The Relationship between Foreign Direct Investment and Exports from the Technology Sector in Costa Rica

Rodolfo Santamaria

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The Relationship between Foreign Direct Investment and Exports from the Technology Sector in Costa Rica

DISSERTATION
Presented in Partial Fulfillment of the Requirement for the Degree of Doctor of Philosophy
Lynn University

By
Rodolfo Santamaría

Lynn University
March, 2011
THE RELATIONSHIP BETWEEN FOREIGN DIRECT INVESTMENT AND EXPORTS FROM THE TECHNOLOGY SECTOR IN COSTA RICA

Santamaria, Rodolfo, Ph.D.

Lynn University, 2011

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ACKNOWLEDGEMENTS

In the journey of life no one walks alone and when you start thinking who
accompanied you, is time to reflect and acknowledge the ones that walked beside you,
and helped you along the way. Over the years, many urged me to pursue a career; others
helped me to succeed, the most relevant, my wife Margarita, who was always there for
me and never had any doubt that I was going to be successful. Cuqui, thanks for making
this aspiration a reality!

Thanks to my two sons, Rodolfo and Roberto for supporting me all these years
and sacrificed many fun trips and vacations, so I was able to complete assignments
during my school years at Lynn University. I also need to thank Dr. Farazmand, Dr.
Norcio and Dr. Miller for their leadership and support when I needed the most.
ABSTRACT

The research examined the relationship between FDI, imports and exports of the technology sector in Costa Rica. A three-stage procedure was used to examine this relationship: Testing Time Series Properties, Cointegration and Granger to estimate FDI significance and effects of FDI on technology sector exports. The results suggest an export-platform for FDI supporting that the finding may be important for Costa Rica. Also, examined were links between FDI and imports, which may show the significance effects of FDI and imports.

The study followed a causal correlational approach to analyze the relationship between FDI, imports and exports, and respective regression equations. A first step tested time series data for stationarity using Augmented Dickey-Fuller and Phillipe-Pherron; and excluding Lumsdaine and Papell to detect two-time structural breaks in the unit root analysis, because the time horizon was too narrow for reliable estimates of breaks. The second step was cointegration testing and finally, the third step is the Granger test addressed in terms of a VAR (vector auto regression) system. Granger was used to find any indication of FDI inflows causing technology sector exports to increase and technology sector imports to decrease, which may indicate the presence of an FDI export-platform strategy and that FDI inflows into the technology sector, may cause import substitution. Secondary data for the period 1995 to 2008 was used to analyze the relationship between FDI, imports and exports of the technology sector. The finding provided important implications for Costa Rica, strategic trade and foreign investment policies.
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Chapter 1: Introduction to the study

Introduction and Background to the Problem

Purpose

This research examined the relationship between Foreign Direct Investment (FDI) and host country technology exports using data sets for the period 1995 to 2008, specifically investigating the relationship between FDI inflows and Costa Rica technology sector exports. This economic sector started in the early 1990s after several technology companies from the United States, decided to have offshore production in a country near North America, and chose to invest in Costa Rica. Costa Rica became a technological hub for many global multinational corporations (MNEs) after the year 2000 (CINDE, 2008). Data for this research, came in the form of published reports from the International Monetary Fund, Comtrade, World Development Indicators (WDI), World Bank and Banco Central de Costa Rica (BCC) Databases, International Financial Statistics (IFS) published by the International Monetary Fund (IMF), World Development Indicators, and UNCTAD World Investment Report.

FDI has increased substantially during the last 20 years, becoming an important capital flow for developing economies and contributing to host economies in the areas of economic and export growth (Bouoiyour, 2003; Mnieh & Owusu-Frimpong, 2004; Wint, Campbell, & Barclay, 2005; Blonigen, 2005; Johnson, 2006b; Johnson, 2006c; Kornecki & Raghavan, 2008). Costa Rica has been one of the attractive investment locations, partially as a result of its outward-oriented development strategy; and was able to attract foreign direct investment as part of its outward-oriented strategy, its political and
institutional stability, strong democratic state, and international trade accords (Schuler & Brown, 1999; Monge-González, Rosales-Tijerino, & Arce-Alpízar, 2005).

Foreign direct investment and its impact on economic growth and exports have been the subject of research for many years. Despite the vast volume of empirical and theoretical literature leading to the positive link of FDI and economic growth and exports, there are few researches showing conflicting evidence on the subject (Zhang, 2001; Chowdhry & Mavrotas, 2006; Johnson, 2006b; Pradham, 2008).

Exports may stimulate economic growth in the country and if FDI promotes exports, FDI may indirectly enhance economic growth in the host country (Johnson, 2006a). Many researchers have attempted to explain the causal relationship between FDI and exports and between FDI and multinational enterprises’ engagement in global trade, from the host country’s perspective; and to examine the determinants and the influence of FDI on the recipient country’s export performance (Kim & Lyn, 1990; Zhang & Song, 2000; Erdal & Tatoglu, 2002; Zhang, 2005; Baliamoune-Lutz, 2004; Vuksic, 2006; Sanchez-Ancochea, 2006; Johnson, 2006b). According to Markusen (1995), the increase of MNE activity over time in world trade and the global economy changed the trade patterns and performance of many FDI recipient countries, thus creating assumptions that MNEs had begun to shift trade in specific sectors.

Literature concerning FDI and exports shows positive effects and links between FDI inflows to developing countries and exports, where foreign direct investment is now used as one of the indicators of the interdependence of economies (Alguacil et al., 2002; Johnson, 2006b; Kutan & Vuksic, 2007; Falk & Hake, 2008). When FDI occurs under
reasonably competitive conditions, multinational enterprises (MNEs) making those investments positively impact a country's development path (Kohonen, 2005; Moran, 2007). Developing countries seek FDI in the form of infrastructure and financial services that could contribute to their development process, and that are linked to MNEs that control or own production assets located in more than one country (Johnson, 2005; Wint, Campbell & Barclay, 2005; Blonigen, 2005, Prakash et al., 2008).

In Latin America, Costa Rica stands out as a major recipient of FDI inflows to Central America and the Caribbean Region (UNCTAD, 2006). Costa Rica, due to its political and economic stability, educated workforce, location, and attractive investment incentives, received the highest FDI inflow in Central America (US$ 1.44 B in 2006), mainly in high-tech electronics, medical devices, services, pharmaceuticals, and tourism industries (ECLAC, 2006). Costa Rica's success in attracting FDI by Intel (MNE from the United States), was based on the ability of its skilled and capable work force's ability to absorb technology, rather than on mere FDI incentives (World Bank, 2006). In Costa Rica, the average annual FDI inflow during the 1980s rose from $40 million to $1.8 billion during the period 1980-2007. Based on available data, Costa Rica is the only country in Latin America where most FDI inflows went to the manufacturing sector, with 68 percent of total FDI inflows going to high-tech industries (electronics and medical instruments). Also, FDI to the technology and medical service sectors in different geographical areas of the country has been increasing during the last decade, creating new jobs that Costa Rica did not have before and were filled with local human capital (Cordero & Paus, 2008; CINDE, 2008).
In this review the causal (independent) variable is Foreign Direct Investment (FDI), and the dependent variables are exports and imports. The question to be answered through this research was: Does Foreign Direct Investment from the United States, Non-United States partners, and local investment increase exports from the technology sector in Costa Rica?

The purpose of this research used a causal correlational approach between foreign direct investment, imports to and exports from the technology sector in Costa Rica. There is an agreement that FDI fosters benefits to host country's economies and therefore it is important to increase the understanding, via scholarly inquiry, on how FDI impacts a developing country's economy (Alfaro & Rodriguez-Clare, 2004; Johnson, 2006a).

**Definition of Terms**

**Technology Sector**

During the period of 1990 to 2000, important high tech MNEs decided to establish offices and manufacturing operations of certain products in Costa Rica. This group of companies included, among others, Intel, Siemens, Hitachi, Alcatel and Conair, high tech medical devices manufacturers Baxter and Abbott and later followed by technology service centers, such as Western Union, Oracle, Infosoft and Hewlett Packard to later become a true technological hub in the new millennium (CINDE, 2008).

According to A.T. Kearney (2007) Costa Rica is positioned as a key destination for MNEs in many industries, especially for advanced manufacturing, medical devices and services in the Free Trade Zone in Costa Rica, where more than 200 global companies established operations. Costa Rica seems to be benefiting from MNEs
restructuring and low cost country relocation of large corporations, to become a
technology and knowledge-driven economy, where local companies are now successfully
competing in the global market. Costa Rica is the 4th high technology exporter in the
world, has an FDI per capita of $448 and is one of the most competitive locations, above
Latin America’s largest economies like Brazil, Mexico and Chile; and per capita GDP is
almost 7 times higher than China’s (Rodriguez-Clare, 2001; Monge Gonzalez, Tijerino &
Rica (TIC) started to grow at an accelerated pace after 1995, and by 2008 reached an
unprecedented 35% of Costa Rica's total exports. More than 500 companies make up the
TIC sector which exports to United States and other countries (Mata & Vartanián, 2001).

There are three distinct major segments in the technology sector, Services,
Medical Devices and Advanced Manufacturing. The services segment is comprised of
shared services, contact centers, back office, software, design, architecture, construction,
interactive advertising and audiovisuals. This segment grew from one company in 1995
to 95 companies in 2008 with 28,416 employees. The medical devices segment is
comprised of medical device companies, medical device contract manufacturers,
suppliers, sterilization and others. This segment started in 1987 with Baxter and grew to
31 companies in 2008, with 9,376 employees. The last segment is advanced
manufacturing which started with Intel and this segment currently is the most
technologically modern. This segment accounts for 55 companies with 13,228 employees
(CINDE, 2008). Figure 1-1 shows the composition and support services of technology
sector in Costa Rica.
Independent Variable

Foreign Direct Investment

Theoretical Definition: The causal (independent) variable is the inward foreign direct investment (FDI) to the technology sector in Costa Rica. Foreign direct investment is investment (lasting presence) by foreign investors in productive assets in an entity located in an economy (the host country) other than the one in which the foreign investor is located (the source country) (OECD, 1996; World Bank, 2003; International Monetary Fund, 2001; Blonigen, 2005; Johnson, 2006a; Kornecki et al., 2008).

To enter a market MNEs can execute three types of direct investment. The first, Greenfield Investment, occurs when an MNE invests in a physical facility or structures where there are no previously established facilities; and this investment could be in the form of a joint venture or wholly owned subsidiary. The second, Brownfield Investment,
occurs when MNEs invest in a physical establishment followed by development of new production facilities, in the form of either a joint venture or wholly owned subsidiary. The third type of direct investment occurs when an MNE acquires an existing firm in the form of a joint venture or wholly owned subsidiary. According to Graham (1995), any researcher working with FDI needs to clarify what the data on hand stands for, and how and to what extent it can be interpreted. Graham continues arguing that foreign direct investment is a “misnomer,” indicating that FDI is an incorrect term derived because of the form, action, or origin of the subject, in reference to the investment nature of FDI, which is a decisive ingredient of the term (Graham, 1995; Stephen & Pfaffman, 2001).

Operational Definition: FDI data are part of the balance of payments statistics found in the International Monetary Fund (IMF) Balance of Payments Manual, Fifth Edition, 1993 (BPM5), the Organization for Economic Cooperation and Development (OECD) Benchmark Definition of Foreign Direct Investment (Benchmark), Third Edition, 1999, Europe (ECE), and provided by the Economic Commission for Latin America and the Caribbean (ECLAC) and United Nations Council for Trade and Development (UNCTAD) through its annual publication "World Investment Report".

