views that Risk diversification, Ownership, Control and competitive advantages are some of the major reasons that result in a number of activities taking place in separate countries. Jun and Singh (1996) assert that investment might migrate from a host country inviting

investment to another searching for political stability in addition to transparent and well established legal and tax system. However, Lukes and Venables (1996) argue that market access is the prime factor that influences potential investors.

But those are related to the objectives of any organization to maximize the shareholders' wealth. Market access and cost minimization in a secured investment environment are the major reasons for foreign investors to choose a certain host country. Serven et al. (2008) put that justification into economic mold by arguing that FDI is useful for two reasons. First, because production finally displays decreasing returns to scale, it is optimal to spread production across different locations. Second, by investing abroad, investors benefit from diversification of risk from the productivity shock in their own country. This supports the analysis done by Rowland and Tesar (2000) for Canada, Germany and the United States covering the period of 1984-1992.

In recent research, however, there is clear consensus in the literature about why multinationals invest in certain locations. Globerman and Shapiro (1999) assert that MNCs are usually attracted by the strong economic fundamentals of the host countries. Those fundamentals include market size, income, trade policies and political and macroeconomic stability. However, those researchers also recognize that foreign investors seeking an export base would be less focused on local market size and more concerned about the relative cost of production. Still, they have considered those investment incentives as relatively minor determinants of FDI decisions.

Blomstrom and Kokko (2003) argue that the view on the importance of the incentives for MNCs to invest abroad have begun to change in recent years. The proliferation of investment incentives across the world is an indication of that. According to their research, more than 100 countries provided various incentives in the mid-1990s and dozens more have introduced such incentives since then. Nowadays, very few countries compete for foreign investment without any form of subsidies. UNCTAD (1995) reports financial subsidies ranging from USD 14000 per job for Mazda's 1984 investment in Flat Rock, Michigan to USD 254000 per job for Ford and Volkswagen investing in Setubal, Portugal in 1991. Moreover,

Neven and Siotis (1993) report subsidies of about 30,000 ECU per worker for investments in Belgium, France and Luxemburg.

Except for processing zones and industrial zones, most of the developing countries base their incentive schemes on tax holidays and other fiscal measures that do not require direct payments. According to Blomstrom and Kokko (2003), there are no reliable calculations of program costs and it is almost impossible to quantify the flow of FDI to each country in the absence of incentives. Due to the lack of published data on the type and amount of FDI subsidies, it is even more demanding to make explicit comparisons of how different types of incentives influence the investment flows and firms' behavior, although it is possible that there are significant differences between subsidy programs. Direct financial subsidies are likely to have main influence on the Location decisions, while tax holidays may affect operational decisions for several years. Tylor (2000) suggests that fiscal preferences have become more significant determinant of direct investment flows, internationally. This is very important because most FDI incentives apply particularly to Greenfield investments.

The global trade liberalization further encouraged MNCs to setup international production networks. Through those networks, a larger share of output is shipped to international customers or affiliated companies in other countries rather than sold to local consumers. This allowed smaller countries to compete for investments that could have been directed to the major markets decades ago. Regional integration has similar effects, allowing MNCs to supply member states from a single location within the region. This enforced policy makers to set up more incentives to attract international investors.

2.4 The Interaction between FDI and Technology Diffusion

Technology diffusion plays a very important role in the process of economic development. The interaction between the FDI and the technology diffusion is considered to be important in the discussion of FDI. Indeed, the transfer of technology has become the predominant issue around which discussion of MNCs and their dealing with developing countries evolve. That is because technology is

believed to be a very strong source of economic growth, capital accumulation, trade and changes in the organization of social and production relations. It is the channel through which economic growth in the host country is achieved.

The scientific consensus assures that FDI creates technology spillovers. Spillovers stimulate technology diffusion in the host country. Many researchers including Coe and Helpman (1995), Eaton and Kortum (1996), Keller (1998) and Connolly (1998), quantify the importance of international spillovers. They assert that the international technology spillovers take place through many channels among which FDI is one of them. FDI is considered as the main avenue of technology movement in the modern open economies. Also, Zhong-Chang et al (2008) study the effect of FDI on technology spillover and draw a conclusion that there is a limited effect of spillover. Moreover, Romer (1990) asserts that the endogenous growth theory confirms the role of technological progress as an endogenous source of economic growth.

According to Lee (2003), the following determine the diffusion of technology:

1. The party who has the technology
2. The channels of diffusion
3. The party who receives the technology
4. The environment and/or the capacity of the receiver

Yet, to understand how the technology diffuses, we have to study the nature of technology. There is still no consensus on the nature of technology. Early theoretical literature on economic growth, such as depicted by Solow (1956) and Swan (1956), did not elaborate enough on the nature of technology. It is assumed exogenously given and is not systematically investigated. Recent work on economic growth considers technology as technological knowledge. This is highlighted in the theory of endogenous economic growth[5].Technological knowledge in the endogenous growth literature is usually described as the design, instructions or blueprint for new intermediate input. Romer (1995) defines technological knowledge as the instructions that allow a company to combine limited physical resources in arrangements. The resulting arrangements are usually more valuable than the knowledge. Lee (2003) identifies two intrinsic

[5] Please refer to Grossman and Helpman (1991) and Romer (1990) for further information about technology and growth introduction.

characteristics of technology. Technology is non-rival in the sense that it is possible to use it with minor marginal cost for production improvement. Rival inputs could only be used once in production process and new rival input is needed for another output. The second characteristic is that the benefits of technology can be retained for some finite period through patents and copyrights by the pioneer. Then they will be extended to firms and individual external to the investor (public returns). These benefits are the spillovers mentioned at the beginning of this section. A good example is the blueprints of new products, which may be duplicated and further developed by other producers without assuming all costs for development of original products. That process of spillover is the major source of generation for economic growth.

In order to understand how spillovers take place, the essence of knowledge has to be first understood. That is because spillovers are knowledge that is not known to everyone. One of the most important classifications of knowledge is whether it is Tacit (personal) or Codified (explicit). **Tacit knowledge** is codified knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it[6]. Codified knowledge is knowledge that can be articulated and stored as a preparation for others to use it. French and Bell (1995) argue that technology consists of complex information, both codified and tacit. Polanyi (1958) creates the distinction between tacit and codified knowledge. That distinction according to him is very important to understand problems in the transfer of technology. Technological knowledge is only partially codified because it is impossible or very expensive to codify it. Rowe and Boise (1974) and Saviotti (1998) define explicit or codified knowledge as the knowledge that have been or could be converted into symbols for easy transmission, replication and storage. This type of knowledge partakes of some public goods properties. This makes it a potential source of increasing returns. Teece (1997) finds that non-codified part of the costs of transferring technology between plants is substantial. He estimates the cost of such action to be 20 % of total project cost while shown that non-codified knowledge continues to be important for understanding patterns in the creation and diffusion of knowledge. Special methods are used to transfer tacit knowledge into codified knowledge. According to Nonaka and Takouchi (1995), those methods, known as horizontal methods, include Apprenticeship/

[6] Please refer to Collins, H.M. "Tacit Knowledge, Trust and the Q of Sapphire" Social Studies of Science' p. 71-85 31(1) 2001

Training research cooperation, Imitation, hands-on workshops and on-job training. Vertical transformation methods include those identified by Chang and Stiglitz (2001), as the ones transmitted to central repository or library and then accessed by the interested parties.

Another important argument pertinent to the importance of understanding knowledge and technology transfer is whether the scope of knowledge diffusion is local or global. Lee (2003) argues that even though there are those who emphasize on the tacit knowledge and the importance of technology diffusion in economic growth, nowadays due to the progress in transportation and communication, technological knowledge is getting more global attention. Parente and Prescott (2000) assert that knowledge is global but countries differ in per capita income because differences exist in the actually employed technological knowledge. Countries vary in the ability to adopt new technologies and the efficient use of operating technologies. That ability depends on the policy arrangement handled by the host country's policy makers. This result is derived from the historical evidence that includes the world textile industry in the 20th century. Keller (2002) finds that spillovers from technology diffusion are significantly substantial, locally, not globally, as the benefits from spillovers are declining with the distance. This is the result of his estimation of the amount of R&D expenditures on a geographic basis. However, he also discovers that technological knowledge over time becomes considerably more global.

Whether the source of technological transfer is local or global, it should have very strong effects on the economic policies of countries. Lee (2003) assumes that if the source of technological progress is local, governments are forced to use policy tools to promote domestic firms in the fields of research and development. However, if the source is global, policy efforts should concentrate on seeking and securing domestic firms awareness and readiness to foreign technology and expediting foreign technology diffusion.

2.5 Channels of Technology Diffusion

At this stage, it is relevant to talk about the channels through which technology diffusion takes place. Lee (2003) argues that there is no reason for technology spillovers to be confined to domestic borders in open economies. International spillovers of technology are transmitted through several channels. The most important channel is FDI, which is the subject of my research. For that reason this section is devoted for the literature review of this channel. Another important channel is the international trade in final goods. Lichtenberg and Potterie (1996) examine two potential channels of technology diffusion, which are trade and FDI. Using the data from OECD countries, they examine the FDI composition effect of technological diffusion. They find that outward FDI and Trade are simultaneous channels of technology diffusion. The third channel is the migration of scientists and engineers while these educated people attending workshops and seminars and establishing contacts. Finally, purchasing foreign technology is a vital channel of technology diffusion. Moosa (2002) mentioned that technology diffusion may take place through several channels. These channels include imports of high technology products, adoption of foreign technology and acquisition of human capital.

As mentioned at the beginning of this research, focus is on FDI as a channel of technology diffusion. For this reason, a complete section is dedicated to review different aspects of this channel.

2.6 The Effects of FDI on Technology Diffusion

As mentioned above, the FDI is considered the most important channel through which technology diffuses. According to Moosa (2002), MNCs consider FDI as major channel for the access to advanced technologies by developing countries. Knowledge transferred from the MNCs to its subsidiaries may leak out to the host country, giving rise to the spillover effect from FDI. Various channels of spillovers include labor turnover from MNCs to local firms, technical assistance/support to suppliers and customers and the Demonstration effects on local firms.

According to Blomstrom and Kokko (2003), the earliest discussions of spillovers in the literature of FDI date back to 1960s. The first author to, systematically, include spillovers resulting from FDI is MacDougall (1960) in his analysis of general welfare effects due to foreign investment. Corden (1967) also investigates the effects of FDI on optimum tariff policy. Similarly, Caves (1971) examines the industrial pattern and welfare effects of FDI.

For the host countries, two important issues pertinent to the FDI and technology diffusion must be considered. The First is the quantitative importance of the technology spillover to the economic growth of the lagged countries. Second is how to maximize the spillovers in the host country. Most of the research quantifies the technology spillovers by using the TFP as an indicator. Those researchers include Coe and Helpman (1995) and Keller (2002). Several other researchers try to prove the positive correlation between the FDI and spillovers. Most of the studies, however, use data on aggregate country level when more work need to be done on firm level. Jae Hawa (2002) uses micro level firm data to examine the role of FDI by Korean and US firms in technology diffusion. He explores patterns of technology flows from US firms to Korean firms and identifies the role of FDI in enhancing technology spillovers between the two countries. He proves that FDI is an important channel for technological diffusion, but it has a weak effect on domestic productivity. Branstetter (2000) finds that FDI enhances knowledge spillovers into and from Japanese firms. He uses firm level data of United States FDI into the Japanese firms.

Other researchers, however, cast doubt on the proposition that FDI plays an important role in the technology diffusion. Those researchers include Lall and Streeten (1977), justifying their position by considering the appropriateness of technology with respect to the products that are made with the technology transfers and to the factor endowments of host countries. It is not only that the products are developed in high income countries, but these authors also argue that it is in the nature of MNCs that their products are excessively sophisticated in relation to the needs of developing countries. Winter (1991) agrees with Lall and Streetens' argument. He states that MNCs frequently pass on old technologies that can be too capital intensive for local economy. Such a technology transfer, according to Winter would create a dualistic structure in the host country

containing a small advanced industrial sector linked to the outside world surrounded by large capital-starved sector. If the technology is capital intensive in relation to factor endowment in the host country, then technology transfer would worsen employment and income inequality. Also, it would distort influences on technology used by other firms and bias in production towards sophisticated products.

Lall and Streeten (1977) further argue that even if the appropriateness of the technology is disregarded, the role played by MNCs and FDI in the transfer of technology may be limited. The following reasons justify their argument. First, other technology resources exist besides MNCs. Second, the relative importance of MNCs in transferring technology depends on several factors including the trading of technology. Third, the FDI may not be the only way of absorbing technology from the MNCs. Fourth, the price set for the technology transfer depends on the bargaining skills of both the host country and the MNCs. According to Narula and Dunning (1999), the MNCs have greater bargaining power than the host countries. Winter supports that MNCs are very skilled and powerful negotiators enabling them to win the bilateral negotiations with the governments of the host countries.

Most of the studies classify spillovers from FDI into four components: – Demonstration-Imitation or Re-Engineering, Competition, foreign Linkage and Training effects.

2.6.1 The Demonstration-Imitation/Re-engineering

The basic idea in the Demonstration effect states that the exposure to superior technology from multinational firms may direct local firms to update their production techniques. In the absence of FDI, it is usually very expensive for local producers to acquire the necessary information for adopting new technologies if they are not originally introduced in the local economy by MNCs. Afterwards, technology is demonstrated to succeed in the local business environment. According to Connolly (1998), even though it is difficult to manage, Imitation, when successful, may have very strong effect on technology diffusion. This action

takes place when local manufacturers perform what is known as Reverse-Engineering. Imitation resembles innovation since it has learning concept to learn properties. The successful Imitation by a firm develops firm vision into how goods may be re-engineered and improved. The higher the technologies of the cloned products, the more likely local firms are able to innovate. Repeating Imitation actions will increase the chance of technology diffusion.

The important issue here is how FDI promotes the effect of Imitation on technology diffusion. The Imitation effect arises from differences in the level of technology between foreign investors and local firms. Foreign firms with more advanced technologies participate in the local markets to introduce new products demonstrating advanced technologies. Through direct contact with foreign industries, the domestic firms can watch and imitate the way foreign firms operate. Moreover, the transfer of labor from foreign firms to local manufacturers will speed up the process of technology diffusion through Imitation. The early research on technology diffusion through FDI focused on this effect according to Findlay (1978), Koizumi and Kopecky (1977). Imitation in addition helps in reducing the technology gap. Glass and Sagi (1998) build a model that describes how the quality of technology transfer through FDI is linked to Imitation when the absorptive capacity of low developing countries is limited. According to them, successful Imitation of low quality levels makes FDI involving high quality levels possible through reduction of technology gap. A subsidy to Imitation or a low tax quality FDI encourages Imitation relative to innovation. Countries frequently rely on successful Imitation of foreign technologies to achieve indigenous technological development. Japan relied heavily on the assimilation of foreign technologies in its initial phase of development, according to Blumenthal (1976).

FDI may expand the set of technologies available to local firms. One, however, must be careful since more variety of choices may imply faster technology adoption, especially if the incentives for adoption are altered due to the impact of FDI on domestic market structure (Lin and Saggi, 2004). Suppose that an FDI lowers the cost of technology adoption and lead to faster adoption of new technologies by local firms. Foreign firms in such a scenario would face very strong Competition as a result of faster technology diffusion and they may also alter the very terms and conditions of their original technology transfer. For

example, foreign firms may transfer lower quality technologies to avoid the leakage or adoption by local firms. Other researchers argue that due to the large size and other advantages MNCs enjoy, they can alter the market outcome in their favor despite technology leakage. Das (1987) presents a model in which local firms may learn from the MNCs who act as dominant firms facing local competitive fringe in the product market. Das (1987) concludes by showing that despite technology leakage, the MNCs may find it profitable to transfer technology.

2.6.2 The Competition effect

The Competition effect may be defined as the effect resulting from the existence of differences in the production economies of scale between the host country firms and the foreign investors. It takes place when the entry of foreign firms leads to more intense Competition in the local industry. In such cases, local firms are usually obliged to be more efficient in using existing technologies and resources. They may even introduce new technologies to overcome the strength of the foreign investors and grab their market shares, Kinoshita (1998). Aitken and Harrison (1999) argue in their research analysis that the presence of multinational firms improves productivity in domestic firms due to the increased Competition. The strength of Competition comes from the assumption that foreign investors are firms that operate in foreign markets and they have already incurred fixed cost. As a result, they are in a strong position to compete with established domestic firms. From that perspective, they are even in a better position than those local entrants with previous experience. As long as efficiency gap leads for profitability differences, FDI will increase Competition at least for the short-term.

Despite the fact that the Competition finally leads to technology diffusion and consequently to economic growth of the host country, there is a strong argument in the literature that Competition may finally lead to the wipe-out of the local firms. Sembenelli and Siotis (2002) use firm level data covering all Spanish manufacturing sectors during the period of 1083-1996. According to their model, the Competition effect of FDI depresses the margins of firms that operate in industries that are characterized by important foreign presence. Boone (2000)

concentrates on the analysis of different parameters of Competition. He shows that unless domestic firms improve their productivity, FDI might finally lead to crowding out of domestic firms and as a result, reduction of Competition for the long-term. Marakusen and Venebles (1997) assert that Competition effect may condition the way FDI helps the local industry towards TFP growth. They show that FDI has two effects on host economies; first of which is the Linkage through intermediate demand and the product Competition effect through which domestic firms may be forced to exit. Their model suggests that while multinationals can act as catalyst to improve local industries, local industry and multinationals never coexist for long-term. Authors use the experience of some countries in East Asia where foreign investors serve as catalyst for economic development and have been finally wiped out by strong Competition.

Finally, Strobe et al. (2004) analyze the impact of FDI on development of local firms. . They draw a graph that may judge the aforementioned arguments. Their focus is on the effect of Competition resulting from FDI on the development of local firms in Ireland. Using a simple theoretical model to illustrate how different forces work, they prove that a number of domestic firms follow a U-shaped curve where Competition dominates first resulting in high level of technology diffusion and finally outweighs by the positive externalities.

2.6.3 The Linkage Effect

Linkages take place when foreign affiliates materialize transactions with local suppliers and customers. When the cost of communication and transportation is high, foreign investors often choose to buy intermediate goods from domestic suppliers. That is what is known as Backward Linkages (Vertical linkages). **Forward linkages** (Horizontal Linkages), however, take place when technical complexity increases and domestic producers may seek to purchase intermediate goods from foreign suppliers. Those goods are assumed to be superior to those obtained from the local markets. Holland and Pain (1998) examine whether the impact of international linkage is affected by particular host country institutions. They find that the impact of FDI appears greater in more open economies. They suggest that factors like Competition, legal system and effective Corporate

Governance may help in the diffusion of foreign technologies resulting from linkages.

In the case of Backward Linkages, foreign firms may provide technical assistance and Training to local suppliers and may oblige them to buy new materials to maintain the quality of the intermediate goods. Even in the absence of such actions, local suppliers are required to meet the demand of higher quality and timely delivery with resulting benefits of innovation. Javorcik (2004) asserts the fact that spillovers are more likely to take place through Backward Linkages. That happens when contacts between domestic suppliers of intermediate goods and the multinational clients are active and thus they may not have been captured by earlier studies. Foreign investors have no benefits from preventing technology diffusion to upstream sectors. Instead, they may benefit from the improved performance of the intermediate input suppliers. For that reason, Backward Linkages are the most likely channels through which spillovers will take place. Javorcik finds that those spillovers will take place through the following:

(1) Direct knowledge transfer from foreign investors to local suppliers.
(2) Requirements for higher product quality and timely delivery introduced by foreign investors, which provide incentives to local suppliers to upgrade their management and technology skills.
(3) Multinationals' existence may increase the demand of intermediate products, which allow suppliers to gain benefits from economies of scale.

While Blomstrom et al. (2000) confirm that empirical studies hardly analyze vertical spillovers, theoretical justification of their existence is proved by many researchers including Rodrigues (1996), Markusen and Venable (1999). The existence of this type of linkage is favorable when foreign firms have to purchase a certain percentage of intermediate goods in host country instead of importing from suppliers at the home country. That is known as the “local content requirement” or **Vertical Spillovers**”.

In terms of Forward Linkages, Borensztein, De Gregorio and Lee (1998) assert that in open economy models of endogenous technological changes, MNCs bring advanced technologies to the local economy that allow them to produce variety of goods and services in the host country. Forward Linkages may positively impact

productivity by directly introducing new inputs to domestic production and indirectly through access to foreign technologies **(Horizontal Spillovers)**. Javorcik (2004) supports that domestic suppliers may increase their productivity as a result of their accessibility to improved less costly intermediate products of foreign investors. Some of those activities might be accompanied by provision of complementary services that may not be available if goods are imported by foreign investors from their own suppliers. Lee et al (1998) predict that foreign intermediate goods may involve acquisition of knowledge resulting from foreign R&D investment. If the cost of intermediate goods is less than its opportunity costs, then there will be gain from having access to foreign goods.

2.6.4 The Labor Mobility Effect

The efforts exerted to train local workers lead finally to productivity growth through technology diffusion according to Kinoshita (1998). This might be through formal or on-job training provided by foreign joint venture partners, foreign buyers or suppliers. Usually, local firms train their own workers to improve product quality in order to last with foreign entrants who have competitive advantages over them. Unless the host country's labor force builds up the corresponding skills, the arrival of new technologies may not lead to productivity growth. Training is usually considered invaluable investment, despite the fact that it involves accumulation of skills. Because the skill is specific to technology, it incurs an adoption cost, which is known as the training cost. Some other researchers prove that the probability of a successful technological transfer is more if the labor force is trained well in advance of the inception of the new project.

The benefits for the host country's economy may also take the form of the rent that trained managers receive from foreign affiliates to prevent them from moving to local competitors. Spillovers may develop when subsidiaries of foreign firms train local employees, which will later join local firms or set up their own businesses. This will allow them to bring technological and managerial knowledge they have previously acquired. The fact that foreign investors undertake substantial efforts to train local workers has been documented by

many researchers including Lindsey (1986). Empirical research indicates that foreign investors offer more training to technical workers and managers than local firms according to Chen (1983). At early stages, foreign affiliates rely heavily on expatriates, but due to their higher prices, they tend to replace them by local workers who have been properly trained in the meanwhile.

Training local workers might affect the decision of foreign investors to invest abroad. Fosfuri (1998) confirms that MNC might anticipate that by investing abroad and instructing local workers to use some particular technology, might lead to spillovers of knowledge to local firms and/or to higher wages to prevent workers from moving. Therefore, it might choose exports instead of FDIs to protect intangible assets or to avoid payment of rents to trained workers.

2.7 Empirical Evidence on Spillovers from FDI

The measurement of the spillovers from FDI is not an easy task. The reason for that is basically the unavailability of the data necessary to conduct such a measurement. The statistical studies of spillovers usually depict the overall impact of the presence of MNCs on the productivity of local firms. The studies usually estimate the production functions for local producers and include the foreign share of the industry as one of the variables. Despite the limited accuracy of the data available, the studies provide some important evidence on the presence and the pattern of the spillover inflows. As mentioned at the beginning of this chapter, most of the researchers use the TFP as an indicator for technological spread and diffusion. An example for empirical analysis of TFP growth and technology diffusion includes Zhang (2007) using data available from 1980 to measure the TFP. He utilizes the Data Envelop Analysis (DEA) to find out the TFP particularly brought by FDI. He concludes that China's technology has been promoted as a whole, which is reflected in the promotion of TFP as a result of FDI. Another evidence is highlighted by Kong (2008) using double of 28 industries in Fu-Jian province of China for his empirical analysis. Based on data collected between 2000 and 2006, he calculates the correlation between TFP and FDI to measure the technological progress and the resulting spillovers. Even though, he finds out that the effect is insignificant and slow, he concludes that technological progress is concentrated on labor intensive industries.

The statistical analyses of the spillovers from FDI are usually on either inter-industry level or Intra-Industry level. Empirical evidence of both types is discussed in detail.

2.7.1 Inter-Industry Empirical Evidences

Examples of this type of research follow. Katz (1969) infers that the inflow of FDI in Argentina manufacturing sector in the 1950s had a significant impact on the technologies used by local firms. The technical progress, according to his study, takes place in the MNCs' own industries as well as in other sectors. Spillovers exist because foreign affiliates force domestic firms to modernize by imposing minimum standards of quality on them. The host nations according to him do not benefit directly from FDI. Instead, the gains come from the spillovers of the foreign firms' activities. Aitken and Harrison (1999) examine the inter-industry effects on the Venezuelan manufacturing sector and argue that Forward Linkages generally bring positive spillovers. They conclude that linkages appear to be less beneficial because of the foreign firms' high import propensities. Kokko (1994) in his Mexican Inter-Industry data analysis conjectured that spillovers are more likely in some industries than others. In the industries where there is a wide technology gap between local producers and MNCs, externalities from MNC's presence are unlikely to materialize. His research finds that there a positive correlation between foreign presence and local productivity in sectors where the market share of MNC's affiliates is not too high. Kugler (2001) conducts a very comprehensive study of the diffusion of spillovers in measuring both technological and linkage externalities from FDI. According to his study, optimal organization of the MNCs involves minimization of profit losses due to leakage of technical information to competitors. Host country's firms within the MNCs' sector experience limited productivity gains ensuing FDI. Other producers may benefit when MNCs transfer knowledge to local clients. Kugler in his conclusion finds that the greatest impact of MNCs in Colombian manufacturing is across rather than within the subsidiaries' own industries. Tian (2007) performs a structural analysis of FDI effect on TFP and technology on Shanghai sectorial level. This exploration led to the conclusion that the direct effect of FDI on TFP is stronger than the effect of spillovers. Another important phenomenon he derived is that the

direct effect from OECD and the spillovers are in opposite direction. Huang (2009) studies the institutional features and FDI on technological efficiency in the Chinese industry. He uses 26 manufacturing industries to collect data in the period from 1999 to 2007. Utilizing the Frontier Theory Model (FTM) he finds that the technological efficiency of the Chinese manufacturing industry is increasing annually. He states that FDI has a positive spillover effect on the manufacturing industry of China.

2.7.2 Intra-Industry Empirical Evidences

One of the examples of this type of research includes Caves (1974) who tests the effects of FDI on the manufacturing sectors of two host countries, namely, Australia and Canada. He argues that clear benefits for the host countries come from both income taxes collected from the subsidiaries and the productivity increase of the local firms. The host nations, according to him, do not gain directly from FDI. Haddad and Harrison (1993) use data from an annual survey of all manufacturing firms in Morocco. As a result of their study the foreign firms exhibit higher level of TFP but their rate of TFP growth is lower than domestic firms. Aitken et al (1996) measure spillover from FDI through the labor market from the data collected from Venezuela, Mexico and the United States. The idea is that technology spillovers should increase the marginal labor product and that should show up in the comparatively increased wages of workers. The study shows that there is no positive impact of FDI on wages of workers employed by domestic firms in both Venezuela and Mexico. This finding contrasts with those for the United States, where a larger share of foreign firms in employment is associated with overall higher average wage and higher wages in domestic establishments. Aitken and Harrison (1997) use annual census data on over 40,000 Venezuelan firms. They observe each plant over a period of time to avoid discrepancies incurred in the past Intra-Industry studies. They find positive relationship between foreign equity participation and plant performance, implying that foreign participation does indeed benefit plants that receive such participation. This effect is robust for plants that employed less than 50 employees. Zhang and Jiang (2008) in their recent studies on the Intra-Industry level utilize the Herfindahl-Hirschman Index (HHI) to measure the relationship between FDI and the Chinese industrial agglomeration. Using the Data Envelop

Analysis (DEA) to measure the TFP, they conclude that FDI stimulates technological progress in some industries. Gong and Guo (2009), conclude in their recent study, the technological progress brought by FDI inside the Chinese industries, based on data collected between 2004 and 2006 on FDI and TFP growth. Their studies reveal that there is technological progress in the wholesale and retail sector, messaging services and computer software industry.

Table 2.1 lists the Summary of Cited Empirical Studies done by different researchers supporting the Inter- and Intra-Industry Empirical Evidences quoted in this section.

Study	Author	Scope/Method	Contribution
Production Functions, Foreign Investment and Growth	Katz (1969)	Used the production function to estimate the Argentina manufacturing sector technology progress>	Infers that the inflow of FDI in Argentina manufacturing sector in the 1950s had a significant impact on the technologies used by local firms. The technical progress, according to his study, takes place in the MNCs' own industries as well as in other sectors. Spillovers exist because foreign affiliates force domestic firms to modernize by imposing minimum standards of quality on them. The host nations according to him do not benefit directly from FDI. Instead, the gains come from the spillovers of the foreign firms' activities
Multinational Firms, Competition and Productivity in Host-Country Markets	Caves (1974)	Testing the effects of FDI on the manufacturing sectors of two host countries, namely, Australia and Canada	He argues that clear benefits for the host countries come from both income taxes collected from the subsidiaries and the productivity increase of the local firms. The host nations, according to him, do not gain directly from FDI
"Are there Positive Spillovers from FDI? Evidence from Panel Data for Morocco	Haddad and Harrison (1993)	Using firm level data, they develop econometric techniques to assess productivity spillovers from MNCs in Morocco	Foreign firms exhibit higher level of TFP but their rate of TFP growth is lower than domestic firms.
Technology, market characteristics and spillovers	Kokko (1994)	Mexican Inter-Industry data analysis	He conjectures that spillovers are more likely in some industries than others. In the industries where there is a wide technology gap between local producers and MNCs, externalities from MNC's presence are unlikely to materialize. His research finds that there a positive correlation between foreign presence and local productivity in sectors where the market share of MNC's affiliates is not too high.
Wages and Foreign Ownership: A comparative Study of Mexico, Venezuela, and the United States	Aitken et al (1996)	Measuring spillover from FDI through the labor market from the data collected from Venezuela, Mexico and the United States	The idea is that technology spillovers should increase the marginal labor product and that should show up in the comparatively increased wages of workers. The study shows that there is no positive impact of FDI on wages of workers employed by domestic firms in both Venezuela and Mexico. This finding contrasts with those for the United States, where a larger share of foreign firms in employment is associated with overall

			higher average wage and higher wages in domestic establishments.
Spillovers, foreign investment, and export behavior	Aitken and Harrison (1997)	Using annual census data on over 40,000 Venezuelan firms and observing each plant over a period of time to avoid discrepancies incurred in the past Intra-Industry studies.	They find positive relationship between foreign equity participation and plant performance, implying that foreign participation does indeed benefit plants that receive such participation. This effect is robust for plants that employed less than 50 employees.
The Sectorial Diffusion of Spillovers from FDI	Kugler (2001)	Study of the diffusion of spillovers in measuring both technological and linkage externalities from FDI	According to his study, optimal organization of the MNCs involves minimization of profit losses due to leakage of technical information to competitors. Host country's firms within the MNCs' sector experience limited productivity gains ensuing FDI. Other producers may benefit when MNCs transfer knowledge to local clients
Does FDI Promote Chinese TFP? An Evidence based on DEA and Co-Integration	Zhang (2007)	Using data available from 1980 to measure the TFP and utilizing the Data Envelop Analysis (DEA) to find out the TFP particularly brought by FDI.	He concludes that China's technology has been promoted as a whole, which is reflected in the promotion of TFP as a result of FDI.
FDI Effects on China's Technology Development: A Structural Analysis based on the Case of Shanghai	Tian (2007)	Structural analysis of FDI effect on TFP and technology on Shanghai sectorial level	I. This exploration led to the conclusion that the direct effect of FDI on TFP is stronger than the effect of spillovers. Another important phenomenon he derived is that the direct effect from OECD and the spillovers are in opposite direction
FDI and Technology Progress-Empirical Analysis Based on Panel Data in Fu-jian Province	Kong (2008)	Using 28 industries in Fu-Jian province of China for his empirical analysis, based on data collected between 2000 and 2006 and calculating the correlation between TFP and FDI to measure the technological progress and the resulting spillovers	Even though, he finds out that the effect is insignificant and slow, he concludes that technological progress is concentrated on labor intensive industries.
Economic Analysis of FDI and R&D's Promotion to the Development of Technology in China	Zhang and Jiang (2008)	Study on the Intra-Industry level utilizing the Herfindahl-Hirschman Index (HHI) to measure the relationship between FDI and the Chinese industrial agglomeration.	Using the Data Envelop Analysis (DEA) to measure the TFP, they conclude that FDI stimulates technological progress in some industries

The influence of institutional features and FDI on the technological efficiency of China's manufacturing industry: An analysis based on industrial data	Huang (2009)	Study of institutional features and FDI on technological efficiency in the Chinese industry; using 26 manufacturing industries to collect data in the period from 1999 to 2007 and utilizing the Frontier Theory Model (FTM).	He finds that the technological efficiency of the Chinese manufacturing industry is increasing annually and FDI has a positive spillover effect on the manufacturing industry of China. .
Outward Foreign Direct Investment and Technological Progress of Industries: A Review of Literatures and an Empirical Study in China	Gong and Guo (2009)	Estimated the TFP using the Cobb-Douglas production function, in the Chinese industry between 2004 and 2006.	They conclude that the technological progress is brought by FDI inside the Chinese industries, based on data collected between 2004 and 2006 on FDI and TFP growth. Their studies reveal that there is technological progress in the wholesale and retail sector, messaging services and computer software industry.

Table 2.1 Summary of Cited Empirical Studies

2.8 FDI in Saudi Arabia

On the contrary of International Monetary Fund (IMF's) and the OECD's definition of FDI, the definition of FDI in SAGIA does not specify a threshold level that distinguishes FDI from portfolio investment. Both IMF and OECD set a minimum of 10% capital ownership for a foreigner to be a foreign investor according to Almahmoud (2010). Accordingly, the Executive Rule of Foreign Investment Act (2000) defines FDI as the investment of foreign capital in an activity licensed under the act and rules. The rule, applied by specifying the foreign capital, could be in one of the following forms:

- Cash, securities and commercial papers.
- Foreign investment profits, if reinvested to increase capital, expand existing investment entities or establish new ones.
- Machinery, equipment, fixtures, spare-parts, means of transportation and production requirements related to the investment.
- Intangible rights such as licenses, intellectual property rights, technical know-how, administrative skills and production techniques.

Almahmoud (2010) further investigates SAGIA's definition by mentioning that FDI may be either fully owned by foreign firm or partially through a joint venture.

This section introduces the Saudi FDI experience. It gives a brief about the development of this economic activity in the country. At this stage, it is worth mentioning that this economic activity started prior to the establishment of SAGIA. The section also gives a brief statistical analysis of the FDI inflows to the country during first eight to ten years of the twenty first century. Finally this section concludes by giving a general view about the problems concerning this experience.