The main source of data collection for UNCTAD comes from published official FDI data directly from central banks or any other government approved entity. Also, UNCTAD FDI data are complemented by data obtained from the International Monetary Fund (IMF), the World Bank, the Organization for Economic Co-operation and Development (OECD), the Economic Commission for Europe (ECE) and the Economic Commission for Latin America and the Caribbean (ECLAC).
According to the World Bank (2006), the net foreign direct investment is the sum of inflow of capital to the country divided by its Gross Domestic Product. The data collection and calculation follow previously agreed upon guidelines provided by researchers between the World Bank and its partners. The Development Data Group within the Development Economics Vice Presidency is in charge of assimilation, compilation, inventory preparation, archiving, retrieval, and dissemination of data.

**Dependent Variables**

Dependent variables are imports and exports of the technology sector.

**Exports**

Theoretical Definition: Exports include goods and services that are produced domestically but sold abroad. MNEs start to trade in the foreign market, and after firms are comfortable with their partners, economic, social and political conditions, MNEs may establish a subsidiary in the host country or embark on joint ventures with local enterprises. Therefore, FDI may occur and shortly after, MNEs may start to export (Hockman & Djankov, 1996; UNCTAD, 1996; Liu, X., Wang, C. & Wei, Y., 2001; World Bank, 2006).

Operational Definition: The World Bank publishes the World Development Indicators (WDI) as an appendix to its World Development Report and a stand-alone CD-ROM package which includes export data by specific country. Costa Rica is part of this database.
**Imports**

Theoretical Definition: Imports are goods and services that are foreign produced but sold domestically. Imports indicate market presence for products and MNEs may seek to produce them locally, therefore justifying MNE's investment to be present in the host country. Now in the host country, MNEs may import basic intermediate goods and supplies produced in the country where the MNE is coming from (intermediate goods produced by headquarters) to satisfy quality standards (Hockman & Djankov, 1996; UNCTAD, 1996; Liu, X., Wang, C. & Wei, Y., 2001; World Bank, 2006). For this research, import data did not include imports of capital goods to the technology sector.

Operational Definition: The World Bank publishes the World Development Indicators (WDI) as an appendix to their World Development Report and a stand-alone CD-ROM package which includes export data by specific country. Costa Rica is part of this database. Table 1.1 shows the variable definition of FDI, imports and exports and the source of each variable.
Table 1. Variable Definitions

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<td><strong>Independent</strong></td>
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<td>Foreign Direct</td>
<td>Foreign Direct Investment to the Technology Sector (US Dollars)</td>
<td>UNCTAD, World Bank, OECD, IMF, ECLAC, ECE</td>
<td>Exports</td>
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<tr>
<td>Investment</td>
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<td>Imports</td>
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*Delimitations and Scope*

This research is limited to Costa Rica and focuses on exports from the technology sector, therefore it cannot be generalized to other countries or economic sectors in Costa Rica. Data analysis is limited to what already exists, presented in the form of a time series by yearly aggregation. Other extraneous variables, such as GDP (Gross Domestic Product), balance of trade and human capital, may influence performance and are not in the scope of this research.
According to the World Bank (2008), FDI data collection is different from
country to country, and statistics may be collected by different agencies for different
reasons, but all converging to the World Bank. Statistical and data work is performed by
the Development Data Group (DECDG) in the Development Economics Vice
Presidency, which works directly with the World Bank’s regions and sectors, following
professional standards in data collection, compilation, and dissemination, ensuring that
all data users can have confidence in the quality and integrity of the data produced.

The SAS Software and STATA, Data Analysis and Statistical software
were utilized in the data analysis derived from the World Bank datasets (Costa Rica) and
Costa Rica Central Bank. The data was presented with appropriate graphical displays,
concepts of variability, causation, correlation, standard deviation, descriptive statistics to
identify outliers, communicate, and support predictions and conclusions. Inferential
statistics, including time series regression, ANOVA and t-test was utilized to test
hypotheses. Time series data was used to find the impacts of foreign direct investment on
Costa Rica's imports and exports from the technology sector for the period of 1995-2008.
Chapter 2: Literature Review, Theoretical Framework, Research Questions, and Hypotheses

Introduction to the Review of the Literature

Exports may stimulate economic growth in the exporting country and if FDI promotes exports, FDI may indirectly enhance economic growth (Johnson, 2006a; Johnson, 2006b). Many researchers have attempted to explain the causal relationship between FDI inflows and exports from the host country’s perspective, examining the determinants and the positive influence of FDI inflows on the recipient country’s export performance (Baliamoune-Lutz, 2004; Sanchez-Ancochea, 2006; Vuksic, 2006; Zhang, 2005; Zhang & Song, 2000). Research has also been performed on the subjects of foreign direct investment (FDI), the formation of multinational enterprises (MNE), their engagement in global trade which generates global flows, and exports (Erdal & Tatoglu, 2002; Johnson, 2006b; Kim & Lyn, 1990). According to Markussen (1995), the increase of MNE activity in world trade and the global economy has increased steadily over time. Additionally, changes in the trade patterns and performance of many FDI recipient countries created assumptions that MNEs had begun to shift trade in specific industries.

According to Kutan and Vuksic (2007), “FDI-promoting policies should lead, among other things, to a significant increase in the host country's exports” (p. 32). There are several models and theories that explain the relationship between the exploration and implementation of an MNE as an FDI channel and the impact on the host country's exports. These include multinational enterprise, the flying geese model, product life cycle, and the OLI paradigm.
Theories Related to FDI, Exports and Imports

Theories have been developed to explain trade patterns and types of foreign direct investment (FDI), comparative advantage theory, imperfect markets (Heckscher, 1919; Ohlin, 1933), product lifecycle (Vernon, 1966), MNE theory (Caves, 1971; Hymer, 1960, 1976; Penrose, 1959), internalization models (Buckley & Cason, 1976; Rugman, 1981), and eclectic paradigm OLI (Dunning, 1993). Other theories include trade-oriented theories enhancing Heckser and Ohlin (Samuelson, 1948, 1949, 1953), factor proportions theory (Heckscher-Ohlin-Vanek (HOV) theorem, 1968), spillover endogenous growth theory (Arrow, 1961; Borenztein, DeGregorio, & Lee, 1998; Schultz, 1962; Uzawa, 1965), new growth theory (Romer, 1993), and the flying geese theory (Akamatsu, 1961, 1962). MNE’s transaction cost-based theory includes research by Teece (1977), Rugman (1981), Williamson (1979), and Hennart (1982), which state that MNEs are firms that cross domestic boundaries and markets to organize agents located in other countries.

Multinational Enterprises and Dunning Eclectic Paradigm.

There has been a significant amount of theoretical research regarding the formation of multinational enterprises (MNE) and what motivates foreign direct investment (FDI) since the early 1900s. Many theories and points of view have been developed to explain multinational corporations’ activities; among them are theories generally used to explain the engaging of corporations in international investment (Erdal & Tatoglu, 2002; Kim & Lyn, 1990). FDI theories and exports are closely related to MNEs and the way they perform investments overseas (Kutan & Vuksic, 2007). Penrose (1959) observed that external demand does not limit firm-level growth rates or absolute
size, for they can look for investment opportunities in their current markets domestically and internationally, and the constraints to growth and firm size come from within.

Stephen Hymer (1960) followed with the theory of the multinational enterprise (MNE), which posited that firm-specific advantage needs to be exploited before it weakens, and argues that the strength of this advantage enables international firms to successfully compete against firms in a foreign market. Hymer indicated that oligopolistic firms (in host market) have monopolistic advantages, which are transferred abroad to collect monopolistic profit. Buckley and Casson (1976) provided an MNE theory about long-term projections of an MNE’s growth and structure, explaining the existence of foreign direct investment when firms replace market transactions with internal transactions as a way to avoid market imperfections for intermediate inputs. Dunning (1977) developed the eclectic paradigm (OLI), postulating ownership of specific advantages, location-specific advantages, and internalization advantages, stating that FDI occurs when its net present value is positive and greater than those of alternative modes of international production. Dunning’s eclectic approach and paradigm indicates that MNEs set up subsidiaries to take a technological advantage overseas when licensing is too difficult to arrange with domestic firms in a recipient country. Rugman and Verbeke (1992) stated that the previous assertion has its limitations when MNEs’ growth is present in foreign markets. On the other hand, Buckley and Casson (2007) stated that the theory describing an MNE’s growth should include incremental geographic diversification into new markets and product innovation.
Pitelis (2007) reinterpreted Dunning's (1993) eclectic (OLI) paradigm using a Penrosean approach, disputing that an MNE's international expansion is determined by shaping the OLI-parameters and connecting internal strengths with external opportunities (Pitelis & Verbeke, 2007; Pitelis, 2007; Steen & Liesch, 2007; Verbecke & Yuan, 2007). According to Markusen and Venables (1998), to analyze the effects of FDI on a host country's exports, it is useful to distinguish between horizontally and vertically integrated multinational firms. When an MNE is horizontally integrated, it produces the same product in several plants located in more than one country, and when the MNE is vertically integrated, different stages of the production process are completed in different countries. Horizontally integrated MNEs are created due to trade barriers, such as tariff barriers (high duties) and costly logistics. This forces the firm to invest locally (FDI) to increase capacity by building additional plants in the host country to meet domestic demand or to export from the existing plant in the home country. Research presents the effects of FDI on trade flows between home and host countries, where a foreign subsidiary of an MNE supplies markets in third countries (Markusen & Venables, 1998; Markusen & Maskus, 2002). Helpman, Melitz, Yeaple (2004) research shows that MNEs tend to have higher productivity than other domestic companies (including local exporters), and the higher productivity of the MNEs may be a reflection of the ownership advantage (assets) including production process, new products, and human capital (Markusen & Maskus, 2002; Helpman et. al., 2004).
**Flying geese model.**

Akamatsu (1961, 1962) developed three models named after bird migration, as flocks migrate in common patterns. The Flying Geese pattern (ganko keitai) relates to a series of curves in graphs showing data from imports and production for internal consumption and exports over a period of time (Kasahara, 2004; Ozawa, 2005). In the first stage, the developing economy starts to import, and through spillovers, gradually starts to form domestic production development. The second stage begins with local production of imported goods, thus performing import-substituting production, with FDI, local capital, or mixed. The third stage starts when local production increases to the extent that there is manufacturing excess, triggering the export of these domestically produced goods (Kasahara, 2004; Ozawa 2005). This theory explains how developing countries may become developed countries adopting specific industries, producing first for the domestic market and then starting to export as soon as the industry matures. If the process is repeated many times, it may lead to a rapid economic development, such as the one experienced in post-war Japan (Kasahara, 2004; Nkong, 2008).

**Product life cycle.**

Vernon (1966) developed the PLC (Product Life Cycle) theory to provide an explanation of FDI increases from United States-based MNEs. There are four stages--innovation, growth, maturity, and decline. During the first stage, innovation, MNEs manufacture new and creative products for the local market with no FDI, and the excess is exported overseas. In the second stage, growth, MNEs start to perform FDI to other countries, transferring innovative knowledge, and foreign competitors begin to enter the market. In
the maturity stage, demand for US export products declines, FDI is allocated to these new markets, and a demand increase occurs for manufactured products in these new countries. At the decline stage, cost reduction becomes a priority for MNEs as they lose their comparative advantage to lower cost producing countries (Nkong, 2008; Vernon, 1966, 1979).

Foreign Direct Investment and Exports

A spillover from MNEs’ FDI strengthens the host country’s knowledge threshold through human capital preparation, skills attainment, and improved management practices and exports. Thus, FDI increases productivity and can stimulate domestic investment and technological progress (Borenstein et al, 1998; Cortright, 2001; Nkong, 2008). Nkong’s (2008) panel study of businesses in Cameroon found evidence that FDI contributed to higher capacity, and that spillover effects lead to export growth. Results suggested a positive relationship between inward FDI and export performance.

Hassan (2000) investigated whether trade balance is an indicator of foreign direct investment by an MNE, addressing determinants of foreign direct investment in Asia, trade balance as an indicator of FDI, and any lag effect on FDI for a specific Asian country. The study was based on annualized time series data from an eight-country panel in Asia: China, Malaysia, Sri Lanka, Thailand, Vietnam, India, Japan, and South Korea. Results indicated that for the majority of the countries in the panel, significant statistical correlations existed among explanatory variables (GDP growth rate, trade balance, percentage change in real wages, and the average tax rate) and monetary size of FDI. For the majority of countries, the coefficient of trade balance was statistically significant, and
for two countries, the study indicated significant statistical correlations existed between a one-period lag monetary size of FDI and the current period FDI. Literature suggested that MNEs enhance their value by negotiating better incentives from the host country, when MNEs import or export products in countries with trade balance problems. This study showed that an MNE looking to place its FDI in an export location would be best served by investing in one of the Asian countries in the panel that was facing trade balance problems.

Using data from Morocco, Baliamoune-Lutz (2004) showed that foreign direct investment contributes to higher growth both directly and indirectly through its effect on exports. Findings and methodology from the research could be used by business decision-makers to enhance the measurement of expected risks through the effect estimation of increased FDI to the host country. According to Baliamoune-Lutz (2004), FDI has the potential to contribute to political stability in Morocco through efficient allocation of corporate resources. Because limited research in Arab countries related to linkages among FDI, GDP growth and exports in a single model, her study intended to fill the void in the literature by using Moroccan data from 1973 to 1999, including Granger-causality technique to explore the relationships between FDI, exports, and economic growth. This approach was used in the research for Costa Rica's technology sector exports and FDI.

Baliamoune-Lutz (2004) stated that the direction of causality between FDI and economic growth has been addressed in a limited number of studies and the empirical studies provide mixed results, finding evidence of both unidirectional and bidirectional causality. Data for the research was from the International Monetary Fund (IMF)'s International Financial Statistics as well as FDI flows from the IMF's Balance of
Baliamoune-Lutz (2004) indicated a bi-directional causality between FDI and exports, leading to the belief that growth causes FDI and exports. Because there was no statistical evidence to support the hypothesis of growth-driven FDI, there is disagreement that FDI does not seem to react to economic growth. Another finding was that foreign investors seemed to value more the country's export incentives and its access to European markets than GDP performance. For GDP growth, FDI and exports tended to influence economic growth and causality from FDI to GDP growth was present. This finding was inconsistent with previous research results. Her findings suggest that the negative effects on domestic firms were compensated by the positive effects of higher FDI, and the positive influence of exports on economic growth suggested trade liberalization, good performance, and export promotion policies.

Results supported a bi-directional causality between FDI and exports, as well as a positive influence from exports to economic growth. There were direct and indirect effects of FDI on growth and the role of FDI in promoting economic growth of the host country. According to Baliamoune-Lutz (2004), FDI and exports seemed to be complementary, while there was no empirical support for the proposition that higher economic growth was a major determinant of exports and FDI. There was sufficient
evidence that FDI and exports performed by MNE, MNE's exports, could be reflected in higher GDP. The findings in the research should be useful to American business decision-makers by helping negotiators convince host governments of the benefits FDI has on the economy. Based on the findings, results suggested that these countries should promote export-oriented FDI.

In the last two decades, MNEs started to look for other geographical areas in search of new opportunities, including Latin America (Johnson, 2005; Jordaan, 2005). MNEs tend to invest in developing countries with stable political and economic environments (Chavez, 2005; Monge-Gonzalez, Rosales-Tijerino & Arce-Alpízar, 2005), and Costa Rica was able to attract foreign direct investment as part of its outward-oriented strategy for development (Monge-González et al., 2005). An empirical study by Sanchez-Ancochea (2006) compared the experiences of Costa Rica and the Dominican Republic in creating new comparative advantages in manufacturing exports and its impact on economic development. The study contained three arguments: First, the apparel sector is unlikely to act as an engine of economic development, second, high public spending in health and education, and FDI to specific targets has been fundamental in the creation of comparative advantages (away from apparel) with higher technological content in exports. Sanchez-Ancochea (2006) continued arguing that the new export sectors still lack sufficient linkages to the rest of the economy, and most of their value added goes into profits for MNEs.

Sanchez-Ancochea (2006) analyzed the development effect of exports from the free trade zones (FTZs), comparing Costa Rica and the Dominican Republic. Costa Rica and the Dominican Republic became major apparel suppliers to the United States in the
1990s; however, the sector is experiencing problems due to Chinese competition. The study analyzed the policy responses of Costa Rica and the Dominican Republic to attempts to diversify into technological sectors and the inadequacy of their strategy. Using FTZs and other incentives as a way of promoting new exports became a key policy of many countries in Latin America, where new exports would become fuel for economic growth, contributing to the expansion of other sectors of the economy.

Sanchez-Ancochea (2006) organized the study into the following four sections: 1) a discussion of the differences and similarities in development trajectories and comparative advantages; 2) a general value-added limitation of the FTZ’s importance and contributions to the apparel sector; 3) attempts to move into exports with higher technological content; and 4) unresolved problems of long-term sustainability by comparing Costa Rica with Singapore. The comparison revealed the importance of long-term policy outcomes, especially regarding investment in human capital and public capacities.

Sanchez-Ancochea (2006) indicated that Costa Rica’s success in attracting technological MNEs was based on public commitment to high levels of public spending in health and education, as well as public and private selective targeting. Additionally, in the Dominican Republic, horizontal (apparel) specialization was difficult to beat because of labor force limitations. The study analyzed dynamic comparative advantages in activities located in the FTZs and difficulties in promoting long-term growth.

Sanchez-Ancochea (2006) indicated that targeting specific MNEs and investing in education might not be enough because of the need to increase linkages between the new
sectors and the rest of the economy. By revisiting the Singapore and Taiwan experience, which succeeded by promoting exports through state-led foreign investment and generous incentives for small and medium local firms, the author indicated limitations in addressing the relationship with GDP, the establishment of programs to attract more FDI, and relationships with current infrastructure.

Sanchez-Ancochea's (2006) study concluded and reinforced with new data, that the horizontal sector is unlikely to act as an engine of economic development when it is based on dependent relations with the U.S. and other developed countries. Another conclusion was that exports generate low domestic value added, behave like commodities, and do not create productive assets to generate a worthy circle of exports. In addition, the author stated that long-term commitment to accumulate human capital is key to the ability to move away from apparel and go into exports with higher technological content and long-term demand growth. The new export sectors may not resolve the current export-led model or the lack of integration between the export sector and the rest of the economy.

Baliamoune-Lutz (2004) studied the effects of FDI on exports, concluding that there was positive bi-directional causality between FDI and exports, as well as a positive influence from exports on the economic growth of the host country. Nkong (2008) found positive relationships between inward FDI and export performance, where FDI inflows lead to an expansion in exports. Bhandari et. al. (2007) examined the effectiveness of foreign direct investment in the Czech Republic, Estonia, Hungary, Latvia, Lithuania, and
Poland, finding that an increase in domestic capital and FDI inflows positively affected economic growth.

Empirical evidence also indicates that technology transfer increases exports and capital flows in host countries and improves local firm productivity. Kugler (2006) found that MNEs have incentives to limit horizontal transfer (competitors) and intensification of vertical transfer (suppliers and customers). Reid (2007) emphasized that FDI diversity contributes to economic growth (GDP) in developing countries, and FDI inflows accelerate technology transfer and enhance international competitiveness via exports. Monge-Gonzalez et al. (2005) found that new knowledge spillovers from MNEs to domestic firms in Costa Rica are used to produce goods and services that are exported.

Zhang (2005) investigated an FDI-export linkage using industrial data indicating that FDI had a positive impact on China’s export performance and that its export-promoting effect is greater than domestic capital with a larger effect in labor-intensive industries. The study focused on the role of FDI, using a model capturing and isolating the FDI-export link. Therefore FDI is treated as an additional factor specifying the following export function:

\[ X_i = f(K_i K^o W_i SE_i D_i) \]

where \( X_i \) is export volume in industry; \( K_i \) and \( K^o \) are foreign capital (i.e., FDI) and domestic capital in the industry, respectively; \( W \) represents wage rate; and \( SE \) measures scale economies. \( D \) is an industrial dummy based on factor intensity.

The following equation (2) from Zhang (2005) constitutes the basis for the cross-section analysis of the FDI-export link data on 186 industries in 1995. The addition of a
constant term and a stochastic component to equation (1) results in the following econometric specification:

\[ X_t = \beta_0 + \beta_1 K_t^F + \beta_2 K_t^D + \beta_3 W_t + \beta_4 SE_t + \beta_5 D_t + \epsilon_t \]

where \( \beta_1, \beta_2, \beta_3, \) and \( \beta_4 \) are export elasticities with respect to FDI, domestic capital, labor costs, and scale economies, where all variables except the dummy are taken in the form of a natural logarithm to reduce possible heteroscedasticity.

**Empirical Studies**

Understanding why a firm decides to service a foreign market is an important aspect regarding FDI, especially if they have many location options. In foreign markets, host countries offer incentives and subsidies to have FDI inflows, and this foreign investment generates externalities in the form of technology transfer, improving domestic firms’ productivity when externalities emanating from MNEs are positive (Aitken & Harrison, 1999; Blomstrom & Kokko, 2003; Blonigen 2005). When firms expand to a foreign territory, MNEs choose FDI to a foreign market over their domestic one; one where there is a positive, simple correlation between industry productivity and multinationals attracted to high-productivity industries in a host country (Gao, 1999; Luo, 1999; Blonigen, 2005; Lu & Beamish, 2006).

Foreign direct investment and its impact on the economic growth of a host country has been the subject of much research debate for many years (Johnson, 2005; Samuelson, 2004, 2005). The extent of FDI contribution to economic growth depends on
the economic and social conditions of the recipient country. Therefore, countries would benefit from increased FDI inflow when they have good balance of trade, openness, and high technological levels (Buckley, Clegg & Wang, 2002). With the globalization of manufacturing, MNEs react differently to changing patterns of economic growth, especially when there is foreign direct investment (FDI) inflows to a recipient country in foreign markets (Desai, Foley & Hines, 2008).

According to Zhang (2005), the main regression results are easily distinguished and the performance of the econometric models is satisfactory. The regressions have a good fit with significant F-statistics at the 1% level in all cases, and the explanatory power of the regressions is reasonably high for the sample and sub-samples. FDI seems to have a predominant influence on China’s export performance and in all cases, the FDI variable has relatively large and statistically significant coefficients. The t-statistics for FDI are much larger than those for domestic capital and the adjusted $R^2$ suggests that about 60% of the variance in exports is explained by FDI alone. The effect of FDI on exports is larger in labor-intensive industries than in capital-intensive industries, where coefficients of the factor-intensity dummy are statistically significant and have the expected sign, suggesting differences in FDI effects on two industry groups. The estimates of other independent variables are consistent with the theoretical prediction, where the coefficients of domestic capital stock, wage rate, and scale economies are statistically significant and have the correct signs. Finally, Zhang’s (2005) study continues with the result of the White test, which indicates that values of the test statistic are too small to justify non-acceptance of the null hypothesis of heteroscedasticity and
correct model specifications, suggesting absence of heteroscedasticity and other major specification errors (Zhang, 2005).

Jayanthakumaran and Lee's (2007) study examined the association among government policy interventions, Foreign Direct Investment (FDI) and exports in Taiwan and China, by applying the LP (Lumsdaine & Papell, 1997) approach with two endogenous structural breaks and a cointegration relationship between FDI and exports in Taiwan using the Johansen and Juselius (1990) approach, and causal relationships between FDI and exports in both Taiwan and China using the Granger causality tests respectively. The study tests the hypothesis that the introduction of free trade zones in Taiwan and China had a positive impact on FDI and exports using the evaluation of cointegration and causal links between inward FDI and exports.