2.8.1 Development of the FDI in Saudi Arabia

The World Investment Report issued in 2002 asserted that the volume of FDI has dramatically decreased between 2000 and 2001 due to the world-wide economic slump. Accordingly, it went down by 50 % from $1492 billion USD to $735 billion

USD. This was primarily due to the decrease in the second form of FDI, namely, mergers and acquisitions. The trend, however, continued in the year 2002 according to the IFC and Saudi German Development and Investment Company (SAGECO) report. The most affected countries were the industrial countries. Saudi Arabia according to the 2003 statistics was not affected by that trend.

From the Saudi Arabian perspective, the sixth development plan issued for the years 1995-1999 depicted that FDI in the industrial sectors declined aggressively. The number of licenses issued was less than 5 % of the total licenses granted. At the same time, in terms of capital investment, industrial sector represents 5.4 % of the total capital invested in both services and industrial sectors. Therefore, it became important to adopt the strategic laws of foreign investment.

The team in charge of the research revealed that there were discrepancies in the statistics announced by SAGIA and those found in the World Investment Report. For example, year 2000 SAGIA figures mentioned that total investment in the country was 18.3 billion USD, while the World Investment Report estimated 28 billion USD. That was justified by the massive inflow of foreign capital into Saudi Arabia's oil sector. Unfortunately, that was not recorded in the national figures. Other justifications may include differences in definitions and deLimitations. Just because the SAGIA figures were more detailed, specific and accurate, the researchers used them to conduct the following analysis.

It was previously stated that the SAGIA's end of 2000 figures stood at 18 % USD with foreign capital share of 33.1 %. The 33.1 % of those was distributed to the following. The USA with 2.323 billion USD stood first while Japan stood second with 592 million USD. France and the UK stood third and fourth, respectively, with 207 and 155 million USD. **Table 2.2**[7] shows those figures with more detailed analysis where 85 % of that foreign capital (**Appendix B, Table 1**), unfortunately, was concentrated in the oil and petrochemical sectors. That was the result of 13 joint ventures only with Saudi Basic Industries Company (SABIC) and the Saudi Arabian Oil Company (SARAMCO).

[7] Figures in the Table 2.2 are reported in Saudi Riyal (SR) (1 USD ≈ 3.75 SR) , conversion varies on daily bases and the USD is used for the analyses because it is a standard currency may be easier for the reader to understand. Also, figures are quoted from the world investment report , variation in conversion rate could cause misunderstanding.

In July 2000, the SAGIA adopted the new investment law, which has led to a considerable increase of the newly licensed joint venture capital. Within two years, total applications to joint ventures amounted to 1,595 individual projects with total capital of 12 billion USD. 59 % of those joint ventures were related to industrial projects while 41 % related to non-industrial with foreign partners having the majority. 143 of the new applications were for the Europeans with total finance of 2.2 billion USD.

The following reflects the SAGIA analysts' point of views about those joint ventures:

- The capital invested was less than the authorized capital. Actual capital invested was 18.3 billion USD while the authorized was 46.6 billion USD.
- In the 10 years span (1990-2000) total joint venture capital stock grew by 162 % while the participation of FDI increased with foreign share of 137 % jump. That means the total joint venture capital decreased in the same period from 36.5 % to 33.1 %.
- The FDI invested capital varies drastically according to the countries of origin. The US, UK and Japan joint ventures represent 40 % of the total while the German speaking countries (Germany, Switzerland and Austria) combined 30 % of the total invested capital.
- US took the first place in terms of the actual capital invested (38 % of the total) followed by Japan (10 %) and the German speaking countries combined 5 % only. The rest of Europe combined 10 % while the Middle East countries represented 13 % on aggregate.
- In 2000, the total number of joint ventures was 1,924. USA stood first with 283 joint ventures followed by the UK with 159 joint ventures. The geographical leader in terms of the number of joint ventures was the Middle East Countries with 648 joint ventures.

Country/Region	Total Ventures	Total Country (FDI) paid in Capital in Million Riyals											
		Overall total		Agriculture		Construction		Manufacture		Services		Mining	
		Mio. R	%	Mio. R	%	Mio. R	%	Mio. R	%	Mio. R	%	Mio. R	%
United States	283	8,713	100	–	–	52	1	7,368	85	1,250	14	43	0
United Kingdom	159	583	100	3	1	122	21	379	65	66	11	13	2
Japan	40	2,219	100	–	–	54	2	2,115	95	46	2	3	1
France	71	778	100	28	4	46	6	98	13	602	77	3	0
German, Austria, Switzerland	154	1,181	100	–	–	86	7	1,026	87	52	4	17	1
Rest of Europe	245	2,340	100	1	0	136	6	1,240	53	954	41	8	0
Middle East	648	3,008	100	6	0	150	5	1,568	52	1,281	43	3	0
North Africa	42	180	100	–	–	34	19	37	21	106	59	2	1
Rest of Africa	16	63	100	–	–	10	16	48	77	4	7	0	0
South East Asia	66	393	100	–	–	95	24	291	74	7	2	0	0
Pakistan, India, China, Afghanistan	76	1,242	100	–	–	28	2	1,149	92	65	5	1	0
South America	28	410	100	–	–	20	5	365	89	19	5	0	0
Caribbean Islands	54	1,499	100	24	2	14	1	1,429	95	23	2	7	0
Australia, New Zealand, Canada	42	115	100	7	6	11	9	82	71	10	9	6	5
Overall Total	**1,924**	**22,724**	**100**	**79**	**0**	**858**	**4**	**17,196**	**76**	**4,485**	**20**	**106**	**0**

Table 2.2 *Total Country (FDI) paid in Capital in Million Riyals*

- The overall sectorial statistics of the FDI shows that 75 % was in manufacturing while 20 % was in services. When comparing that to the international picture, one may find that generally speaking most of the countries have high percentages in manufacturing. Examples include the USA (85 %) Japan (95 %) and the German Speaking Countries (87 %).
- In terms of the inward stock, year 2000 figures depict that Saudi Arabia stands first when compared to the other Arab countries, as shown in **Table 2.2**

During the period of my study 2004 to 2008, the structure of the FDI inflows in the country has changed. The available figures clues that the USA continued to lead with a stock of 22.028 billion USD. The United Arab Emirates (UAE) ranked second with a total investment of 14.642 billion USD. Thanks to the King Abdullah Economic City development project at Rabigh located in the Eastern Province. This project is implemented by Emaar, which is owned by Dubai Holding. The Japanese investors injected around 9.45 billion USD during those four years bringing up their total investment stock 12.026 billion USD. The big joint venture between Saudi Aramco and Sumitomo (Petro-Rabigh) is the largest investment that caused this escalation. The Kuwaitis investors found the Saudi market as a safe haven for their investment. Their investments are basically in two fields, which are the retails market and the oil exploration. Their total investments reached 9.382 billion USD. The French oil total also had a mega joint venture with Saudi Aramco. The name of the company is Saudi Aramco Total Petrochemicals Refinery (SATORP) and it is located in the Eastern Province of Saudi Arabia. The SATORP project helped in increasing the French investment to 8.927 billion USD.

Reading in the previous paragraph analysis, one may realize that FDI is still concentrated in the Oil and Petrochemicals industry. This is basically because companies will benefit from the oil prices and companies have had their joint ventures with the major oil company, Saudi Aramco, putting them in a stronger competitive position relative to the other international companies. The top ten foreign countries in terms of stock investment until the year 2008 are shown in **Table 2.3**. This table is derived from the “2008 statistical analysis report of FDI in Saudi Arabia” issued by the National Competitiveness Center (NCC) of SAGIA.

Year	2005	2006	2007	2008	Total	FDI Stock
Total FDI Inflows to KSA	12,097	18,293	24,318	38,222	92,930	114,227
USA	84	1,594	3,978	5,199	10,855	22,028
UAE	5,015	-19	2,381	5,873	13,250	14,642
Japan	2,540	3,512	1,068	2,337	9,457	12,026
Kuwait	25	267	2,370	4,461	7,123	9,382
France	2,057	2,053	1,136	3,434	8,680	8,927
Netherlands	49	820	904	3,374	5,147	7,544
China	0	1,100	1,428	1,529	4,057	3,752
Bahrain	445	789	593	1,003	2,830	3,548
Jordan	73	557	384	582	1,596	2,673
United Kingdom	147	636	444	800	2,027	2,230

Table 2.3 *FDI Inflows in Saudi Arabia in millions USD (2004-2008)*

As the foreign investment act identified two types of ownerships for FDIs, the number of licenses issued by SAGIA has increased sharply. Moreover, the control of licenses issued and the ownership share shows that foreign investors seek more control. This is clearly indicated in **Table 2.4**, as the number of wholly owned project has reached 3668 projects. Almahmoud (2010) reported the number of wholly owned project in 2005 to be 2523.

Share Range (%)	No. of Projects
0 to 10	132
11 to 25	831
25 to 50	1478
51 to 75	844
75 to 99	509
100	3668
Total	**7462**

Table 2.4 *Projects by foreign ownership*

2.8.2 Investment Experiences and Problems in Saudi Arabia

The IFO and SAGECO research team identified several reasons for the Europeans and Saudi partners to get engaged in business cooperation. In that

aspect, the point of views of the European companies and those of the Saudis had to be considered. The European companies had seven following reasons to engage in business with the Saudis:

(a) Supplying the Saudi local Markets
(b) Regional exports
(c) World-wide exports
(d) Raw materials supply
(e) Low production cost
(f) Infrastructure
(g) Favourable investment conditions

The Saudi businessmen, however, had five following reasons to engage in business with the Europeans:

(a) To acquire the know-how
(b) To acquire capital
(c) To gain access to foreign markets
(d) To improve company's image in the local market
(e) To expand the range of production and services to high tech and high quality products/services.

The first four reasons for both parties are the most important according to the survey. **Figure 2** in **Appendix B** shows how important those reasons were. At this stage, it is very important to know how those partners started doing business. The researcher's survey identified eight different business starting points, as follows:

(a) Existing trade/business relationships
(b) Trade fairs/information visits
(c) Advertisements
(d) Business associates/representatives
(e) Consultants/chartered accountants
(f) Diplomatic representatives (embassies, consulates)
(g) Chambers of Commerce/business associations
(h) SAGECO, SAGIA and other institutions specialized on Saudi Arabia.

Of course, to judge on what the most common way was, both parties' point of views had to be considered. **Figure 1** in **Appendix B** depicts the results of that survey. Analysis of the results showed that the Saudi partners relied less on business associates than the Europeans. However, they relied on the consultants and diplomatic channels more than the European partners.

The IFO and SAGECO report also measured the difficulty in getting the information necessary for business cooperation and also the satisfaction from it. While 12 % of the businesses that answered that question expressed an extreme difficulty in getting the necessary information, 42 % had no problems. The remaining 42 % had at least some problems.

2.9 Summary and Conclusion

The study of FDI and technology diffusion is very important to advance countries' economies. FDI positively affect the economy of host countries by transferring both, financial resources and technology, as analysed by Choi (1997). For those reasons, countries strive to attract foreign direct investors. Countries even change their national polices just to promote FDI. They build up their image through marketing. Moreover, through facilitation, some countries try to assign certain project coordinators to covert foreign investors' aims into actual projects. Also, they would introduce many services to promote knowledge transfer to their own people. Those reasons encourage investors to go international. Investors also view risk diversification, ownership, control and competitive advantages as major reasons to invest abroad according to Krueger (1995). Other investors add political stability, transparency and good tax systems to justify migration of their financial resources, as examined by Lukes and Venables (1996).

There is strong scientific consensus that FDI generates technology spillovers, which eventually stimulate technology diffusion in the host countries, as stated by Connolly (1998). MacDougall (1960) is the first author to include spillovers as a result of FDI, systematically. There are two important issues related to the FDI and technology diffusion. The first is the quantitative importance of the technology spillovers to the economic growth of the countries. The second is how to maximize the host country's spillovers. Some researchers doubt that FDI plays

an important role in the diffusion of technology. Winter (1991) argues that MNCs frequently pass old technologies to the host nations. Lall and Streeten (1977) argue that spillovers are not appropriate for the products in the host countries. Even if the appropriateness of the spillovers is disregarded, the role played by MNCs and FDI in the adoption of the technologies is very limited.

Spillovers from FDI are divided into four major components:

The first is the **Demonstration-Imitation effect**. It states that exposure to superior technology of international firms may direct local firms to update their production techniques. The information gained from FDI helps firms to acquire expensive information necessary to adopt new technologies. Imitation takes place when local firms perform reverse engineering. Connolly (1998) asserts that it is difficult to achieve Imitation. But when successful, it is very effective.

The second component of the spillovers is the **Competition effect**. It is the effect resulting from the existence of differences in the production economies of scale between the host country firms and the foreign investors. It takes place when the existence of the foreign investors leads to strong Competition in the local industry. It obliges firms to be more efficient in using technologies and resources.

The third component is the **Linkage effect**. It is divided into vertical and horizontal. Vertical Linkages take place when the foreign investors choose to buy intermediate goods from domestic suppliers. The Horizontal Linkages take place when domestic suppliers seek to purchase intermediate goods from foreign suppliers. Those goods are assumed to be superior to those available in the local market.

The fourth effect is the **Labour Mobility effect**. It is the efforts exerted to train local workers or what is known as on-job training. This training might be provided by the foreign joint ventures, foreign buyers or suppliers. Moreover, local firms train their own workers to improve their operations and products. Spillovers may develop when subsidiaries of foreign firms train local employees, who may later join local firms or set up their own companies.

The measurement of the spillovers from FDI is a difficult task. The unavailability of the necessary data makes it so. However, the studies available provide important evidences on the presence of the spillovers inflow. The statistical studies on spillovers are either on inter-industry level or on Intra-Industry level. The Inter-Industry studies the spillovers over the different industries. The Intra-Industry studies provide evidence of the spillovers inside a certain industry.

Chapter 3 Conceptual Framework

3.1 Introduction

Measuring technology diffusion is not an easy task. Researchers, however, measure the change in productivity as an indicator of positive or negative spillovers. Further, TFP has been utilized as a measure of country's long term technological uplift or dynamism. Spillovers are directly related to the diffusion of technology. Krugman (1991) confirms this fact of knowledge spillovers having no paper trail by which they may be measured and tracked.

Many researchers investigate the four effects of FDI on technology diffusion. However, most of the studies consider those effects, separately. That is why they used to consider one of the effects while holding the other effects constant. In this study, however, I consider the four effects, namely, Imitation-Demonstration, Competition, Linkage and Training effects, simultaneously. This is done by examining the effects of technology spillovers and the investment in human resources on the productivity growth of the local firms when FDI is present. I refer to the investment equation proposed by Parente and Prescott (1994) to achieve that objective. In addition, different control variables are integrated in the analysis in order to explore the mechanism of FDI effects on the TFP. The control variables include Industrial Classifications, Geographical Location, Age and Size.

The productivity growth of a firm may be explained by the firm's investment, positive externalities from stock of the world knowledge and the barriers to technology adoption. Assuming that the Competition effect is embedded into the other three effects, the model examines all other effects as potential sources of productivity growth. Parente and Prescott (1994) propose a theory of economic development in order to explain the existing income disparity and the considerable development in Japan. Their focus is on technology adoption and barriers to technology diffusion. In the model, a firm's investment decision to advance its technology level depends on two factors. The first factor is the level of general and specific knowledge in the world. The second factor is the size of barriers to adoption in the firm's specific country. If the level of technology in the

world is greater than in the firm's country, then the firm may benefit from the existing technologies. The firm can depend on the high level of technology in the rest of the world to diffuse advanced technology or it can invest in R&D to advance its technologies. The former is called the Catch-Up effect of the developing countries or as Benhabib and Rustichini (1990) call it, the advantage of a lagged country in the process of economic development. Further, Kinoshita (1998) derives a model from the Parente and Prescott and that model is the basic model used to analyze Part I of this thesis.

3.2 Research Problem and Questions

The purpose of this research is to investigate the mechanism through which FDI promotes technology spread in Saudi Arabia. This is done by analyzing the effects of the FDI on the technology diffusion. The Parente and Prescott (1994) model is modified to suit the nature of this research and is used to estimate the TFP for the Saudi Industrial Sector over the past five years in the presence of the FDI. Analyzing the results of this research will give an answer to the question whether spillovers through Demonstration-Imitation, Competition, Linkage and Training effects are important sources of productivity growth.

The research model is utilized to answer questions related to maximizing the spillovers from FDI. In order to achieve that, I explore the mechanism through which technology spreads out in Saudi Arabia. This is done by considering sixteen different control variables. The analysis is done comprehensively by eliminating some of the control variables from the basic model and testing the change in results.

The other part of the research will answer questions related to the possible future effects of FDI. It will consider the future effects quantitatively, which will be supported by qualitative analysis.

3.3 Research Hypotheses

Based on the previous analysis and literature review, the following are the hypotheses used to explore the mechanism of technology diffusion in Saudi Arabia:

H1: The spillovers' effects (Demonstration-Imitation, Competition, Linkages and Training) from FDI are important source of technology diffusion (productivity growth).

There are four channels through which FDI can help in the diffusion of technology, which subsequently result in the productivity growth of local firms, as follows:.

This first channel is the **Demonstration-Imitation effect**. It results from the differences in technology level between foreign investors and local firms.

The second channel is the **Competition**. It occurs when the involvement of foreign firms lead to more intense Competition between the local firms due to which the local industry is obligated or forced to be more efficient in the utilization of production factors.

The third channel is the **Forward and Backward Linkages**. This effect would take place when foreign investors materialize transactions with local suppliers and customers.

The fourth channel through which technology diffuses is **Training**. This channel represents the training efforts by local and foreign investors, which finally lead to productivity growth and faster mobility of human resources. Training however is not a direct effect stems from FDI. Workers mobility rather is stimulated by training efforts and therefore it is studied through this hypothesis.

As mentioned previously this hypothesis is looked at by other researchers when each effect is considered holding the other effects constant. In this research all the effects are considered, simultaneously. The existence of the spillovers' effects at the same time, hopefully, will create favorable results that may boost the level of technology in Saudi Arabia.

This hypothesis is affected by many factors, among which is the Absorptive Capacity of the host country. Cohen and Levinthal (1990) define Absorptive Capacity as the country's ability to value, assimilate and apply new knowledge. It is studied on multiple levels (Individual, group, firm and national level). Its study involves a firm's innovation performance, aspiration level and organizational learning. Cohen and Levinthal (1990) are the first ones to introduce the theory of Absorptive Capacity. However, it is modified by many researchers such as Teece et al (1997) to include the concept of dynamic capability. The buildup of Absorptive Capacity is an important issue in this research and it is highlighted by the results derived from the quantitative part of this research. This can be done only after discovering the FDI mechanisms, which affect technology diffusion.

The other important issue that can be explained by this hypothesis is the barriers to technology adoption. These barriers take several forms, among which, regulatory and legal constraints, bribes, violence, outright sabotage and work strikes. Whatever the form it takes, each one of those barriers has an effect on the increasing adoption cost of technology.

Finally, the diffusion of technology can be quantitatively described by the measurement of the increase in productivity of local firms. The Cobb-Douglas production function will help in the measurement of the output of the different firms.

H2: The interaction between the Linkage and Competition due to investment of MNCs will increase the productivity (technology diffusion) of the local firms.

MNCs are companies that already operate in foreign markets. Presumably, they have already incurred fixed cost. They are usually in good positions to compete with well-established domestic firms and are in better positions to compete with new entrants with no previous experience. Boone (2000) states in his analysis that new technologies brought by MNCs would allow them to create economies

of scales and consequently increase their efficiency. Local firms will have to find solution to this problem. This issue fosters Competition and, therefore, leads to productivity increase. He asserts that the failure of local firms to compete would lead to crowding-out of domestic firms followed by exit.

Foreign investors, however, might be forced to leak knowledge to local manufacturers. This happens when the cost of transporting the materials necessary for production is very high. Foreign firms would transfer information to their local suppliers. In addition, the quality of the materials supplied by the local suppliers might not be up to the expectations of the foreign investors. In such cases, foreign firms may even train local suppliers' employees to improve the quality of their production. The above mentioned factors will cause Backward Linkages. Blalock (2001) provides an evidence of productivity increase through Backward Linkages.

If foreign investors switch from affiliates to local suppliers, this will force local suppliers to improve their productivity. Increase in the demand of goods will eventually lead to Competition. Lall (1980) confirms this fact that foreign investors are obliged in some cases to train local suppliers on new technologies and higher quality products. This is especially true when the transportation and tax rates are high. **Crespo & Fontoura (2007)** added that firms could impact the productivity of their suppliers via the increased demand for their products, perhaps allowing them to realize economies of scales and become more efficient. Eventually, foreign manufacturers will choose to deal with firms that have better quality and lower prices. This will definitely foster Competition and lead to higher productivity.

Further Competition increase may be caused by the relationship between foreign investors and their local customers. Markusen and Venables (1999) argue that this is true when foreign investors supply local market with higher quality products at lower prices. This is quite dependent on the commitment of the foreign manufacturers to sell in local markets and do not take the advantage of efficiency and cheaper resources to export products. To conclude this descriptive part of the thesis, the entry of foreign investors will lead to

Competition increase. Linkages could be a medium of that jump in Competition and as a result it could cause productivity increase. An opposite effect, however, could occur when the entry of the foreign firms causes a crowding effect and lead to shut down of local manufacturers' plants, according to Aitken & Harrison (1999). However, most of the literature states that local firms will be more competitive and survive through innovation and better allocation of resources, as acclaimed by Blomstrom & Kokko (1998).

H3: The interaction between the Training and Mobility of Workers will increase the productivity (technology diffusion) of the local firms.

This hypothesis studies the transfer of knowledge, skills and attitude from foreign firms to local firms. When foreign subsidiaries hire local workers, they are able to increase their productivity only after giving them the appropriate training. In addition, foreign firms would incur what is known as the training cost to increase their product quality. Technological spillovers from those FDIs arise when those workers and managers are later hired by local firms. The skills built up by local workers and managers would accumulate and become very attractive for local firms. Jovanovic (1997) proves the fact that local firms start seducing the skilled workers by higher salaries and benefits and resulting increase in the Workers' Mobility. He discusses the relationship between human capital and technology.

Moreover, foreign firms may try to cripple the mobility of their employees to local firms by increasing their benefits. This action is successful but it has its own side effects. Local workers and managers may develop enough capital and skills to establish their own companies. That may benefit the host country by improving the economy. Fosfuri et al. (1998) develop a model to test the Workers' Mobility effect on the technology diffusion. They prove that Workers' Mobility increases the spillovers from FDI.

Other researchers argue that workers mobility is the first step of technology transfer. One of those researchers includes Fosfuri et al (2001) asserting that workers who have been previously working with foreign investors may get the

necessary training and move to other firms. Those workers share knowledge and skills grasped from foreign counterparts. Superior knowledge in this case is transferred from the former to the latter. Fosfuri et al (2001) argue that this phenomenon takes place because foreign investors cannot retain their local employees. Other researchers argue that foreign firms are only able to protect their assets by adding further benefits to their employees. This includes introducing training packages and paying higher wages. This is assumed by Fosfuri et al (2001) and Lipsey & Sjoholm (2002). This action would diminish the befit from labor turnover. Others argue that this is true only in low developed countries due to the fact that those countries pay low wages, according to Crespo & Fontoura (2007). Sometimes, the legislation of the host country could limit the labor mobility, which in turn reduces the benefit through this channel. This includes countries from the GCC where local and foreign labor cannot freely move. The situation gets more complicated when countries impose more rules on property rights. This would limit local employees from using the knowledge gained from foreign investors when developing their knowledge in domestic firms, says Fosfuri et al (2001). Another factor that can limit or boost up the effect of this interaction is the type of training provided to labor. Acquisition of more firm specific knowledge and skills from training limits the amount of spillovers through mobility since the benefit to the outside firm is minimum and restricted.

3.4 Formulating the Model

The Parente and Prescott (1994) model is used for investigating the effects of technology spillovers on the productivity growth of local firms in the presence of FDI. Kinoshita (1998) further develops the Parente and Prescott model to derive his model, which will be used as a base model for the investigation of TFP growth in Saudi Arabia. Even though, Kinoshita used the model to investigate each individual effect of technology diffusion, his model is used to investigate all the channels, simultaneously. Further, I add different control variables to provide extensive analysis of this case study. The selected model gives me flexibility to do this. While reviewing the literature no other model has

investigated the four channels of technology diffusion. Moreover, this research tackles around 16 different control variables, which is not done in Kinoshita (1998) case. The following analysis shows how the model is derived. Parente and Prescott model is:

$$X_{A_t} = \pi \int_{A_t}^{A_{t+1}} \left(\frac{S}{W_t}\right)^{\alpha} dS$$

Where:

X_{A_t} = An investment that a firm has to make to advance technology level from A_t to A_{t+1}

π = Parameter that indexes the size of barriers to technology adoption in the firm's country

S = real variable that represents technology advancement level.

W_t = Stock of knowledge in the world

α = a constant representing the contribution of labor and capital to the advancement.

W_t represents the stock of general and scientific knowledge in the world. Assuming that all firms have access to the knowledge, therefore, the spillovers would equally spread throughout the entire world. The investment, a firm has to make in order to advance its technology level, is represented by X_{A_t}. This variable depends on the firm level of technology at the time of investment. It also depends on the size of the barrier to technology adoption in the country in which the firm is located.

It is clear from the model that the firm's investment decision to advance its technology depends on the level of general and scientific knowledge in the world and the barriers to adoption in the country of the firm. Furthermore, the world stock of knowledge is assumed to increase at constant rate. That is to say:

$$W_t = W_0(1+\gamma)^t$$

Integrating the above equation, we get the following result:

$$(\alpha+1)X_{At} = \pi \frac{A_{t+1}^{\alpha+1} - A_t^{\alpha+1}}{W_0(1+\gamma)^{\alpha t}}$$

If the time interval between A_t and A_{t+1} is very small, then the term ($A_{t+1}^{\alpha+1} - A_t^{\alpha+1}$) of the equation is, approximately, equal to the derivative ($\dot{A}_t^i$) and evaluate $\frac{A}{W_t}$ at A_t; the equation could be transformed to:

$$\dot{A}_t^i = \mu(\frac{A_t^i}{W_t^k})^\theta X_{A_t}^i \quad \text{.....(1)}$$

Equation (1) represents the TFP growth of any firm ***(i)*** in the ***(k)*** industry as the following variables mean:

$$\theta = \frac{1}{(1+\alpha)}$$

$\dot{A}_t^i$ = TFP growth of the "*I*" firm

W_t^k = Best practice firm's level of TFP in the (*k)* industry

$X_{A_t}^i$ = the investment of the (*i*) firm

μ = The inverse of the adoption barrier parameter (π)

In this model, it is clear that the TFP is affected by the adoption barrier parameter, the spillover term and the training variable representing a firm's cost of efforts to accumulate knowledge. To implement this model we have to assume that all the firms have the same adoption barrier since they are located in the same country and implement the same policies. The spillover term in the above equation may be defined as the ratio of a firm's TFP level to the highest TFP level in the industry $(\frac{A_t^i}{W_t^k})$. It represents the relative position of the *(i)* firm to the best practice firm within the same industry. If a certain firm is less productive than the best practice firm initially, it may benefit from positive externalities from

more productive firms. The Training variable in that equation is $X^{i}_{A_t}$. This term represents an empirical problem for the above equation. Whenever a firm does not provide Training in the above equation, TFP growth is zero, eliminating the spillover effects (Catch-Up effects) in the original Parente and Prescott (1994) Model. This feature is incorporated in order to assure that a firm may not benefit from being behind unless it makes investment in training. However, in this study, there may be cases in which firms may improve their technology through the spillovers effect in the absence of the training investment. Kinoshita (1998) finds a solution for this problem. The training investment is a function of a binary Training variable and can be written in the following form:

$$X_{At} = e^{\eta T_i} \quad \text{.....(2)}$$

Where:

T_i = the incidence of Training, which is 1 for a firm trained skilled worker during the research period or 0 otherwise. The dependent Variable in equation (1) transforms to get:

$$e^{\frac{\dot{A}_{it}}{A_{it}}} = \mu\left(\frac{A_{it}}{W_t^{k}}\right)e^{\eta T_i} \quad \text{.....(3)}$$

Different foreign variables should be added to the basic model to identify the channels through which foreign investment affects the firms' TFP growth. The various industry differences should also be taken into account (Age) that will make "μ" a function of additional variables:

$$\mu = \exp(\beta_0 + \beta_1 Forgn + \beta_2 Link + \beta_3 Frn\_ind + \varsigma) \quad \text{.....(4)}$$

Where:

Forgn = Foreign Joint Ventures (Binary)

Link = Foreign Forward and Backward Linkages (Binary)

Frn_ind= Foreign presence in the industry measured as the share of foreign firm's employment to the total industry.

ς = Firm specific effect (Age)

Combining equations (2) (3) and (4) would result in:

$$\frac{\dot{A}_{it}}{A_{it}} = \beta_0 + \beta_1 Forgn + \beta_2 Link + \beta_3 Frn\_ind + \varsigma_i + \theta \ln \frac{A_{it}}{W_t^k} + \eta T_i \quad \text{..... (5)}$$

$$\frac{\dot{A}_{it}}{A_{it}} = \ln \frac{A_t}{A_{t-1}}$$

The data related to the amount of capital and the number of unskilled/skilled labor is used to calculate the TFP growth. At this point, it is very relevant to introduce the Cobb-Douglas[8] production function that is used to iterate, if the estimate for the TFP growth is the same for each year.

$$Q = AL^a K^b$$

Where:

Q= Output

L= Labor

K=Capital

a, b = Constants representing the contribution of capital to the growth of (L) and (K), respectively.

A = TFP.

This equation is used to find out the TFP. The model in equation (5) is considered the basic model in this research. However, to further explore the technology diffusion mechanism via FDI, more control variables are added to the basic model. Those control variables include the Size of the companies, the Industrial Classification and the Geographical Location of the companies. I introduce those control variables, as follows:

I_k = The Industrial Classification: There are seven industries; each company in the survey takes a binary number for this.

R_j = The Geographical Location: There are four locations; each company takes a binary number for this.

[8]Developed by an American, Paul Douglas and a mathematician, Charles W. Cobb in 1928. Cobb and Douglas also suggested that the share of Labor and Capital are constant over time.

δ_k = The coefficient for the industrial Classifications: There are seven industrial classifications.

ϕ_j = The coefficient for the Geographical Location: The companies selected are from four major regions.

C = The Size of the organization in terms of number of employees.

Ω = Coefficient of the Size of the organization based on the number of employees.

Equation (5) will be transformed to Equation (6), as follows:

$$\frac{\dot{A}_{it}}{A_{it}} = \beta_0 + \beta_1 Forgn + \beta_2 Link + \beta_3 Frn\_ind + \varsigma_i + \theta \ln \frac{A_{it}}{W_t^k} + \Omega C + \varepsilon_i + \eta T_i + \sum_1^7 \delta_k I_k + \sum_1^4 \phi_j R_j \quad (6)$$

Equation (6) is called the main model since it has all the possible control variables and it will be the basis on which we will explore the mechanism of TFP growth.

3.5 Conclusion

To sum up this chapter, measuring technology diffusion is not an easy task. This is mainly due to the difficulties related to data collection. This thesis is of two main folds. The first is related to the measurement of the TFP growth and the second one is related to the assessment of the future effect of FDIs existence in the Saudi manufacturing market. The two issues are going to help discovering the mechanism though which FDI enhances technology diffusion. Three hypotheses are utilized to achieve this task. The first Hypothesis (H1) is investigated by utilizing the Parente and Prescott 1994) equation. Specifically, Kinoshita (1998) model, which stems from that equation, is used to analyze the four channels, extensively, through which technology diffusion take place. The data analysis in this research has two parts. The first part is based on data collected from both foreign and local investors. To analyze the data collected in this part, a model is developed using the Parente-Prescott equation. Using the

OLS regression technique, the model is run out. The objective of running the developed model is to explore the mechanism through which FDI promotes TFP growth by testing the four effects (Demonstration-Imitation, Competition, Linkage and Mobility).

The second part of this research helps in the analysis of data collected from local investors only. The objective of this analysis is to test local investors' expectations of the future of FDI effects on technology diffusion. The first factor to consider is interaction between Competition and Linkage. The second factor is the interaction between Training and Workers' Mobility. The quantitative analysis is supported by descriptive analysis based on the data derived from the local investors' survey. The assessment of the future effects, however, is mostly done using descriptive data analysis. The next chapter will elaborate on the data collection and administration.

Chapter 4 Methodology

4.1 Introduction

This study aims to investigate the mechanism of TFP growth due to the effects of FDI in Saudi Arabia. The Kinoshita (1998) model is utilized to analyze the TFP growth through the different channels of technology diffusion. This chapter explains this concept. It also includes a brief analysis of the questionnaires and data collected to run out the model. The method used to investigate part I and part II of the thesis is also explained. Also, sampling strategy, data collection and administration is also explained in details. Finally, the response rate and characteristics of the responding firms is detailed.

4.2 Data Collection

Reviewing the literature one may summarize the data used in literature either cross sectional or firm level data. Caves (1974) is first one to use cross-sectional data and his work model is extended to Globerman (1999) who uses Canada's cross sectional data to investigate the spillovers from FDI. Several other studies used the cross sectional data from the Mexican manufacturing sector[9]. One thing common to note about all the aforementioned studies, is that they all find positive effect of the MNCs on the productivity of domestic firms.

Haddad and Harrison (1993) are the pioneers in their study to use firm level data. They develop econometric techniques to assess productivity spillovers from MNCs in Morocco. They find negative spillovers effect of multinationals presence on the productivity. Almost all the studies are carried out after Kokko (1996) who uses firm level data except a small number of them. Also, all the studies find negative effect except few of them.

9 Those studies include Blomstrom and Presson (1983), Blomstrom (1986), Blomstrom and Wolff (1994) and Kokko (1994, 1996)

The firm level data, to test my research model, are collected through a survey conducted in Saudi Arabia. It is collected from the different industrial cities located in Eastern and Central Provinces of Saudi Arabia.

4.3 Description of the Data

The questions in the two parts of survey cover information related to the performance of the local and foreign firms. The first part concerns both foreign and domestic investors. It covers information on capital investment, number of production employees by type, the value of total production at current prices and the cost of materials at current prices. Those figures are collected for five years starting from 2004 to 2008. More information is requested and those are related to the age of the firm and number of employees. Questions 1 to 8 constitute the important data required to calculate the productivity of different firms in each year. So, it is the basic numerical data collected in this survey. The other questions are mostly crude in nature (Yes/No) and they are simplified due to the educational level of some of the respondents. The data collected, aim to provide signals related to Foreign Joint Venture, Foreign Linkages, Foreign Stock and Training. These are all dummy variables and they have their own drawbacks on the results of the Regression Model. Example includes Question 10 asks about whether firms send their employees to training or not. The value of training in this case is dummy (0 or 1). Clearly, this does not differentiate between a firm who sent one employee to training and another firm who assigned 100 employees to attend training seminars and courses. Similarly, Question 12 aims to measure the Linkages. This is also treated as a dummy variable, which does not recognize the scale of cooperation with suppliers and buyers. Question 9 also has the same effect on the result since the Demonstration-Imitation effect takes place through the foreign joint ventures.

The second part of the questionnaire concerns the domestic producers only. It is used to analyze the future effect of the FDI on the diffusion of technology. The questions are related to the expected effects through the four channels (Demonstration-Imitation, Foreign Linkages, Competition and Labor Mobility).

That is done in an effort to collect the opinions of the local and foreign firms' managers about those effects. This part starts by asking investors about their own classification of business. Seven standard classifications were listed as options. Those are Wood, Food, Textile, Chemical, Machinery, Non-Metallic and Others industry. Secondly, the questions pertain to the local manufacturers about their expectation of the level of Competition due to the existence of FDIs. The next question draws local investors' feedback about the source of that competetion (Foreign Investors, Local investors or both). The fourth question measures the expected reaction of those investors. It sets four possible reactions, which are improving efficiency, cooperate with other companies or introduce new technologies. The next question retrieves expectations about the difference in technology level. The wider the technology levels the greater is the chance to absorb in the foreign investors' technologies. Questions (6 to 8) are more related to the reaction of foreign firms' products. The local firms will either buy their products, imitate them, continue with the same products or establish relations with foreign investors that will foster innovation. Question identifies the type of linkages that local investors have with their foreign counterparts. It sets four options – first is the Forward Linkage (sell them intermediate goods), Backward Linkage (Buy intermediate goods from foreign manufacturers), both Forward and Backward Linkage (buy and sell goods) or have no linkage at all. Question 8 digs in further to investigate the type of products changes due to the existence of foreign investors. Questions 9 and 10 measure the effects of Mobility and Training. While Question 11 measures the local investors expected benefit from the foreign technologies and sets four levels: 'yes', 'yes strong', 'no' and 'not at all'.

4.4 Sampling Strategy

The Ministry of Commerce (MOC) had provided me with a list of all factories located in the Kingdom of Saudi Arabia accessible through their database. The list of factories revealed that there were around 4048 factories in Saudi Arabia. These factories are distributed over thirteen major regions. These regions are Dammam in the Eastern Province, Makkah and Madinah in the Western

Province, Riyadh, Qassim and Hail in the Central Province, Najran, Aseer, Jizan, and Al-Baha in the Southern Province, Al-Jouf, Tabouk and the Northern Borders in the Northern Province.

The sample selected to conduct the survey contains 2600 factories located in the Eastern and Central Provinces of the country. The Eastern Province has 904 and the Central Province has 1696 factories. The reason for the selection of these two provinces to conduct the survey is that they are geographically attached. In addition, the Eastern Province is quite exposed to foreign investors since it is an oil rich area.

The factories are also divided, based on the type of products they manufacture. This classification is well recognized all over the world and it is also used by the Saudi Arabian Ministry of Commerce. In the Eastern Province, for example, there are 904 factories. They are divided into Food (120), Textile (29), Wood (22), Chemical (95), Non-metallic (146), Machinery (41) and Others (451). In the Central Province, however, there are 1696 factories. They are classified into Food (246), Textile (92), Wood (12), Chemical (160), Non-metallic (250), Machinery (116) and Others (820). According to the latest SAGIA report, the foreign investors represent 29.9% of the total local factories. The number of foreign investors targeted is 1288. They are divided into Food (121), Textile (96), Wood (30), Chemical (231), Non-metallic (231), Machinery (123) and others (456). This sample was selected based on coordination with SAGIA management.

4.5. Administration and Data Collection

The full questionnaire was professionally printed in A4 size white paper and stapled. An endorsement letter was mailed to the managers of public affairs in each firm (Appendix A). The letter explained the purpose of the survey. It also requested the respondents' cooperation assuring guarantee of confidentiality. The questionnaire was mailed to the managers personally enclosed with reply-

paid envelopes. In order to maximize the response rate, follow up e-mails and telephone calls were sent and conducted in some cases, included resending the questionnaire if it got lost or truncated. Due to the nature of data, it is not easy to collect the data. Response was expected to be low. Yet, I decided to capitalize on my relationship with SAGIA and MOC. A support letter was drafted by the SAGIA governor to support my research. This has helped in boosting up the response rate. This is expected in a business environment like Saudi Arabia where the authorities of SAGIA and MOC help to ease business process. Another important support in the data administration was received from the secretaries in my office. Due to the size of the sample , follow up with population and collection of questionnaires and finally the data arrangement was supported by secretaries in my office.

4.6 Data Analysis Method (Part I)

To predict the different variables, the Ordinary Least Squares (OLS) regression method is used in addition to the different standard statistical tests. In OLS regression, I use linear combinations of predictor (independent) variables to compute expected values of the response (dependent) variables. The simplest form of the OLS regression is as follows:

$$y = \sum \beta_j x_j$$

These expected values are conditional on the independent variables. The full model for OLS includes both the structural or systematic component ($\sum \beta x$) and a random component, (ε).

$$y = \sum \beta_j x_j + \varepsilon_j = x\beta + \varepsilon_j$$

The dependent variable in this equation is (y), while the independent variable is (x). This simple form is usually expanded to include explanatory variable and transformations. In the case of our research model, we have:

$$\frac{\dot{A}_{it}}{A_{it}} =$$

$$\beta_0 + \beta_1 Forgn + \beta_2 Link + \beta_3 Frn\_ind + \varsigma_i + \theta \ln \frac{A_{it}}{W_t^k} + \Omega C + \varepsilon_i + \eta T_i + \sum_1^7 \delta_k I_k + \sum_1^4 \phi_j R_j$$

The dependent variable is $\frac{\dot{A}_{it}}{A_{it}}$. This variable can be transformed to the following form:

$$\frac{\dot{A}_t}{A_t} = \frac{d \ln A_t}{dt} \cong \frac{\Delta \ln A_t}{\Delta t} = \frac{\Delta \ln A_t}{1} = \frac{\ln A_{t+1} - \ln A_t}{1} = \ln \frac{A_{t+1}}{A_t}$$

So, the model is run first as base model to configure the Catch-Up and Training effects. The dependent variable is the TFP growth between a period (t) to (t+1). Then, the basic model is run to include the foreign variables (Foreign Joint Ventures, Foreign Linkages and Foreign Stock in the industry). Finally, the main model is run to include the foreign variables and all the other control variables (Age, Size, Industrial Classification and Geographical Location). This type of analysis in addition to the standard statistical tests (f-test) is used to test the first hypothesis.

4.7 Data Analysis Method (Part II)

Part II of this research is composed of two hypotheses. The first Hypothesis (H1) investigates the local manufacturers' expectations of the interaction between:

- **Competition and Linkage -** The effect of this interaction of technology diffusion (H2).
- **Training and Workers' Mobility -** the effect of this interaction on technology diffusion (H3).

The two way Analysis of Variance (Two way ANOVA), method is used to investigate these two hypotheses, quantitatively. The two-way ANOVA is an extension of the one-way ANOVA. The "two-way" comes because each item is classified in two ways, as opposed to one way.

Using the two way Analysis of Variance usually yields three results for each hypothesis test:

1. The effect of the first independent variable on the dependent variable.
2. The effect of the second independent variable on the dependent variables
3. The effect of the interaction between the two independent variables on the dependent variables.

The two-way ANOVA is followed by extensive descriptive data analysis to depict the main features of the data collection, quantitatively. This type of data analysis differs from the normal inductive statistics. The descriptive statistics summarize a data set, rather than use the data to learn about the population that the data are thought to represent. This generally means that descriptive statistics, unlike inductive statistics, are not established on the basis of probability theories. Even when a data analysis draws its main conclusions using normal inductive statistics, descriptive statistics are generally also presented.

4.8 Response Rate

The nature of the data requested to run the model is confidential. For that reason, it was difficult to get a reasonable level of interest by sending the survey through the fax only. Extensive follow-ups through telephone calls had to be done in order to bring up the response rate to a reasonable level. The following few paragraphs explain the strategy used to collect the needed data.

The survey needed to be distributed to both local industrial investors and FDIs as well. In order to do that, both local investors and foreign investors' names and addresses had to be collected. The above information is not published for public

usage. However, to collect the local investors names and addresses and the type of activity, I had to contact the Ministry of Commerce in Saudi Arabia. Yet, even the simple data that includes the names and addresses of the investors was of confidential nature, according to the employees of the ministry. A letter addressed to the minister had to be drafted and sent for his approval. The minister was very supportive and he gave his instruction to the employees for the release of the information.

To collect the data of the foreign investors, SAGIA had to be contacted. Three e-mail messages were sent to the persons responsible of the data. The reply from them stated "The data you requested is of confidential nature; sorry we cannot fulfill your request". As a result two visits were conducted to SAGIA headquarters in Riyadh. Finally, employees asked to draft a letter stating my request. In addition to the letter of request, I had to sign an attestation of confidentiality representing a document that holds me responsible for releasing any data received from SAGIA. Finally, the list of both local and foreign investors was in my hand to conduct the survey as the basis of my research analysis.

In the two parts of survey necessary to conduct the study, as mentioned previously, **Part 1** covered both local and foreign investors in the Eastern Province and three other cities (Riyadh, Qassim and Hail) located in the Central Province of Saudi Arabia. As shown in **Table 4.1,** the total number of local investors surveyed was 2600. However, the total number of industrial foreign investors in the Eastern and Central Provinces is 1288. So **Part 1** of the survey was sent to 3888 industrial investors on aggregate. The number of questionnaires returned and received was 1503. The response rate for **Part 1** concerning local investors is 57.81 %.

Category		Location				Total (%)
		Eastern Province	Riyadh	Qassim	Hail	
Total Sent		**904**	**1515**	**150**	**31**	**2600**
Industry Classification	Food	79	146	26	3	254 (16.9)
	Textile	20	51	1	0	72 (4.79)
	Wood	10	10	0	0	20 (1.33)
	Chemical	80	82	6	0	168 (11.18)
	Non-Metallic	117	210	17	3	347 (23.09)
	Machinery	23	65	6	0	94 (6.25)
	Others	197	319	23	9	548 (36.46)
Total Responded		**526**	**883**	**79**	**15**	**1503**
Response Rate (%)		**58.19**	**58.28**	**52.67**	**48.39**	**57.81**

Table 4.1 *Local Investors responding to Part 1 of the Survey*

The local investors in Eastern Province responded to 526 questionnaires out of total sent (904), giving the response rate 58.19 % in the Eastern Province. The response rate for the investors in Riyadh was just similar (58.28 %) to that of the Eastern Province (58.19 %) when out of 1515 surveys sent in Riyadh, local investors responded to 883.

Similarly, as shown in **Table 4.2**, **Part 1** of the survey was sent to the foreign investors through the fax, thanks to the information supplied by the SAGIA. That information included the fax numbers of the foreign investors. The survey was sent to 1288 foreign investors. The number of foreign investors operating in Eastern Province was 333. However, the number of investors in the Central Province was 955.

Table 4.2 depicts the response rate for the foreign investors' survey where 495 foreign investors responded to the survey out of total 1288 questionnaires sent, giving the response rate of 38.43 %. The response rate for foreign operators in the Eastern Province was 42.94 % when 143 of them responded out of total 333 questionnaires sent. In the Central Province, however, the response rate was 36.86 % when the total number of questionnaires sent was 955 out of which only 352 foreign investors responded. The confidentiality nature of the data requested justifies the humbleness of the response rate.

Category		Location				Total (%)
		Eastern Province	Riyadh	Qassim	Hail	
Total Sent		**333**	**955**			**1288**
Classification	Food	7	16	4	1	28 (5.66 %)
	Textile	13	12	7	2	34 (6.87 %)
	Wood	3	6	0	0	9 (1.82 %)
	Chemical	39	49	3	0	91 (18.38 %)
	Non-Metallic	22	43	23	4	92 (18.59 %)
	Machinery	18	62	7	1	88 (17.78 %)
	Others	41	93	17	2	153 (30.91 %)
Total Responded		**143**	**281**	**61**	**10**	**495**
Response Rate (%)		**42.94**	**36.86**			**38.43**

Table 4.2 *Foreign Investors responding to Part 1 of the Survey*

Part 2 of the survey was only sent to local investors. As mentioned in the previous chapters, it is supposed to help in the descriptive analysis of hypotheses H2 and H3. Since the questionnaire was attached to **Part 1** of the survey and sent together, the same response rate was expected and the same analysis of the cities and Provinces would apply to Part 2.

4.9 Data Preparation

The procedure of data preparation includes data cleaning, normality and reliability checking and finally analyzing the characteristics of the responding firms.

The received data was first substituted into the Statistical Software Package for The Social Sciences (SPSS) and then into the version I used, Predictive Analysis Software (PACW) Statistics 18.01. For confidentiality purposes each company was given a code number based on the instructions of both SAGIA and the Saudi Ministry of Commerce.

The treatment of missing data started with looking at the data and rechecking responses. In statistics and survey principles, missing data might be for one of the two reasons. Either the data entry was missed or the questions were not

really answered by the respondents. The missing data seemed to be randomly distributed. In this case, remedies can be implemented by finding out the magnitude of their effects. Hair et al, (1998) suggest four methods that can be used to treat the missing data. These four ways are, case wise deletion, pair wise deletion, substituting an imputed value and mean value substitution. Obviously, the first two methods, namely, case wise and pair wise deletion are not preferable for my research analysis because these methods would reduce the number of useable questionnaire results. That is due to the fact that both methods would handle missing values by deleting cases from the analysis. Specially, in **Part 1** survey, the response rate for foreign investors is relatively low (38.43 %). The method of substituting an imputed value makes a prior inference about the relationship between variables. However, assumption about the different cases may not be easily made. That is why this method is not considered. Mean value substitution method is the most widely used. It replaces the mean value of that variable with mean value base on all valid responses. Therefore, it maintains the sample size without making assumptions about the relationship between variables. This method is considered the most suitable for my study.

The missing data represents less than one percent (1 %) of the total responses and as such it is not considered very significant in the study. All the missing data were from Questions 1 to 8 of Part 1 of the survey. The reason for that might be the unavailability of the data due to the difficulty of going back to five years old data. Another reason might be due to the misunderstanding of the question itself. Of the one percent missing values, about 18 % was attributed to Question 2. Almost 32 % of the one percent missing data was from Question 4. The Saudi government imposes a minimum Saudization rate on both local and foreign investors. The investors might be reluctant to release this rate. 33 % of the missing data is from Question 6. The cost of material is critical; that is why 11 % of the missing data was from Question 7. Only 6 % of the missing data is from Question 8. To make sure that data substitution is just and accurate in adopting the method of missing data, a run out of the data is done after deleting the 19 companies who did not respond to those questions. The result of this run out is compared with the data that is used for this research. The adjusted R-square is found to be the same; that is 10 %, which means that the 10 % of variance in TFP growth is explained by the Catch-Up, Demonstration-Imitation, Linkage,

Competition, Training and Age. Also, the overall model is significant (F-Significance=0), which is similar to value found when the model is run with mean substituted values. The magnitude of the different effects (β-values) is found to be the same. It proves that the mean substitution method is the right method and the missing values do not affect the result.

4.10 Outlier and Normality Examination

The next step of data preparation process is known as Checking Outliers that are different from other observations, according to Barnett and Lewis (1995) where the type of data is usually different from majority of the sample data. That means data are indicative of population characteristics that would not be discovered in the normal course of analysis. However, this data may affect the results of any other examination method, according to Hair and Anderson (1998). For this reason, it is important to examine the data for the presence of outliers to ascertain their influence. The SPSS software, I use in my research, has an Explore-Analysis feature to identify the extreme values where two types of outliers are encountered. First of which is due to mistakes in the data entry process. Data in this case have to be rechecked and corrected. The second type of data is incorrectly provided by the respondents. This type of data is spot checked and has to be corrected, accordingly.

The outliers' identification is usually followed by Normality checking. Hair and Anderson (1998) refers Normality to the shape of the data distribution for an individual metric variable. A normal standard distribution is bell shaped and indicates that the Arithmetic Mean is zero and the standard deviation is one. Because of the dummy variables in my analysis, normality test is not applicable. This fact is highlighted by several statisticians. One of them is Daniel B. Suits (1984) who asserts that the use of dummy variables automatically makes the normality test obsolete.

4.11 Summary and Conclusion

To summarize this chapter, two questionnaires are developed to run the model and to investigate the expected future effects of FDI existence in Saudi Arabia. The first survey targeted both FDIs and local investors in the Eastern Province of Saudi Arabia. These two regions were selected based on the fact that the Eastern Province is an oil rich area and it is an attraction for foreign investors. Central region is the capital and Saudi government has put a lot of money to develop it. The two regions are geographically attached. The response rate of foreign investors is 38.4 % while the response rate for the 57.8 %. The missing data represents 1 % of the total responses and they were covered using the mean value substitution method was adopted to substitute for the missing values.

Chapter 5 Data Analysis and Findings Part I

5.1 Introduction

The purpose of this chapter is to analyze the data received from the respondents. The analysis of the results is in two parts. The first part is a quantitative data analysis, which is used to explore the mechanism through which FDI promotes TFP growth by investigating Hypothesis (H1). The analysis of the first hypothesis represents the implementation of both the basic and the main models that are derived from the Parente-Prescott model. The purpose of this analysis as mentioned in the previous chapters plays a role in raising a firm's productivity. If the foreign technologies spillover to domestic counterparts via various avenues, we will observe an increase in the TFP.

The second part of the analysis is both quantitative and descriptive analysis of the Hypotheses (H2) and (H3). Both hypotheses investigate the future effects of the FDI on the technology diffusion in Saudi Arabia. The Hypotheses (H2) looks into the effects of the foreign investors' activities on the Competition in local markets and eventually on the technology diffusion. This part is handled through statistical-descriptive analysis. This analysis is based on the results of the survey sent to local investors (**Appendix A, Part 2**). The analysis of the Hypotheses (H2) also includes a section related to effects of Linkage on the diffusion of technology due to the injection of capital by the foreign investors. It is also based on descriptive and frequencies' analysis.

The Hypotheses (H3) analysis is related to the Mobility effect due to the training activities exercised by the foreign investors. The analysis is also done through quantitative and descriptive analysis. Due to the depth of the analysis, Chapter 5 is dedicated to analyze the first Hypothesis (H1) while Chapter 6 is dedicated to analyze the results for Hypotheses (H2) and (H3).

5.2 General Characteristics of the Responding Firms

The selection of the sample in my research analysis is based on the geographical Location of the firms. It is mentioned previously that survey is done in the two Provinces of Saudi Arabia, namely, Eastern Province and the Central Province. The analysis in this section considers the responding firms in terms of the type of Activity and the Size of the firm.

Table 5.1 corresponding to **Table 4.1** illustrates the number of the responding national firms based on Location and Activity. Out of the total 2600 local firms and 1503 responding to the survey in the local industry, the response rate from each industry is:

- 16.9 % from the Food industry.
- 4.79 % from the Textile industry.
- 1.33 % from the Wood industry.
- 11.18 % from the Chemical industry.
- 23.09 % from the Non-metallic industry
- 6.25 % from the Machinery industry.
- 36.46 % from Others industries.

Table 5.1 analyzes the facts and the others related to the rest of the industrial categories. The above percentages are also affected by the number of the firms in each industry.

Category	Local Investors			
	Number of Investors	Percentage of the total	Number of Respondents	Percentage of the total respondents
Food	366	14.08	254	16.90
Textile	396	15.23	72	4.79
Wood	121	4.65	20	1.33
Chemical	34	1.31	168	11.18
Non-Metallic	255	9.81	347	23.09
Machinery	157	6.04	94	6.25
Others	1271	48.85	548	36.46
Total	**2600**	**100**	**1503**	**100**

Table 5.1 *Percentage of Local Investors' Respondents to the Total Sample*

It is quite normal to find out that the majority of the respondents are from the Others industries. This is because the number of the firms in that industry is 1271 firms out of total 2600 firms surveyed. So the sample size of this category represents 48.85 % of the total sample.

Table 5.2 corresponding to **Table 4.2** illustrates the number of the responding foreign firms based on Location and Activity. Out of the total 1288 foreign firms and 495 responding to the survey in the local industry, the response rate from each industry is:

- 5.66 % from the Food industry.
- 6.87 % from the Textile industry.
- 1.82 % from the Wood industry.
- 18.38 % from the Chemical industry.
- 18.59 % from the Non-metallic industry
- 17.78 % from the Machinery industry.
- 30.91 % from Others industries.

Those rates are affected by the size of the sample from each industry. The case for the Others category in the sample of the foreign investors is similar to that of the local investors. The number of the investors in at category is 495 and the number of those responding is 153, giving the highest response rate of 30.91 % in the sample.

Category	Foreign Investors			
	Number of Investors	Percentage of the total sample	Number of Respondents	Percentage of the total respondents
Food	121	9.39	28	5.66
Textile	96	7.45	34	6.87
Wood	30	2.33	9	1.82
Chemical	231	17.93	91	18.38
Non-Metallic	231	17.93	92	18.59
Machinery	123	9.55	88	17.78
Others	456	35.40	153	30.91
Total	**1288**	**100**	**495**	**100**

Table 5.2 *Percentage of Foreign Investors' Respondents to the Total Sample*

Based on Questions 3 and 4 of Part 1 survey, the sizes of the responding firms in percent are analyzed from the number of local and foreign employees of the responding firms, as follows:

- The firms with less than 30 staff represent 22 % of the total foreign and local respondents.
- The firms with more than 30 staff and less than 100 represent 23 % of the total respondents
- The firms with more than 100 staff and less than 1000 represent 26 % of the total respondents.
- The firms with more than 1000 represent 29 % of the total respondents.

5.3 Data Analysis and Findings (Part I)

In this section, extensive analysis of the data is performed. The analysis commences by comparing the performance of foreign firms to the local firms. I estimate the results of Equation (5) that represents the basic model. Next, I add up more control variables on step by step basis starting with the Age variable, the Size, geographical Location and finally, the Industrial Classification. The basic model is tested with each single control variable, separately, and then with multiple variables. For example, the basic model is tested with Age only and then with Size. Next, the basic model is tested with Size and Age variables together. Furthermore, I continue the analysis by integrating the Location as a control variable in basic model. Second, it is tested together with Size. Third, the basic model is tested with Location and Age together. Fourth, the basic model is run with Size and Age, simultaneously.

Finally, the main model (Equation 6) is tested by integrating all the control variables mentioned in the previous paragraph. Again, the controlled variables are substituted in the analysis and tested with the Industrial Classification, separately. This action and pervious two actions are taken in an attempt to come up with the mechanism through which FDI promotes TFP growth or technology diffusion. This analysis is further supported by considering the model run out for three different sizes of companies when the number of employees is considered

as an indicator for small, medium and large industries. The intra-regional and Intra-Industrial analysis is performed to help explore the mechanism for the FDI promoting technology diffusion and, hence, TFP growth.

5.4 Performance of Foreign Firms Relative to the Local Firms

The analysis of foreign firms' performance is carried out in two folds. In the first fold, the share of each sector relative to the local is found. In the second fold, I derive key ratios depicting performance indicators. **Table 5.3** illustrates the share of foreign firms and the number of valid observations for each sector.

Category	Respondents		Total Sample	
	Foreign Share (%)	Number of respondents	Foreign Share (%)	Total Number in the sample
Food	9.9	282	24.8	487
Textile	32.1	106	27.3	352
Wood	31.0	29	46.9	64
Chemical	35.1	259	47.5	486
Non-Metallic	21.0	439	47.0	492
Machinery	48.4	182	43.9	280
Others	21.8	701	26.4	1727
Total	24.8	1998	33.1	3888

Table 5.3 *Foreign Firms Share per Sector*

The foreign share is the percentage of foreign firms to total firms in a particular industry. In this sample, the foreign presence is most dominant in the Chemical sector (47.5 %). Many foreign investors target the Chemical sector in Saudi Arabia because it is very rewarding for foreigners. They try to utilize the cheap prices of the raw materials because Saudi Arabia is an oil country and the government introduces so many incentives for both local and foreign investors in this sector. The second sector is the Non-Metallic. It represents 47 % of the total industry. Obviously, so many foreign investors came from the Arab countries and started to establish small businesses in the Saudi Arabian market. No matter how small or large, it is considered foreign investment. The Wood sector is the third on the rank (46.9%). This is considered a labor-intensive sector. The huge presence of the foreigner reflects the luxurious life of the Saudi Citizens.

The relative performance of foreign investors through different performance ratios is on industry groups or categories as well. All the ratios to be determined are based on the average of foreign firms' performance on a particular industry to the average of local industries' performance. If the performance of the foreign firm is better than the local one, the ratio would be greater than one.

Based on the sample data in Questions 2 to 4 of Part 1 survey, the first ratio to be analyzed in this section is the Capital (K) to Labor (L) ratio. The ratios for the different industries are shown in **Table 5.4**. From this table, one may notice that the foreign firms in all industries are more capital-intensive than the local firms. This may reflect the status of the capital and technology utilization by the foreign firms. The foreign firms are using less manpower and more capital. If the foreign firms are more productive, this suggests that the foreign firms have better technologies than the local firms. Generally speaking, capital intensity for foreign firms is 2.26 times as high as local forms. Consequently, foreign firms are doing better than the local firms in this aspect.

Industry	Capital:Labor (K/L) Ratio
Food	3.28
Textile	2.35
Wood	1.1
Chemical	1.4
Non-Metallic	4.3
Machinery	1.3
Others	2.1
All Industries	2.26

Table 5.4 *Capital to Labor Ratio (K/L)*

The second ratio to be analyzed is the Size ratio based on the sample data in Questions 2 to 4 of Part 1 survey. The Size may be in terms of number of employees or in terms of sales whereas in this study the Size ratio is measured in terms of sales. The Size used for the analysis of the model is in terms of number of employees. **Table 5.5** illustrates the Size ratio in terms of sales, for all industrial categories. It is obvious that local firms are generally doing better in terms of sales. Except for the Textile sector, the average Size of local firms is better in all the industries.

Industry	Size:Sales Ratio
Food	0.9
Textile	3.1
Wood	1.5
Chemical	0.15
Non-metallic	0.7
Machinery	0.65
Others	0.4
All Industries	0.24

Table 5.5 *Size Ratio in terms of Sales*

The third ratio that is considered is the value of Exports relative to the total Sales. This is known as the Export Propensity. The Export Propensity ratio for the different industries is shown in **Table 5.6** Smaller firms tend to export less by principle. The amount of Exports from the Saudi firms is generally low. Most of the Exports are from the oil industry. Yet, the Exports by the foreign investors are at the minimum level. In most of the small industrial sectors, like Food, Textile and Wood, Saudi Arabian citizens consume whatever is produced in the country. In fact, the Saudi government in a lot of cases is obliged to forbid exporting in order to keep the prices' index at a reasonable level. For example, in 2009, Saudi Arabia issued a decree for the stoppage of wheat exports. This is due to the huge consumption in the country.

Industry	Exp:Sales Ratio
Food	0.4
Textile	0.1
Wood	0.12
Chemical	0.12
Non-metallic	0.4
Machinery	0.1
Others	0.3
All industries	0.18

Table 5.6 *Export Propensity (Export/Sales)*

Table 5.7 depicts the Age ratio of how long the foreign firms have been in business relative to the local firms. When the FDI regulations in Saudi Arabia

were improved, the first industry tackled was the Chemical industry. This was due to the willingness of the government to improve the petrochemical industry. The promotion in the prices of oil derivatives encouraged the foreign investors to set their own plants in Saudi Arabia. Moreover, the SAGIA set a minimum capital to be invested by FDI in order to get the necessary licenses required for operation. Investors in small industries could not afford it. That is why they could afford to buy the licenses. Recently, SAGIA has reduced the minimum amount of capital to one million Saudi Riyal. It was further reduced to half million Saudi Riyals in 2009. This has motivated the small investors to set up their shops and factories in the country. This fact is illustrated in **Table 5.7**. In the Food, Textile, Wood and Others industries the foreign investors are relatively newer than the local investors. The foreign investors are even newer in the Chemical industry. However, they are older relative to the rest of the industries.

Industry	Foreign : Local (Age Ratio)
Food	0.3
Textile	0.1
Wood	0.2
Chemical	0.9
Non-metallic	0.43
Machinery	0.25
Others	0.39
All Industries	0.45

Table 5.7 *Foreign : Local (Age Ratio)*

The Training Ratio (TRN) is calculated by finding the number of foreign firms that assign their employees to attend relative to the number of local firms assign their employees to attend. Training ratio is very important that gives indication about the efforts exerted by foreign firms relative to the local firms. Because training local employees will help in the process of technology diffusion, foreign firms are always hesitant to train local employees. The training in this case is considered binary. To elaborate, if the firms send local employees for training then TRN is equal to 1. However, if there are no training efforts, TRN is zero. During the past three years, the Saudi Human Resources Development Fund (HRDF) has been very active in supporting local firms to train young Saudis. The idea of the HRDF is based on utilizing the fees for issuing work permits for expatriate employees, to train Saudis. At the beginning, the fund supports local investors by paying half the

salary of any high school or technical college graduates. In addition, the fund will support training the Saudis by paying the training fee. This has motivated local investors to send their employees for training. The HRDF management has improved its activity by introducing the strategic partnership projects. Through the strategic partnerships projects, the HRDF cooperates with the Technical and Vocational Training Commission (TVTC) and other investors to establish polytechnic training institutes. Those training institutes specialize in the disciplines of the local investors and HRDF would pay all the operational expenses of the training institutes. The local investors would furnish the training institute with the required equipment necessary for practical training. Another important condition imposed by the TVTC is to hire an international operator specialized in the vocational training to run the training center. On the other hand, SAGIA imposes certain Saudization rate on the foreign investors. Moreover, the foreign investors have to train Saudi employees. Yet, these criteria are not being audited. So, the foreign investors are not as active as local investors on the training side. This fact is depicted in **Table 5.8** by the Training Ratio (TRN). Reading inside the table, the foreign investors working in the Chemical industry are the most active. The size of the foreign Chemical companies is relatively large. Those companies are under focus and their activities in terms of training and Saudization is usually monitored by the Saudi government. The government wants to make sure that the prices promotion given for those investors eventually pays back. On the other hand, the investors in Food, Textile, Wood, Machinery, Non-Metallic and the Others industries are considered smaller in size. It is even difficult to control their activities. These companies are not active in training. Most of them do not even satisfy the Saudization requirements.

Industry	TRN
Food	0.1
Textile	0.05
Wood	0.03
Chemical	0.84
Non-metallic	0.35
Machinery	0.25
Others	0.15
All industries	0.19

Table 5.8 *Training Ratio (TRN)*

Both foreign Backward and Forward Linkages seem to be very strong for foreign firms. This has to be a fact in both Chemical and Non-Metallic industries, since they depend on oil derivatives to produce their final products. Even the small investors that operate in Food and Wood in this case are very strong. **Table 5.9** shows this fact by Linkage Ratio (LINK). The foreign investors in Food, Chemical and Non-Metallic are, approximately, three times stronger than the local investors. On aggregate, the foreign investors are 2.8 times stronger that the local ones.

Industry	LINK
Food	3.5
Textile	1.2
Wood	1.9
Chemical	3.5
Non-metallic	2.9
Machinery	1.1
Others	1.3
All industries	2.80

Table 5.9*Linkage Ratio (LINK)*

The Labor Productivity Ratio (Y/L) in **Table 5.10** assumes superiority of foreign investors in terms of productivity level. The Labor Productivity Ratio in our case is defined as the value added to the total number of workers. It is higher for all foreign owned firms. The highest Labor Productivity Ratio (4.1) is earned by the foreign investors in the Food and Non-Metallic industry. The lowest performance (1.1) is shown by the Others industry.

Industry	Y/L
Food	4.1
Textile	1.6
Wood	1.4
Chemical	3.0
Non-metallic	4.1
Machinery	3.6
Others	1.1
All Industries	2.60

Table 5.10 *Labor Productivity Ratio (Y/L)*

As shown in **Table 5.11**, the TFP ratio compares output of the foreign firms relative to the output of the local firms regardless of the input. A host country economy would benefit from the foreign investors only if the foreign firms are assumed to be more productive. The general performance shows that foreign firms generally have higher TFP than the local firms. Some of the TFP ratios are notably negative because the Mean of either foreign or domestic investors is negative. For example, the negative value for the TFP ratio of the Machinery industry appeared because the mean of domestic firms is negative. The foreign firms are doing better than local firms in Food, Chemical and Non-Metallic firms. The foreign firms' high performance relative to the local firms might be for many reasons. One of them is the highly skilled and trained workers from the home of the foreign firms. Another reason is that foreign firms may have better technologies utilized for production.

Industry	TFP
Food	5.6
Textile	-3.9
Wood	-2.3
Chemical	9.4
Non-metallic	-14.1
Machinery	-1.5
Others	0.52
All industries	2.60

Table 5.11 *TFP Ratio*

5.5 Explanation of Major Constructs

This section explains the major constructs of the main model. **Table 5.12** gives a brief explanation of each construct and presents the way it is calculated.

Variable	Definition	Calculation
$\dot{A}_t^i$	TFP growth of the i[th] firm	These two terms are utilized to calculate the dependent variable which is $\frac{\dot{A}_{it}}{A_{it}} = \ln \frac{A_t}{A_{t-1}}$ (For Calculation of TFP and TFP growth, (Please, refer to the description below)
A_{it}	TFP Level of the i[th] firm	
W_t^k	Best Practice level of TFP in each industry	Refer to the description below for the calculation of TFP
$Forgn$	Foreign Joint Ventures (Binary)	A binary constant. $Forgn$ =1, if the firm has a foreign joint venture with a partner or otherwise, $Forgn$ = 0.
$Link$	Foreign Forward-Backward Linkages (Binary)	Foreign Linkage, $Link$ =1 if the firm has a foreign buyer or supplier or otherwise. $Link$ =0.
Frn_ind	Foreign Presence in the industry. This variable is used to calculate the Competition effect.	$Frn-ind$ = measured as the share of foreign firm's employment to the total industry= Number of firms' employees
ς	Firms Specific effects (Examples - Age and Size)	The number of years a firm has been in business represents the Age. Data for Age is derived directly from the survey Q1. Size is measured in terms of number of employees. Data for size are derived from the survey Q3.
$\ln \frac{A_{it}}{W_t^k}$	The magnitude of spillovers effect from a leading firm to the rest of the firms (Catch-Up).	Please refer to raw one , two and three of this table for calculation details
W_t^k	Best practice firm's level of TFP in the "k" industry	For calculation of the TFP, please, follow the description below.
T_i	Training	Training is binary derived from Q10 in the survey. It expresses the training activity of the firm. If the firm sends its employees to attend formal training; it indicates that it is active in training and takes value of 1 or otherwise, 0.
I_k	The Industrial Classification: There are seven industries; each company in the survey	I_k = 0 if the company does not

	takes a binary number.	belong to the “k” industry. I_k = 1 if the company belongs to the “k” industry. There are two sources for this data. The two sources are the MOC and the SAGIA databases.
R_j	The Geographical Location: There are four locations; each company takes a binary number for this.	R_j = 0 If the company is located outside the “j” geographical location. R_j = 1 if the company is located inside the “j” location. There are two sources for this data. The two sources are the MOC and the SAGIA databases.
C	Size of the company	Equals the number of employees; Data for Size is derived from the survey Question 3.