Jayanthakumaran and Lee's (2007) study continues finding possible government interventions on FDI and exports using unit root analysis in the presence of multiple endogenously determined structural breaks (intervention analysis), applying Lumsdaine and Papell's (Lumsdaine & Papell, 1997) approach using historical FDI and export time series from 1952 to 2005 for Taiwan and 1979 to 2005 for China. The LP approach reduces the incorrect judgment of time series stationarity, leading to model misspecification in the Granger causality test. The causality test by Granger (1969) is performed in a framework of a vector autoregression (VAR) model or error correction model (ECM).

Jayanthakumaran and Lee's (2007) study continues following three steps for the Granger causality test: the first step identifies the property of stationarity of time series
data, applying two conventional unit root tests, Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests. Important to note is that ADF and PP fail to consider breaks in the time series. If structural break(s) exist in the series, ADF test statistics may have been biased toward the non-rejection of a unit root when the series is stationary within each of the sub-periods (Perron, 1997). Therefore, Lumsdaine and Papell’s (LP) model is applied to detect two-time structural breaks in the unit root analysis, and the result of stationarity of each time series by using the LP approach replaces the result from the ADF and PP tests (Lumsdaine & Papell, 1997). Jayanthakumaran and Lee (2007) argue that if the break date(s) is/are located in the same year as the occurrence of the incident, it could be concluded that the time series was affected by the structural break. The LP approach adapts a revised ADF test, augmenting two endogenous breaks. The Lumsdaine and Papell (LP) model considered by the study is:

\[
\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \varphi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t
\]

where \( \Delta \) represents the first difference operator, \( y_t \) is the time series being tested, and \( t \) is a time trend variable. \( t = 1, \ldots, T \), where \( c(L) \) is a lag polynomial of known order \( k \).

Jayanthakumaran and Lee's (2007) model includes a sufficient number of lags \( k \) to ensure the residual term \( \varepsilon_t \) is white noise, and the optimal lag length \( k \) is selected based on the general-to-specific approach suggested by Ng and Perron (1995). \( DU1t \) and \( DU2t \) are dummy variables. The model allows for two breaks in both intercept and slope term of the trend function, and break dates are determined, depending on the minimum value of the \( t \) statistics for \( \alpha \). Using annual time series in this study, Jayanthakumaran and
Lee (2007) followed Lumsdaine and Papell (1997) in assuming $k_{max}$ up to 8. The second step is the cointegration test. If time series are linked to form an equilibrium relationship in the long run, they will move closer together, implying a long-run equilibrium with an economic system converging over time. For this step, the study uses the Johansen and Juselius (1990) approach. This approach is achieved if two variables are $I(1)$ and developed based on a VAR approach initiated by Johansen (1988), where a $p$-dimensional VAR model involving up to $k$-lags can be specified as follows:

\begin{equation}
Z_t = \alpha + \Pi_1 Z_{t-1} + \Pi_2 Z_{t-2} + \ldots + \Pi_k Z_{t-k} + \epsilon_t
\end{equation}

where $Z_t$ is a $(p \times 1)$ vector of $p$ potential endogenous variables and each of the $\Pi_i$ is a $(p \times p)$ matrix of parameters and $\epsilon_t$ is the white noise term. Equation (4) can be formulated into an ECM form:

\begin{equation}
\Delta Z_t = \alpha + \Pi_k Z_{t-k} + \sum_{i=1}^{k-1} \theta_i \Delta Z_{t-i} + \epsilon_t
\end{equation}

where $\Delta$ is the first difference operator, $\Pi$ and $\theta$ are $p$ by $p$ matrices of unknown parameters, and $k$ is the order of the VAR which translated into a lag of $k-1$ in the ECM. $\epsilon_t$ is the white noise term.

Jayanthakumaran and Lee's (2007) model continues with the third step, the Granger causality test. This test is applied based on a stationary dataset, as it is necessary to establish the stationarity properties of the data using the unit root analysis. The model presented a logarithm set of two variables for the Granger causality in a bivariate Vector Autoregression (VAR) as follows:
(6) \[ LFID_t = \sum_{j=1}^{p} \alpha_{11,j} LFID_{t-j} + \sum_{j=1}^{p} \alpha_{12,j} EXPORT_{t-j} + \varepsilon_{1t} \]

(7) \[ EXPORT_t = \sum_{j=1}^{p} \alpha_{21,j} EXPORT_{t-j} + \sum_{j=1}^{p} \alpha_{22,j} LFID_{t-j} + \varepsilon_{2t} \]

where \( \varepsilon_{1t} \) and \( \varepsilon_{2t} \) are white noise and \( p \) is the lag length. The significance of the lagged terms \( (\alpha_{12,j}, j=0, 1, ..., p) \) and \( (\alpha_{22,j}, j=0, 1, ..., p) \) constitutes a short-run Granger causality test.

Jayanthakumaran and Lee's (2007) model presented four possible situations where two variables may have a causal relationship as follows:

a) One-way causality from FDI to exports if \( \sum_{j=1}^{p} \alpha_{22,j} \neq 0 \) and \( \sum_{j=1}^{p} \alpha_{21,j} = 0 \)

b) One-way causality from exports to FDI if \( \sum_{j=1}^{p} \alpha_{12,j} \neq 0 \) and \( \sum_{j=1}^{p} \alpha_{11,j} = 0 \)

c) Bi-directional causality between FDI to exports if \( \sum_{j=1}^{p} \alpha_{12,j} \neq 0 \) and \( \sum_{j=1}^{p} \alpha_{22,j} \neq 0 \)

d) No causal relationship between FDI to exports if \( \sum_{j=1}^{p} \alpha_{12,j} \) and \( \sum_{j=1}^{p} \alpha_{22,j} \) are not statistically significant.

Further, if two variables are I(1) but cointegrated, then equation (4) and (5) can be formulated into ECM as follows:

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\[ \Delta \text{LFDIt} = \sum_{j=1}^{p-1} \beta_{11,j} \Delta \text{LFDIt}_{t-j} + \sum_{j=1}^{p-1} \beta_{12,j} \Delta \text{LEXPORT}_{t-j} + \alpha_1 \text{EC}_{t-1} + \epsilon_{1t} \]

\[ \Delta \text{LEXPORT}_{t} = \sum_{j=1}^{p-1} \beta_{21,j} \Delta \text{LFDIt}_{t-j} + \sum_{j=1}^{p-1} \beta_{22,j} \Delta \text{LEXPORT}_{t-j} + \alpha_2 \text{EC}_{t-j} + \epsilon_{2t} \]

where \( \Delta \) is the first difference operator, and \( \epsilon_{1t} \) and \( \epsilon_{2t} \) are white noise. \( \text{EC} \) is the error correction term, and \( p \) is the order of the VAR which translated into a lag of \( p-1 \) in the ECM. \( \alpha_1 \) and \( \alpha_2 \) represent the speed of adjustment after FDI or exports deviate from the long-run equilibrium in period \( t-1 \). The coefficients of lagged value, \( 12, j \beta \) for \( j=1,\ldots,p-1 \), in equation (8) represent short-run effects of export performance on FDI and \( 21, j \beta \) for \( j=1,\ldots,p-1 \), and in equation (9) represent short-run effects of FDI on export performance. A test of the joint significance of these lagged terms constitutes a short-run Granger causality test.

Jayanthakumaran and Lee's (2007) study attempted to demonstrate the historical effect of FDI on exports in Taiwan and China, presenting that government intervention in the form of export processing zones in China (EPZ) and special economic zone in Taiwan (SEZ) in Taiwan and China had a positive impact on FDI and exports. After the application of Lumsdaine and Papell's (1997) model, the study found significant trend breaks for China in 1984 and Taiwan in 1968. These breaks coincided with government interventions when both established export processing zones in China in 1993 and special economic zone in Taiwan in 1970 to attract foreign investors associated with investments in labor-intensive, light manufacturing to make use of China’s and Taiwan’s workforces.

Finally, Jayanthakumaran and Lee's (2007) study found that there is a lack of long-run relationships between FDI and exports in Taiwan (which is a developed country...
and results may vary from country to country) and one-way causal relationship flows from exports to FDI, indicating that countries with export potential attract FDI.

According to the study, there are policy implications for other developing countries, where export processing zones and special economic zones capable of providing additional skilled resources during the initial stages of economic development, and that FDI encouragement functions as a transitional strategy to move from import substitution to export orientation (Warr, 1989).

Lee and Perera's (2007) study examined the causal relationship between FDI and Taiwan exports and structural breaks in the annual time series from 1952 to 2005. The model used cointegration and error correction modeling (ECM) techniques after considering the existence of the multiple structure breaks in the data. The study used a three-stage process to examine the causality. First, the unit root tests using the Augmented-Dickey-Fuller (ADF) and the Phillips-Perron (PP) test were used to examine stationarity for univariate time series. If the presence of structural breaks in time series data is not considered, the conventional unit root tests may have been biased toward the non-rejection of a unit root when the series is trend stationary within each sub-period (Perron, 1997). Therefore, a unit root test with two endogenously determined structural breaks is achieved by using the Lumsdaine and Papell approach (LP, 1997). Second, the cointegration test was applied to inspect the long-run relationship between FDI and exports after achieving the integration test. The cointegration test is performed using Johansen’s approach when the pair variables are stationary in first difference. Third, the Granger causality test was performed on a stationary basis in the framework of either the vector autoregression (VAR) model or vector error correction model (ECM).
The unit root analysis in the presence of structural breaks by using the LP
approach is formulated as follows:

\[ \Delta y_t = \mu + \beta t + \theta DU_{1t} + \gamma DT_{1t} + \omega DU_{2t} + \varphi DT_{2t} + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \]

where \( \Delta \) represents the first difference operator, \( y_t \) is the time series being tested, and \( t \) is a time trend variable. \( t = 1, \ldots, T \), where \( c(L) \) is a lag polynomial of known order \( k \). This model includes sufficient numbers of lags, \( k \), to ensure the residual term \( \varepsilon_t \) is white noise, and the optimal lag length \( k \) is selected based on the general-to-specific approach suggested by Ng and Perron (1995). \( DU_{1t} \) and \( DU_{2t} \) are dummy variables for a mean shift occurring at times \( TB_1 \) and \( TB_2 \) \((1 < TB < T\)); \( TB \) is the break date), respectively. \( DT_{1t} \) and \( DT_{2t} \) are the corresponding trend shift variables. \( DU_{1t} = 1 \) if \( t > TB_1 \) and zero otherwise; \( DU_{2t} = 1 \) if \( t > TB_2 \) and zero otherwise; \( DT_{1t} = t - TB_1 \) if \( t > TB_1 \) and \( DT_{2t} = t - TB_2 \) if \( t > TB_2 \) and zero otherwise.

Lee and Perera's (2007) model (10) allows for two breaks in the intercept and the slope term of the trend function. The break dates were determined according to the minimum value of the t statistic for \( \alpha \). Using an annual time series, the model followed Lumsdaine and Papell (1997), assuming \( k_{max} \) up to 8. If the t-statistic of \( \alpha \) was higher than critical value, then the unit root of the null hypothesis could not be rejected. Then, this study follows with the Johansen and Juselius (1990) approach to the number of cointegrating vectors when both series are \( I(1) \). The cointegration test for the time series data was developed based on a vector autoregression (VAR) where a \( p \)-dimensional VAR model involving up to \( k \)-lags can be specified as follows:
(11) \[ Z_t = \alpha + \Pi_1 Z_{t-1} + \Pi_2 Z_{t-2} + \ldots + \Pi_k Z_{t-k} + \varepsilon_t \]

where \( Z_t \) is a \((p \times 1)\) vector of \( p \) potential endogenous variables and each of the \( \Pi_i \) is a \((p \times p)\) matrix of parameters and \( \varepsilon_t \) is the white noise term.