Table 5.12 *Main Constructs*

The most important issue is the calculation of the constructs for the estimation of the TFP levels. As mentioned previously, the TFP is defined as the portion of output that is not explained by the amount of input used in production. It is always recognized as a measure of country’s long term technological changes. Using the Cobb-Douglas equation is the most common way of finding the value of TFP growth. The standard form of the equation is expressed, as follows:

$$Q = AL^a K^b$$

That is to say, total output (Q) is a function of Total-Factor Productivity (TFP), Capital input (K), Labor input (L) and the two inputs’ share of outputs (a, b). Solow, R. M. (1956)[10] utilizes this equation to come up with a measurement of the TFP defined in the equation as “A”. The equation was put in the following form:

$$Q(t) = [K(t)]^a [A(t)L(t)]^{(1-a)}$$

The Cobb-Douglas function is a log-linear equation:

[10] Solow, R. M. is an American economist known for his work in economic growth modeling, Solow residuals calculation is a very important way utilized for the calculation of the TFP.

$$\ln Q(t) = a \ln K(t) + (1-a) \ln A(t) + (1-a) \ln L(t)$$

The Capital Intensity (a) is defined as the amount of fixed or real capital presented in relation to factors of production. The capital is easy to measure in nominal terms. It is the value of total capital to the total potential output. However, in order to find out the real value of the capital intensity, the 2004 prices are used as a base when the prices are deflated. The above mentioned equation is utilized to calculate the value of the TFP level. Each firm has an A-value for the five years. The values in the above equations are collected from the survey, as follows:

Q = Value of total production	(Question 6)
K = Total Capital investment	(Question 2)
L = Total Number of Workers	(Question 3)
a = Capital intensity = (total capital / total output)	(Question 2 / Question 6)

As motioned above, the Capital Intensity is deflated annually. The value of the TFP is calculated for the five years and the average is taken. The best practice firm in terms of TFP is taken as the value of W_t^k .

The investigation of the Cobb-Douglas equation could be done using regression analysis. This may help in getting indication of the value of the TFP as well as the constants. To run a regression model usually the equation takes the following form.

$$Ln\, Q(t) = A + \alpha\, ln\, L(t) + \beta\, ln\, K_{(t)}$$

The result of the Cobb-Douglas equation could be found in **Appendix-C**.

5.6 Running the Model and Hypothesis Testing

The model is run using the SPSS in which the data has to be codified first. OLS regression is conducted with a dependent variable:

$$\ln \frac{A_t}{A_{t-1}}$$

This analysis is consistent with Parente-Prescott investment equation described in Chapter 3. The model is run several times to explore the mechanism by which FDI promotes the TFP growth through the four channels. The foreign technologies spillover to the local counterparts through the four different channels, namely, Demonstration-Imitation, Linkages, Competition and Training. If this were the assumption, then, an increase in the productivity of the domestic firms would take place.

In this research study, the Demonstration-Imitation effect is presumably represented by joint ventures. The Foreign Linkages, however, take place through the transactions between suppliers and buyers. Foreign stock in industry indicates the Competition effect. This is because the foreign presence in the industry obliges the local firms to increase their productivity. However, an overlapping area may exist since the foreign presence may represent the Demonstration effect. This is because the presence of more foreign firms increases the probability that technologies are transmitted to local firms.

5.7 Hypothesis Testing

The first Hypothesis (H1) can be stated in the following form:

H0: *The spillovers' effects from FDIs, do not lead to technology diffusion.*

Ha: *The spillovers' effects from the FDIs are important source of technology diffusion.*

To discover the mechanism through which FDI leads to technology diffusion by testing the above hypothesis systematically, the basic and the main models are tested several times, as follows:

1. The first run out does not include the foreign content of the firms. The model does include the direct measurement of the spillovers, which is represented by the term:

$$\theta \ln \frac{A_{it}}{W_t^k}$$

This is known as the Catch-Up effect. The Training effect represented by the term ηT_i will also be considered in this regression analysis. In addition, the effect of the firms' Age is added to the run out. This test is used as a benchmark for the other tests that includes the foreign variables.

2. The second run out includes all the foreign variables (Basic Model). This leads to the final judgment of the different variables' effect on the hypothesis testing. To elaborate, this test determines whether the foreignness of a number of firms in a certain industry play role in the rising up TFP when the other variables (Age, Size, Location and Industrial Classifications) are not controlled.

3. The next run outs of the model represents adding different control variables to the basic model and manipulating those in a way that would allow to understand the effect of each control variable on the basic model and henceforth, on the TFP growth. This is done by including the following control variables in the following sequence:

   a. Age
   b. Size
   c. Both Age and Size
   d. Geographic Location only
   e. Both geographic Location and Age
   f. Both geographic Location and Size
   g. Geographic Location, Age and Size
   h. The basic model manipulation including seven run outs (please, refer to subsection **5.9.** for details)

4. The other run out that helps discovering the subject mechanism, includes the following:
   a. Dividing the companies according to the number of employees into three Sizes: small, medium and large industries and conducting the run out for each tier.

b. Conducting Intra-Regional analysis for the four geographical locations
c. Conducting Intra-Industrial analysis for the seven industrial classifications.
d. Comparing the interaction of different foreign effects with each other; run out for companies subject to foreign effects with those that are not. Examples include companies that have Demonstration with companies do not have Joint Ventures and companies who have Linkage with those, which do not.

This helps in analyzing and exploring where the effects are noticeable and how they interact with the TFP growth.

5.8 The Catch-Up, Training and Age Effects

Table 5.13 reports the regression results on the Catch-Up and Training effects. The overall model is statistically significant at the 99 % confidence interval. The F-value (54)[11] shows that the model has a good fit and represents. The coefficient of the Catch-Up effect (θ) is – 0.071 and it is also statistically significant at 1 % significant level since it has a P-value of zero where the average increase of a firm TFP is 7.1 % due to one unit increase in the Catch-Up. This figure also reflects the other effects such as the industry-specific demand shocks. When a particular industry experiences demand prosperity during this period, the Catch-Up effect may be overestimated. The Training (η) is also significant at the 1 % level and seems to be more significant than the Catch-Up effect. Firms that provide training seem to be growing faster (TFP) than the other firms by 9 %. The Age effect is also statistically significant having a P-value of zero. The R-square for this run out is 8 % and the adjusted R-square is 7 %.

Without the foreign variables, the Catch-Up and Training effects in Saudi Arabia are effective but not considerable. Obviously, the Catch-Up effect will only be maximized if the Demonstration-Imitation efforts in the country are very active. Practically speaking, this is not the case in the country because of the fact that Saudi Arabia depends heavily on buying products from other countries rather than manufacturing in the Kingdom.

[11] For more details about the regression please refer to Appendix-C (Regression Results).

Catagory	Values
Intercept (β_0)	0.270*** (0.024)
Catch-Up (θ)	-0.071*** (0.019)
Training (η)	0.089*** (0.030)
Special Effect (Age)	0.009*** (0.001)
R-square	0.080
Adjusted R-square	0.070
F-Value	54.320***

*** indicates 1 % significance level

Table 5.13 *Catch-Up, Training and Age effects*

The results above are inconsistent with those depicted by other researchers. Examples include Kinoshita (1998) who could not find an evidence of spillover due to Catch-Up effect in China at the same significance level. Even the Age effect at 1 % significance level is very weak.

Table 5.13 illustrates the results of the model run out at a significance interval of 0.01 %. The significance interval expansion shows improvement in the results. In conclusion of the above two run outs, the Null-Hypothesis is rejected and there is relationship between the increase in productivity and the three effects. Previous studies on the Training effect on the TFP improvement include Bartel (1991) whose results show that training has a positive impact on productivity. He uses Labor Productivity as a dependent variable and utilizes the Time Series Tool to prove that relationship.

5.9 Foreign Investment and TFP Improvement Test

In the last section, I find that the Catch-Up and Training effects alone do not help very much in improving the TFP. I also show that Null-Hypothesis is rejected and there is a relationship between the increase in productivity or technology diffusion and the Catch-Up, Training and Age of the firm.

In this section, we add the foreign factors to test this relationship. This will test whether the foreignness of the firms in the different industries play major roles in the firms' productivity growth. In order to fully analyze the model, more control variables are added to the model. These control variables include Age, Size, Location and the type of Industry. The Age and Size are derived directly from the survey. The Age represents the number of years a certain company has been in business. The Size is measured based on the number of employees. However, the Location and the type of Industry are treated as dummy variables.

5.9.1 Age as a Control Variable

Table 5.14 reports the result of the basic model run out. Each variable represents a different channel through which FDI helps increasing productivity of the firms in different industries. The first conclusion that can be drawn here is that the overall model is statistically significant at the 1 % confidence interval (F-significance = 0). Only two variables, namely, the Linkage (β2) and the Competition (β3) effects are statistically significant having their P-values of zero. The Linkage effect has a magnitude of 0.100 on the TFP growth. The Competition effect has a magnitude of 0.281 on the total development of the TFP at the 1 % significance level. The Catch-Up effect is also positive but it is statistically insignificant. The Training effect is also statistically insignificant at the 1 % level. The model run out at 1 % significance level and its result is also shown in **Table 5.14**.

Category	Age	Size	Age &Size
Intercept (β_0)	0.216*** (0.042)	0.21*** (0.040)	0.22*** (0.041)
Catch-Up (Θ)	-0.010 (0.020)	-0.01 (0.022)	-0.01 (0.020)
Imitation (β1)	0.010 (0.040)	0.01 (0.044)	0.00 (0.044)
Linkage (β2)	0.100*** (0.020)	0.110*** (0.023)	0.100*** (0.022)
Competition (β3)	0.0281*** (0.060)	0.311*** (0.063)	0.280*** ((0.060)
Training (η)	0.00 (0.030)	0.020 (0.033)	0.02 (0.032)
Special Effect (Age)	-0.01 (0.000)	-	0.00 (0.000)
Size (Ω)	-	0.00	0.00 (0.000)
R-square	0.100	0.101	0.103
Adjusted R-square	0.099	0.100	0.101
F	38.221***	37.784	32.554

Notes: (1) 1% = ***, 5% = **, 10% = *, statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.14 *Spillovers Effects Including Foreign Variables - Size and Age of Industry*

The limited impact of foreign investment is also depicted by Haddad and Harrison (1993). They find the similar results in the Moroccan manufacturing sector for the years 1985 to 1989. The only difference in the Saudi industry is that the Linkage and Competition effects are statistically significant and effective. Aitken and Harrison (1994) examine the impact of FDI in the Venezuelan manufacturing sector between 1979 and 1989. They find the different variables being statistically insignificant.

The result can be concluded by summarizing the tabulated results. With coefficient of determination (R-square) of 0.10 at confidence intervals of 99 % and an adjusted R-square of 10 %, there is a clear evidence of spillovers due to foreign firms' existence in Saudi Arabia. The F-value for the two tests is 38.221 for both. The Null-Hypothesis can be rejected and the foreign investors' existence does help in the development of the TFP in Saudi Arabia. The above result is valid when the four effects are acting at the same time. In the next section, the test is conducted for all the organization that has the different effects working perfectly when I check the effects of each channel on the other variables.

5.9.2 Size as a Control Variable

Table 5.14 (Column 3) shows the result of the model run out when the Size is injected with Age excluded. As mentioned previously, the Size is represented by the number of employees in each firm. The table depicts that there is no change in the result and the only two variables that are statistically significant are Linkage (P-Value=0 <0.01) and Competition (**P-value=0<0.01).** Only the magnitude of the effect has increased slightly when the Size is added. The Linkage effect in the overall model becomes 0.110 while the Competition effect has increased by 3 % to become 0.311. The overall model stays significant and the R-square and the adjusted R- square remain the same (10 %). Size is still having a zero effect and is statistically insignificant.

5.9.3 Integrating Control Variables - Age and Size

In this section, both Age and Size are integrated in the model. The purpose of this is to check if the addition of Size to the basic model makes a difference in the overall result.

The **Table 5.14 (Column 4)** above shows the analysis when the Size is added as a control variable, as follows:

1. R-square remains the same at 10 % and adjusted R-square has not improved as good as expected. The addition of the Size and Age do not improve the fit of the model.
2. The overall model is statistically significant (F=38.22, F-Significance= 0).
3. The Size does not seem to have any effect and it is statistically insignificant. The same conclusion applies to the Age effect.
4. Linkage and Competition have 0.100 and 0.280 effects, respectively. They are both statistically significant (p < 0.01) and their effect remains robust.

We may summarize sections **5.9.1** to **5.9.3** by comparing the results for four cases. The first case is when the model is run without the Size and Age effects. The second case is when the Age only is included. The third case is when the Size is only included and the fourth case is for the integration of both the Size

and the Age. The table shows that the inclusion of more control variables did not improve the fit of the model when R-square and the adjusted R-square did not change at all. Both of them remained at the 10 % level, which does not explain much of the variance. Further, both variables proved to have zero effects in the development of the TFP as they remain insignificant. Two variables that remained robust in all the cases are Linkage and Competition effects. They are, however, stronger when the model is run out without Age and Size. When only the Size effect is added, R-square and adjusted R-square magnitudes stand at 10 %.

Further to using the Size as a control variable, dividing the respondents based on the number of employees and analyzing the results verify the aforementioned conclusion. The respondents' groups are divided into three groups based on the number of employees, as follows:

1. **Small size industries -** having less than 50 employees (Size < 50)
2. **Medium size industries** - having more than 50 and less than 500 employees (Size > 50 ≤500)
3. **Large size industries**- having more than 500 employees (Size > 500)

The **Table 5.15, (Column Two)** shows the results for the Small Size industries: Analysis of the Small Size industries is, as follows:

1. The R-square and adjusted R-square are 11 % and 10 %, respectively.
2. The overall model is statistically significant (F-Significance = 0)
3. Two variables are statistically significant. Those are Linkage (0.070) and Competition (0.371). The Competition effect remains robust.
4. The model shows that Competition increases for small industries whereas Linkage decreased.

The **Table 5.15, (Column Three)** shows the results for the Medium Size industries:

1. The overall model is statistically significant (F-Significance = 0)

2. Two variables are statistically significant at the 1 % level. Those are Linkage (0.120), Competition (0.281) and Training (0.112) is statistically significant at 5 % level and Competition effect remains as the most robust effect.
3. The Catch-Up effect did improve but it is statistically insignificant.
4. The model shows that in Medium Size industries there is evidence of technology diffusion through three main effects, which are Linkage, Competition and Training.

The **Table 5.15, (Column Four)** shows the results for the Large Size industries:

R-square and adjusted R-square are similar to the Small and Medium Size industries, which are 11 % and 10 %, respectively.

1. The overall model is statistically significant (F-Significance = 0)
2. Two variables are statistically significant at the 5% and 1% levels. These are the Catch-Up Catch-Up (-0.080) and Linkage (0.151), respectively.

To summarize that comparison, the fit of the model is the same for the three industries. R-square and adjusted R-square stand at 11 % and 10 %, respectively, for the three industry sizes. Linkage remains significant in the three cases while the Catch-Up is only significant for the Large Size industries only (0.080) at the 95% significance level. Competition effect helps in the development of the TFP growth in the cases of Small and Medium Size industries, although stronger for the Small Size industries (0.371). The Demonstration-Imitation effect was never significant. The Age has zero effect in the three cases.

	Small Industries	Medium Industries	Large Industries
Intercept (β0)	0.305*** (0.073)	0.150* (0.086)	0.138 (0.101)
Catch-Up (Θ)	0.010 (0.021)	0.000 (0.040)	-0.080** (0.043)
Imitation (β1)	0.020 (0.040)	-0.040 (0.072)	0.040 (0.082)
Linkage (β2)	0.070*** (0.020)	0.120*** (0.040)	0.151*** (0.050)
Competition (β3)	0.371*** (0.060)	0.281*** (0.120)	0.023 (0.151)
Training (η)	-0.030 (0.033)	0.112** (0.063)	0.000 (0.070)
Special Effect (Age)	0.00 (0.000)	0.00 (0.000)	0.000 (0.000)
R-square	0.11	0.110	0.110
Adjusted R-square	0.10	0.100	0.100
F	17.954***	12.454***	9.75***

Notes: (1) 1% = ***, 5% = **, 10% = * , statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.15 *Comparing effects for the different Sizes of Industry*

It is important to note in the above table that Training is statistically significant and more stimulating for Medium Size industries that have better focus in Human Resources Development (HRD). They are even very careful in the selection of the type of training they provide for their employees. They also have better monitoring system for the attitude of the attendees. Another thing is that Competition goes down for large companies because the nature of the Saudi market is monopolistic. Linkage, however, stays the most effective channel in the different sizes of industry. The strength of the material exchange between different suppliers and vendors is very strong in the Saudi market.

5.9.4 Location as a Control Variable

In this section more control variables are added to those injected in the previous sections. Those variables are all related to the Location and treated as dummy variables. The analysis started by including the Location as dummy variable to the basic model. This is followed by including the Location and the Age. Then, the Size integrated with the Location. Finally, the Location, Age and Size are integrated. This is followed by Intra-Regional analysis in which the foreign effect on TFP is measured and analyzed.

When the Locations of the firms are treated as dummy variables, the analysis of the model is shown in **Column Three** (Location only) of **Table 5.16.** The results are analyzed, as follows:

1. The R-square and adjusted R-square stand at 12 % and 11 %, respectively. The model does not explain much of the variance. Adding more dummy variables did not help in improving the adjusted R-square.
2. The overall model is statistically significant (F-Significance = 0)
3. When we control for the Regions, the major foreign variables in the model are statistically insignificant and their effects almost vanished. The Catch-Up and Training effects also disappear.
4. Two dummy variables related to the Locations of the firms are statistically significant at the 1 % interval and these are the Eastern Province (0.221) and Riyadh (0.201). Qassim is statistically significant at the 10% significance interval.

For simplicity, the effects of Hail and Qassim are not robust and they are dropped from the analysis. In **Column Four** (Location and Age) of **Table 5.16** the next run out is where the Age and Location are controlled and the results are analyzed, as follows:

1. The R-square and adjusted R-square stand at 11 % each. The model does not explain much of the variance. Adding the Location and the Age as dummy variables did not improve the fit of the model.
2. The overall model is statistically significant (F-Significance = 0).
3. When we control for the Region and the Age, the major foreign variables in the model are statistically insignificant and their effects almost vanish. The Catch-Up and Training effects also disappeared. One variable of interest is statistically significant at the 10% significance interval, which is Linkage (0.050). One unit increase in linkage improves the TFP growth by 5 %.
4. Two dummy variables related to the Location of the firms are statistically significant. These are for the Eastern Province (0.163) and Riyadh (0.162). Their effects in the TFP growth are also robust.

In the next analysis of the model run out showing the results in **Column Five** (Location and size) of **Table 5.16**, the Size is integrated with the Location to find out the effect when the Size is measured by the number of employees. The results show that adding the Size to the Location produces similar result as that for the Age and Location. This proves that neither the Size nor the Age affect the model. As the **Table 5.16** depicts, the adjusted R-square remained at the 11 % level. The Size effect on the model is almost zero. When the Location is treated as a dummy variable, Riyadh and Eastern Province have strong effects and they withdraw the strength from the other foreign variables. The effect of Competition remained robust at 0.112, but also it was statistically insignificant. Similar to previous results, firms from Eastern Province and Riyadh have coefficients of 0.163 and 0.162 respectively.

In the next section, the case of adding Size, Age and Location are investigated where the Location is also treated as dummy variable. The result of this analysis is shown in **Column Six** (Age, Size and Location) of **Table 5.16**. The table shows that even adding both Size and Age to the model does not improve the model fit where the R-square and adjusted R-square are, approximately, 11 % variance in TFP growth resulting from the foreign effects, Catch-Up, Location, Size and Age.

Table 5.16 compares the results for the Location, Age and Size effects. The table gives a clear picture of the following conclusions. The summary of the Location analysis is, as follows:

1. The R-square and adjusted R-square only improved by 10 % when the Location is added to the basic model. When the Age and Size are separately added, the model fit does not improve. Similarly, when the Size and Age are both added, R-square and adjusted R-square values do not change.
2. The basic model is statistically significant (F-Significance = 0), in all the cases.
3. When we control for the Region, foreign variables' effects became weaker. The Eastern Province and Riyadh takes control of the TFP growth by 16 % each and they are both statistically significant in all the cases. Among the foreign effects, only Competition has a strong effect on the TFP growth. It

helps in the TFP growth having a coefficient of 0.110 while, Linkage has a coefficient of 0.050. Competition is statistically insignificant while linkage is significant at the 10 % interval. It does not change even when the Size and Age effects are included. Size, Age and Training have zero effects on the overall TFP growth. Also, Catch-Up, Imitation and Training have very little effect on TFP growth and all of those are insignificant.

Control Variables	Basic Model	Location Only	Including Age & Location	Including Size & Location	Size, Age & Location
Intercept (β_0)	0.231 (0.062)	0.150** (0.062)	0.163** (0.060)	0.153** (0.063)	0.165** (0.061)
Catch-Up (Θ)	-0.010 (0.023)	0.020 (0.021)	0.010 (0.022)	0.010 (0.023)	0.010 (0.022)
Imitation (β1)	0.011 (0.033)	-0.031 (0.040)	-0.023 (0.040)	-0.021 (0.041)	-0.020 (0.040)
Linkage (β2)	0.110*** (0.032)	0.030 (0.033)	0.050* (0.032)	0.050* (0.033)	0.050* (0.032)
Competition (β3)	0.310*** (0.091)	-0.010 (0.090)	0.111 (0.072)	0.112 (0.070)	0.110 (0.077)
Training (η)	0.022 (0.032)	0.00 (0.030)	0.000 (0.030)	0.000 (0.000)	0.000 (0.033)
Special Effect (Age)	-	-	0.000 (0.0000)	-	0.000 (0.000)
Size	-	-	-	0.000 (0.000)	0.000 (0.000)
(Ø1) Eastern Province	-	0.221*** (0.050)	0.161*** (0.041)	0.163*** (0.044)	0.160 (0.041)
(Ø2) Riyadh	-	0.201*** (0.042)	0.161*** (0.033)	0.162*** (0.033)	0.160 (00.030)
(Ø3) Qassim	-	0.05* (0.060)	-	-	-
(Ø4) Hail	-	0.05	-	-	-
R-square	0.101	0.121	0.111	0.112	0.110***
Adjusted R-square	0.100	0.111	0.111	0.111	0.110***
F	29.231***	28.782***	31.583***	31.582	28.061***

Notes: (1) 1 % = ***, 5 % = **, 10 % = * , statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.16 *Comparing effects when Location is added as a Control Variable*

To elaborate further on the Location as control variable, Intra-Regional analysis is conducted. In this section, the four FDI effects are investigated. As previously done, Intra-Regional analysis is conducted for four geographical areas, namely, Eastern Province, Riyadh, Qassim and Hail. This analysis considers the Eastern Province of Saudi Arabia. This region is located on the Arabian Gulf. It is one of the Provinces in the world having the largest oil reserve in the world. Ever since the startup of the oil revelation, this area has been the economic target for the oil companies. In addition, Saudi Aramco, the largest oil company in the world, selected this area as the location of its Head Quarters. Also, SABIC's major operations are conducted in Jubail, which is located in the Northern part of Eastern Province. All of these factors and others help the Eastern Province population to be the most educated among Saudis. **Column Two** (Eastern Province) of **Table 5.17** shows the results of the analysis.

The analysis shows that the overall model is statistically significant (F-significance = 0). The adjusted R-square is 12.4 %. Among all the effects only the Competition (P-value=0) is statistically significant having a coefficient of 0.550 with considerable effect on the TFP growth.

The second region in analysis is the city of Riyadh that is the capital of Saudi Arabia and considered the financial center of the country. It has the largest population and has most of the banks' Head Quarters located including the Central Bank of the Gulf Cooperation Countries (GCC). Recently, the Government of Saudi Arabia allocated a lot of money to further develop the city and transfer it from a desert to a state of the art smart city in the Kingdom of Saudi Arabia. Among the projects that are under construction, is the Princess Nora University, which is going to be the largest university in the Middle East. Another Mega Project is the King Abdullah Petroleum Studies and Research Center (KAPSARC). The result of the analysis of Riyadh city is shown in **Column Three** of **Table 5.17.**

The analysis shows that overall model is statistically significant (F-significance= 0). The adjusted R-square is 10 %, which is less than that for the Eastern Province. However, two effects are statistically significant, which are Linkage and Competition. The coefficients of Linkage and Competition effects are 0.130 and 0.280, respectively. Training and Age effects are statistically insignificant and they have zero effect.

Qassim is an agricultural city located west of Riyadh and has been lacking the industrial development. However, its people are well known as well as educated as traders. It has two major areas known as Onaiza and Burraidah. It highly depends on farming as a source of living. One of its major products is dates. The analysis of the model for Qassim city is shown in **Column Four** (Qassim) of **Table 5.17**.

The number of respondents in this area is 139. The result shows very weak coefficient of determination, which means that the model depicts little bit of the variance in the dependent variable (R-square= 6 %). Moreover, when accounting for the number of dependent variables, the adjusted R-square only shows 2 % of

the variation. The overall model is statistically insignificant (F-significance=0.2 >0.05) and therefore, only the Competition effect is statistically significant at the 10 % level.

Hail is the fourth geographical Location for analysis. Its land is mostly covered with farms and it is also far away from the industrial cities. Its population is low relative to the other three geographical locations that are analyzed. The number of respondents in Hail is the least among the four locations. **Column Five** (Hail) of **Table 5.17** depicts the analysis inside Hail.

The number of firms that responded inside Hail is 24. The R-square is 34 %, which is relatively a good representation of the dependent variable. However, the adjusted R-square is only 10 %. The basic model is statistically insignificant (F-significance =0.22>0.05). None of the effects is statistically significant. Therefore, there is no evidence that there is any indication of technology diffusion in the city.

Table 5.17 summarizes the Intra-Regional technology diffusion analysis. The result shows that only two effects are statically significant in Riyadh. Those are Linkage and Competition at the 1% interval. In Dammam, however, only Competition is statistically significant at the same interval. In Qassim, Competition is significant at the 10% level. Therefore, the TFP growth due to technology effect is strong inside Dammam and Riyadh.

Control Variable	Eastern Province	Riyadh	Qassim	Hail
Intercept (β_0)	0.284*** (0.091)	0.120*** (0.091)	0.106 (0.143)	0.640 (0.420)
Catch-Up (Θ)	-0.023 ((0.033)	-0.010 (0.022)	-0.021 (0.070)	0.182 (0.123)
Imitation (β1)	-0.090 (0.062)	0.052 (0.050)	-0.133 (0.381)	0.060 (0.342)
Linkage (β2)	-0.011 (0.062)	0.130*** (0.033)	0.030 (0.110)	0.063 (0.291)
Competition (β3)	0.550*** (0.172)	0.280*** (0.083)	0.300* (0.180)	0.393 (0.320)
Training (η)	0.054 (0.052)	0.000 (0.054)	-0.220 (0.520)	-0.79 (0.290)
Special Effect (Age)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.011)
R-square	0.132	0.111	0.061	0.340
Adjusted R-square	0.124	0.100	0.020	0.100
F	15.854***	23.482***	1.450	1.55

Notes: (1) 1 % = ***, 5 % = **, 10 % = * , statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.17 *Intra-Geographical Analysis*

5.9.5 Types of Industry as Control Variables

In this section, each type of industry is added to the model as a control variable. There are seven industrial classifications and each one is treated as a dummy variable. For the proper analysis, I investigate by adding a type of industry to the basic model. Then, Age is integrated as a variable. This is followed by including the Size with all the options. Finally, the Locations of the firms are included to the basic model for analysis.

In the first run out, there are ten dummy variables. These variables are Demonstration-Imitation, Linkage, Competition, Training, Food, Wood, Textile, Chemical, Non-Metallic, Machinery and Others industry. **Column Six** (Classification) of **Table 5.18** shows the results of this analysis in the run out.

The analysis relative to each type of industry used as a Control Variable in the table above is, as follows:

1. Adjusted R-square indicates that 11 % of the variance in TFP growth resulted by the foreign effects, Catch-Up, Imitation, Linkage, Competition,

Training and the seven types of industries. The addition of dummy variables does not improve the model fit.

2. The basic model is statistically significant (F-Significance = 0).
3. The major variables in the model are statistically insignificant. Their effects have reached a minimum level when the seven dummy variables are added. The best among all foreign variables is the Linkage (0.030) that is statistically insignificant.
4. Five of the dummy variables related to the industrial classification of the firms are statistically significant at the 1 % interval and their effect is quite robust. These variables are Machinery (0.240), Chemical (0.230), Others (0.200), Non-Metallic (0.180) and Food (0.150). The Textile effect on the TFP growth is (0.190) and it is statistically significant at the % significance interval. The wood is statistically insignificant.

This model is run out seven times to investigate the following cases:

1. The inclusion of the seven industries as dummy variables together with Age of the firm.
2. The Inclusion of the seven industries as dummy variables together with Size of the firms.
3. The inclusion of the seven industries as dummy variables together with both Size and Age.
4. The inclusion of the seven industries as dummy variables together with Location.
5. The inclusion of the seven dummy variables together with Size and Location.
6. The inclusion of the seven dummy variables together with Age and Location.
7. The inclusion of the seven dummy variables together with Size, Age and Location.

For simplicity, I present the table of the option number seven, which includes total of sixteen variables. The result of the other option is presented in the comparison table. The inclusion of the seven variables together with Size, Age and Location stimulates the effect of sixteen different variables. Among those, there are twelve different dummy variables. Seven of those are for industrial classifications; two

for geographical areas of Riyadh and Qassim; three for the foreign variables, Demonstration-Imitation, Linkage and Training. The results of this run out are shown in the **Last Column** (Main model) of **Table 5.18**.

The analysis follows:

1. Adjusted R-square indicates that 11 % of the variance in TFP growth is depicted by the foreign effects, Catch-Up, Training, Age, Size, Location and seven types of industries. The addition of the dummy variables does not improve the model fit.
2. The basic model is statistically significant (F-Significance = 0).
3. The major variables in the model are statistically insignificant. Except for Competition, which has a coefficient of 0.050, their effect has reached a minimum level when the eleven dummy variables were added. All foreign variables and the Catch-Up effect are insignificant.
4. The Size and Age are still insignificant.
5. The two geographical locations Eastern Province and Riyadh are insignificant having coefficients of 0.082 and 0.061, respectively.
6. Four of the dummy variables related to the industrial classification of the firms are statistically significant at the 5 % interval and their effects are strong. These variables are Machinery (0.190), Chemical (0.180), Others (0.160) and Non-Metallic (0.140). The other three variables, namely, Food, Textile and Wood are all insignificant. The Textile effect has a coefficient of 0.133. The Food effect has a magnitude of 0.111 while the Wood has a negative effect (-0.062).

Table 5.18 compares the results of the seven run outs, as follows:

1. The addition of further dummy variables to the basic model improves the fit of the model very little. Once the seven classifications of industries are added, the adjusted R-square improves by 10 % only. This means that the model explains, approximately, 11 % of the variance in TFP growth resulted by the foreign variables and the Classifications. The addition of the Location, Size and Age do not improve the adjusted R-square.
2. In the basic model, two foreign variables are significant at 99% confidence interval and they are both robust. Those are Linkage (0.110) and Competition (0.310). Once the industrial classifications are added, the strength of those two variables disappeared. The paradigm of strength is shifted to four of the industries -

Machinery (0.240), Chemical (0.230), Others (0.200) and the last one Non-Metallic (0.180).These factors continued robust even with addition of the Location, Size and Age. The strongest effect among the foreign effects is in the Machinery industry and that is for the case in which the sixteen variables are included in the model.

3. The Catch-Up effect and the other foreign variables are insignificant with the addition of more dummy variables. Even with the addition of the Size and Age, the case is the same. In fact the effect of Size and Age in the TFP growth continues to be nil.

Control Variables	Basic Model	Classification Only	Classification & Age	Classification & Size	Classification & Location	Classification, Location & Age	Classification , Location & Size	Classification, Location, Age & Size (Main Model)
Intercept (β0)	0.231 (0.062)	0.040 (0.131)	0.055 (0.112	0.044 (0.092	0.040 (0.089)	0.010 (0.078)	0.143** (0.070)	0.152** (0.021)
Catch-Up (Θ)	-0.010 (0.023)	0.011 (0.021)	0.010 (0.020)	0.010 (0.019)	0.010 (0.019)	-0.020 (0.017)	0.010 (0.018)	0.010 (0.022)
Imitation (β1)	0.011 (0.033)	-0.010 (0.040)	-0.010 (0.020)	-0.010 (0.019)	-0.020 (0.018)	-0.020 (0.024)	-0.021 (0.022)	-0.022 (0.044)
Linkage (β2)	0.110*** (0.032)	0.030 (0.033)	0.031 (0.032)	0.031 (0.026)	0.020 (0.026)	0.041 (0.020)	0.021 (0.020)	0.021 (0.033)
Competition (β3)	0.310*** (0.091)	0.022 (0.090)	0.031 (0.021)	0.031 (0.020)	0.041 (0.021)	-0.010 (0.000)	0.042 (0.001)	0.050** (0.101)
Training (η)	0.022 (0.032)	0.000 (0.033)	0.000 (0.000)	0.000 (0.001)	-.020 (0.002)	-0.01 (0.002)	-0.020 (0.042)	-0.011 (0.041)
Special Effect (Age)	-	-	-	-	-	-0.020 (0.046)	-	0.000 (0.000)
Size (Ω)	-	-	-	0.000 (0.000)	-	-	0.000 (0.000)	0.000 (0.000)
(∅1) Eastern Province	-	-	-	-	0.081 (0.078)	0.082 (0.060)	0.081	0.082 (0.062)
(∅2) Riyadh	-	-	-	-	0.061 (0.065)	0.061 (0.064)	0.062 (0.060)	0.061 (0.051)
(δ1) Food	-	0.150*** (0.050)	0.160** (0.068)	0.160*** (0.064)	0.101 (0.062)	0.103 (0.060)	0.100 (0.064)	0.111 (0.071)
(δ2) Wood	-	0.000 (0.120)	0.000 (0.118)	0.000 (0.112)	-0.071 (0.110)	-0.063 (0.094)	-0.071 (0.098)	-0.062 (0.130)
(δ3) Textile	-	0.190** (0.080)	0.191 (0.068)	0.190** (0.064)	0.130 (0.064)	0.130 (0.060)	0.131 (0.058)	0.133 (0.0100)
(δ4) Chemical	-	0.230*** (0.050)	0.241*** (0.042)	0.232*** (0.038)	0.171** (0.037)	0.182** (0.033)	0.170** (0.028)	0.180** (0.022)
(δ5) Non-Metallic	-	0.180*** (0.044)	0.190*** (0.033)	0.190*** (0.031)	0.130* (0.030)	0.140** (0.036)	0.130** (0.038)	0.140** (0.040)
(δ6) Machinery	-	0.240*** (0.060)	0.240*** (0.044)	0.240*** (0.042)	0.180** (0.040)	0.190** (0.038)	0.180** (0.068)	0.190** (0.082)
(δ7) Others	-	0.200*** (0.041)	0.210*** (0.030)	0.200*** (0.030)	0.150** (0.028)	0.160** (0.026)	0.150** (0.039)	0.160** (0.073)
R-square	0.101	0.12	0.122	0.110	0.122	0.124	0.123	0.120
Adjusted R-square	0.100	0.110	0.111	0.110	0.111	0.114	0.112	0.111
F	29.231***	21.99***	20.542	19.321	18.011***	18.256***	17.523***	16.640***

Notes: (1) 1% = ***, 5% = **, 10% = * , statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.18 *Comparing effects when Age, Size, Location and Classification are added as Control Variables*

5.10. Comparing Results for Firms with and without Demonstration-Imitation

Table 5.19 compares the results when each effect is maximized or vanished. **Column Two** titled Imitation shows the results for the firms with perfect Demonstration-Imitation effect and those with no Imitation. The results show that for firms with perfect Demonstration-Imitation, there is no evidence of spillover through the four foreign variables. Also the firms with no Imitation activities have no evidence of spillovers through the variables of interest (foreign variables). The results in the table also show that for firms with perfect Imitation, there is no evidence of spillovers through the other control variables like the geographical Location or even the industrial Classification. The catch up effect in this case is statistically significant at the 10% interval. To the contrary, for firms with no joint ventures or Imitation activities, there is evidence of TFP growth in four major industrial sectors. Those sectors are Machinery (0.200), Chemical (0.193), Others (0.171) and Non-Metallic (0.138) for FORGN=0. Those are significant at the 5 % interval.

To reflect the above mentioned fact on real life condition, the firms that usually promote Imitation in the country are few. Even though the big companies that have joint ventures are supposed to have a considerable spillovers' effect due to Imitation, these companies are few relative to those who do not have this promotional feature. The other factors in this case are not significant. In fact, the relationship between Imitation and the other spillovers' effects like Training, Linkage and Competition are very minimal. Those small companies usually do not have joint ventures and the other three effects seem dominant.

Coefficients	Imitation		Linkages		Competition		Training	
	FORGN =1	FORGN =0	LINK =1	LINK =0	(COMPT>0.33)	(COMPT≤0.33)	T=1	T=0
Intercept	-0.110 (0.331)	0.000 0.000	0.051 (0.160)	0.000 (0.000)	-0.270 (0.311)	0.361 (0.047)	-0.501 (0.348)	0.000 (0.000)
Catch-Up (Θ)	0.132* (0.072)	0.011 (0.022)	0.010 (0.022)	0.010 (0.031)	0.041 (0.033)	0.000 (0.019)	0.033 (0.037)	0.012 (0.019)
Imitation (β1)	-	-	-0.042 (0.051)	0.000 (0.063)	-0.053 (0.082)	0.000 (0.051)	0.072 (0.092)	-0.043 (0.047)
Linkage (β2)	0.071 (0.080)	0.023 (0.034)	-	-	0.217*** (0.070)	-0.031 (0.032)	0.131 (0.082)	0.032 (0.033)
Competition (β3)	-0.052 (0.310)	0.080 (0.103)	0.262** (0.140)	-0.162 (0.151)	0.000 (0.162)	-0.201 (0.301)	-0.074 (0.362)	0.180 (0.110)
Training (η)	0.202 (0.112)	-0.032 (0.042)	-0.023 (0.042)	-0.113 (0.083)	-0.194 (0.090)	-0.042 (0.047)	-	-
Special Effect (Age)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size (Ω)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
(∅1) Eastern Province	0.291 (0.251)	0.082 (0.063)	0.071 (0.081)	0.173* (0.010)	0.122 (0.130)	0.071 (0.063)	0.433 (0.372)	0.069 (0.062)
(∅2) Riyadh	0.464 (0.251)	0.043 (0.062)	0.093 (0.080)	0.013 (0.073)	0.071 (0.112)	0.058* (0.057)	0.412 (0.382)	0.062 (0.052)
(δ1) Food	-0.082 (0.392)	0.091 (0.081)	-0.022 (0.180)	0.221** (0.102)	0.311 (0.540)	0.191* (0.113)	0.462 (0.150)	0.071 (0.069)
(δ2) Wood	-0.083 (0.441)	-0.132 (0.160)	0.010 (0.240)	-0.061 (0.201)	-0.222 (0.222)	0.173* (0.121)	0.422 (0.512)	-0.228 (0.150)
(δ3) Textile	-0.054 (0.362)	0.113 (0.123)	-0.011 (0.191)	0.261 (0.150)	0.063 (0.191)	0.231** (0.139)	0.349 (0.388)	0.034 (0.111)
(δ4) Chemical	-0.162 (0.510)	0.193** (0.083)	0.083 (0.183)	0.283 (0.122)	0.170 (0.153)	0.231** (0.096)	0.317 (0.428)	0.088 (0.093)
(δ5) Non-Metallic	-0.021 (0.392)	0.138** (0.073)	-0.013 (0.170)	0.310** (0.113)	0.231 (0.191)	0.231** (0.113)	0.452 (0.440)	0.072 (0.069)
(δ6) Machinery	-0.012 (0.414)	0.200** (0.080)	0.080 (0.170)	0.218** (0.142)	0.072 (0.160)	0.278** (0.113)	0.571 (0.749)	0.139 (0.083)
(δ7) Others	-0.183 (0.390)	0.171** (0.071)	0.062 (0.170)	0.218** (0.102)	0.151 (0.150)	0.241** (0.094)	0.191 (0.430)	0.139 (0.072)
R-square	**0.131**	**0.120**	**0.150**	**0.101**	**0.220**	**0.100**	**0.150**	**0.120**
Adjusted R-square	**0.070**	**0.110**	**0.130**	**0.080**	**0.190**	**0.090**	**0.122**	**0.110**
F	**2.320*** **	**16.061*** **	**13.193*** **	**5.391*** **	**8.321*** **	**10.540*** **	**5.220*** **	**13.519*** **

Notes: (1) 1% = ***, 5% = **, 10% = * , statistical significant variables
(2) Values between parenthesis indicates the standard error

Table 5.19 *Comparing firms with extreme effects cases*

5.11. Comparing Results for Firms with and without Linkages

Table 5.19, **Column Two** (Linkages) shows the results for firms with Linkages (LINK=1) and firms without Linkages (LINK=0). Firms with Linkages are those who have transactions with foreign suppliers or buyers. Firms without Linkages are those who do not interact with foreign buyers or suppliers. The data in this table represents a measure of the local firms' openness to the foreign sources. The Linkage effect does not seem to be effective in the productivity growth (*P-value= 0.75).* The number of companies that have relations with suppliers is 1244,, which represents 36.9 % of the total respondents. Regarding the other factors, the Catch-Up, Demonstration-Imitation and Training effects are not statistically significant at the 5 % confidence interval in both cases. For companies that have Linkages with the FDI, the Competition is the only effect that is statistically significant (*P-value = 0.04).* However, for those without this type of relation, Competition is statistically insignificant. Furthermore, for companies without Linkages, there seems an effect on productivity growth in four major sectors, namely, Food (0.221), Machinery (0.218), Non-Metallic (0.310) and Others (0.218) industries. Eastern Province is also statistically significant at the 90% confidence interval. A few research studies in those sectors have investigated the effects of Foreign Linkages on firm's productivity. In one of the studies Aw and Batra (1994) analyzes the case of Taiwanese firms. Their studies examine the correlation between Foreign Linkages and firms' efficiency. They conclude that Foreign Linkages facilitate the access of local investors to foreign technologies. Moreover; they find that firms engaged in positive investments in research, development and training tend to have higher technical efficiency.

In addition, they assert that the effect of the investments is independent of Foreign Linkages . Their results are inconsistent with my study in which I find that Competition only has a statistically significant effect. However, my research result and Aw and Batra (1994) contradict the result obtained by Kinoshita (1998) who finds that efficiency measured as productivity growth is dependent on Training and Linkages. In the theoretical literature, Lucas (1993) highlights that trading or openness is "a must" for a country to move towards better qualities. This is consistent with Helpman (1991) model in which openness means direct access to technology frontier.

5.12. Comparing Results for Firms with and without Competition

Table 5.19 **Column 4** (Competition) illustrates the results of the analysis with and without Competition where an assumption is made regarding the level of foreign share of employment relative to the whole industry. The idea of foreign Competition assumed in this section is, that the larger the share of the foreign firms, the higher is the Competition. As mentioned in the literature review, the Competition may be so intense to the extent that foreign firms might dominate the market and increase the number of local investors in the exiting market. In the previous two sections of this research, the two effects namely, Demonstration-Imitation and the Linkage, are assumed binary. The Competition effect differs since it is represented by the foreign share of employment to the total employment in the industry. The average rate of the aforementioned ratio is 0.33. To test the Competition effect, I assume that any firm who has a ratio higher than 0.33 is highly involved in the Competition. The number of firms that are quite involved in the Competition is 489 while the number of firms that are below average is 1509. Both models are statistically significant (F-significance =0). The Catch-Up effect in both cases is statistically insignificant. Similarly, the Imitation effect in both cases is statistically insignificant at the 5 % confidence interval (*P-value>0.05).* Competition effect is statistically significant at the 10 % interval. in case of strong Competition firms,

The Linkage (0.217) and Training (-0.193) effects are statistically significant at the 1 % and 5 % intervals, respectively. For the firms without Competition, none of the foreign variables are significant. However, there is also evidence of spillovers through four major industrial sectors. Those are Chemical (0.231), Machinery (0.278), Non-Metallic (0.23) and Others (0.241). They are all significant at the 5 % interval while Riyadh (0.058), Textile (0.231) and Food (0.193) are significant at the 10 % interval.

The percentage of firms that are above average and quite involved in the Competition is 24.5 % computed from the regression analysis while the percentage of firms that are below average is 75.5 %. Both models are statistically significant (F-significance = 0). The spillovers' effect in both cases is statistically insignificant.

5.13. Comparing Results for Firms with and without Training

The investment in skills is one of the most important factors that could help the local human resources to grasp technological knowledge and put it to practical use. The type of training that is considered in this case is the formal type of training. Formal type of training may be either in long form like the apprenticeship programs or in the form of developmental short courses. The test of Training here is binary. It means that companies either train (*T=1)* or do not train employees (*T=0).*

The first comment on the analysis in **Table 5.19, Column Five** (Training), is that both the models are statistically significant at the 95 % significance interval. The second comment is related to the adjusted R-square, which is 12 % for companies that organize training programs for their employees while it is 11 % for companies, which do not provide any training.

In both cases, none of the foreign variables is statistically significant. In addition, in the case of the companies that are involved in training, all the variables including the geographical Location and the industrial Classification are statistically insignificant. In the case of companies that are involved in training, there is evidence of spillovers in the Others industry only. All the other variables in this case are not significant.

Before the year 2008, the Training in KSA was not very active. Even the FDIs were not required formally to train the local employees. However, there are training efforts made by FDI, but its effect is limited relative to the overall industry. Based on the previous research efforts producing the same results, Kinoshita (1998) finds that the firms providing training exhibit higher productivity rate in China. He also finds that this result is statistically significant at the 10 % level that is not so at the 1 % and 5 % significant levels. After the year 2008, the Saudi Government took the initiative in training its citizens. The efforts include what is known as the strategic partnership agreements. These agreements include the manufacturers (Local or Foreign), the TVTC and an international training operator. The international training operator is responsible for conducting formal training for the Saudi employees.

5.14. Intra-Industry Analysis

To complete the analysis from the previous section, additional investigation is steered inside each individual industry. This analysis will make it easier for the decision makers to take different actions pertinent to the enhancements of technology diffusion. As it is the case in the previous section, the analysis will include the four effects of FDI technology diffusion.

5.14.1. The Food Industry

In the food industry, **Table 5.20**, **Column Two** (Food), shows that the model is statistically significant at the 95 % confidence interval. Digging inside the model itself, shows that the only effect that is playing a strong role is the Competition. The other factors are not statically significant. The Competition inside the Saudi Food industry is really strong. The food market expands very quickly as the Government of Saudi Arabia provide very strong support to local producers/manufacturers. This is done through financing certain selective equipment required.

Category	Food	Textile	Wood	Chemical	Non-Metallic	Machinery	Others
Intercept	0.127 (0.450)	0.271 (0.198)	0.056 (0.175)	0.140 (0.111)	0.118 (0.171)	0.196 (0.150)	0.183 (0.022)
Catch-Up (Θ)	0.049 (0.058)	0.078 (0.069)	0.070 (0.077)	-0.033 (0.048)	0.022 (0.048)	-0.011 (0.052)	-0.060 (0.080)
Imitation (β1)	0.072 (0.102)	-0.033 (0.130)	-0.367 (0.243)	-0.033 (0.100)	-0.022 (0.088)	-0.091 (0.150)	0.000 (0.067)
Linkage (β2)	0.012 (0.078)	0.183* (0.102)	0.483** (0.170)	0.142 (0.078)	-0.030 (0.060)	0.100 (0.099)	0.088** (0.042)
Competition (β3)	0.638*** (0.210)	0.282** (0.138)	-0.520* (0.280)	0.248* (0.160)	0.719*** (0.178)	0.322 (0.220)	0.413** (0.012)
Training (η)	-0.193 (0.192)	0.330** (0.178)	-0.570** (0.220)	0.032 0.078)	0.023 (0.068)	-0.024 (0.098)	-0.019 (0.0760)
Age	0.000 (0.000)	0.000 (0.000)	0.017 (0.011)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
R-square	0.083	0.190	0.550	0.210	0.090	0.160	0.120
Adj. R-square	0.062	0.140	0.420	0.190	0.080	0.130	0.110
F	4.040***	3.721***	4.912***	11.140***	7.390***	5.542***	15.04***

Notes: (1) 1% = ***, 5% = **, 10% = * , statistical significant variables

Table 5.20 *Intra-Industrial Analysis*

Moreover, the government applies very high tariffs on Food Imports. In addition, manufacturers in this sector have another advantage, which is exporting to the Gulf Cooperation Countries (GCC) free of tax. Yet, the market is not limited to the GCC countries but to all the Arabian Peninsula including Yemen. From the ANOVA table, the Competition effect plays the major role in the diffusion of technology. It has a coefficient of 0.638 on TFP growth model. Among all the effects, the Competition effect is the only one that is statistically significant (P value=0). On the contrary, the Age does not play any role. The Linkage, Imitation and Catch-Up have coefficients 0.012, 0.072 and 0.049, respectively. However, all of those are statistically insignificant around the 10 % confidence interval.

5.14.2 The Textile Industry

Referring to **Table 5.20 Column Three** (Textile)**,** the analysis of the run out in the Textile industry shows that the model is statically significant since the F-value is zero at 95 % confidence interval. The three effects that are statistically significant are Linkage (*P=0.05),* Competition (*P=0.04)* and Training (*P=0.03).* The Training effect, however, has the strongest effect on the diffusion of technology. Its coefficient has a value of 0.330. The Competition plays the second major role in the increase of the TFP. It is statistically significant and its coefficient value is estimated to be 0.282. Moreover, Linkage has the third strongest effect on productivity having coefficient of 0.183, but it is significant at the 10% interval. The adjusted R-square (14 %) does reflect a very good fit for this curve. The Textile industry in Saudi Arabia is well known as a low class type of investment. Most of the investors in this sector are from countries like Pakistan, Afghanistan and India. The development of this business started when Saudi Nationals started to hire employees from those countries to operate their small factories. Yet, a lot of those factories are actually owned by the workers themselves. The Saudi nationals eventually get part of the profit due to sponsoring those workers.

Systematically speaking, only the Japanese started to invest in the Saudi Textile industry by establishing the Saudi Japanese textile factory located in the Eastern Province of Saudi Arabia.

5.14.3 The Wood Industry

Table 5.20, **Column Four** (Wood), shows that the model is statistically significant at the 5 % confidence interval. The Adjusted R-square explains 41.9 % of the variance. Two of the effects, however, are statistically significant. Those are the Linkage (*P-value* = 0.01) and the Training (*P-value= 0.02)* effects. Competition is statistically significant at the 10 % interval. The companies having Linkages with producers or suppliers are assumed to have a higher productivity growth, the coefficient of the Linkage being 0.483. Training is negatively related to the growth. Logically speaking, this phenomenon cannot be explained. Despite having one of the largest consuming markets in Middle East, Saudi Arabia has very few local and foreign investors in the Wood industry. Most of the local investors refer the reasons to the invasion of the Chinese products to the local market. The government of Saudi Arabia is advised at this stage to apply high tariffs on wood product imports and at the same time provide the required support to the local and foreign investors in this field.

5.14.4 The Chemical Industry

Table 5.20, **Column Five** (Chemical), is one of the most active industries in the country. Saudi Arabia has one of the largest Petrochemical complexes in the world. It is located in the Eastern Province of the country in Jubail city. The Saudi Government started the first phase of this project in 1983. Most of the projects started as joint ventures between the Saudi Basic Industries Company (SABIC) and other international companies. The fact that Saudi Arabia is the largest producer of oil supported this project. The government discounts special prices of oil and oil products for SABIC. Yet, the project further developed recently and Jubail II project has started jointly between local companies and FDIs. Major participants in the development of this sector include companies like the French Total and the Daw Petrochemical. From the South East Asia, the Japanese Sumitomo found its location in the Saudi Petrochemical through a joint venture with the largest oil company in the world, which is Saudi Aramco. Together, they established Petro-Rabigh Company located in the Western Province of Saudi

Arabia. Despite all of those facts the model in run out does not show any evidence of technology spillovers to the country.

According to the results reported in **Table 5.20** the overall model is statistically significant (F-significance =0). The Competition effect plays the major role in the TFP growth having a coefficient of 0.248 and it is statistically significant at the 10 % interval.

5.14.5 The Non-Metallic Industry

Table 5.20, **Column Six** (Non-Metallic), is one of the biggest industries in Saudi Arabia. Non-metallic industry includes products like plastics, papers and rubber summarizing the 433 observations. The R-square and the adjusted R-square values are 9 % and 8 %, respectively. This means that the regression model describes 8 % of the variance. Yet, the overall analysis of the model is statistically significant at 5 % confidence interval, since the significance value is almost zero. The only effect that is playing a role according to the model run out is the Competition (*P-value=0).* The Competition effect (0.719) helps in improving the productivity being statistically significant. Other channels help in the TFP growth in smaller scales. However, they are all statistically insignificant.

5.14.6 The Machinery Industry

Table 5.20, **Column Seven** (Machinery), is considered one of the most sophisticated industries. Saudi Arabia does not manufacture highly technical machines. This fact is reflected in the run out of this model in **Table 5.20** inside this industry the technology transfer is zero. The (*P-value*) of all the factors is above the 10% confidence interval. The run-out shows that there is no sign of technology diffusion inside this sector. Even though the overall model is statistically significant, none of the individual effect is.

5.14.7 The Others Industry

The Others industry is almost the largest in terms of the number of local investors. The model run out result in **Table 5.20, Column Eight** (Others), shows that the result is significant at the 5 % confidence interval. The adjusted R-square depicts that the curve represents 11 % data of the 700 observations. The factors that are statistically significant are the Linkage (*P-value=0.04)* and Competition (*P-value=0.01).* One unit increase in the Linkage helps developing the TFP by 8.8% while one unit increase in the Competition helps increasing the TFP by 41.3%.

The other factors including Demonstration-Imitation and Training are not significant. The Linkage effect helps in the TFP growth and has a coefficient of 0.088. The Competition, having a robust coefficient (0.413), however, is stronger than the Linkage. The summary of this result is found in **Table 5.20**.

5.15. Conclusion

The model run out investigates several scenarios. In the first run out attempt, the foreign variables are excluded and there is a significant effect resulting from Catch-Up and Training effects. The alternative hypothesis cannot be accepted in this case and Null-Hypothesis is accepted. In the second run out, the model includes the foreign variables (Basic model). The results show that the Competition has a significant effect when operating with other foreign variables. Its effect is estimated to be robust on the TFP growth. The Linkage effect is also strong. Both Linkage and Competition are statistically significant at the 5 % level. The other variables' effect is very weak and statistically insignificant. The other four run outs are additional meant for testing effects for firms with and without individual effects. The scenarios' investigation is continued by adding different control variables. This includes the addition of variables like Age, Size and Location and finally the industrial Classification (main model). The more control variables we add, the further insignificant foreign variables of interest become. In fact, when all of those control variables are added, the significant variables dominated. Those are Chemical, Non-Metallic, Machinery and Others industry.

The above results are the only conclusions. However, those are not the only scenarios considered. Several other scenarios including comparison between variables that have the foreign effects and those that do not have are investigated here. The consideration of so many scenarios aims at finding the mechanism through which FDI promotes the TFP growth.

Most of the results are statistically insignificant. In conclusion, when I add the control variables and run out the basic model, all foreign variables are statistically insignificant. Our Main Hypothesis cannot be warranted and the Null-Hypothesis "*The spillovers' effects from FDI, do not lead to technology diffusion"* is accepted. There is a clear evidence of spillovers that lead to technology diffusion through the foreign effects. The analysis will be continued by considering the Intra-Industrial analysis and then the interaction of variables.

To summarize the first part of results, one may say, it helps to explore the hypothesis based on quantitative data analysis. As mentioned previously, it is distributed to both foreign and local manufacturers. The **Hypotheses (H1)** states the following:

H1: The spillovers' effects (Demonstration-Imitation, Competition, Linkages and Training) from FDI are important source of technology diffusion (productivity growth).

The analysis led to the, hereunder, listed conclusions:

- Without the foreign variables the technology diffusion exists in the four geographical areas. But the scale of that existence is very low.

- When the foreign variables were included, both Competition and Linkage effects show a sign of improvement in the TFP level.

- Both Demonstration-Imitation and Training effects do not show any sign of improvement in the TFP level and, therefore, they fail to play a major role in technology diffusion.

The above mentioned results obliged the direction of the research to the move from Inter-Industrial to Intra-Industrial analysis. The Intra-Industrial analysis reveals the following conclusions:

- Inside the Food industry, there is only one effect that has an effect in the diffusion of technology and that is the Competition.

- Regarding the diffusion of technology inside the Textile industry, three effects are playing roles. Those effects are Linkage, Training and Competition.

- Only the Linkage and Training effects are helping to improve the TFP level in the Wood industry.

- Even though, the Chemical industry is very active in Saudi Arabia and the foreign presence is very intensive in two of the four geographical areas investigated, there is no sign of technology diffusion.

- The Competition effect plays a major role in the technology diffusion inside the Non-Metallic industry.

- None of the four effects showed a sign of support for technology diffusion inside the Machinery industry.

- Concerning the Others industry, only the Competition and the Linkage effects help technology to diffuse or productivity level to improve.

The aforementioned results can lead to the conclusion that there is no clear evidence of spillovers that lead to technology diffusion and the Null-Hypothesis could not be rejected.

Chapter 6 Data Analysis and Findings Part II

6.1 Introduction

In this section, the second part of the research questionnaire is analyzed both quantitatively and qualitatively. It starts with quantitative analysis of the Hypothesis (H2). It is followed by the descriptive data analysis of the same hypothesis. This is because the nature of the survey requires integration between facts and figures. The same sequence is followed for evaluating the Hypothesis (H3)

Quantitatively speaking, I use the two-way Analysis of Variance to evaluate both Hypothesis (H2) and (H3). The Analysis of Variance (ANOVA) methodology is quite effective in determining if two or more group-Means differ due to chance or if observed differences are indeed the result of true difference between phenomena. ANOVA analysis, however, is not limited only to studies involving one single variable. ANOVA can be used to examine differences with two or more factors (independent variables) at the same time. A common use of ANOVA methodology is to use a two-way ANOVA statistical test to determine differences and possible interactions when variables have two or more categories. When two-way ANOVA is used, it is possible to determine whether:

1. There is a difference due to variables acting independently.
2. There is a difference due to variables' interaction.

Therefore, the two-way ANOVA can be used to explain real-world scenarios. This method of analysis can be utilized to test the following:

1. If the Mean of the first independent variable is equal to the population-Mean.
2. If the Mean of the second independent variable is equal to the population-Mean.
3. If the interaction between the two variables has a relationship with the dependent variable.

Qualitative analysis is supported by descriptive data. These data include cross-tabulated data that are derived from the Part II of the survey.

6.2 Quantitative Data Analysis of Hypothesis (H2)

Hypothesis (H2) aims to test the possible future interaction between **Competition** and **Linkage**. To elaborate, it will test whether the interaction between those two variables lead to technology diffusion. These data are derived from the local manufacturer's survey **Part 2**. The local manufacturers are asked to address their expectation pertinent to the entry of FDIs into the Saudi market. Regarding the Linkage effect, they are asked whether they will buy, sell, buy and sell or they will not have relationship with foreign investors. Regarding the Completion effect, local investors are asked to address their expectation of the Competition after the entry of the foreign investors. The question is whether the entry of FDIs will make Competition strong or not. Local investors are given four options. Those options are - Yes Strong, Yes, Not at all or No. The reason for using this type of scale is to utilize it for the qualitative analysis. The third question related to the analysis of the Hypothesis (H2) is related to the effect of the FDI entry on productivity. Local investors are asked whether the entry of foreign investors will help to increase, decrease or will not affect their firm productivity.

At this stage, it is relevant to address the Null and the alternative hypothesis:

H0: ***The interaction between the Linkage and Competition due to investment of MNCs will not increase the productivity (technology diffusion) of the local firms.***

Ha: ***The interaction between the Linkage and Competition due to investment of MNCs will increase the productivity (technology diffusion) of the local firms***.

Table 6.1 depicts the result of the two-way ANOVA table. This table is derived directly from the SPSS model. Before I start the analysis of the result in the table, I would like to introduce the last column of the table. Partial Eta square (η^2) describes the "proportion of total variation attributable to the factor", excluding other factors from the total non-error variation. Cohen (1990) suggests that the value of η^2 = 01 has a small effect, η^2 = 0.09 has a medium effect and η^2 = 0.25 has a large effect.

The following conclusion can be derived from the two-way ANOVA table, as follows:

1. The first variable Competition is not statistically significant at the 5 % confidence interval. The overall result can be written as (F=0.876, p=0.45>0.05, η^2 =0.02).

2. The second variable Linkage is not statistically significant since the significance value is more than 0.05. The overall result can be written as (F=1.890, p=0.129>0.05, η^2 =0.04).

3. The interaction between the two effects Competition and Linkage and their combined effect (Competition * Linkage) are not statistically significant. The significance of the interaction 0.142 is larger than 0.05. The overall result can be written as (F=1.502, p=0.142>0.05, η^2 =0.09).

4. R-square (0.015) and adjusted R-square (0.006) are very small, which support the analysis above.

Dependent Variable: Effect on Productivity						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	14.920[a]	15	0.995	1.556	0.079	0.015
Intercept	2477.455	1	2477.455	3874.763	0.000	0.723
Competition	1.681	3	0.560	0.876	0.453	0.002
Linkage	3.626	3	1.209	1.890	0.129	0.004
Competition * Linkage	8.640	9	0.960	1.502	0.142	0.009
Error	950.762	1487	0.639			
Total	**7715.000**	**1503**				
Corrected Total	**965.682**	**1502**				

a. R-square =.015 (Adjusted R-square =.006)

Table 6.1 *Two-way Analysis of Variance for the Competition and Linkage*

The two-way Analysis of Variance shows that the interaction between the Competition and Linkage due to the investment of MNCs in Saudi Arabia does not have any effect on productivity. Therefore, the Null Hypothesis cannot be rejected. There will not be technology diffusion in the country through those two

effects. There are a lot of descriptive tables and statistics related to this analysis. Those tables and spastics are intensively analyzed in the qualitative data analysis of Hypothesis (H2).

6.3 Descriptive Data Analysis of Hypothesis (H2)

This part seeks, tentatively, to conduct a critical qualitative analysis of the key hypothetical statements undergirding my research work so far. This analysis is based on cross tables derived from Part II of the survey. However, before delving into the contending aspects of the foregoing assertion, it is prudent to establish the background structure that will eventually lead to the analysis proper. For the most part, MNCs have a wealth of international exposure in their chest, more so when it has to do with market dynamics. Principally, as they operate in a foreign market they have already overcome the stumps of fixed costs thus creating the leeway to engage with domestic firms in a very competitive manner. Additionally, they are also able to exert their leverage over new entrants to the market based on the factors that have been mentioned earlier.

MNCs also operate with the leverage of economies of scale that comes about as a result of the technologies they inject into the system allowing them to have a better efficiency pool than domestic competitors. Conscious of this, domestic firms will have to devise mechanisms that will enhance their ability to effectively compete with the foreign MNCs. Driven by the need to be competitive both domestic and foreign MNCs will usher in a new dispensation of enhanced productivity. Previously, notable researcher such as Boone (2000) has been able to establish the validity of this argument to the effect that in an aura of Competition failure by domestic firms to devise adequate response mechanism puts them in the uncomfortable state of experiencing crowding-out effect that will ostensibly push them out of business.

Alternatively, there arises a situation where international MNCs may have to leak knowledge to domestic corporations for the sheer reason of suiting their productivity or financial convenience. All this comes with the goal of getting a mutually satisfying pedigree between international MNCs and domestic

corporations. The factors that sustain the Backward Linkages are part of the main argument of this section. It is with this background that the findings gathered from the survey are analyzed within the context of the hypothesis mentioned above. The survey brings together the views expressed by domestic industry players within the Food, Textile, Chemical, Non-Metallic, Machinery and Others. They are drawn from four major geographical areas within the Kingdom of Saudi Arabia. I will start the analysis by considering the cross tables' results of the items related to Competition and Technology.

6.3.1 The Effect of Competition on Technology Diffusion

Assuming foreign MNCs are edging over domestic corporations, the natural instincts for the local corporations are to respond in ways that will enhance not just their own individual competitiveness but gaining an upper hand on the market. Should this persist the impact is going to be a general spillover onto the entire industry with a potential to impact productivity. To analyze how feasible it is and judging from the responses of the participants presented in **Table 6.2 (Q2 & MOC database)** there is a subtle clue emerging with significance as to how Competition plays an important role in the host country's economy.

		Competition				Total
		Yes, Strong	Yes	Not at all	No	
Location	Eastern Province	95	262	52	117	526
	Riyadh	102	458	109	214	883
	Qassim	10	47	7	15	79
	Hail	0	10	2	3	15
Total		**207**	**777**	**170**	**349**	**1503**

Table 6.2 *Location* Competition Cross-Tabulation*

The first point to note is that there is a broad geographical representation of responses from Eastern Province, Riyadh, Qassim and Hail to the level of consensus regarding how inevitable Competition is to domestic corporations. This is well grounded in the fact that the sum of anticipated Competition from respondents for the "Yes" stands at 262 for Eastern Province and 458 for Riyadh.

To make an aggregate assessment it stands to reason that expectation of Competition representing the sum of “Yes, Strong” and “Yes” reaches 65.5 percent of total responses (1503).

What matters from this is principally within the range of how they will respond from the anticipated Competition in their various industries. It subsequently begs the question of how come 519 representing the sum of “Not at all” and “No” respondents think they will not be vulnerable to Competition. All together 23.5 percent of the respondents do not see Competition in their industry feeling much less threatened by it. This inference depicts the internal leverage mechanism between both local and domestic corporations as they operate in their respective industries. Boone (2000) concedes that under an aura of strong anticipation of Competition expressed in the confidence level of a corporation, be it local or foreign, means that the path for increased effective productivity has been set. Since local corporations would have to grapple with the reality of foreign corporations, their ability to compete is critically connected to their ability to withstand any form of crowding out and ultimate survival.

From the same **Table 6.2**, the trend of the expectation of Competition is strongly towards local corporations. To test whether Competition from foreign corporations is a motivation for improved productivity or not, the response from **Table 6.3 (Q2 & Q4)** increasingly points to the latter. More local corporations would prefer cooperating with the foreign corporation or introducing new technologies more than they think they will improve their productive efficiency. The underlining reasoning here is the desire to benefit from any possible spillover, one which would not be easily given away by the foreign corporation at no cost. Fundamentally, there is bound to be a reaction from the local corporations to deal with Competition, be it through any of the possible options itemized in **Table 6.3**, albeit differences in expected outcomes. This is proven by comparing the figures for “Yes, Strong & Yes” reaction against “Not at all & No” reaction, with the former outnumbering the latter being 984 and 519, respectively.

		Local Firms Reaction			Total
		Improve Efficiency	Cooperate with FDI	Introduce New Technologies	
Competition	Yes Strong	40	53	114	207
	Yes	163	229	385	777
	Not at all	30	52	88	170
	No	80	104	165	349
Total		**313**	**438**	**752**	**1503**

Table 6.3 *Competition* Local Firms Reaction Cross-Tabulation*

Table 6.4 **(Q2 & Q6)** also points to a favorable reaction over non-reaction by local corporations in response to different conditions in technology. Coping with Competition on the market shows that local investors will prefer reaction to none but the response scope emanates more from the technology side and the Imitation practices than it has to do with the efficiency factor. Moreover, a considerable number of manufacturers will continue with the same products. Amazingly enough, 33.78 % of them would prefer the same products continuation.

		Reaction To Product Introduced By FDI				Total
		Product Imitation	Direct Cooperation	Continue with Same Product	Buy Production Technology	
Competition	Yes Strong	207	37	51	48	207
	Yes	775	127	269	168	775
	Not at all	170	25	68	45	170
	No	349	63	119	73	349
Total		**408**	**252**	**507**	**334**	**1501**

Table 6.4 *Competition Reaction to Product introduced by FDI Cross-Tabulation*

Foreign investors, however, might be obliged to leak knowledge to local manufacturers. Take the trend presented in **Table 6.4** as another poignant case in point particularly dedicated towards measuring the practical response of the Backward Linkage for the local corporations. This happens when the cost of transporting the materials necessary for production is very high. Foreign firms would transfer information to their local suppliers. There is strong reason to believe that the case for linkage is firmly entrenched amongst respondents than it is for assertions of non-linkage. Much of it stems from the situation where foreign investors would be left with little or no option at all but to share their expertise

with their local partners - the expertise sharing cuts across a broad range of strands beyond basic operational procedures. In addition, the quality of the materials supplied by the local suppliers may not be up to the expectations of the foreign investors. In such cases, foreign corporations may even train local suppliers' employees to improve the quality of their production.