Equation (11) can be formulated into an ECM form:

(12) \[ \Delta Z_t = \alpha + \Pi_k Z_{t-k} + \sum_{i=1}^{k-1} \theta_i \Delta Z_{t-i} + \varepsilon_t \]

where \( \Delta \) is the first difference operator, \( \Pi \) and \( \theta \) are \( p \) by \( p \) matrices of unknown parameters, and \( k \) is the order of the VAR which translated into a lag of \( k-1 \) in the ECM.

The third step is the Granger causality, which was based on the framework of either the VAR or error correction model (ECM). The Granger (1969) causality model is built on a stationary basis. A bivariate VAR model for testing the Granger causality is formulated as follows:

(13) \[ LFDI_t = \sum_{j=1}^{p} \alpha_{11,j} LFDI_{t-j} + \sum_{j=1}^{p} \alpha_{12,j} EXPORT_{t-j} + \varepsilon_{t1} \]

(14) \[ EXPORT_t = \sum_{j=1}^{p} \alpha_{21,j} EXPORT_{t-j} + \sum_{j=1}^{p} \alpha_{22,j} LFDI_{t-j} + \varepsilon_{t2} \]

where \( \varepsilon_{t1} \) and \( \varepsilon_{t2} \) are white noise. We can consider (4) and (5) the framework of vector autoregressive (VAR) models, and \( p \) is the lag length of VAR. The Akaike Information Criterion (AIC) (Akaike, 1974) was used in selecting the optimal order of lags in the estimations. A test of joint significance of these lagged terms \(( \alpha_{12,j} = 0, j = 1, \ldots, p \) and \( \alpha_{22,j} = 0, j = 1, \ldots, p \)) constitutes a short-run Granger causality test.
If two variables are both \( I(1) \) but cointegrated, then the Granger causality test is performed in the framework of ECM which is formulated as follows:

\[
\Delta LFDI_t = \sum_{j=1}^{p-1} \beta_{1j} \Delta LFDI_{t-j} + \sum_{j=1}^{p-1} \beta_{2j} \Delta EXPORT_{t-j} + \alpha_1 EC_{t-j} + \varepsilon_t
\]

\[
\Delta EXPORT_t = \sum_{j=1}^{p-1} \beta_{1j} \Delta LFDI_{t-j} + \sum_{j=1}^{p-1} \beta_{2j} \Delta EXPORT_{t-j} + \alpha_2 EC_{t-j} + \varepsilon_t
\]

where \( \Delta \) is the first difference operator, and \( \varepsilon_1t \) and \( \varepsilon_2t \) are white noise. EC is the error correction term, and \( p \) is the order of the VAR, which translated into a lag of \( p-1 \) in the ECM. \( \alpha_1 \) and \( \alpha_2 \), represent the speed of adjustment after the FDI or exports deviate from the long-run equilibrium in period \( t-1 \). The coefficients of lagged value, \( \beta_{1j} \) for \( j = 1,...,p-1 \), in equation (15) represent short-run effects of export performance on FDI, and \( \beta_{2j} \) for \( j = 1,...,p-1 \), in equation (16) represent short-run effects of FDI on export performance. A test of joint significance of these lagged terms constitutes a short-run Granger causality test.

Lee and Perera's (2007) study found after applying the ADF test and PP tests that LTFDI is trend stationary, \( I(0) \) and the remaining variables are stationary in the first difference, \( I(1) \) at 5 per cent significance level. PP tests suggest that LTFDI and LUSFDI are trend stationary, \( I(0) \), whereas the remaining variables are stationary in the first difference, \( I(1) \). Since conventional unit root tests may have been biased toward the non-rejection of a unit root, the property of stationarity of univariate time series data depends on the results from the LP approach, which allows two structural breaks in the time series. The LP approach found that the first break date in the time series of LTFDI in 1968 coincides with the effective operation of EPZs in Taiwan in the same year; and the second break date in 1979 coincides with the Taiwanese unstable political event in 1978.
in which formal diplomatic relations between the U.S. and Taiwan broke. Trace statistics and Max-Eigen statistics suggest that there is no cointegrating relationship because both variables are $I(0)$.

Lee and Perera (2007) observed that the positive association between inward FDI and export expansion in Taiwan has been confirmed. Also, from the break date in univariate time series data of total FDI and total exports, the study argued that the Taiwanese government's encouragement of FDI and exports positively stimulated FDI and exports. Lee and Perera's (2007) study also indicated that the structural break is affected by big international shocks (oil crisis in 1973 to 1975 and Asian financial crisis in 1997 to 1998) and infrequent events (appreciation of Japanese Yen in the second half of 1980s). Lee and Perera (2007) concluded that the Taiwanese government's intervention successfully stimulated FDI and exports, and inward FDI had a positive influence on export performance. Also, this study concludes that it is not deep enough regarding Taiwan's export performance and it narrowly focuses on FDI advantages; and the limitation is the presence of structural breaks that may not explain more than two breaks.

Pramadhani, Bisoondeelal and Driffield's (2007) research examined the causal relationships between inward direct investment, growth and trade in Indonesia for the period 1990 – 2004. The study reviewed if there were strong/weak positive or negative associations between the presence of MNEs and Indonesian exports and imports activity; and to determine if causal links exist between variables. The research followed the approach of Pacheco-López (2005) to investigate causal relationships between FDI,
exports, and imports, the direction of causality between FDI and imports, and FDI and exports using bivariate error correction models.

Pramadhani, Bisoondeel and Driffield's (2007) study uses a three-step approach to establish whether there are any long-run relationships between the variables in a bivariate analysis, then test for long-run and short-run causality using error correction models. In addition to investigating the causal relationship between FDI and imports and FDI and exports in a bivariate framework, the authors also investigated the causality relationship between these variables in a multivariate framework including GDP, allowing the investigation of linkages in the model; and providing an insight into several hypotheses, such as the export growth (ELG) hypothesis, import growth hypothesis (ILG), and any developmental effects of FDI (Aitken et al, 1997; Aitken & Harrison, 1999; Balassa, 1978; Edwards, 1998).

For bivariate models related to FDI and imports and FDI and exports, the model investigates whether there are long-run relationships as follows:

(17) \[ fdi_t = \beta_{11} + \beta_{12}m_t \]

(18) \[ fdi_t = \beta_{21} + \beta_{22}x_t \]

and for the multivariate model search for long-run relationships as follows:

(19) \[ fdi_t = \beta_{31} + \beta_{32}x_t + \beta_{33}m_t + \beta_{34}y_t \]

where \( fdi \) represents FDI, \( m \) represents imports, \( x \) represents exports, and \( y \) represents GDP.
According to Pramadhani, Bisoondeeal and Driffield (2007), the variables are non-stationary I(1) variables which were tested using a cointegration approach to determine the nature of the long-run relationships. The study tested for the presence of cointegrating relationships between the variables using the Johansen (1988) maximum likelihood method within a vector autoregressive (VAR) framework. Gonzalo (1994) demonstrated that Johansen's (1988) procedure has superior properties to other methods of testing cointegration. The test in Pramadhani, Bisoondeeal, and Driffield (2007) continues with letting $z_t$ denote a $p \times 1$ vector of variables which are not integrated of an order higher than one, then $z_t$ can be formulated as a VAR model of order $k$:

$$z_t = \Pi_1 z_{t-1} + \Pi_2 z_{t-2} + \Lambda + \Pi_k z_{t-k} + \text{deterministic components} + \epsilon_{1t}$$

where $\epsilon_{1t}$, is independently and normally distributed and are coefficient matrices.

The model can be reparametrized to yield a vector error correction model of the form:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Lambda + \Gamma_{k-1} \Delta z_{t-(k-1)} + \Gamma z_{t-1} + \text{deterministic components} + \epsilon_{2t}$$

where $\epsilon_{2t}$ is independently and normally distributed, and $\Gamma_1, \Gamma_2, \Lambda, \Gamma^{t-(k-1)}$ and $\Gamma$ are coefficient matrices. Let $r = \text{rank}(\Gamma)$, then if $0 < r < \Gamma$ the matrix $\Gamma$ can be partitioned into $p \times r$ matrices $\alpha$ and $\beta$ such that $\pi = \alpha \beta'$ and $\beta' z_t$ is $I(0)$ (Johansen and Jesulius, 1990). $r$ is the number of cointegrating relationships and each column of $\beta$ is the cointegrating vector. In this study the trace test (Johansen, 1995) is used to determine the number of Cointegrating relationships between the variables in this bivariate and in multivariate model.
Pramadhani, Bisoondeeal, and Driffield (2007) continue with the investigation of the causal relationships between FDI, imports and exports in both bivariate and a multivariate framework. If a set of I(1) variables is cointegrated, causality tests conducted in the first difference VAR framework will not be specified properly unless the error correction term is also included in the VAR specification. For example, if one wishes to investigate the causal relationship between FDI and exports in a multivariate model, the tests are conducted on error correction equations of the following forms:

\[
\Delta fdi_i = \sum_{i=1}^{k} \alpha_i \Delta fdi_{i-1} + \sum_{j=1}^{k} \alpha_{2j} \Delta x_{i-j} + \sum_{p=1}^{k} \alpha_{3p} \Delta m_{i-p} + \sum_{q=1}^{k} \alpha_{4q} \Delta y_{i-q} + \delta_1 \text{ECT}_{i-1} + \varepsilon_{3i}
\]

(22)

\[
\Delta x_i = \sum_{i=1}^{k} \beta_i \Delta fdi_{i-1} + \sum_{j=1}^{k} \beta_{2j} \Delta x_{i-j} + \sum_{p=1}^{k} \beta_{3p} \Delta m_{i-p} + \sum_{q=1}^{k} \beta_{4q} \Delta y_{i-q} + \delta_2 \text{ECT}_{i-1} + \varepsilon_{4i}
\]

(23)

where ECT is the error correction term derived from the long-run cointegration relationship between FDI, exports, imports and GDP. This way, short and long-run causality can be tested.

Pramadhani, Bisoondeeal, and Driffield (2007) conclude that inward direct investment in Indonesia leads to increased trade, and also agree with the general development theories finding vertical foreign direct investment. The results of the causality testing are consistent with results from Alguacil et al. (2002) and Pacheco-López (2005), where FDI and exports have a two-sided causality. Also, Pramadhani, Bisoondeeal, and Driffield (2007) found that the relationships are more complicated than suggested by previous research, where FDI growth effects are important to explain causality and the long-run effects of FDI. At the end, the study concluded that there is
increased dependence on foreign investors for future development and the concentration of resources is in the foreign-owned sector.

Johnson's (2006b) working paper for CESIS (Centre of Excellence for Science and Innovation Studies) investigates the flows of FDI and trade in eight East Asian economies, using data for the period 1980 to 2003 and focusing on the relationship between FDI and host country exports. The study uses time series regressions for each economy and panel data estimations, which indicates that FDI has a significant and positive effect on host country exports, suggesting an export-platform FDI for these economies. Johnson (2006b) found no clear link between FDI outflows and exports, where FDI outflow functions as complement and substitute for country exports. Granger causality tests found that FDI caused exports, providing evidence that the export-platform FDI strategy applies to the economies.

The first step of the research estimate time series and panel data, using total exports as the dependent variable and total FDI inflows and outflows as independent variables, following this time series equation:

\[
EXP_t = \beta_0 + \beta_1 FDIIN_t + \beta_2 FDIOUT_t + \varepsilon_t
\]

where \( EXP_t \) represents total exports per capita time \( t \), \( FDIIN_t \) is the inward flow of FDI per capita, \( FDIOUT_t \) is the outward flow of FDI per capita, and \( \varepsilon_t \) is the disturbance term.
Johnson (2006b) continues applying the augmented Dickey-Fuller (ADF) test on the individual time series for all eight economies. The ADF-test estimated the following regression:

\[
\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \epsilon_t
\]

where \( Y_t \) is the time series being investigated for non stationarity, \( t \) is the trend variable, and \( \epsilon_t \) is the error term. The null hypothesis is that \( \delta = 0 \), implying the existence of a unit root and a non-stationary time series.