A spillover from a foreign multinational to a local corporation will not yield the desired impact if the local corporation does not have the internal leverage capacity to take in the stream from the foreign entity. Earlier in this section, **Table 6.5 (Q2 & Q5)** reflects a similar thought pattern gathered from the survey responses. Yet, another important factor that plays a vital role in this equation is the difference in technology level between local investors and their counterparts. Theoretically and practically speaking, the absorptive capacity of former will increase as the gap in technology increases. **Table 6.5** indicates that the number of local investors who anticipate high technology gap is 265 out of 1503 respondents. This indicates one of two things. Either the anticipated rate is underestimated or the benefit from technology transfer is minimal. More indication comes from the fact that the local investors, who think that there is high Technology Level Difference, represent "Yes, Strong" and "Yes" (181) out of the total "Low" and "High" (652). This means that 27.76 % of them are conscious enough to the fact that could be rather economically positive.

Category		Technology Level Difference			Total
		Low	High	The Same	
Competition	Yes Strong	93	47	67	207
	Yes	378	134	265	777
	Not at all	82	27	61	170
	No	180	57	112	349
Total		**733**	**265**	**505**	**1503**

Table 6.5 *Competition* Technology Level Difference Cross-Tabulation*

The above mentioned analysis is summarized by conducting the Chi-Test to check the relationship between Competition and productivity. As shown in **Table 6.6**, Chi-Square Tests accept the Nil-Hypothesis that there is no relation between Competition and productivity since the significance value is more than 0.05. The

Chi-Square Test also shows that the data really has very good fit. Since the Pearson Chi-Square value is 7.121, which is less than the minimum expected value of 45.70.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.121[a]	6	0.310
Likelihood Ratio	7.203	6	0.302
Linear-by-Linear Association	0.451	1	0.502
No. of Valid Cases	1503		

a. 0 cells (0 %) have expected count less than 5. The minimum expected count is **45.70**.

Table 6.6 *Chi-Square Tests for the Effects of Competition and Productivity*

6.3.2 The Effect of Linkage on Technology Diffusion

As Multi-National Corporations engage in their operational activities in the host country, they create the stage for the diffusion of their operational technologies within the host country. The diffusion eventually spills over to the local corporations, which augment their productive capacities in very phenomenal ways, because of the technological diffusion. Therefore, the benefits that the host country, in this case Saudi Arabia, accrues from technological diffusion are of latent significance to its long-term growth prospect.

Reports of the survey results displayed in **Table 6.7 (Q2 & Q7)** above provide a good roadmap that clearly illustrates the possible direction of linkages. The key factor here is to determine if the expected linkage is forward or backward as part of building case for the main hypothesis of this section. Principally, the survey response is gathered from industry players in all the industries mentioned earlier in this section. The resulting linkage will have impact on the level of Competition not just within the specific provinces but the nation as a whole; thanks to FDI inflows. Clearly, the implied connection to the foundational hypothesis proves that the injection of capital and technology has the grounded propensity to trigger Competition within the domestic Saudi economy. For this reason, the hypothesis is accepted as one that can be fully expressed in practical terms to the investment terrain in Saudi Arabia.

		Linkage				Total
		Sell them intermediate goods	Buy intermediate goods from them	Buy and Sell intermediate goods	No Linkage	
Classification	Food	254	21	110	110	254
	Textile	72	10	28	28	72
	Wood	20	3	8	8	20
	Chemical	168	15	61	61	168
	Non-Metallic	347	29	146	146	347
	Machinery	94	5	33	33	94
	Others	548	38	274	274	548
Total		**632**	**121**	**90**	**660**	**1503**

Table 6.7 *Linkage effect on businesses*

As shown in **Table 6.8**, Chi-Square Tests support the conclusion that there is a relation between the Linkage and productivity growth as depicted by the significance value less than 0.05 where the data has a very good fit since the Pearson Chi-Square value is less than 24.19, which is the minimum expected value.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.513[a]	6	0.001
Likelihood Ratio	23.046	6	0.001
Linear-by-Linear Association	0.855	1	0.355
No. of Valid Cases	1503		

a. 0 cells (.0 %) have expected count less than 5. The minimum expected count is **24.19**.

Table 6.8 *Chi-Square Tests for the Effects of Linkage and Productivity*

6.3.3 The Effect of Competition and Linkage Interaction

This section will analyze the interaction between Competition and Linkage and its effect on the productivity. It can be seen from **Table 6.9 (Q2 & Q7)** when the local firms demonstrate a greater desire to “sell them intermediate goods” rather than “buy intermediate goods from them” or even “buy and sell intermediate goods.”

Put together “yes strong” and “yes” for the first indicator of selling intermediate goods stands at 433, which is greater than the sum of 199 representing “Not at all” and “No” for the same indicator of selling intermediate goods.

		Linkage				Total
		Sell them intermediate goods	Buy intermediate goods from them	Buy and Sell intermediate goods	No Linkage	
Competition	Yes Strong	82	20	29	76	207
	Yes	351	51	32	343	777
	Not at all	52	23	11	84	170
	No	147	27	18	157	349
Total		**632**	**121**	**90**	**658**	**1503**

Table 6.9 *The Interaction between Competition and Linkage*

Notwithstanding the previous work of Blalock (2001) in arguing that Productivity can be increased through Backward Linkages. The data in **Table 6.8** does not exclusively confirm this from a strictly qualitative basis. Before relating this to the direct implications it presents in **Table 6.9**, there are still some useful deductions that can be drawn from it. On the indicator of “buy and sell intermediate goods” the figures obtained on average are still less than those coming from either “sell” or “buy” alone. By way of inference, the connecting base is very weak and may not have significant impact. These are the tentative sentiments that are captured in **Table 6.9** where the total values related directly to Linkages are expressed. The “Yes, Strong” and “Yes” sentiment is stronger than the “Not at all” and “No” sentiment, as expressed by 565 and 278, respectively.

Going by the convention of Intra-Industry spillovers, the main impact of any spillover from an MNC takes place within the specific industry that the corporation operates. The underlining premise for such a posture is that domestic firms motivated by the desire to become very competitive in coping with the entry of the foreign corporations will seek to improve their productivity operations and this leads to the eventual spillovers. There is yet another dimension to this trend based on the notion that domestic corporations operating in the same industry with their foreign counterparts stand a good chance of acquiring some of the firm-

specific technology of the foreign corporation because of factors supporting labor mobility and other related avenues for Imitation.

Coming from very deep analysis there is a consensus that the effects of spillovers are more positively facilitated by strong direct benefits arising from capital investment and some cases even employment. Notwithstanding, there are instances where Intra-Industry spillovers are not possibly taking place to the extent that the effect they can potentially have on the host country's economy will not be positive, as stated by Kugler (2006). Barring all unforeseen circumstances, an MNC will not freely offer its firm-specific asset to domestic corporations when the MNC cannot benefit from such a move. Nevertheless, a good natural response is for the MNC to come out with ways and mechanisms that will either totally avoid the leakage of its firm-specific assets or alternatively minimize it to its lowest possible terms.

Additionally there have been concerns expressed about the level of reaction that will be accorded to foreign corporations that enter a domestic market. Most often the reaction may trigger a negative impact on local corporations that are operating within the same industry. These come in the form of the uneasiness that domestic firms will face in their bid to adopting superior operational techniques used by the foreign corporations. Aitken and Harrison (1997) argue as a direct consequence of this difficulty that domestic firms will be unprepared to meet the impact of being pushed very high on the matrix of their average cost curve brought about by the inherent desire to get competitiveness.

Domestic firms may also have to contend with other difficulties related to the incompatibility of skills when recruiting personnel that have had previous training by foreign corporations.

Inter-Industry Linkages also feature highly as yet another potent source of spillover effects from foreign to domestic corporations within the host country's economy. Previous studies by Kugler (2006) further leans credence to the fact that both Forward and Backward Linkages are very vital channels through which spillovers can occur vis-à-vis supplier and customer relations as opposed to

spillover occurring within a specific industry particularly in the midst of mounting Competition between corporations for dominance of their respective industries.

As shown in **Table 6.10**, Chi-Square Tests show that there is a relationship between Competition and Linkage, but the data does not have very good fit since the Pearson Chi-Square value of 47.551 is greater than the minimum expected value of 10.18.

Chi-Square Tests			
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	47.551[a]	9	0.000
Likelihood Ratio	41.619	9	0.000
Linear-by-Linear Association	1.068	1	0.301
No. of Valid Cases	1503		

a. 0 cells (.0 %) have expected count less than 5. The minimum expected count is **10.18**.

Table 6.10 *Chi-Square Tests for the Effects of Competition and Linkage*

6.3.4 Conclusion of the Descriptive Analysis

The descriptive analysis mentioned in the previous three sections is compared to other researchers' analysis resulting in the proper conclusion. Blomstrom et al (2000) in a related study with an empirical model establish the veracity or otherwise of this claim. They contend that the ultimate cost of a foreign multinational offering its technological assets to the local corporation has an inverse relationship with the possible spillover effects that may result from the process. Their model proceeds to argue that the cost that local corporations in the host economy would incur from adopting a technology coming from a foreign corporation has an inverse relationship with the expected state of spillover that will occur. In practical terms it can be interpreted in this way; under conditions where a technology is very costly to acquire, local corporations have very little incentive to go for it. If a technology is costly to guard then it becomes easier for foreign corporations to offer the technology to local corporations.

Furthermore, a local corporation is more inclined to adopt a technology from a foreign corporation if the level of the prevailing technological gap between the two

is not so wide. Under such circumstances, the local firm is said to have a more assertive capability to rake in the new technology more than when the gap is so wide. Should a local corporation want to defy convention by adopting the technological process of the foreign corporation it may have to grapple with difficulties in effectively implementing the technological asset in question? From **Table 6.11 (Q5 & MOC database)** below, Riyadh has more corporations with relatively low levels of technological gaps vis-à-vis foreign corporations and are, therefore, in a better position to absorb foreign technology than say Hail or Qassim. Practically speaking, Eastern Province has been more exposed to western culture ever since the start of the oil revolution. The oil and petrochemical industries are more attached and reachable to those local investors settled in Eastern Province. Relative to the number of investors in Eastern Province, this fact is proved.

Shifting to the possible implications of the presence of foreign MNC and the level of productivity, their activities have on the host economy, points to an overwhelming consensus proving that productivity most often receives a positive swing, according to Blomstrom et al, 2000.

		Technology Level Difference			Total
		Low	High	The Same	
Location	Eastern Province	238	100	188	526
	Riyadh	450	151	282	883
	Qassim	39	14	26	79
	Hail	6	0	9	15
Total		**733**	**265**	**505**	**1503**

Table 6.11 *Technology Level Difference by Geographical Area*

Notwithstanding this broad consensus, some critical observers such as Kugler (2001) have cited a weakness in the consensus reflected in the fact that much of these findings essentially reflect the practice in developed countries with little focus on developing countries. The universal nature of this assertion is, therefore, called to question, thus leaning further credence to the basis of this hypothesis. For a technological spillover to take place there should be a fundamental mechanism through which this process can be facilitated, recalling the

differences in the level of technological disposition of a foreign MNC and a local firm.

Besides the differences in the prevailing gap, there is another important scope of the level of how complementary a local firm is with regards to a foreign corporation on the technology barometer. If there is a fair level of complementary disposition, it becomes relatively easier for technology to diffuse from the foreign corporation to the local one. **Table 6.12 (Q1 & Q12)** contains relevant details that can be of extremely good in evaluating the depth of this assertion from both the Inter-Industry and Intra-Industry implications.

		Effect on Productivity			Total
		Productivity Increase	Productivity Decrease	Will Not Affect Productivity	
Classification	Food	71	82	101	254
	Textile	21	25	26	72
	Wood	5	7	8	20
	Chemical	54	45	69	168
	Non-Metallic	86	127	134	347
	Machinery	29	24	41	94
	Others	138	206	204	548
Total		**404**	**516**	**583**	**1503**

Table 6.12 *Effect on Productivity by Business Classification*

A list of different industries considered under this study is catalogued as the first step to the establishment of the comparative analysis. Indeed, there is no gain denying that the possible effect of FDI will not be uniformly spread across the different industries of the host economy. There are peculiar factors exclusive to some industries that may not be necessarily shared by other players in different industries. Food and Textile industries should be cited to prove a legitimate factor that has to do with specific sociocultural factors that are resistant to external influences. Therefore, the possibility of a foreign MNC influencing this area is very limited in scope. For example the First and Second indicators representing “Productivity increase” and “Productivity Decrease” share very marginal differences in their values for both the Food and Textile industries (Food 71 and 82 and Textiles: 21 and 25), respectively.

There is strong evidential basis to prove that as domestic corporations appropriate the technological leverage of foreign MNC the latter would have to incur any costs as a result of this process. Some of the overt forms of the cost arising include fall in future profits because of the corporation loosing monopoly of its specific leveraging wheels. On the contrary, there is very little evidence to prove that a foreign corporation stands to benefit from appropriation of its technological leverage through spillovers. Some of the few isolated instances of potential benefits include the following:

- Indeed, should the foreign corporation be interested in acquiring a form of perceived beneficial technology from the host economy then under such a condition it is considered very prudent.

- A foreign corporation stands to gain from economies of scale as it pursues innovativeness through outsourcing of some of its research and development needs.

- Chances are that the local affiliates of the foreign corporation may receive some forms of commercial privileges from the government of the host country, which may not be readily accessible to the foreign corporation. The privileges may simply be of greater worth to the foreign corporation than the technology spillover that it experiences.

Conscious of this, should foreign corporations in the Kingdom of Saudi Arabia make adequate provision for the risk of their technologies spilling over to domestic corporations' works to enhance their own internal efficiency mechanism. Furthermore, it helps the foreign MNC manage the costs that comes with shielding their technologies from appropriation by local corporations.

It will be good to assess each of these industries vis-à-vis the varied degrees of their respective technological viability in comparison to a foreign MNC. Some of the industries may derive their strength from an indigenous source advantage to enable them leverage the power of the market and would, therefore, be in a better place to absorb a technological spillover than Others industries within this same study. Stated differently, there is a strong reason based on figures emanating from **Table 6.12** that in the case of Saudi Arabia the connection between impact of a technological spillover and eventual productivity is in some

ways dependent on indicators that are endogenously active within Intra-Industrial Sectors.

Nevertheless, where appropriations cannot be prevented under very ideal conditions the foreign corporation would have to critically evaluate the related costs and benefits that can be accrued from the possible spillover of technology that can be accessed by domestic corporations. Naturally, if the perceived gains that can be accrued are high then the motivation to guard against Imitation will be strategically reduced. The conventional stream will be gauged by assigning a positive functional denotation to the corporate value of the technology that will be appropriated. Again, it includes the measured capacity of the domestic corporations to fully utilize this value to the maximum point.

On the other hand, the benefits are derived from the process since it involves a cost benefit analysis. For this indicator to be gauged, the prime factor to consider is the available latitude of protection that the governments in host economies are willing to safeguard intellectual properties through relevant institutional structures. For this to happen there should be a positive relational function associated to the technology that will be put on offer in the host economy and most importantly easily within the reach of the foreign corporation to make up for its own technology spillover to industries within the host economy. Conditions on the ground at the host country level are in many ways consistent with the level of desire by domestic corporations to acquire the technological leverages of foreign MNCs. One key condition can be explained by the depth of the optimization posture of domestic corporations in Saudi Arabia.

There are also inherent questions that relate exclusively to the MNCs based on the key decisions they make and how that ultimately impact spillovers in the host country. Some of the key decisions include the location factor, when it comes to deciding where to move production activities. There is arguably a legion of factors that MNCs consider to guide them in deciding which direction they should steer on the international sphere. Within the limited scope of this section emphasis is placed on the tentative level of spillover factors. Barring all conditions an MNC will enter a foreign market granted there is enough insulation against Imitation of any type. In the short run MNCs entering a new market are keen to ensure that

their initial costs of entering a new market are well recouped before any diffusion can limit this from taking place.

6.4 Quantitative Data Analysis of Hypothesis (H3)

Hypothesis (H3) tests the possible future interaction between Training and Workers' Mobility. To elaborate, it will test whether the training and experience gained by local workers due to the existence of FDI will help in spreading out technological knowhow. I would like to mention that these data are derived from the local manufacturers' survey. The local manufacturers are asked to address their expectation pertinent to the entry of FDIs into the Saudi market. Regarding the Training effect, they are asked whether the entry of FDIs will oblige local manufacturers to "Formally Train their employees", "Informally Train their employees", "Hire employees from other companies" or "Take no Action". Regarding the Mobility effect, local investors are asked to address their expectations of employees' Mobility to the entry of the foreign investors. The question is whether the entry of FDIs will inspire their employees and makes them move to another foreign firm, local firm or they will be able to retain their employees. The third question related to the analysis of the Hypothesis (H3**)** is related to the effect of the FDI entry on productivity. Local investors are asked whether the entry of foreign investors will help to increase, decrease or will not affect their firm's productivity.

At this stage it is relevant to address the null and the alternative hypothesis:

H0: ***The interaction between the Training and Workers' Mobility will not increase the productivity (technology diffusion) of the local firms.***

Ha: ***The interaction between the Training and Mobility will increase the productivity (technology diffusion) of the local firms.***

Table 6.13 depicts the result of the two-way Analysis of Variance. This table is derived directly from the SPSS output model.

The following conclusion can be derived from the two-way Analysis of Variance table:

1. The first variable, which is Training in this case is not statistically significant at the 5 % confidence interval. The overall result can be written as (F=1.639, p=0.178>0.05, η^2=0.03).

2. The second variable, which is Mobility in this case, is not statistically significant since the significance value is more than 0.05. The overall result can be written as (F=0.160, p=0.853>0.05, η^2=0.00).

3. The interaction between the two effects, namely, Competition and Linkage and Competition is not statistically significant. The significance of the interaction 0.158 and is larger than 0.05. The overall result can be written as (F=1.551, p=0.158>0.05, η^2=0.06).

4. R-square (0.011) and adjusted R-square (0.04) are very small, which supports the above mentioned analysis.

Tests of Between-Subjects Effects						
Dependent Variable: Effect on Productivity						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial η^2**
Corrected Model	10.557[a]	11	0.960	1.498	0.126	0.011
Intercept	2749.137	1	2749.137	4291.548	0.000	0.742
Mobility	.204	2	0.102	.160	0.853	0.000
Training	3.150	3	1.050	1.639	0.178	0.003
Mobility * Training	5.961	6	0.994	1.551	0.158	0.006
Error	955.125	1491	0.641			
Total	**7715.000**	**1503**				
Corrected Total	**965.682**	**1502**				

a. R-square = 0.011 (Adjusted R-square =.004)

Table 6.13 *Two-way Analysis of Variance for the Training and Mobility*

The two-way Analysis of Variance shows that the interaction between the Training and Mobility due to the investment of MNCs in Saudi Arabia is not expected to have any effect on productivity. Therefore, the Null Hypothesis (H0) cannot be rejected. There will not be technology diffusion in the country through those two effects. There are a lot of descriptive tables and spastics related to this

analysis. Those tables and spastics are intensively analyzed in the descriptive data analysis of Hypothesis (H3).

6.5 Descriptive Data Analysis of Hypothesis (H3)

This hypothesis studies the transfer of knowledge, skills and attitude from foreign firms to local firms. When foreign subsidiaries hire local workers, they are able to increase their productivity only after giving them the appropriate training. In addition, foreign firms would incur the training cost to increase their product quality. Technological spillovers from those FDIs arise when those workers and managers are later hired by local firms. The skills built up by local workers and managers would accumulate and become very attractive for local firms. Local firms would start seducing those workers by higher salaries and benefits. This will increase the workers' mobility. This fact is illustrated by Jovanovic (1997) where he discusses the relationship between human capital and technology.

Equally important to note the quality of human resources available within the host economy is a related factor in influencing how foreign investments will flow into it. The quality of the labor force also influences the capacity to utilize fully, practically, any technological spillover in significant ways.

Typically, should there be any spillover, such as those that are directly connected with scientific knowledge, comes with a corresponding set of standards that are dependent on the availability of the medium through which the spillover can take place. Some of the notable areas include the manner in which contractors, employees and in some isolated cases consults shuttle between corporations, according to Dedrick et al (2003). Clearly, this is not very distinct or remote from the existing trends that have been recorded in the past especially relating to specific industries such as those involving heavy production technologies. It is worth stating that according to David (1990), an economic historian, skilled factory employees in the United States such as engineers and architects played an integral role in diffusing the knowledge regarding the processes that goes into the installation of devices like the electric dynamo.

In view of the hypothesis for this section, a vivid illustration can be cited here while painting the picture more clearly. Should a hypothesis of knowledge diffusion be attributed to take place exclusively within corporations of the same industry (Intra-Industry), which is very typical for the type of knowledge that is in vogue for designated advancements in some aspects of technical knowledge or related additional knowledge-based services within the country and can be used as an indicator of the innovation potential for corporations operating within the same industry. In the same manner, should there be cases of diffusions centered exclusively within the regional level, it stands to reason that diffusions can be gauged based on the investment levels that are seen within the dimension of geographical considerations more than other factors.

The data used to conduct this part of the research has been collated from the responses of participants who have had one form of contact or exposure with both domestic and foreign corporations in the Kingdom of Saudi Arabia. The responses provide the basis of the data used to conduct the analysis establishing the veracity or otherwise of this hypothesis. It should be acknowledged that the data used here does not provide very precise details of the diffusion nature of technology as described in the literature. Amongst all the tables used, the process of testing this hypothesis is specifically tilted to gauge how employees will react to situations of working either for domestic firms or foreign owned corporations in the different areas of the host country. Also it is important to find out if the level of education or training has anything to do with their choice of mobility.

6.5.1 The Effect of Labor Mobility

There is no gain in denying the vital role that skills received by employees on the job are very vitally connected to the ultimate ability of domestic employees to gain very vital skills for their overall betterment at the end of the day. These are skills that are not only momentarily useful for them in the discharge of their current duties but also important as it improves upon their general chances of getting employed in the future perhaps either in the same industry or elsewhere. The development of managerial skills through enhanced training is undeniably

connected to the thread of a corporation's progress be it domestic or foreign owned.

The specific areas of concern for technology diffusion through labor mobility is best expressed in instances where any of the top managerial hierarchy of a corporation move from one to the other, in this case, if it is movement from a foreign corporation to a domestic one. Clearly such a movement cannot prevent the transfer of any form of expertise gained or utilized from the foreign corporation to the new destination within the domestic corporation. Indeed, this research acknowledges the pivotal role played by other non-managerial staff shuttling through foreign and domestic corporations. From the perspective of the notable literature cited in the foregoing paragraph, technology diffusion can mainly take place according to three conspicuous channels.

There are instances where domestic corporations instead of initiating their own technological base would assume the convenience of imitating the technology they observe in vogue by the foreign corporation. This trend is called the Demonstration effect by some scholars, such as Blomstrom et al (2000). Then another scenario comes into picture. The domestic corporations would have to respond to demands of the market for higher standards of performance based on a trigger offered by foreign MNCs.

Under such a scenario the domestic corporation is compelled by the strong desire to be competitive or be at par with the high standards placed on the market. It becomes tenable to adopt the technology used by the foreign corporation. In the final context, the mobility of labor between corporations both local and foreign can be a source of technology transfer within the host economy. Technology transfer through labor mobility can be experienced when workers from foreign owned corporations transfer or relocate to domestic corporations after they have been trained by and worked for the foreign MNC.

Increasingly, policy makers are becoming convinced that technical advancement expressed through the creation of knowledge serves as an important fulcrum in leveraging economic progress. Hitherto to this concession more economic progress is ascribed to neoclassical models that sought to attribute economic

growth to the abundance of factors such as capital and labor amongst other factors of production. Under the neoclassical model of economic progress, an economy would drift towards eventually reaching a state of equilibrium that is characterized by measuring the prevailing level of per capita income against factors such as population growth, depreciation and investment without a corresponding steady income growth.

Indeed, it is worth acknowledging that pioneering research work by Solow (1956) made inferences to the vital role of technology in spurring economic growth yet fell short of providing explicit details beyond the mere representation of technology as an exogenous element within the process itself. The underlining reason behind the entire steady acknowledgement does however refer to vital factors such as accepting that if convergence in per capita income levels is to take place it had to be done in tandem with a corresponding convergence in technology.

Conscious of this, a new trend has emerged as a result, in discussing wider economic growth policies, which represents a shift from considering technical progress as an exogenous factor to one that now embraces it as an endogenous one. Knowledge creation and dissemination are steadily evolving into the mainstream discourse of contemporary development theories. With this in mind it is not farfetched to equate knowledge as an imperative public good; it comes with such paradigms including, training, research and development and education in all cases inherently structured to resist any inclination towards diminishing returns to scale human capital or its related form of labor.

A crucial point that deserves further probing is centered on the question of the effect of regional differences within the country playing a role, if any at all, in the diffusion of technology through labor mobility across the various parts of the country. What is also worthy of asking is whether the prevailing labor competence in the regions under study in this research plays any part in diffusion of technology judged by how mobile employees are. Mobility per se may take place but it will be important to gauge if this mobility is Inter-Industry or Intra-Industry even by this parameter there are equally related factors about whether the scope of mobility is centered within the wider scope of FDI.

For diffusion to be considered appropriately there is the need for putting into perspective, the level of economic attributes that can be ascribed to tentative diffusions. It, therefore, brings to focus the level of competence cited as an integral part of the discourse. To gauge or quantify this, it is important to use aggregate indices to measure the prevailing knowledge level of the state of external sources that can be accessed by corporations in ways that are consistent with the means by which corporations are able to acquire the knowledge resource that they need.

The most widely used approach used to assess the diffusion of technology through mobility has been centered mainly on the stream of regional investments in most cases or the use of aggregate industrial indices. In the case of this research, it is also observed that regions such as Riyadh are more associated with the service industry than it certainly is for Qassim, which may result in difficulty in attributing for differences arising from regional variations. In recognition of this difficulty, it is clearly appropriate to come up with mechanism that addresses the specific benefit of knowledge diffusion by analyzing specific data on productivity and service delivery. Yet, these methods do not serve the main purpose of this study because of the inability to collate and construct data based on this method. For this reason it will not be cited as an appropriate method to meet the ending completion of this research.

Again for the purpose of measuring technology diffusion, Labor Mobility serves as the most ideal standard gauge to provide insight into the required information. It has this advantage because it makes room for regular contact in ways that are effective for the introduction and implementation of new technology to an organization. To avoid the challenge that comes from working with information about cross-sectional industrial assessment, emphasis here is placed on analyzing the views and expectations of respondents based on the survey questionnaire.

It is also known that often times Labor Mobility turns to exhibit local trends than external, which suggests that location is a cardinal factor in establishing the connection between labor market trends and location specific factors. For instance, any corporation entering a new market would be consistent in

understanding the production dynamics within the host economy. Clustering has emerged as another connecting link between the loose ends of diffusion and Labor Mobility; for which some observers including Goldfarb and Greenstein (2005) reason that clustering on geographic considerations has a lot to do with an untold inherent desire to tap into a perceived high access to knowledge pool.

At this juncture it is becoming crucial to acknowledge that Location factor will feature very highly in gauging all the sides to the hypothesis under consideration. As a direct consequence it is important to question whether or not Location ultimately plays a part in helping a corporation be it foreign or domestic to derive maximum returns from their investment as a result of Labor Mobility within the industry.

Location as a prime factor in determining employee mobility has been strongly established from the results of the survey conducted. Thus far the data gathered to explain the effects of possible spillovers reflected in taking the cumulative average of the entries in **Tables 6.14 (Q1 & Q11), 6.15 (Q1 & Q9), 6.17** and **6.18** indicate that the spillover ultimately produces a rate of return to local investment to, approximately, 35 percent. The underlining reasoning, here, is premised on the understanding that it is part of regular practice for corporations to recruit a significant chunk of their technical manpower from within the local economy. Therefore, managers will be keen to establish the quality of the manpower base before fully entering into that market.

		Benefit from FDI Know-How				Total
		Yes, Strong	Yes	No, Not at all	No	
Classification	Food	9	30	101	114	254
	Textile	3	14	29	26	72
	Wood	1	6	5	8	20
	Chemical	12	24	57	75	168
	Non-Metallic	13	42	161	131	347
	Machinery	9	8	35	42	94
	Others	3	51	249	245	548
Total		**50**	**175**	**637**	**641**	**1503**

Table 6.14 *Businesses Classified* Benefit from FDI Know-How of FDIs*

Foreign investors will additionally be keen to get a fair idea of the direction of their average investments perhaps more specifically with respect to the rate of return standing at approximately 35 percent raising questions for further clarification. If the average rate of return is placed say one standard deviation above the Mean which points to a rate of return that is above general private investment levels. Undoubtedly, if there is very high rate of return the indication is that there is a connection with the movement of labor, which may extend the discourse beyond the confines of the narrow location factor.

Specific attention is given to **Tables 4.1, 6.12, 6.14 and 6.15** with the view of testing how it exposes any of the contentious issues highlighted in the hypothesis. For simplicity each of the tables listed above is analyzed from the perspective of drawing the link that exists within the Intra-Industry phase as the mobility discourse is examined closely. The first worthy point to note so easily that within this context there is no uniformity within the corporations and industries surveyed for this study. From this perspective for foreign investment to become very viable in any way, it should be backed by internal augmenting factors in supporting how Mobility can be very divisive drawing from multiple industries, thus critically suggesting that Mobility is not limited to the same industry but has the capacity to extend to other sectors of the economy as well.

Reforming any type of organization is arguably a very demanding task both in physical and financial drain. Levy and Murnane (2003) point out that making changes to the operational activities of an organization with the introduction of new technological know-how comes at a cost that is often times not explicitly appropriated by management. In view of the financial cost tag that comes with invention, the average corporation has the propensity to take the easy path of Imitation instead of endogenously crafting what might exclusively work for them. Indeed, the greatest effect is felt within the sojourning relationship between multinationals and their local subsidiaries.

Taking cognizance of the foregoing, it is possible to draw the link between spillovers and proximity factors. With this in mind, an easy assumption that can be made is that the smaller the dividing distance the greater the possibility of a spillover with the opposite case being the possibility in the event of a flip of the

coin. It can be attributed to the ease with which the propagation of knowledge can dictate the pace of mobility within an Intra-Industry setting as opposed to conventional structures of transmission. Good examples can be traced to the level of interaction between employees on diverse for even under the conventional sense where employees belong to a common organization the latitude for engagement is broadened under conditions of narrow proximity.

On the question of the location specific variables, an important key feature that has been highlighted multiple times in this research based on the pattern observed in other previous research topics on the same subject shows geographical location as one of the indicators of gauging diffusion of technology by means of the mobility of labor force from foreign to domestic corporations through FDI. Indeed, this study has also taken that aspect critically to settle on the key contending factors mentioned in previous chapters of this study.

A review of the most common trend of gauging the geographical proximity factor in labor mobility has been to assess corporations based on where the specific locations of their headquarters are. As an example, it will be like identifying how many corporations have their headquarters located in any of the regions being studied in this research? How many of them operate within the same industry? Despite the good intentions with using the location of the headquarters of a corporation as a standard yardstick to evaluate its impact on its regional location, it ultimately proves to be an ineffective approach for several reasons. Chief among them is that often times the labor market in Saudi Arabia is not structurally stratified in ways that makes target pooling a viable recruitment strategy.

		Workers' Mobility			Total
		Move to Domestic Firms	Move to Foreign Firms	Stay in the Same Firm	
Classification	Food	60	94	100	254
	Textile	24	24	24	72
	Wood	3	8	9	20
	Chemical	43	58	67	168
	Non-Metallic	99	115	133	347
	Machinery	25	40	29	94
	Others	142	185	221	548
Total		**396**	**524**	**583**	**1503**

Table 6.15 *Workers' Mobility in the different Business Categories*

For practical reference from the results of the research survey, it will be prudent to consider **Tables 6.15** and **6.16** **(Q9 & Q11)** both of which present details about the mobility of workers across the geographical limit of the Kingdom of Saudi Arabia. The first thing to consider will be the ground parameters of location or proximity factors, which has been highlighted in the previous paragraphs. There is no doubt that the setting of the research survey is conducted within the boundaries of Saudi Arabia, which partly answers for the proximity factor, there is a hegemonic labor market under consideration here. However, unclear the quality of this labor force is, the understanding is that employees can easily be mobile on personal choice as part of an Inter-Industry or Intra-Industry track. Each case looks feasible yet the determinant here remains the question of expertise.

Referring to **Table 6.15**, the review of the indicators that employees have to gravitate between the choice to “Move to Domestic Firms” or “Move to Foreign Firms” or even “Stay in the same Firm”. These indicator categories are also measured against the different industries operating within the entire country. In any case this part does not elicit information on a regional basis for now. Between all the three indicators, respondents have expressed the least desire to move to domestic firms at any rate. There are more willing to “Stay in the same Firm” than either “Move to a Foreign Firms” or “Move to a Domestic Firm” as captured in the following data values 583, 524 and 396, respectively.

For the measurement of the possibility of any type of diffusion I make the computational scale based on the regularity of flow of corporations within which a domestic corporation is very likely to attract 10 percent of its labor force from foreign MNCs. I am motivated to use this approach because of its appropriateness for the hypothesis used in this model. For instance, given that the Labor Mobility remains critically connected to the medium of diffusion of technology and knowledge transfer, the level of diffusion that a domestic corporation will receive is directly related to the source from which the labor is moving from.

In other words, if there is a high amount of labor mobility from foreign corporations to domestic ones then the level of diffusion will be correspondingly very high and a similar reverse situation can be cited to assess the veracity of

this hypothesis. **Table 6.15** provides answers to some of the possible effects of Labor Mobility over the long term range based on the perceptions of employees located in all the regions of the research area. When it comes to the Food industry there are more workers unwilling to move between domestic and foreign corporations than there are for those willing to consider each of the options. The figure for those unwilling to move is 100, which is in comparison to 94 and 60 for those willing to move to foreign firms and domestic firms, respectively.

Quantitatively, the difference between moving to foreign firms and remaining is very negligible especially compared to Others industries within the same country such as Textile and Wood industries. A figure of 24 is recorded for all the indicators of the Textile industry where as 3, 8 and 9 is recorded for the same indicators of Wood industry. These three industries have been put as an average indication for all the regions, which in itself suggests clearly of a low level possibility of labor moving from foreign corporations to domestic corporations, thereby, raising questions again about the possibility of any spillover if there is very limited enthusiasm of mobility from the foreign to the domestic corporations.