The Schwarz information criterion was used to determine the number of lagged difference terms and the Akaike Information Criterion (AIC) (Akaike, 1974), which is a formal approach to determine the number of lags to use in the Granger causality tests using. Johnson (2006b) concluded that unit root tests detected non-stationarity in the time series data, then was transformed to the first difference using regressions. These regressions provided indications of a positive effect of FDI on exports, suggesting an important regional FDI export platform. The results for FDI outflows effects suggested that FDI outflows complements and substitutes exports, as suggested by previous literature.

Granger causality tests indicate that FDI inflows cause exports, providing further evidence that export-platform FDI is present in the East Asian economies. The results of the study suggest that FDI have a positive effect on host country exports.

Erdal and Tatoglu (2002) conducted an empirical analysis of the theory of location, using location-related determinants impacting FDI inflows to Turkey from 1980
to 1998. Evidence from this study supported the existence of a positive relationship between FDI inflow and market size (GDP). This study also used other variables to establish a statistical relationship with FDI inflows, such as exchange rate instability and overall economic instability, infrastructure, and the openness of the host country economy. Based on this relationship, the lack of exchange rate and economic stability prevented Turkey from receiving a higher rate of FDI inflows, even though it offered locational advantages such as market size, infrastructure, economy openness, and market attractiveness.

The model by Erdal and Tatoglu (2002) was based on a time series technique suggested by Johansen (1988), where the host country market size is measured by gross domestic product (GDP). Results show that domestic market size is positively related to foreign direct investment inflows, and when the host country market size increases, opportunities for foreign investors increase. Several limitations exist, such as sample size, unavailability of data regarding the country of origin and investment type, which in turn control the FDI impact in Turkey. However, relevant data exist to support the assertion that FDI inflow has a positive influence on GDP and exports. Additional research was suggested based on the examination of facts and data.

Kornecki and Raghavan (2008) analyzed five Central and Eastern European (CEE) countries during the post-communist era. These countries (Poland, Czech Republic, Hungary, Slovakia and Slovenia) became members of the European Union (EU) on May 1, 2004. The study tested a hypothesis that FDI inflows would contribute to the economic growth of the CEE countries. The research consisted of three parts. The
first had a macroeconomic view, and examined GDP per capita and the economic growth rate. The second part examined inward FDI as percentage of GDP, while the third section estimated FDI impact on economic growth in the CEE using an aggregated regression growth model. The FDI and economic growth relationship methodology was based on the production function model (Brock, 2005).

A relevant part of this study is that Kornecki and Raghavan (2008) analyzed the regression results, considering the FDI effect on economic growth via technology. Results supported the argument from the theory of endogenous growth that examines the effect of FDI on economic growth via technology, where new technology is transferred and spread throughout the entire economy and is not limited to industries with FDI. Study results showed a positive relationship between FDI inflows and economic growth in the CEE, and strong impact of FDI on GDP growth. The aggregated model of the CEE economic growth showed a strong impact of FDI on output growth, thereby supporting the hypothesis that FDI is an important factor of economic growth, that FDI contributes to economic growth in CEE countries, and that FDI is a key element of continuous economic growth.

Cordero and Paús (2008) analyzed Costa Rica as an attractive destination (location specific) for multinational enterprises (MNEs) and the FDI impact on Costa Rica's economic development. Results showed that during the last decade, Costa Rica was the only country in Latin America where a major portion of FDI inflows went to manufacturing, and that Costa Rica was very successful at attracting FDI into technology sectors. Additionally, FDI in the Free Zones (FTZs) had a positive impact at the
macroeconomic level, but limited impact at the microeconomic level. This was because
backward linkages and technological spillovers were small, due to the limited potential
for spillovers and domestic absorptive capacity for linkages.

Cordero and Paús (2008) reviewed the FDI progress in Costa Rica and its
relationship to economic development, where FDI had a positive macroeconomic impact,
contributing to the financing of the trade deficit, and indirectly to foreign exchange and
price stability, as well as generated export growth and employment. Relevant findings
included that FDI has made only a small contribution to the country’s knowledge-based
assets. Even though positive FDI effects exist through training and university curricula to
accommodate MNEs locally, backward linkages and successful introduction into global
value chains have been very limited. The study suggests that in order to succeed in a very
intense and competitive global environment, the Costa Rican government needs to
develop and implement a strategy that lays out priorities and policies and that contains a
multi-agency approach.

Many researchers focused on finding a relationship between FDI and trade (or
imports and exports) in the home country as opposed to host country. Few, such as Zhang
for Mexico, and Mekki (2005) for Turkey focus on the host country. These studies take
methodological approaches to find conflicting results concerning the relationships
between trade (imports and exports) and FDI (Pramadhani, Bisoondeel & Driffield,
2007).
Relationship between FDI and the Technology Sector

Research Questions.

This research examined the relationship between FDI and the growth of technology sector exports of the host country, Costa Rica, using data sets for the period 1980 to 2008, specifically investigating the relationship between foreign direct investment to the technology sector and its exports, and between foreign direct investment and imports to the technology sector.

The research questions for this proposal were:

1. Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica?
2. Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?
3. Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?
4. Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica?
5. Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?
6. Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica?

7. Is there a positive relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?

8. Is there a negative relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?

Hypotheses.

The following hypotheses are concerned with the general impact of FDI from Costa Rica trading partners on exports from the technology sector:

H1: There is a positive significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.

H2: There is a negative significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H3: There is a positive significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.
H4: There is a negative significant relationship between inflow of Foreign Direct Investment from the non United States countries to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H5: There is a positive significant relationship between inflow of Local Investment to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.

H6: There is a negative significant relationship between inflow of Local Investment to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H7: There is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1995 to 2008 period.

H8: There is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1995 to 2008 period.

Figure 2.1 shows the hypothesized model of this study.
Figure 2.1. Hypothesized Model
Chapter 3: Research Methodology

Research Design

Using theoretical and empirical literature as the basis for the critical analysis, this section describes the research methods used to examine the relationship between foreign direct investment, imports to the technology sector of goods and services and exports from the technology sector of goods and services in Costa Rica. This analysis focused on the relationship between FDI and Costa Rica host country technology sector exports and FDI and imports of the technology sector for period 1995 to 2008.

This is an empirical research followed with a three stage examination of time series (Granger, 1999; Salvatore & Reagle, 2002; Hoover, 2005; Chao, 2005; Castle & Shephard, 2009) and the regression analysis is as follows:

1. Specification of the model using a specific stochastic equation, together with a priori theoretical expectations about the sign and size of the parameters of the function.

2. Data collection on the variables of the model and estimation of the coefficients of the function, using appropriate econometric techniques.

3. Evaluation of the estimated coefficients of the function, based on economic statistical and econometric criteria.

Time series are a collection of observations made sequentially over time. The first step of the analysis is to plot the observations (time plot) to obtain descriptive measures of the properties of the series. When observations are taken for two or more variables, it
may be possible to use the variation in one time series to explain the variation in the other series, leading to a further understanding of the mechanism that generated a specific time series. While multiple regression models are occasionally helpful, they are not designed to handle time series data with all the inherent correlations, so other models were considered (Chattfield, 2004; Granger, 1979; Lee, 1996; Libanio, 2005).

There are three general points from which to build models from economic data (Chattfield, 2004):

1. Economic data is naturally affected by feedback, making modeling difficult.

2. The economy has a complex, non-linear structure that may change over time and data sets are often small.

3. Statistical inference is usually conditional on an assumed model and focuses on uncertainty due to sampling variation and estimation of model parameters.

In this study the causal (independent) variable is Foreign Direct Investment (FDI) and Exports and Imports are the dependent variables. The research questions are: 1. Does Foreign Direct Investment from the United States, non-United States partners, and local investment affect exports from the technology sector in Costa Rica? 2. Does Foreign Direct Investment from the United States, non-United States partners, and local investment affect imports to the technology sector in Costa Rica?

The purpose of this research was to examine the relationship between foreign investment and exports from the technology exports; and between foreign direct investment and imports to the technology sector in Costa Rica. There is an agreement that
FDI fosters benefits to host country economies and that it is important to increase the understanding, via scholarly inquiry, on how FDI impacts a developing country’s economy. The research uses a causal correlational approach followed that of Johnson (2006b), Pramadhani, Bisoondoyal and Driffield (2007) and Lee and Perera (2007), where the unit root analysis approach reduces the incorrect judgment of stationarity of the time series and the application of Granger causality test. The Granger causality techniques were performed in a framework of the vector autoregression (VAR) model and the error correction model (ECM). These findings provided useful background for trade, foreign investment policies, and development strategies for Costa Rica.

The SAS Software and STATA, Data Analysis and Statistical software was utilized in the data analysis. In this research study, all variables were presented to answer the research questions. Inferential statistics, which include time series regression, ANOVA and independent t-test, were utilized to test hypotheses.

The study used regression to analyze the relationship between FDI, imports and exports, and respective equations. Macroeconomic time series have unit roots and by using OLS (ordinary least squares) it may generate spurious correlation (two variables trending over time, tend to have high correlation, even if they are not related) when regressing non-stationary time-series. When spurious correlation happens, Granger causality test (Granger, 1979) results may be misleading. As the aim of this research was to identify causality relationships, it is critical to test each individual time series for unit roots before applying the Granger causality test (Granger, 1969, 1988). For this reason, Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979; Greene, 1997) and Phillips...

The first step for the Granger causality is to test the time series data for stationarity, and for this purpose, two unit root tests (ADF and PP) were applied. If structural break(s) exist in the time series, the ADF test may be biased when the series is trend stationary within each of the sub-periods (Perron, 1997). Therefore, Lumsdaine and Papell's (LP) test was applied to detect two-time structural breaks in the unit root analysis, and the result of stationarity of each time series replaces the result from ADF and PP tests. The structural break may occur by reflecting, for example, a country's economic policy reforms or recession (Perron, 1997). If the breaks are located in the same year, then the time series was affected immediately by this break. If the breaks are located in the year after the occurrence, the time series was affected gradually by this structural break (Valadkhani, Pahlavani & Layton, 2005). The LP approach is an improvement of the ADF test, which augmented two endogenous breaks.

The second step is the cointegration testing for bivariate models related to FDI and exports and FDI and imports (Hypotheses 1, 2, 3, 4, 5 and 6). The study investigated the existence of long-run relationships of the following form:

$$(19) \quad H1 \ EXP = \beta_1 + \beta_2 \text{FDI}_{\text{U.S.}} + u$$

where EXP is exports from the technology sector, FDI_{U.S.} is Foreign Direct Investment from the United States to the technology sector, $\beta_1$ the unknown
constant parameter, parameter $\beta_2$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

(20) **H3** $\text{EXP} = \beta_1 + \beta_3 \text{FDIN-U.S.} + u$

where EXP is exports from the technology sector, FDIN-U.S. is Foreign Direct Investment from non-United States countries to the technology sector, $\beta_1$ the unknown constant parameter, parameter $\beta_3$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

(21) **H5.** $\text{EXP} = \beta_1 + \beta_4 \text{DI} + u$

where EXP is exports from the technology sector, DI is Domestic Investment to the technology sector, $\beta_1$ the unknown constant parameter, parameter $\beta_4$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

(22) **H2.** $\text{IMP} = \beta_1 - \beta_2 \text{FDIN-U.S.} + u$

where IMP is imports to the technology sector, FDIN-U.S. is Foreign Direct Investment from United States to the technology sector, $\beta_1$ the unknown constant parameter, parameter $\beta_2$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

(23) **H4.** $\text{IMP} = \beta_1 - \beta_3 \text{FDIN-U.S.} + u$

where IMP is imports to the technology sector, FDIN-U.S. is Foreign Direct Investment from non-United States countries to the technology sector, $\beta_1$ the
unknown constant parameter, parameter $\beta_3$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

(24) $\text{H6. IMP} = \beta_1 - \beta_4 \text{DI} + u$

where IMP is imports to the technology sector, DI is Domestic Investment to the technology sector, $\beta_1$ the unknown constant parameter, parameter $\beta_4$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

For the multivariate model (Hypothesis 7 and 8), the search for the long-run relationship took the following form:

(25) $\text{H7. EXP} = \beta_1 + \beta_2 \text{FDI}_{\text{U.S.}} + \beta_3 \text{FDI}_{\text{N-U.S.}} + \beta_4 \text{DI} + u$

where EXP is exports from the technology sector, FDI_{U.S.} is Foreign Direct Investment from the United States, FDI_{N-U.S.} is Foreign Direct Investment from non-United States countries to the technology sector, DI is domestic investment to the technology sector, and $\beta_1, \beta_2, \beta_3$ and $\beta_4$ are the unknown constant parameters.