		Benefit from FDI Know-How				Total
		Yes, Strong	Yes	No, Not at all	No	
Workers' Mobility	Yes	38	112	404	366	920
	No	12	63	233	275	583
Total		**50**	**175**	**637**	**641**	**1503**

Table 6.16 *Workers' Mobility and the benefit from FDI Know-How*

They are more willing to "Stay in the same Firm" for a host of reasons, which may reasonably include job security or the lack of high competitive skills that can facilitate easy mobility. There could also be reasons of remuneration, yet the fact clearly remains that the shifting from foreign corporations to domestic ones is simply very limited in scope as per the views gathered and analyzed from **Table 6.17 (Q9 & Q12)**, although providing useful inferences does not constitute a strong justification to reach a conclusion as yet.

The summary of the aforementioned analysis is shown in **Tables 6.16** and **6.17.**

The analysis in **Table 6.16** is only justifiable if it is compared to the benefit from FDI Know-How expectations. Out of 920 firms that expected mobility of their workers, only 150 firms expected their firms to benefit from the Mobility Know How (Yes, Strong + Yes). However, firms who expected no mobility and expected their Know-How level to increase are 275 firms.

In **Table 6.17**, productivity due to mobility will, hopefully, increase based on 249 local suppliers' expectations. According to 349 local manufacturers, there will be no effect on productivity. The undesired result comes from 322 local producers who claimed that productivity will decrease that sounds unrealistic. According to them, the mobility of their workers will negatively affect their manufacturing plants' production levels. The huge size of the FDI may seduce their workers to make them move and eventually affect their productions.

		Effect on Productivity			Total
		Productivity Increase	Productivity Decrease	Will Not Affect Productivity	
Workers' mobility	Yes	249	322	349	920
	No	155	194	234	583
Total		**404**	**516**	**583**	**1503**

Table 6.17 *Workers' mobility effect on Productivity*

As shown in **Table 6.18**, Chi-Square tests accept the Nil-Hypothesis that there is no relation between Workers' Mobility and productivity, which is not in favor of the conclusion that was mentioned in the previous paragraph. The data, however, have very good fit since the Pearson's Chi-Square value is very small relative to the expected value.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.131[a]	4	0.536
Likelihood Ratio	3.149	4	0.533
Linear-by-Linear Association	0.030	1	0.863
No. of Valid Cases	1503		

a. 0 cells (.0 %) have expected count less than 5. The minimum expected count is 106.44.

Table 6.18 *Chi-Square Tests for the effects of Workers Mobility and Productivity*

6.5.2 The Effect of Training

The human resources area is one of the most important items in all the technology diffusion process. The results pertinent to training are not very promising. **Table 6.19 (Q1 & Q10)** does add some very vital impetus to the discourse in very straightforward ways. Like **Table 6.17**, three key indicators are employed to analyze the response coming from the survey all with the ultimate view of critiquing the role of offering training to employees and how that can affect their mobility tracks either Intra-Industry or inter-industry perspective. It should be noted that the key indicator here is Training or Capacity building but the three sub-indicators include "Informal Training, Formal Training and Hiring Employees from FDI." Performing any of the tasks under each of the sub-indicators comes with a cost tag at any rate. But, of course, with some variation in the manner in which the costs are borne. For instance Informal Training may not cost as much as Formal Training, which incidentally will not cost more than Hiring Employees from foreign investment.

The investor will definitely want to gain returns to investment on the human capital irrespective of how it will be done. Informal Training being the cheapest of all the three sub-indicators happens to have gained the highest corroborated responses from the perspective of Inter-Industry mobility. Measured against each of the industries listed here people whose mobility will require Informal Training are more inclined to pursue the mobility track than those whose mobility require contractual hiring through foreign investment or Formal Training. A good example is seen in the Chemical industry, which has recorded a figure of 105 for Informal Training as opposed to 46 for those seeking Formal Training to be able to engage in mobility of technology from both sides of the equation.

Category		Training				Total
		Formal Training	Informal Training	Hiring Employees from FDI	No Action	
Classification	Food	46	151	39	39	254
	Textile	9	50	6	6	72
	Wood	7	13	0	0	20
	Chemical	46	105	16	16	168
	Non-Metallic	75	226	38	38	347
	Machinery	23	55	11	11	94
	Others	106	341	80	80	548
Total		**312**	**941**	**60**	**190**	**1503**

Table 6.19 *Effect of Training on different Business Classifications*

More so, when it comes to the grand total it is reflected again that those requiring Formal Training to be able to satisfy the veracity of this hypothesis constitute just a third of the figure of those requiring Informal Training that is 312 by 941. **Table 6.19** also proves that ideally employers are willing to offer "Informal Training" to employees as opposed to "Hiring Employees from FDI." The figures are 941 and 60, respectively. The underlining possible inference is that there is very limited enthusiasm for Labor Mobility as a factor of FDI amongst all the states that have been considered in this research.

From the foregoing analysis the picture is lucidly emerging that chances of technology transfer through labor mobility from the foreign MNC to domestic corporations in Saudi Arabia does not fit the idealistic spectrum in very exact ways meaning the weight of truth and certainty that comes with this hypothesis is deficient in depth.

Category		Workers' Mobility			Total
		Move to Domestic Firms	Move to Foreign Firms	Stay in the Same Firm	
Location	Eastern Province	121	195	210	526
	Riyadh	253	293	337	883
	Qassim	16	33	30	79
	Hail	6	3	6	15
Total		**396**	**524**	**583**	**1503**

Table 6.20 *Workers' Mobility in different Geographical Areas*

In the case of Saudi Arabia, referring to **Table 6.20 (MOC database & Q9)**, it is hard to establish the connection between technological spillovers across the different regions of the country that are being considered in this research. There is no evidence of overt labor mobility as a direct response to the need to facilitate any spillover coming from FDI. By far the closest that can be somewhat near to provide a connecting rod is **Table 6.21 (MOC database & Q10)**, which displays the Location specific features of Saudi Arabia spread between the Eastern Province, Riyadh, Qassim and Hail.

		Training				Total
		Formal Training	Informal Training	Hiring Employees from FDI	No Action	
Location	Eastern Province	112	329	68	68	526
	Riyadh	186	551	108	108	883
	Qassim	14	50	11	11	79
	Hail	0	11	3	3	15
Total		**312**	**941**	**60**	**190**	**1503**

Table 6.21 *Training Activity in Geographical Areas*

Riyadh so far takes the lion's share naturally because of its place as the political citadel of the Kingdom and may, therefore, be a good magnetic effect on the labor market, which may be running on its terms of dynamism. Out of the total of 1503 Riyadh is able to take more than half of the current value at 883 trailed by Eastern Province, Qassim and Hail in ascending order.

The above mentioned analysis summary can be found in **Table 6.22 (Q10 & Q12).** Most of the Saudi manufacturers do not value the Formal Training. Only 85 out of 1503 local investors thought that productivity will increase due to sending their employees to attend formal training. Moreover, 583 local investors think that training regardless of the type, will not affect productivity.

		Effect on Productivity			Total
		Increase	Decrease	Will Not Affect	
Training	Formal Training	85	107	120	312
	Informal Training	319	409	463	1191
Total		**404**	**516**	**583**	**1503**

Table 6.22 *Training Activity Effect on Productivity*

As shown in **Table 6.23 (Q10 & Q5)**, 225 local investors think that the benefit from FDI Know-How is valid due to Training. The rest of the firms (641) think that Training will not play a role.

		Benefit from FDI Know-How				Total
		Yes, strong	Yes	No, Not at all	No	
Training	Formal Training	41	37	116	118	312
	Informal Training	9	138	521	523	1191
Total		**50**	**175**	**637**	**641**	**1503**

Table 6.23 *Training Activity and the Benefits from FDI Know-How*

As shown in **Table 6.24**, Chi-Square test rejects the Nil-Hypothesis depicting that there is no relation between training and productivity growth (significance 0.049< 0.05). In addition, the distribution of the data is good because the Pearson Chi-Square value is less than the minimum expected value (10.834<16.13).

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.834[a]	6	0.049
Likelihood Ratio	10.983	6	0.0495
Linear-by-Linear Association	0.192	1	0.661
No. of Valid Cases	1503		

a. 0 cells (.0 %) have expected count less than 5. The minimum expected count is **16.13**.

Table 6.24 *Chi-Square Tests for the effects of Training and Productivity*

6.5.3 The Interaction between Mobility and Training

Foreign firms may try to cripple the mobility of their employees to local firms by increasing their benefits. This action is successful but it has its own side effects. Local workers and managers may develop enough capital and skills to establish their own companies. This action may benefit the host country by improving the economy. Fosfuri et al (1998) develops a model to test the Workers' Mobility effect on the technology diffusion. He proves that Workers' Mobility increases the spillovers from FDI. Chances are that workers that are very likely to be mobile under this stream will exhibit either one or more of the following features:

- Employees that have once worked with a foreign corporation but are no longer with that foreign corporation but have received training from a foreign corporation.

- Employees that worked exclusively with a foreign corporation after being trained in one form or the other.

- Employees who received training of one form or the other but have never at any point offered their services to a foreign corporation.

- Employees that have been trained by a foreign corporation and have also worked exclusively for the foreign corporation that offered the training.

There is no gain arguing against the inherent potential of knowledge as a dynamic factor that enhances productivity at any level of corporate activity. Be that as it may, the potential for it to spillover because of its singular capacity as a viable asset explains in clear terms why diffusion is much sought after within the corporate landscape. Diffusion of knowledge can best be explained by the fact that knowledge as an asset is not the exclusive preserve of a single entity not even an inventor is able to limit diffusion. Again, it is worthy of note that knowledge transfer takes place at multiple levels across the general stream of the economy.

There have been instances where knowledge diffusion has been criticized for its tendency to undermine the huge investments that corporations expend on research and development. The connecting link between knowledge as an asset and its transfer especially within the corporate world has to do with the extent to which employees are mobile within a specific industry or across an industry. Interestingly, Labor Mobility has gone beyond the corporate world but transcends into traditional areas such as migration of skilled workers to developed economies enticed by high wages.

Table 6.25 (Q9 & Q10) shows that local investors who think that Training will improve the Mobility in Saudi Arabia represent 61.2 % of the total respondents. However, 583 investors do not think that training will have any effect on mobility. Most of those who are in favor of the positive relation between Training and Mobility think the Informal Training will play a better role in this function.

		Workers' Mobility		Total
		Yes	No	
Training	Formal Training	203	109	312
	Informal Training	717	474	1191
Total		**920**	**583**	**1503**

Table 6.25 *Training and Workers' Mobility Interaction*

As shown in **Table 6.26**, Chi-Square test rejects that Idea that there is a relationship between Training and Workers' Mobility and accepts the Nil Hypothesis (H0). The distribution of the data, however, is good.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.923[a]	4	0.687
Likelihood Ratio	3.994	4	0.677
Linear-by-Linear Association	2.365	1	0.124
No. of Valid Cases	1503		

a. 0 cells (.0 %) have expected count less than 5. The minimum expected count is **15.81**.

Table 6.26 *Chi-Square Tests for the effects of Training and Workers' Mobility*

6.6 Summary and Conclusion

The second part of the survey is distributed to local manufacturers only and it helps in the quantitative and descriptive data analysis of Hypotheses (H2) and (H3).

The two way ANOVA approach is used to analyze the data collected from national industrial players. That is followed by extensive descriptive data analysis based on literature and cross tables. I would like to enforce that the survey is

conducted in four major geographical locations in Saudi Arabia, namely - Eastern Province, Riyadh, Qassim and Hail. The survey is divided into two parts.

The second fold of the hypothesis, qualitatively, investigates the following:

H2: The interaction between the Linkage and Competition due to investment of MNCs will increase the productivity (technology diffusion) of the local firms.

H3: The interaction between the Training and Workers' Mobility will increase the productivity (technology diffusion) of the local firms.

The quantitative analysis reveals that there will be no evidence of spillovers due to the interaction between Linkage and Competition due to the investment of MNCs. If the country's competitive environment continues on the same style, the diffusion will not eventually spillover to the local corporations. This will not affect the productive capacities in very phenomenal ways as a result of the technological diffusion. The gains that the host country, in this case Saudi Arabia, accrues from technological diffusion are of importance to its long term growth prospect. Several actions should be taken to guarantee the success. The key factor here is to determine if the expected linkage will be forward or backward as part of building case for the Hypotheses (H2). The implied connection to the foundational hypothesis proves that the injection of capital and technology does not have the grounded propensity to trigger Competition within the domestic Saudi economy. For this reason, the Hypotheses (H2) is rejected.

Pertinent to the descriptive analysis part as a recap of all the points highlighted in testing the veracity or otherwise of the second hypothesis here thus far reveals very insightful details. Spillovers as discussed in the early stages of the section can take the form of technology or expertise, which can occur across Inter-Industry or Intra-Industry; it can also take place through a Forward or Backward Linkage. Therefore, this means that spillovers can be likened to a double-edged sword that cuts across both edges. Its impact can also be felt differently depending on the specific location. Within the confines of this research, specific emphasis is placed on technological spillover. For a spillover to take place from a foreign MNC to a local corporation, it is imperative to establish the limits of the capacity of Local Corporation to absorb and incorporate this spillover technology.

Even within the host economy there is a prevailing level of differences between different industries within the same economy.

As MNCs through FDI engage in their operational activities in the host country, they create the stage for the diffusion of their operational technologies within the host country. The diffusion eventually spillovers to the local corporations and augments their productive capacities in very phenomenal ways because of the technological diffusion. Therefore, the benefits that the host country in this case, Saudi Arabia accrues from technological diffusion are of latent significance to its long term growth prospect.

Regarding the draws from the descriptive analysis of the Hypothesis (H3), there is no evidence of overt labor mobility as a direct response to the need to facilitate any spillover coming from FDI. This fact is applicable for both “Inter” and “Intra” industrial analysis. Therefore, the Hypotheses (H3) is not accepted.

The next chapter further explains the findings and conclusions.

Chapter 7 Findings and Conclusions

7.1 Introduction

The main focus of this research has been to address the effects of FDI on technology diffusion in the Kingdom of Saudi Arabia. The research considered those effects in the manufacturing sector. This is very important as the economy of the Kingdom is largely dependent on oil and petrochemical. The fact that a country's economy depends mainly and highly on one source makes the risk very high. Evidence of this fact includes the economic crises that took place in the year 1998. At that time the price of an oil barrel dropped to $8 US. The Saudi Government suffered as oil is the main drive of the Saudi economy. To solve that problem, the government of the country has to think of diversifying the economic activities. Yet, diversification of activities requires the necessary infrastructure, which includes human resources, financial resources and technology. FDI is an important source of technology diffusion. This research investigated four effects of FDI on technology diffusion. Those effects are Demonstration-Imitation, Linkage, and Competition and Workers' Mobility. The study is conducted on the manufacturing firms in Saudi Arabia. Those firms are located in two major geographical areas, Eastern and Central Provinces. More specifically, they are located in Riyadh, Qassim, Hail and the East of Saudi Arabia. The number of firms that were included in the study was 3888 firms among which there were 2600 local investors and 1288 foreign investors.

The first fold of the research begins by developing a model that may be used to measure the size of the four effects. This model is developed based on Parente and Prescott model published in 1994. Then, I investigated the technology diffusion in the absence of the foreign variables. This step is taken to compare the effect without adding the foreign variables in the equation. The effects of foreign variables are then measured. Based on this analysis, some of the effects are found to be vital for the development of the productivity increase. Others were found to have a zero effect.

The second part of the research discussed the future of the FDI taking in consideration the effects of Linkage, Competition, Labor Mobility and Training. The interaction between the quantitative results of Linkage and Competition do not seem to be a cause of productivity improvement according to the local manufacturers. Same result was discovered when the interaction between Labor Mobility and Training is studied. The quantitative analysis of these effects is supported by intensive descriptive analysis. This descriptive analysis is supported by cross-tables produced from Part II of the survey. The next section provides extensive description of the findings.

7.2 Description of Findings

The economic leaders in the Kingdom of Saudi Arabia realize that their ambitious economic goals require a steady flow of technology and regulating expertise in the country. Therefore, its policy is to welcome foreign capital and invite it to participate in economic development projects in cooperation with Saudi business investors. The Saudi government's established policy is not to impose any restrictions on the movement of capital into and out of the Kingdom and always to respect private ownership. This research investigates the result of this policy implementation. As the amount of capital inflows in the country keeps surging due to FDI, this should be reflected on the increase of the TFP levels of the local manufacturers. The investigation of this reflection is done on both Inter-Industrial and Intra-Industrial scales. Several scenarios are created to come up with the mechanism through which FDI promotes the TFP growth in the country.

On the Inter-Industrial analysis, this research reveals that excluding the FDI will eventually lead to technology diffusion. However, the figures show that the time diffusion is very slow and it will take such a long time for this phenomenon to take place. In this case, the technology diffusion will be through three major effects. Those effects are the Catch-Up effect, Training effect and the other effects like Age of the firm. This situation may be compared with the productivity level of the manufacturers prior to the establishment of SAGIA. At that time the FDI activity in the country was almost dead. The need to compare the situation of the diffusion after the implementation of the new FDI policies in the Kingdom justifies the need to investigate this issue.

The Inter-Industrial analysis appeals by including the four main effects of FDI in technology diffusion. The step is taken to investigate the Hypothesis (H1), which states that "*The spillovers' effects (Demonstration-Imitation, Competition, Linkages and Training*[12]*) from FDI are important source of technology diffusion (productivity growth)".* To do so, the model derived from the Parente and Prescott equation is utilized. Using the OLS regression, I find out that there is evidence of technology diffusion due to the existence of FDI in Saudi Arabia. The two important effects that are playing a strong role in the diffusion process are Linkage and Competition. However, when other control variables are added, those two effects lost strength.

The research continues by investigating role of each individual effect in the technology diffusion. This is done by conducting the analysis considering the two extreme cases. For example, I considered the firms with Demonstration-Imitation effect only. Then, I compare it with firms who do not have Demonstration-Imitation activities. In both cases, there is no evidence of TFP growth due to any of the four foreign variables. Instead, some of the control variables were significant. Those are the Chemical, Non-Metallic, Machinery and Others industries. This shows that firms who concentrate on the Demonstration-Imitation activities usually lose focus on other important subjects related to the business directly. This is clear from the result of the analysis because all firms that have this type of activity did not show any improvement in technology due to the Others effects. Another notable issue from this analysis is that the Catch-Up effect for firms without Demonstration-Imitation is less than those who are practicing this activity. This means that the Catch-Up exists but for those firms with foreign joint ventures, it has a larger scale.

The second comparison is made for firms that have foreign linkages and those who do not. The first conclusion derived from this analysis is that when the foreign relations with buyers and suppliers (Forward and Backward Linkage) are absent, the Catch-Up effect disappears. When the Linkages are absent, the Competition seemingly also disappears. The observations suggest that firms are not engaged to train their employees. The Imitation effect also is insignificant. Foreign linkages are also insignificant in increasing the TFP level. Openness to

[12] Note that training is not considered an effect directly stemming from FDI, rather training stimulates workers mobility and there for it is studied through this hypothesis.

foreign sources even sparks out the interaction between the different industry players. Competition is, however, significant, for firms that are engaged in Linkage activities. Other effects such as Training are insignificant in both cases. Four control variables are significant for companies that are not engaged in Linkage activities. These are the Food, Chemical, Non-Metallic and Others industries. Aw and Batra (1994) research studies examine the effect of foreign linkages on firms' productivity. They analyze the case of the Taiwanese industry and particularly examine the relationship between firms' linkages and efficiencies. The conclusion is that the engagement of firms in this type of investment leads to firms' higher efficiencies.

Another important comparison done in this research is between those firms that undergo high Competition and those who have very low Competition. The result reveals that in the absence of Competition, the technology diffusion through the four foreign variables completely disappears. All the effects considered here do not affect the TFP growth. The Competition is one of the most important effects that force manufacturers to improve their productivity and quality levels. For companies that have strong Competition, two other variables of interest, namely Linkage and Training, are statistically significant. The general impression about the Saudi market is that, it is a sellers' market. That means the level of Competition is low. The access to FDI will increase the number of industry players that will result in higher Competition. However, those industry players should be competent enough in terms of productivity and quality. The regulations of FDI should allow those investors who have the new production capabilities to easily access the Saudi Market.

In the case of comparing companies that send their employees to attend formal training and those who do not, none of the four foreign variables of interest is significant. In the absence of training, only one of the control variables is significant and that is the Others industry. This cast doubt on the quality of training in the country. Despite the amount of money spent for training and educating young Saudis, the return on training is not yet satisfactory. That might be due to the reasons related to the level of training and education.

On the Intra-Industry level, the result of Hypothesis (H1) analysis looked deep into each industry and investigated the four effects. **Table 7.1** depicts the result of the Intra-Industry analysis. The Demonstration-Imitation effect is not positively affecting a single industry. This effect rather helps in the improvement of selected companies in each industry. On the other hand, the Competition effect is supporting the growth in four industries, which are Food, Textile, Non-Metallic and Others industries. Three industries are not being affected by Competition. Those industries are Wood, Chemical and Machinery. The Wood industry is recently affected by the products imported. Chinese products, for example, dominated the Saudi furniture market. This forced so many Saudis to shut down their manufacturing plants. The Chemical industry is a type of monopolistic in Saudi Arabia. Big companies like SABIC, Saudi Aramco and Yensab are mostly owned by the government and their focus is on sales rather than planning to increase productivity. Their main focus is not on the development of the current plants or in encouraging local manufacturers to build their chemical refineries. Rather, most of those are built and manufactured by foreign companies. Foreign companies, as explained in the previous chapters, do not want to reveal any of their technologies. The Training effect requires special attention. Only the Textile industry benefited from the training activities in the country. According to the World Bank database, public spending on training and education is 6.8 percent of GDP and public spending on training and education as percentage of government expenditure is 27.6 percent in 2004 (World Development Indicator/Edstats). Education spending as a proportion of overall spending tripled from 1970 to 2000 and neither economic growth nor the price of oil had much impact on this trend in Saudi Arabia[13]. If this much spending is not helping the country to grow up in technology, the quality of those training and education efforts and initiatives are questionable in terms of educational standards, the comprehension levels of trainees and motivational methodologies used in Saudi educational system for respective employment levels in different business sectors.

Two of the seven industries require further attention from the government of Saudi Arabia. These two industries are the Chemical and the Machinery. Economically speaking, this is very dangerous phenomenon. This is because

[13] *UNESCO IBE 2007.Saudi Arabia," World Data on Education,6th Edition."*, 2005/2007

Saudi Arabia is one of the most active countries in terms of Petrochemicals. Moreover, Saudi Arabia is a very high level consumer in Machinery. The Textile industry is the best among all industries since it is benefiting from three effects, namely Linkage, Competition and Training. The Competition in the Food industry is very high and is helping the TFP improvement. In the Others industry, the productivity growth has boosted up by the Linkage and Competition effects.

Industry	Demonstration-Imitation	Linkage	Competition	Training
Food	No	No	Yes	No
Textile	No	Yes	Yes	Yes
Wood	No	Yes	No	No
Chemical	No	No	No	No
Non-Metallic	No	No	Yes	No
Machinery	No	No	No	No
Others	No	Yes	Yes	No

Table 7.1 *Summary Result of the Intra-Industrial Analysis*

The second fold of the analysis comprises two Hypotheses (H2 & H3). The instrumental survey used to do the necessary analysis, is distributed to all of the local manufacturers. The objective of this part is to diagnose their expectation for the future of the FDI effects on technology diffusion. Hypothesis (H2) states *"The interaction between the Linkage and Competition due to investment of MNCs will affect the productivity (technology diffusion) of the local firms".* The two way Analysis of Variance is used to examine this hypothesis. This type of analysis tests each individual effect on technology diffusion and then the effect of the two variables' interaction. The result shows when both Linkage and Competition work independently, they will not have any effect on technology diffusion. Further, when the two effects interact and work at the same time, they will not have any effect on technology diffusion. This analysis is followed by a comprehensive analysis using cross tables derived from the survey results. The aim of that analysis is to read inside all the expectations of the local investors pertinent to the relation between the three effects.

Similarly, Hypothesis (H3) is tested using the two way Analysis of Variance . It states *"The interaction between the Training and Mobility of workers will increase the productivity (technology diffusion) of the local firms"*. First, the Mobility effect

on productivity is examined independently. Next, the effect of Training on the productivity is tested. Finally, the interaction between Training and Mobility and their effect on technology diffusion is tested. The result reveals that there is not clear evidence that spillovers due to Mobility exist. Also, there is not a clear evidence that there Mobility will affect the productivity growth. The interaction between the two will not provide any improvement in the productivity level. This result is supported by extensive descriptive analysis that is based on local investors' feedback. The following inferences serve as justifications for the above conclusions:

- The technology gap between local manufacturers and their foreign counterparts is very wide to the extent that local manufacturers do not think they will accommodate part of it.

- Lack of fundamental mechanism through which technology will diffuse. Kugler (2001) produced similar results.

- The Catch-Up of new technologies is not complementary in the country. Also, SAGIA is not assigning enough regulation to control this process.

- Foreign investors in Saudi Arabia make provisions for the risk of their technology spillovers to domestic corporations. If it is not the case, FDI would add up the cost of possible technology transfers.

- **Location factors:** FDIs select to move their production locations in such a way that there is enough isolation that would protect their production technologies.

- Foreign firms may cripple the mobility of their employees to the local firms. Fosfuri et al (1998) prove that workers' mobility increases spillovers through FDI. These FDIs will not allow this phenomenon to take place. In our case, the workers' Mobility in Saudi Arabia is questionable.

- There is less confidence of local manufacturers on the value and quality of training. Training polices in the Saudi government organizations have to be revised.

- Being the cheapest, Informal Training or On-Job Training is the most popular among local investors. Our survey figures prove that employers are more enthusiastic to offer this type of training. Even though, it is an effective way of knowledge, skills and attitude transfer, it is very limited to the low level technical aspects of training. It is, in fact, more effective in the operation and maintenance type of training. Unless this type of training is mix-matched with the previous step, which is the Formal Training, its value will be very limited. Training has to be shifted more to the engineering level.

7.3 Conclusions

Countries promote FDI and give away several incentives to foreign investors to achieve a set of defined objectives. Those objectives are usually set, based on the economic situation of the host country. On top of those objectives, there is the attraction of foreign financial resources. Saudi Arabia is one of the richest countries in terms of financial resources. However, these financial resources are very limited. This puts the economy of the country under high risk. Therefore, any slumps in the oil and petrochemical prices might bring the economy to a very bad status. To avoid this risk the economic activities have to be diversified. In order to diversify those activities, the development of the technological environment in the country is “a must”. FDI is one of the most popular way through which technology diffusion could be achieved. According to the analysis found in the content of this research document, the advantages gained from this activity are not comparable to the promotions given by SAGIA.

Table 7.2 provides an overview about the current status of the four channels through which technology diffuses in KSA. Next section of this research will provide set of recommendations that need to be implemented in order to improve the benefits from FDI. The recommendations should help in maximizing the technology diffusion in Saudi Arabia.

Mode of Transmission	Conclusion	Current Impact	
		Intra-Industry	Inter Industry
Demonstration effect	Chances are that domestic corporations may imitate processes and products through FDI are very limited or even absent. Domestic corporations may not have the technical supporting base to incorporate new superior technologies.	No impact	No impact
Competition effects	Domestic firms react impulsively to entry threats from foreign corporations by cutting costs. Domestic corporations, however, are not adopting new technologies. Benefits are limited to four industries out of seven. In the Inter-Industry level the benefit is quite limited.	Positive	No impact
Labor Mobility	Foreign corporations are requiting employees with high skills. At the same time they are limiting the movement. FDIs try to limit the mobility of these employees. Improper estimation may cost domestic corporations in their bid to align human resource capacity against that of foreign manpower. Moreover, potential drain of highly skilled manpower to foreign corporations that offers better remuneration and better conditions of service result in mounting pressure on wages.	No Impact	No impact
Linkages	**Forward Linkages:** Challenges arising from the adoption of new technologies by domestic corporations, which eventually limit their capacity to engage competitively on the domestic market. **Backward Linkages:** Possibility of acquiring high value intermediate products; technological enhancement of the products of the domestic corporations.	Limited Impact	No Impact

Table 7.2 *Conclusion for the Four Effects*

7.4 Recommendations

Based on the findings of this research, I have been working with several committees authorized by SAGIA. Those committees are responsible for improving the technology diffusion in the country. The committee started by studying the infrastructure of the country. The objective of this step is to understand and put the study results and recommendations into actions that will eventually lead to technology diffusion. Eventually, this will lead to diversification of economic activities. The structure of this section starts by introducing the necessary recommendations and followed by giving real life projects recommended by me through the committee responsible for spreading of the technology diffusion in the country.

The first recommendation is regarding the improvement of the Demonstration-Imitation. The best example to learn from in the Imitation experiences is the Chinese case. Truly, China displays the required conditions for FDI spillovers to be sufficient. When it comes to the bargaining power with foreign firms, the Chinese government was always the winner. The Chinese exponentially growing consumption has made the foreign firms presence on the Chinese soil inevitable. One of the policies that led to the Chinese local manufactures' development is the multi-existence of the firms in the same industry. That is, one firm cannot dominate a single industry. This purchasing power has allowed the Chinese government to impose its conditions on the foreign firms. In order to penetrate the Chinese market, the foreign firms had to access through joint ventures only. The Saudi market is incomparable to the Chinese market in terms of power of consumption. However, the adoption of the joint ventures' policy in the manufacturing sector is possible. Saudi Arabia is still the largest consumer in the Middle East. SAGIA was advised to implement the joint ventures policy. To encourage the FDI to get involved in these types of projects, SAGIA was advised to offer more tax holidays.

Foreign companies who participate in joint ventures in the country usually concentrate on the oil and petrochemical sectors. The reason for that is that most of them benefit from the low prices of oil given to the Saudi investors. This fact was confirmed to me during the Emperor of Japan Birthday party conducted at the Japanese Embassy at Riyadh in 2007. At that time the Japanese number of attendees from the Japanese Sumitomo was huge. When I asked one of the company top ranking employees about such existence he answered "we came to capture business opportunities in Saudi Arabia, we would like to be involved in joint ventures with big companies like ARAMCO" When I asked him " Why Saudi Arabia and Why ARAMCO and not any other company" he answered "we will get low oil prices". Establishing joint ventures will benefit the petrochemical industry in Saudi Arabia. Today, a lot of foreign companies are working in this sector and they are getting low oil prices. According to my research, the benefit in terms of technology diffusion in this sector is absent. I would like to impose stronger regulations on companies who would like to be involved such joint ventures. One of the suggestions is to go on Buy-Operate-Transfer System (BOT). Under this

system, the foreign partner has to run the different plants for a certain period, train local workers and eventually leave the country.

Another recommendation pertinent to the joint ventures is to utilize the purchasing power in the electric power industry. In this industry, the demand growth in Saudi Arabia is a two digits figure. The Saudi Electricity Company (SEC), the major electric power producer, transmitter and distributer invests heavily in buying steam and gas turbines. Its estimated investment in the coming ten years will be about $20 billion. The company was advised to get involved in a joint venture with one of the gas turbines' manufacturers. This was through a recommendation delivered to the company's top management in 2009. In 2010, a joint venture agreement between SEC, ARAMCO and Siemens was signed. These joint ventures will help in establishing the first gas turbine manufacturing plants in the country. The turbines will be manufactured and sold inside Saudi Arabia and the major consumers are SEC, ARAMCO and all other power producers and petrochemical plants. Siemens will enjoy a 12 % tax holiday while SEC and Saudi ARAMCO will gain lower prices and will share the profit with Siemens. On the same joint ventures one of the contract items that will help in the development of the Saudi human resources is the establishment of a training center attached directly to the manufacturing plant. The training center will help in training and developing young Saudis in the manufacturing plant. It will also graduate trainees for other companies in specialties related to the same field. To summarize this recommendation, joint ventures will help in diffusing technology through Demonstration-Imitation and also through other agglomerate channels such as Training.

The paper notes that fostering future diversification through technology diffusion stimulated through FDI, KSA economy requires an integrated comprehensive strategy, involving an active partnerships between the Private and Government sectors. The government has to address and play a facilitating role since successful strategies have to tackle economy wide problems faced by the economic agents at their various levels of operations. The private sectors have to play the leading role in implementing strategies to upgrade capabilities. Private production of public commodities in areas as information, export promotion, financing, training, and productivity enhancement techniques will need to be

initiated in a coherent framework. One of the important recommendations is formulation of action plans that will concentrate on various private and public impediments to improving productivity through competitiveness that need to be formulated and implemented at different levels of the economy. In this regard, it is suggested that the Intra-Industry approach towards increasing productivity and Competition to be adopted. The government role is to establish and accelerate policies of implementation. Those polices should target strengthening the role of the private sector, export promotion, attracting FDI, regional and international economic and trade activities' facilitation of appropriate legal-regulatory framework and other measures undertaken to improve the Competition environment in which KSA firms operate. As far as the specific roles played by FDI in this diversification drive, it was noted that FDI would have to be viewed as one of the most effective channels for economic diversification. A stable flow of FDI requires commitment to a long-term strategy designed to improve the investment climate but flexible enough to accommodate new developments. Investment policies should also aim at attracting FDI to improve Competition in the Wood, Chemical and Machinery field where these areas that are ideal candidates for diversification, do not have high Competition relative to the rest of the other business classifications.

Furthermore, care should be taken so that FDI does not crowd-out private domestic investors from its business activities. In this respect, I would like to send a signal related to size of the foreign investors. Gradually, SAGIA administration reduces the restrictions on the foreign investors. One of the serious conditions for FDI regulation is the size limited to SR 500,000. This amount is very small and it allows small investors to crowd the Saudi market causing a negative social-economic impression. In addition, small investors do not have access to the state-of-the-art production technology. This rule states that the minimum amount of capital invested as a condition accessing the Saudi market usually do not add much in terms of technology. The recommendation in context is to not to raise the minimum amount of investment, rather I would like to see SAGIA controlling the type of investment and ask more about issues related to new technologies. Allowing investors to bring this small amount without other values added will not help boosting up the technology. In this case only big investors who have strong access to technological infrastructures are allowed to access the market.

The third issue in this section is the diversification of an economy by encouraging and strengthening inter- and Intra-Industry, sectoral and international linkages. It requires inducing technological change, innovation, an open learning and knowledge sharing system, and change in the organizational structure and behavior of firms, industries, and government. Government has a principal role to play in facilitating this process by addressing systemic type of issues such as provision related to supporting local businesses. This can be achieved by assigning conditions regarding the production inputs. The provision should clearly state that foreign investor should buy a percentage of their production material from local investors. Local investors in this case will have to take two actions. The first action is the improvement of their products. This step will be taken to match their product quality with standards of the foreign investors. The second action is the improvement of their production capacities in order to meet the demand of the foreign investors. Four of the seven economic sectors require attention in this regard and those are Food, Chemical, Machinery and Non-Metallic sectors.

The fourth recommendation is related to the workers' Mobility and Training. Human resources area is the most important element in the technology diffusion process. The results derived from this research reveal two important facts. The first fact is that the mobility of workers is not strong enough so that local manufacturers will be able to adopt technologies in local manufacturers' plants through this channel. The second is that the quality of training in the country is not effective enough to adopt those technologies. However, the second fact could be a cause for the second. That is, the quality of the training does not encourage the local investors to hire the Saudis. A second cause of slow mobility of workers is that foreign investors will try to seize the process through high salary payment. It is noticeable from the study result that the local investors' confidence in the national human resources is very limited.

There are two solutions for the Training and Mobility problems. The solutions are to set up two committees. The first committee is Board of Directors of TVTC. It is related to the improvement of the Saudi technical human resources. The recommendation states that strategic partnerships between the TVTC and local manufacturers should be launched. The details of the partnership urge the TVTC to build vocational training centers. Those training centers should be managed by

the local manufacturer, TVTC and HRDF; however, they should be run by an international operator. The objective of this step is to improve the level of technical training. This recommendation was accepted and some of those training centers are already in operation. Example includes, the National Institute of Technology (NIT) located in Jeddah, The National Petroleum Training Center being run by the TQ of the United Kingdom and the Saudi Plastic Training Center being run by the Japanese Mitsubishi. Another important center is the Saudi Electricity Polytechnic. I am participating in this project as a team leader.

The second recommendation for the training was submitted to the Saudi Electricity Company. It was related to the improvement of the Saudi Engineers. This is done by imposing a condition in any contract to be signed with a foreign supplier. This condition states that Saudi engineers should be assigned to work in the suppliers' manufacturing facilities for a period of one year. During this year Saudi engineers will attend the design, assembly and commissioning stages with the manufacturer. The first batch of engineers from the Saudi Electricity Company has been attending in Siemens manufacturing plants since September, 2011. I had the honor to write up all the regulations for this program and presenting it to the SEC Board of Directors.

7.5 Limitations and Prospects for Future Research

This study uses a distinct data set that is collected from SAGIA, Ministry of commerce and the industrial players. Yet, it has it is Limitations, which are discussed in this section.

7.5.1 Limitations of the Study

The Limitation of my study is of two folds. The first fold is related to the generics of the research comprising location, the period and the target audience. The second fold is related to specific features of the data collected and the measures used to calculate the TFP growth.

The study is conducted in four major geographical proximities of Saudi Arabia, namely, Eastern Province, Riyadh, Qassim and Hail. Those areas are located in two major provinces namely the Eastern and Central province. The study did not cover the other nine geographical proximities of Saudi Arabia, namely, Makah, Madinah, Jazan, Najran, Aseer, Al-Baha, Al-Jouf, Tabouk and the Northern Boarders. Those areas are located in three major provinces, which are the Western, Northern and Southern of the country.

In addition, the data collected and used for the calculation of the Catch-Up effect and the TFP growth is for the period from 2004 to 2008 and does not cover any period prior to 2004 or after 2012. Moreover, the research is limited to the business industrial sector and does not cover any research analysis related to the services sector.

In relation to the specifics of the data, the accuracy of the data varies depending on the size of the organizations targeted. The expectation here is that large organizations are always well managed and they keep a documentation of important data like number of workers, value of exports and value of sales. The data listed on Questions 1-8 of the Survey requires very accurate figures, which may be stored in databases or information management systems of big companies. Some of the small organizations would depend mainly on their memories to answer questions, which may affect the accuracy of their feedback.

Given, the culture and business environment of Saudi Arabia, some of the measures used are crude in nature. Example includes the measurement of Training effects. Yet, the expectation that different target companies would not release information that is sensitive in nature drives the nature of data requested to this direction. Releasing this kind of data would subject them to risk due to the fact that the HRDF and Ministry of Labor would stop funding their programs. This kind of data would affect the Survey results because companies who did train thirty of their employees, for example, would be treated equally with companies who train one or two employees only.

Other measures may have been taken using different methods. Examples include Competition, which is measured based on the foreign share of employment

relative to the total number of employees in each industry. Competition, as mentioned previously, takes seven distinct values. Other method that may have been adopted includes using the number of foreign firms to the number of local firms in each industry. Another method may be using the total sales of foreign firms to the total sales in each industry. The fact an investment a firm can make in accordance, is in human resources that justifies using this measure. In addition, the number of firms may be very small in some of the industries including Food, Wood and Textile. So the study is limited and specific type of measures matching the business and cultural environment of the county have been taken.

7.5.2 Prospects of Future Research

This thesis has made important participation in the literature related to FDI and technology diffusion in Saudi Arabia. The types of data collected, population targeted and the response rate makes it distinguished relative to other studies of the same nature. In addition, the study is very comprehensive since it targeted almost all the possible control variables and also it targeted the different dimensions of the relationship including inter–industry, inter- and intra-regional analysis. Analysis based on the size of industries is also done.

Yet, there are other areas that are left for future researchers. Some of the interested areas include looking at more detailed analysis of FDI effect. This requires more effort in the collection of real data that may reflect the effects. Example of this kind of data includes true figures related to the amount of goods exchanged between foreign investors and their counter partner locals. Another example of data collection may include better measures of training and development figures in the country. The amount of money spent on training in each organization may reveal better and more accurate study. Similarly, Competition effect may be studied using other indicators. Example includes the number of firms in each industry or the rate of foreign sales to total sales.

Other future studies may include investigation of the other technology diffusion effects. Those studies may cover the effects of trades, migration of scientists and Research and Development effects.

Last but not least, the most important issues that have to be considered in the future research is studying the effect of the changes this study created. This includes studying the effects of the new strategic partnership training system that is adopted based on a recommendation from SAGIA and MOC committee in addition to the effects of training conducted with the major vendors and suppliers operating in Saudi Arabia. Finally, the development of the technology buyout and improving the policies, which may lead to technology diffusion, should be an area of focus.

*****************Completion of Thesis****************

GLOSSARY

Absorptive Capacity: Country's ability to value, assimilate and apply new knowledge (Cohen and Levinthal, 1990).

Backward/Vertical Linkages: Contacts between domestic suppliers of intermediate inputs and their multinational clients (Holland and Pain, 1998).

Technology Diffusion: the dissemination of technical knowledge from a person, organization or a country to another through suitable means of communications (Rogers, 2002).

Explicit Knowledge: Knowledge that has been codified and stored in a certain media and can be readily transferred (Saviotti, 1998).

Foreign Direct Investment (FDI: The process whereby residents of one country (the source country) acquire ownership of assets for the purpose of controlling the production, distribution and other activities of a firm in another country (The host country).(Romer, 1990).

Forward/Horizontal Linkages: Domestic Producers buy intermediate products from foreign producers due to the increase of technical complexity

(Holland and Pain, 1998).

Horizontal Spillovers Local firms benefit from the presence of foreign companies in their sector by getting necessary information to improve production (Javorcik, 2004).

Imitation: Local manufacturers/suppliers upgrading their quality of products through exposure to superior technology exposed by technology diffusion (Connolly, 1998).

Innovation: An idea, practice or an object that is perceived as new by an individual or other unit of practice (Rogers, 2002).

Mobility Effect: The effect of moving employees as a result of upgrading the level of knowledge and skills in the competitive local market that leads to

spread of technology through diffusion process in the presence of FDI (Kinoshita, 1998).

Tacit Knowledge: Codified knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it (Polanyi, 1958) .

Technology Spillovers: Externalities of economic activity or processes upon those who are not directly involved in it (Coe and Helpman, 1995).

Technology Transfer: The application of information to use. It is the process through which the results of basic and applied research are *put into use by the receptors* (Rogers, 2002).

Technology: Technical knowledge and skills used in designing for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome (http://en.wikipedia.org/wiki/Technology#cite_note-mwdict-0).

Vertical Spillovers: Local firms benefit from the existence of foreign firms because they supply them with the necessary production materials (Rodrigues, 1996).

ABBREVIATIONS

BOT:	Buy, Operate and Transfer
CINDB:	Costa Rica Investment and Development Board
DEA:	Data Envelop Analysis
FDI:	Foreign Direct Investment
FTM:	Frontier Theory Model
GCC:	Gulf Cooperation Countries
HRDF:	Human Resources Development Fund
IFC:	International Finance Corporation
IMF:	International Monitory Fund
IPA:	Investment Promotion Agency
KAPSARC:	King Abdullah Petroleum Studies and Research Center
KSA:	Kingdom of Saudi Arabia
MNCs:	Multi-National Corporations
MOC:	Ministry of Commerce
MOFA:	Ministry of Foreign Affairs
NIT:	National Institute of Technology
OECD:	Organization for Economic Co-operation and Development
OLS:	Ordinary Least Squares regression of data model
PACW:	Predictive Analytics Software
R&D:	Research and Development
SABIC:	Saudi Arabian Basic Industries Company
SAGECO:	Saudi German Development & Investment Company
SAGIA:	Saudi Arabian General Investment Authority
SARAMCO:	Saudi Arabian American Company
SEC:	Saudi Electricity Company
SPSS:	Statistical Software Package for Social Sciences
SWOT:	Strength, Weaknesses, Opportunities and Threats
TFP:	TFP
TNC:	TransNational Corporations
TRN:	Training Ratio calculated from survey data
TVTC:	Technical and Vocational Training Commission
UK:	United Kingdom
UNCTAD:	United Nations Conference on Trade and Development

USD: United States Dollar

USPs: Unique Selling Points

WTO: World Trade Organization

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Appendix-A

The Survey Questionnaire

Dear Sir,

I am a DBA candidate at the joint Post Graduate degree program of the University of Newcastle Upon Tyne in England and Grenoble Cole de Management in France. Nowadays, I am working on my thesis, which is about the Effect of FDI on Technology Diffusion.

As you know, SAGIA is putting lot of efforts to attract Foreign Direct Investors. This will definitely affect your business in a positive or negative way. It will also help in the development of technology in the country.

I wrote this questionnaire to investigate the above mentioned issues. Please spare five minutes from your valuable time to fill in this survey. I would like also to attest that the information provided by you will be top confidential and will not be released to any other person.

Please return the questionnaire to me through the fax or the e-mail hereunder. Should you have any questions or require further clarification, please do not hesitate to contact me at my mobile #0506807057 or write to me at shakerhm@yahoo.com

Regards

APPENDIX A (CONT'D)

Survey Questionnaire

Subject: The Effect of FDI on Technology Diffusion:

By

Shaker H. Al-Mahasenah,
DBA Candidate, University of Newcastle upon Tyne and
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DBA Program
University of Newcastle Upon-Tyne and Grenoble Ecole de Management

PART 1 Survey Questionnaire

Name of the Company:

Date of Business Establishment:

This part contains general Information about your business performance

No	Question	2004	2005	2006	2007	2008
1.	What is the age of your firm (years)?					
2.	Total Capital Investment in MSR?					
3.	What is the total number of workers?					
4.	What is the number of local workers?					
5.	What is the total number of production employees?					
6.	What is the value of total production (Total Sales at Current Constant Prices in SR) ?					
7.	What is the total cost of material used to produce at Current Prices in SR?					
8.	What is the Total Value of Exports in SR?					

9. Do you currently have foreign joint ventures (Seller or buyer) ?

❑ Yes ❑ NO

10. In the past five years, did your enterprise send employee to formal training?

❑ Yes ❑ NO

11. Do or did you have any plan to diversify business horizontally or vertically?

❑ Yes ❑ NO

12. Does your firm have any Foreign Buyers or Suppliers?

❑ Yes ❑ NO

13. The current international financial crises will

- ❑ Positively affect my investment in Saudi Arabia
- ❑ Will not affect my investment
- ❑ Negatively affect my investment in Saudi Arabia

APPENDIX-A PART 2 Survey Questionnaire

This part contains questions related to your expectation of the future effects of Foreign Investment. (To be sent to Local Investors only)

Q1. How would you classify your business?

❑ Food	❑ Textile	❑ Wood	❑ Chemical
❑ Non-Metallic	❑ Machinery	❑ others	

Q2. Do you expect more Competition in the next few years?

❑ Yes, Strong	❑ Yes	❑ Not at all	❑ NO

If the answer for Q2. is no or not at all, go to Q4, directly.

Q3. With which firms do you expect to compete?

❑ Foreign Firms	❑ Domestic firms
❑ Both Foreign and Domestic firms	

Q4. How will you react to the Competition coming from the entry of Foreign Firms?

❑ My firm to work more efficiently	❑ Cooperate with other companies
❑ Introduce new technologies	

Q5. When foreign firms enter the Saudi market, I expect the difference in technology level between my firm and the foreign firms to be:

❑ Low	❑ High	❑ The same

Q6. My firm will react to the products introduced by foreign firm by:

❑ Imitating their products	❑ Directly cooperate with them
❑ Continue on the same products	❑ Buy the production technology from them

Q7. The entry of foreign firms will help to:

❑ Sell them intermediate goods	❑ Buy intermediate goods from them
❑ Buy and sell intermediate goods to them	❑ None of the above

Q8. I expect my firm to do business with foreign firms which:

❑ Produce the same type of products	❑ Produce different Type of Products
❑ Produce both same and different type of products	❑ None of the above

Q9. The entry of foreign firms will make my employees:

❑ Move to domestic Producers	❑ Move to Foreign Firms
❑ Stay in the same firm	

Q10. To cope with the technology introduced by firms, our firm intends to:

❑ Send employees to formal training	❑ Conduct informal (On-the-Job) training
❑ Hire employees from foreign firms	❑ None of the above

Q11. Do you think you will benefit from the technical know-how when the Foreign Firms come to the country?

❑ Yes, Strong	❑ Yes	❑ Not at all	❑ NO

Q12. The entry of foreign investors will:

❑ Increase my firm productivity	❑ Decrease my firm productivity
❑ Will not affect the productivity of my firm	

Appendix-B

Data Figures

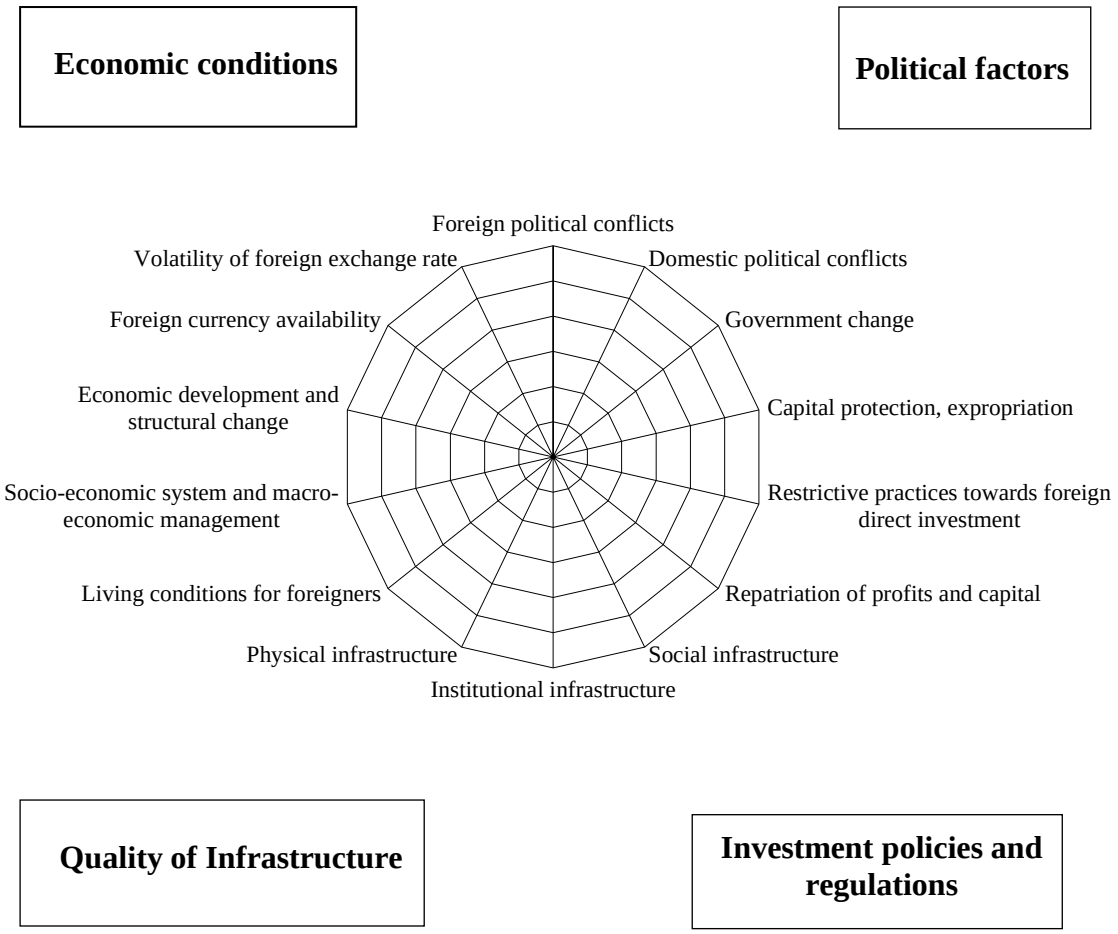


Figure 1 *DEG 14 Indicators of Business Environment Analysis*

Figure 2: The Four Most Important Reasons for Engagement

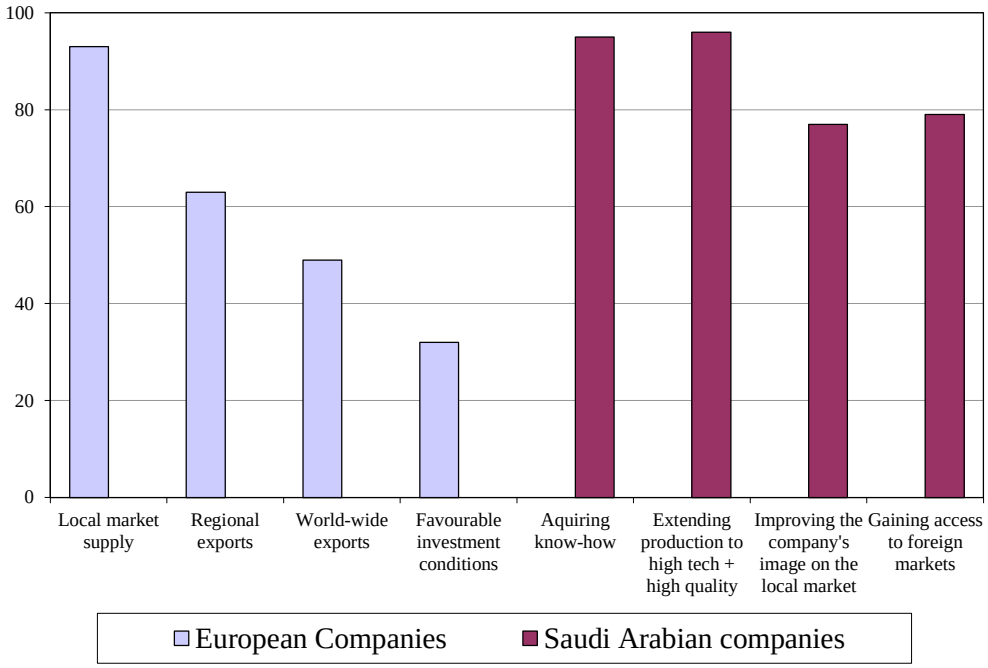
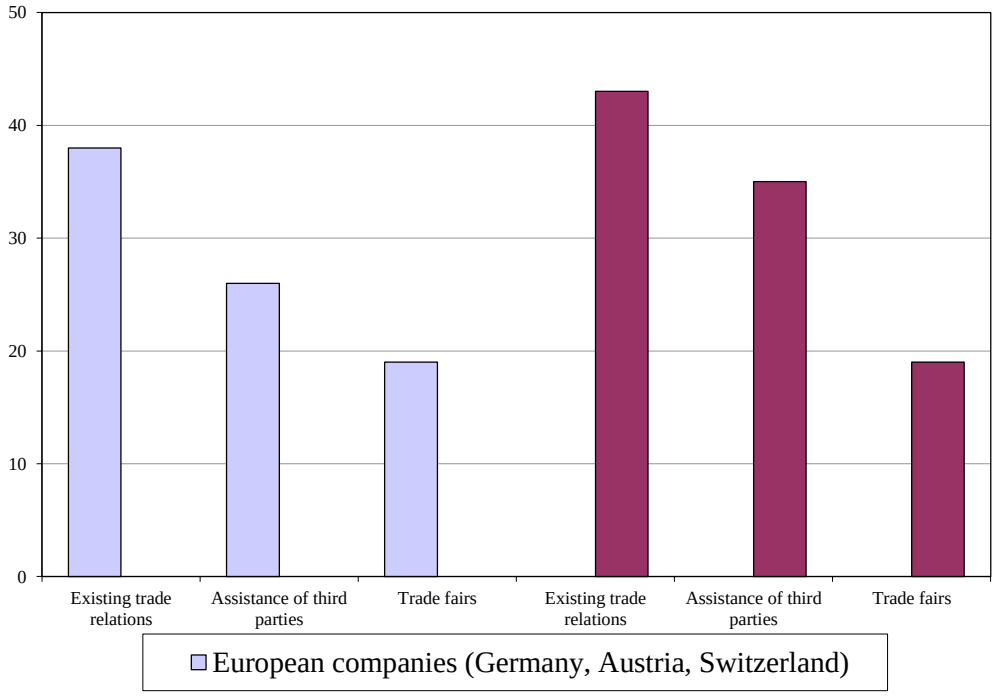


Figure 3: Starting Point of Cooperation



Country	Inward FDI Stock in Million US$	FDI Flow in % of Gross fixed Capital Formation (Average 1995-99)	FDI Stock in Percent of GDP 1999	FDI Stock in US$ per Head of Population[a]
Saudi Arabia	27,845	2.9	20.0	1,418
Egypt	17,770	5.6	19.2	280
Bahrain	5,408	85.5	100.0	9,231
Jordan	1,471	9.8	19.3	360
Kuwait	510	3.7	1.7	275
United Arab Emirates	2,542	2.5	5.3	1,014
Oman	2,455	2.1	15.7	992
Qatar	1,684	8.5	16.9	3,517
Yemen	1,089	–13.1	16.1	48

Table 1 *FDI Inward Stock 1999 in Regional Comparison*

List of Descriptive Statistics

	Mean	Median	Standard Deviation	Minimum	Maximum
Ln (At/At-1)	0.21	0.26	0.58	-3.22	1.22
Ln (Ait/Wtk)	-0.57	-0.37	0.68	-2.30	4.19
FORGN	0.13	0.00	0.34	0.00	1.00
LINK	0.63	1.00	0.48	0.00	1.00
FORGN_IND	0.33	0.33	0.15	0.20	0.80
Training	0.25	0.00	0.43	0.00	1.00
AGE	14.69	9.00	12.39	1.00	50.00
Size (# of Employees)	566.42	63.00	1197.94	5.00	6341.00
Eastern Province	0.33	0.00	0.47	0.00	1.00
Riyadh	0.58	1.00	0.49	0.00	1.00
Food	0.14	0.00	0.35	0.00	1.00
Wood	0.01	0.00	0.12	0.00	1.00
Textile	0.05	0.00	0.22	0.00	1.00
Chemical	0.13	0.00	0.34	0.00	1.00
Non-Metallic	0.22	0.00	0.41	0.00	1.00
Machinery	0.09	0.00	0.29	0.00	1.00
Others	0.35	0.00	0.48	0.00	1.00

Table 2 *Summary of Descriptive Statistics Part 1*

	N	Minimum	Maximum	Mean	Std. Deviation
Competition	1503	1	4	2.44	0.993
Location	1503	1	4	1.72	0.605
Reaction To Product Introduced By FDI	1501	1	4	2.51	1.113
Linkage	1503	1	4	2.52	1.404
Workers' mobility	1503	1	3	2.12	0.798
Training	1503	1	4	2.09	0.864
Benefit from FDI Know-How	1503	1	4	3.24	0.786
Effect on Productivity	1503	1	3	2.12	0.802
Source of Competition	1503	1	4	2.49	1.235
Classification	1503	1	7	4.83	2.190
Local Firms Reaction	1503	1	3	2.29	0.790
Technology Level Difference	1503	1	3	1.85	0.895
Business Expectation	1503	1	4	3.17	0.939
Valid N (listwise)	1501				

Table 3 *Summary of Descriptive Statistics Part 2*

Variable	Definition
X_{A_t}	An investment that a firm has to make to advance technology level from A_t to A_{t+1}
π	Parameter that indexes the size of barriers to technology adoption in the firm's country
S	World Size of Scientific Knowledge
W_t	Best Practice firm of TFP.
$\dot{A}_t^i$	TFP growth of the i firm
W_t^k	Best practice firm's level of TFP in the k industry
$X_{A_t}^i$	the investment of the i firm
μ	The inverse of the adoption barrier parameter π
$\boldsymbol{A_t^i}$	TFP level of the i^{th} firm
θ	The magnitude of spillovers effect from a leading firm to the rest of the firms (Catch-Up).
Forgn	Foreign Joint Ventures (Binary)
Link	Foreign forward-Backward Linkages (Binary)
Frn-ind	Foreign Presence in the industry measured as the share of foreign firm's employment to the total industry.
ς	Firm specific effect (e.g. age)
$Q = AL^a K^b$	Cobb-Douglas Equation for the output
Q	Output
L	Labor
K	Capital
A	Constant
α	Constant
b	Constant
η	Training Factor
T_i	Training

Table 4 List of Variables

Table 5 Correlation Matrix (Part I)

		TFPG	Catchup	FORGN	LINK	FORGN_IND	Train'g	Age	Size	East	Riyadh	Qassim	Hail	Food	Wood	Textile	Chemi-cal	Non-Metallic	Mach-inery	Others
TFPG	Pearson Correlation	1	.017	-.017	.035	-.012	.011	-.017	-.014	.024	-.002	-.028	-.030	-.033	-.041	-.002	.026	-.006	.027	.012
	Sig. (2-tailed)		.452	.444	.121	.588	.615	.461	.536	.275	.919	.214	.183	.139	.068	.926	.237	.801	.234	.580
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Catchup	Pearson Correlation	.017	1	-.005	.019	-.005	.026	.048*	-.027	.002	-.018	.016	.034	-.027	-.011	.005	.026	-.005	-.021	.011
	Sig. (2-tailed)	.452		.823	.384	.814	.241	.032	.225	.940	.431	.475	.124	.226	.630	.839	.237	.808	.360	.634
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
FORGN	Pearson Correlation	-.017	-.005	1	.077**	.003	.057*	.005	-.013	.051*	-.017	-.066**	.010	.071**	.040	.103**	-.137**	-.071**	-.050*	.076**
	Sig. (2-tailed)	.444	.823		.001	.894	.011	.821	.554	.022	.449	.003	.667	.002	.076	.000	.000	.002	.025	.001
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
LINK	Pearson Correlation	.035	.019	-.077**	1	-.100**	.169**	.015	-.008	.292**	-.200**	-.147**	-.016	.253**	-.055*	-.082**	.048*	.006	.072**	.157**
	Sig. (2-tailed)	.121	.384	.001		.000	.000	.495	.717	.000	.000	.000	.462	.000	.015	.000	.031	.773	.001	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
FORGN_IND	Pearson Correlation	-.012	-.005	.003	.100**	1	.047*	.013	-.035	.038	-.120**	.100**	.143**	.001	.191**	.441**	.054*	-.081**	.000	-.256**
	Sig. (2-tailed)	.588	.814	.894	.000		.037	.566	.117	.088	.000	.000	.000	.959	.000	.000	.016	.000	.999	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Training	Pearson Correlation	.011	.026	.057*	.169**	.047*	1	.062**	-.011	.371**	-.283**	-.138**	-.002	.189**	-.021	-.040	.268**	-.187**	-.176**	.241**
	Sig. (2-tailed)	.615	.241	.011	.000	.037		.005	.621	.000	.000	.000	.946	.000	.356	.077	.000	.000	.000	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Age	Pearson Correlation	-.017	.048*	.005	.015	.013	.062**	1	.016	.031	-.037	-.004	.040	-.006	-.022	-.023	.042	-.016	-.030	.013
	Sig. (2-tailed)	.461	.032	.821	.495	.566	.005		.484	.168	.101	.867	.073	.803	.333	.308	.060	.469	.180	.554
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Size	Pearson Correlation	-.014	-.027	-.013	-.008	-.035	-.011	.016	1	-.033	.028	.000	.017	.011	-.001	-.089**	-.024	.003	.015	.035
	Sig. (2-tailed)	.536	.225	.554	.717	.117	.621	.484		.136	.206	.986	.449	.612	.980	.000	.292	.906	.505	.121
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
East	Pearson Correlation	.024	.002	.051*	.292**	.038	.371**	.031	-.033	1	-.838**	-.195**	.080**	-.022	.029	-.009	.102**	-.015	-.072**	.016
	Sig. (2-tailed)	.275	.940	.022	.000	.088	.000	.168	.136		.000	.000	.000	.332	.192	.697	.000	.516	.001	.488
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Riyadh	Pearson Correlation	-.002	-.018	-.017	.200**	-.120**	-.283**	-.037	.028	.838**	1	-.324**	.133**	.000	-.008	.011	-.060**	.003	.076**	.021
	Sig. (2-tailed)	.919	.431	.449	.000	.000	.000	.101	.206	.000		.000	.000	.996	.734	.623	.007	.884	.001	.339
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Qassim	Pearson Correlation	-.028	.016	-.066**	.147**	.100**	-.138**	-.004	.000	.195**	-.324**	1	-.031	.060**	-.033	.006	-.053*	.046*	.002	-.034
	Sig. (2-tailed)	.214	.475	.003	.000	.000	.000	.867	.986	.000	.000		.167	.008	.137	.779	.017	.038	.923	.124
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Hail	Pearson Correlation	-.030	.034	.010	-.016	.143**	-.002	.040	.017	.080**	-.133**	-.031	1	.045*	-.014	-.026	-.043	-.059**	-.036	-.082**
	Sig. (2-tailed)	.183	.124	.667	.462	.000	.946	.073	.449	.000	.000	.167		.043	.542	.239	.052	.008	.112	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998

Food	Pearson Correlation	-.033	-.027	.071**	.253**	.001	-.189**	-.006	.011	-.022	.000	.060**	.045*	1	.049*	-.094**	-.155**	-.211**	-.127**	-.292**
	Sig. (2-tailed)	.139	.226	.002	.000	.959	.000	.803	.612	.332	.996	.008	.043		.029	.000	.000	.000	.000	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Wood	Pearson Correlation	-.041	-.011	.040	.055*	.191**	-.021	-.022	-.001	.029	-.008	-.033	-.014	.049*	1	-.028	-.047*	-.064**	-.038	-.088**
	Sig. (2-tailed)	.068	.630	.076	.015	.000	.356	.333	.980	.192	.734	.137	.542	.029		.204	.036	.004	.087	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Textile	Pearson Correlation	-.002	.005	.103**	.082**	.441**	-.040	-.023	.089**	-.009	.011	.006	-.026	.094**	-.028	1	-.090**	-.123**	-.074**	-.170**
	Sig. (2-tailed)	.926	.839	.000	.000	.000	.077	.308	.000	.697	.623	.779	.239	.000	.204		.000	.000	.001	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Chemical	Pearson Correlation	.026	.026	-.137**	.048*	.054*	.268**	.042	-.024	.102**	-.060**	-.053*	-.043	.155**	.047*	-.090**	1	-.203**	-.122**	-.280**
	Sig. (2-tailed)	.237	.237	.000	.031	.016	.000	.060	.292	.000	.007	.017	.052	.000	.036	.000		.000	.000	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Non-Metallic	Pearson Correlation	-.006	-.005	-.071**	.006	-.081**	-.187**	-.016	.003	-.015	.003	.046*	.059**	.211**	.064**	-.123**	-.203**	1	-.166**	-.381**
	Sig. (2-tailed)	.801	.808	.002	.773	.000	.000	.469	.906	.516	.884	.038	.008	.000	.004	.000	.000		.000	.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Machinery	Pearson Correlation	.027	-.021	-.050*	.072**	.000	-.176**	-.030	.015	.072**	.076**	.002	-.036	.127**	-.038	-.074**	-.122**	-.166**	1	-.229**
	Sig. (2-tailed)	.234	.360	.025	.001	.999	.000	.180	.505	.001	.001	.923	.112	.000	.087	.001	.000	.000		.000
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Others	Pearson Correlation	.012	.011	.076**	.157**	-.256**	.241**	.013	.035	.016	.021	-.034	.082**	.292**	.088**	-.170**	-.280**	-.381**	-.229**	1
	Sig. (2-tailed)	.580	.634	.001	.000	.000	.000	.554	.121	.488	.339	.124	.000	.000	.000	.000	.000	.000	.000	
	N	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix C

Estimation of the Cobb-Douglas Function

In economics, the Cobb-Douglas production function represents the relationship between input and output. In the year of 1928, Charles Cobb and Paul Douglas modeled the relationship between input and output of the American economy during the years 1899-1922. They presented their function as follows:

$$Q = AL^a K^b$$

Solow, R. M. (1956) utilizes this equation to come up with a measurement of the TFP defined in the equation as "A". The equation was put in the following form:

$$Ln\, Q(t) \;=\; A \;+\; \alpha\, ln\, L(t) \;+\; b\, ln\, K_{(t)}$$

Q = Value of total production
K = Total Capital investment
L = Total Number of Workers
a = Capital intensity = (total capital / total output)

In this section I present the regression analysis result of this function. The results attempts to show that the total of the coefficients of the production function is approximately equals to one. Or in other words:

a+ b =1

A regression analysis is run based on the five years average of the total responding firms. Each of those firms has average Q, K, L and A. The result of this analysis is shown in table D1, as follows:

Category	Values
Intercept (A)	2.643*** (0.063)
α	0.807*** (0.043)
b	0.209*** (0.033)
R-square	0.522
Adjusted R-square	0.501

Notes: (1)***indicates 1 % significance level
(2) Values between parentheses indicate standard error

The total of two coefficients is 1.016 which is approximately equals to 1. Yet another conclusion that could be derived from this analysis is that the TFP of the model is approximately equals to 2.643 and it is statistically significant. The analysis also shows that model is more labor intensive than capital intensive. This is indicated by the value of α which is 0.807 and it is statistically significant at the 1 % level. To the contrary the value of b (0.209) which indicates that the model is less capital intensive.

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