The parameters $\beta_2, \beta_3$ and $\beta_4$ are the slope coefficients, and $u$ is the random disturbance, error, or stochastic term.

(26) $\text{H8. IMP} = \beta_1 - \beta_2 \text{FDI}_{\text{U.S.}} - \beta_3 \text{FDI}_{\text{N-U.S.}} + \beta_4 \text{DI} + u$

where IMP is imports to the technology sector, FDI_{U.S.} is Foreign Direct Investment from the United States, FDI_{N-U.S.} is Foreign Direct Investment from non-United States countries to the technology sector, DI is domestic investment to the technology sector, and $\beta_1, \beta_2, \beta_3$ and $\beta_4$ are the unknown constant parameters.
The parameters $\beta_2, \beta_3$ and $\beta_4$ are the slope coefficients, and $u$ is the random disturbance, error, or stochastic term.

If a series forms a long-run equilibrium relationship, and even if the series may contain stochastic trends (i.e. non-stationary, $I(1)$), they will move closely together over time. Therefore, the existence of cointegration implies a long-run equilibrium with an economic system that converges over time (Harries, 1995, p. 22). This analysis used Johansen and Jesuliuss's (1990) approach to the number of cointegrating vectors if two variables are $I(1)$. The cointegration test of maximum likelihood based on the Johansen-Jesulius test is developed based on a VAR approach initiated by Johansen (1988).

The third step is the Granger causality test (Granger, 1969, 1988), where it can be addressed in terms of a VAR (vector auto regression) system. Using Johnson (2006b), if an export platform is important for Costa Rica, FDI inflows should result in an increase in export flows from the host country. Therefore, Granger causality could be used to examine whether FDI Granger inflows cause export flows. The direction of the Granger causality is sensitive to the number of lags; therefore, it is important to use the Akaike Information Criterion (AIC) (Akaike, 1974) to suggest the use of the lag with the lowest computed AIC value. The AIC is defined as: $\ln \text{AIC} = [2k/n] + \ln [\text{RSS}/n]$ where $k$ is the number of regressors, $n$ is the number of observations, and RSS is the residual sum of squares.

For FDI and exports and FDI and imports, the Granger causality test was applied based on a stationary dataset. Hence, it is necessary to establish the stationarity properties of the data, and unit root analysis is conducted for this purpose. Using Johnson (2006b),
Pramadhani, Bisoondeeal and Driffield (2007) and Lee and Perera (2007), if an export platform is important for Costa Rica, the result will indicate an increase in export flows from the technology sector. Therefore, Granger causality was used to examine whether FDI Granger inflows cause export flows or import substitution in the technology sector. The direction of the Granger causality is sensitive to the number of lags; therefore, it is important to use the Akaike Information Criterion (AIC) (Akaike, 1974) to suggest the use of the lag with the lowest computed AIC value. Given a data set, several competing models may be ranked according to their AIC, with the one having the lowest AIC being the best.

Sample


Eligibility Criteria and Exclusion Criteria.

The data collection and calculation followed agreed-upon guidelines provided by researchers, the World Bank, and its partnership organizations. The Development Data
Group in the office of the Development Economics Vice Presidency is in charge of assimilation, compilation, inventory preparation, archiving, retrieval, and dissemination once data is received (World Bank, 2006).

**Units.**

Since most macroeconomic indicators in WDI are unitized by country, data users view the world and understand global change through aggregate units and countries, instead of individual firms or localized areas (World Bank, 2006). Aggregate national statistics are valuable to explain and compare changes and differences among countries in different timeframes (Zhang, 2005, World Bank, 2006).

**Omissions of priorities.**

Some data was omitted due to historical reasons, like times of war, regional turmoil, new indicators not previously collected, etc. FDI data have been collected since 1958, and detailed annual electronic datasets are available from 1972 to the present survey for investment flows and earnings data. However, the investment positions data for the technology sector was collected annually since 1995. Data prior to 1995 was limited or nonexistent and only available by request from Costa Rica Central Bank, Government of Costa Rica Archives and World Bank. (Banco Central, 2006; World Bank, 2006)

**Definitions.**

Errors in methods of data collection arise from inherent differences in operational definitions of variables. For example, economic data exclude works not monetized,
because some economic indicators exclude information because these are non-market behaviors. As a result, there are drawbacks associated with different operational definitions which may bias statistics of production, consumption, labor force, and human welfare.

_Standardization._

Time series data and country data require standardizing the data and noting exceptions to standards. When there are exceptions, comparability of data sets cannot be ensured, resulting in limitations in interpretations.

_Methodology._

Time series comparisons usually involve complex statistical questions to answer, which do not have straightforward analytical solutions. Changing systems of national accounting is another limitation of utilizing secondary data. The WDI, for example, uses terminology in line with the 1993 United Nations System of National Accounts, which is different from the definitions of data variables in use before 1993.

_Bureaucratic quality._

The bureaucratic qualities in many developing and under-developed countries are not sophisticated in collecting and computing even with clear guidelines, affecting quality, reliability and validity of the data. As an example, Figure 3 illustrates the relationship between FDI flows as the source of funds and real investment as the use of funds. Figure 3.1 shows the relationship between FDI and Real investment.
Figure 3.1 shows the Relationship between FDI Flows and Real Investment

These errors affect the accuracy and reliability of the data. Any data with significant changes, 10 times or more, between the previous and the following year for the timeframe of 1995 to 2008 will be excluded to assure the reliability of data.

**Inclusion Criteria.**

1. Macroeconomic data, including foreign direct investment, import and export data of Costa Rica.

2. This study covered the period from 1995 to 2008. The time before 1995 will be excluded, as data was not easily accessible.

**Exclusion Criterion.**

1. This study excludes data before 1995 because data are not easily accessible or nonexistent.
Instrumentation

Econometric Equation.

This empirical regression analysis involves three stages (Granger, 1999; Salvatore & Reagle, 2002; Hoover, 2005; Chao, 2005; Castle & Shephard, 2009) as follow:

1. Specification of the model using a specific stochastic equation, together with a priori theoretical expectations about the sign and size of the parameters of the function.

2. Data collection on the variables of the model and estimation of the coefficients of the function using appropriate econometric techniques.

3. Evaluation of the estimated coefficients of the function based on economic statistical and econometric criteria.

The study followed a causal correlational approach to analyze the relationship between FDI, imports and exports, and respective equations. For bivariate models related to FDI and imports and FDI and exports, the model investigated relationships following the equations:

\[(19) \quad (20) \quad (21) \quad EXP = \beta_n + \beta_{n+1} INV + u,\]

where EXP is exports from the technology sector, INV is Foreign Direct Investment or Domestic Investment in the technology sector, \(\beta_n\) the unknown constant parameter, parameter \(\beta_{n+1}\) is the slope coefficient, and u is the random disturbance, error, or stochastic term.
\[(22) \ (23) \ (24) \ IMP = \beta_n - \beta_{n+1} \text{INV} + u,\]

where \(IMP\) is imports to the technology sector, \(\text{INV}\) is Foreign Direct Investment or Domestic Investment to the technology sector, \(\beta_n\) the unknown constant parameter, parameter \(\beta_{n+1}\) is the slope coefficient, and \(u\) is the random disturbance, error, or stochastic term.

For multivariate models related to FDI and imports and FDI and exports, the model investigated relationships following the equations:

\[(25) \ EXP = \beta_n + \beta_{n+1} \text{INV} + \beta_{n+2} \text{INV}_{\text{US}} + \beta_{n+3} \text{INV} + u,\]

where \(EXP\) is exports from the technology sector, \(\text{INV}\) is investment in the technology sector and \(\beta_n, \beta_{n+1}, \beta_{n+2}, \text{and} \beta_{n+3}\) are the unknown constant parameters. The parameters \(\beta_{n+1}, \beta_{n+2}, \text{and} \beta_{n+3}\) are the slope coefficients, and \(u\) is the random disturbance, error, or stochastic term.

\[(26) \ IMP = \beta_n + \beta_{n+1} \text{INV} - \beta_{n+2} \text{INV} - \beta_{n+3} \text{INV} + u,\]

where \(IMP\) is imports to the technology sector, \(\text{INV}\) is investment to the technology sector, and \(\beta_n, \beta_{n+1}, \beta_{n+2}, \text{and} \beta_{n+3}\) are the unknown constant parameters. The parameters \(\beta_{n+1}, \beta_{n+2}, \text{and} \beta_{n+3}\) are the slope coefficients, and \(u\) is the random disturbance, error, or stochastic term.
Procedures: Ethical Considerations and Data Collection

1. Ethical Considerations
   
a. An application was submitted to the Lynn University Institutional Review Board (IRB) for the investigator to conduct this research.

b. An IRB Form 2 (Request for IRB Exemption) was submitted to the Lynn University IRB because this research does not propose to disrupt or manipulate subjects' normal life.

c. There are no human subjects; therefore no consent was required.

d. Online data recording proceeded after approval by the IRB of Lynn University.

e. The data retrieval and recording required four months from the time of approval by the IRB of Lynn University.

f. The research used SAS Software and STATA, Data Analysis and Statistical software for data analysis.

g. An IRB Form 8 (Termination of Study) was submitted to the IRB of Lynn University after data collection and research was completed.

2. Data Collection Methods

   The data collection and calculation followed agreed-upon guidelines provided by researchers, the World Bank, and its partnership organizations. The Development Data Group in the office of the Development Economics Vice Presidency is in charge of assimilation, compilation, inventory preparation, archiving, retrieval, and dissemination once data is received (World Bank, 2006).
Methods of Data Analysis

The SAS Software and STATA, Data Analysis and Statistical software were utilized in the data analysis. According to the World Bank (2008), statistical and data work is performed by the Development Data Group (DECDG) in the Development Economics Vice Presidency, which works directly with the World Bank’s regions and sectors following professional standards in data collection, compilation, and dissemination, ensuring that all data users can have confidence in the quality and integrity of the data produced.

The majority of data came from the statistical systems of member countries and the quality of this global data depends on how well these national systems perform, under the support, monitoring and help of the World Bank. Development of many global policies, strategies, and goals will be impossible to achieve without this comprehensive national data (World Bank, 2008).

Statistics must be both reliable and relevant; therefore, they need to be compiled correctly, follow standard practices and methodology, meet the needs of the users, and answer the questions posed by researchers and policymakers. The World Bank invests in statistical activities to create and implement a standardized data collection, analysis, compilation and dissemination framework to strengthen the international statistical system for these global datasets (World Bank, 2008).

Data came from the World Bank datasets (Costa Rica) and Central Bank of Costa Rica (source to the World Bank) interpreted with appropriate graphical displays, concepts
of variability, causation, correlation, and standard deviation. Descriptive statistics was used to identify outliers, communicate, and support predictions and conclusions.

Inferential statistics, including time series regression and independent t-test, were utilized to test hypotheses. Time series data were used to find the impacts of foreign direct investment on Costa Rica's exports from the technology sector for the period of 1995-2008 in this study. A three-stage procedure was used to examine the causality and its direction: Testing Time Series Properties, Cointegration and Granger Causality. In the first stage the order of integration was tested using the Augmented Dickey-Fuller (ADF), Phillips Perron (PP), and excluded Lumsdaine and Papell (PP) unit root tests; the second stage involved testing for the existence of a long-run equilibrium relationship between variables using Johansen and Joselius (JJ); and the third stage involved constructing the standard Granger-type causality tests augmented with a lagged error-correction term where the series are cointegrated, including Akaike Criterion (AKC) to find number of lags (Akaike, 1974; Granger, 1999; Salvatore & Reagle, 2002; Narayan & Smyth, 2004; Hoover, 2005; Chao, 2005; Castle & Shephard, 2009).

To answer Research Question 1, "Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Exports).

To answer Research Question 2, "Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the
technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Imports).

To answer Research Question 3, "Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Exports).

To answer Research Question 4, "Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Imports).

To answer Research Question 5, "Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Exports).

To answer Research Question 6, "Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Imports).

To answer Research Question 7, "Is there a positive relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa
Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Exports).

To answer Research Question 8, "Is there a negative relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?" a regression analysis was conducted to describe the macroeconomic indicators (FDI and Imports).

To test Hypothesis 1, there is a positive significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period, regression analysis was applied as follows:

(19) \[ EXP = \beta_1 + \beta_2 FDI_{U.S.} + u, \]

where \( EXP \) is exports of the technology sector, \( FDI_{U.S.} \) is Foreign Direct Investment from the United States to the technology sector of Costa Rica, \( \beta_1 \) the unknown constant parameter, parameter \( \beta_2 \) is the slope coefficient, and \( u \) is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation
(27) \[ \Delta \text{EXP}_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \Delta \text{EXP}_{t-j} + \beta_t + \gamma \text{EXP}_{t-1} + u_t, \]

where \( \Delta \text{EXP}_t \) is exports of technology sector lags in time \( t \), \( \gamma \text{EXP}_{t-1} \) is exports from technology sector of Costa Rica in time \( t-1 \), \( \alpha_0, \alpha_j, \beta_t \) and \( \gamma \) are constant parameters, and \( u \) is the random disturbance, error, or stochastic term.

Cointegration, Long-Run Relationship, and Error Correction

(28) \[ \hat{e}_t = \text{EXP}_t - \hat{b}_0 - \hat{b}_1 \text{FDI}_{U.S.}, \]

where \( \hat{e}_t \) is the estimated long-run relationship, \( \hat{b}_0 \) and \( \hat{b}_1 \) are estimators of the true parameters \( b_0 \) and \( b_1 \). \( \text{EXP}_t \) is exports of the technology sector and \( \text{FDI}_{U.S.} \) is foreign direct investment from the United States to the technology sector.

(29) \[ \Delta \text{EXP}_t = c_0 + c_1 + \Delta \text{FDI}_{U.S.} + c_2 \hat{e}_{t-1} + u_t, \]

where \( \Delta \text{EXP}_t \) is exports of the technology sector lags in time \( t \), \( c_0, c_1 \) and \( c_2 \) are constant parameters, \( \hat{e}_{t-1} \) is the error correction, \( u \) is the random disturbance, error, or stochastic term, and \( \Delta \text{FDI}_{U.S.} \) is foreign direct investment from the United States to the technology sector.

Granger Causality

(30) \[ \text{EXP}_t = b_0 + \sum_{j=1}^{p} b_j \text{EXP}_{t-j} + \sum_{j=1}^{p} c_j \text{FDI}_{U.S.,t-j} + u_t, \]

where \( \text{EXP}_t \) is exports of the technology sector in time \( t \), \( \text{EXP}_{t-j} \) is exports from the technology sector in time \( t-j \), \( b_0, b_j \) and \( c_j \) are constant parameters, \( u \) is the
random disturbance, error, or stochastic term, and FDI\textsubscript{U.S.\_t-j} is foreign direct investment from the United States to the technology sector in time t-j.

To test Hypothesis 2, there is a negative significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period, regression analysis was applied as follows:

\begin{equation}
IMP = \beta_1 - \beta_2 FDI\textsubscript{U.S.} + u,
\end{equation}

where IMP is imports to the technology sector of Costa Rica, FDI\textsubscript{U.S.} is Foreign Direct Investment from the United States to the technology sector of Costa Rica, \(\beta_1\) is the unknown constant parameter, parameter \(\beta_2\) is the slope coefficient, and \(u\) is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation

\begin{equation}
\Delta IMP_t = a_0 + \sum a_j \Delta IMP_{t-j} + \gamma YIMP_{t-1} + u_t,
\end{equation}

where \(\Delta IMP_t\) is imports to technology sector of Costa Rica lags in time \(t\), \(\gamma YIMP_{t-1}\) is imports to the technology sector of Costa Rica in time \(t-1\), \(a_0\), \(a_j\), \(\gamma\) and \(\gamma\) are constant parameters, and \(u\) is the random disturbance, error, or stochastic term.

Cointegration, Long-Run Relationship, and Error Correction

\begin{equation}
\epsilon_t = IMP_t - b_0 - b_1 FDI\textsubscript{U.S.}
\end{equation}

where \(\epsilon_t\) is the estimated error of the long-run relationship, \(b_0\) and \(b_1\) are estimators of the true parameters \(b_0\) and \(b_1\), IMP\(_t\) is imports to the technology sector of Costa Rica.
sector of Costa Rica and FDI_{U.S.} is foreign direct investment from the United States to the technology sector of Costa Rica.

\begin{equation}
\Delta \text{IMP}_t = c_0 + c_1 - \Delta \text{FDI}_{U.S.} + c_2 e_{t-1} + u_t,
\end{equation}

where $\Delta \text{IMP}_t$ is imports to lags in time $t$, $c_0, c_1$ and $c_2$ are constant parameters, $e_{t-1}$ is the error correction, $u$ is the random disturbance, error, or stochastic term, and $\Delta \text{FDI}_{U.S.}$ is foreign direct investment from the United States to the technology sector of Costa Rica.

**Granger Causality**

\begin{equation}
\text{IMP}_t = b_0 + \sum_{J=1}^{p} b_j \text{IMP}_{t-j} + \sum_{J=1}^{p} c_j \text{FDI}_{U.S. t-j} + u_t,
\end{equation}

where $\text{IMP}_t$ is imports to the technology sector in time $t$, $\text{IMP}_{t-j}$ is imports to the technology sector of Costa Rica in time $t-j$, $b_0, b_j$ and $c_j$ are constant parameters, $u$ is the random disturbance, error, or stochastic term, and $\text{FDI}_{U.S. t-j}$ is foreign direct investment from the United States to the technology sector of Costa Rica in time $t-j$.

To test Hypothesis 3, there is a positive significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1990 to 2008 period, regression analysis was applied as follows:
(20) \( \text{EXP} = \beta_1 + \beta_3 \text{FDIN-U.S.} + u, \)

where \( \text{EXP} \) is exports from the technology sector of Costa Rica, \( \text{FDIN-U.S.} \) is Foreign Direct Investment from non-United States countries to the technology sector of Costa Rica, \( \beta_1 \) is the unknown constant parameter, parameter \( \beta_3 \) is the slope coefficient, and \( u \) is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation

(27) \[ \Delta \text{EXP}_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \Delta \text{EXP}_{t-j} + \beta_t + \gamma \text{EXP}_{t-1} + u_t, \]

where \( \Delta \text{EXP}_t \) is exports from technology sector of Costa Rica lags in time \( t \), \( \gamma \text{EXP}_{t-1} \) is exports from the technology sector of Costa Rica in time \( t-1 \), \( \alpha_0, \alpha_j, \beta_t \) and \( \gamma \) are constant parameters, and \( u \) is the random disturbance, error, or stochastic term.

Cointegration, Long-Run Relationship, and Error Correction

(35) \( \hat{\epsilon}_t = \hat{\text{EXP}}_t - \hat{\beta}_0 - \hat{\beta}_1 \text{FDIN-U.S.}, \)

where \( \hat{\epsilon}_t \) is the estimated long-run relationship, \( \hat{\beta}_0 \) and \( \hat{\beta}_1 \) are estimators of the true parameters \( \beta_0 \) and \( \beta_1 \), \( \text{EXP}_t \) is exports from the technology sector of Costa Rica and \( \text{FDIN-U.S.} \) is foreign direct investment from non-United States countries to the technology sector of Costa Rica.
\[ \Delta \text{EXP}_t = c_0 + c_1 + \Delta \text{FDI}_{N-U.S.} + c_2 e_{t-1} + u_t, \]

where \( \Delta \text{EXP}_t \) is exports from technology sector of Costa Rica lags in time \( t \), \( c_0 \), \( c_1 \) and \( c_2 \) are constant parameters, \( e_{t-1} \) is the error correction, \( u \) is the random disturbance, error, or stochastic term, and \( \Delta \text{FDI}_{N-U.S.} \) is foreign direct investment from non-United States countries to the technology sector of Costa Rica.

Granger Causality

\[ \text{EXP}_t = b_0 + \sum_{j=1}^{p} b_j \text{EXP}_{t-j} + \sum_{j=1}^{p} c_j \text{FDI}_{N-U.S. t-j} + u_t, \]

where \( \text{EXP}_t \) is exports from the technology sector of Costa Rica in time \( t \), \( \text{EXP}_{t-j} \) is exports from the technology sector of Costa Rica in time \( t-j \), \( b_0, b_j \) and \( c_j \) are constant parameters, \( u \) is the random disturbance, error, or stochastic term, and \( \text{FDI}_{N-U.S. t-j} \) is foreign direct investment from non-United States countries to the technology sector of Costa Rica in time \( t-j \).

To test Hypothesis 4, there is a negative significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period regression analysis was applied as follows:

\[ \text{IMP} = \beta_1 - \beta_3 \text{FDI}_{N-U.S.} + u, \]

where \( \text{IMP} \) is imports to the technology sector of Costa Rica, \( \beta_1 \) and \( \beta_3 \) are constants, \( \text{FDI}_{N-U.S.} \) is Foreign Direct Investment from non-United States countries to the technology sector of
Costa Rica, \( \beta_1 \) is the unknown constant parameter, parameter \( \beta_3 \) is the slope coefficient, and \( u \) is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation

\[
\Delta IMP_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \Delta IMP_{t-j} + \beta_1 + \gamma IMP_{t-1} + u_t,
\]

where \( \Delta IMP_t \) is imports to the technology sector of Costa Rica lags in time \( t \); \( \gamma IMP_{t-1} \) is imports to the technology sector of Costa Rica in time \( t-1 \), \( \alpha_0, \alpha_j, \beta_1 \) and \( \gamma \) are constant parameters, and \( u \) is the random disturbance, error, or stochastic term.

Cointegration, Long-Run Relationship and Error Correction

\[
e_t = IMP_t - \hat{b}_0 - \hat{b}_1 FDIN_{U.S.},
\]

where \( e_t \) is the estimated long-run relationship, \( \hat{b}_0 \) and \( \hat{b}_1 \) are estimators of the true parameters \( b_0 \) and \( b_1 \), \( IMP_t \) is imports to the technology sector of Costa Rica and \( FDIN_{U.S.} \) is foreign direct investment from the United States to the technology sector of Costa Rica.

\[
\Delta IMP_t = c_0 + c_1 - \Delta FDIN_{U.S.} + c_2 e_{t-1} + u_t,
\]

where \( \Delta IMP_t \) is imports to the technology sector of Costa Rica lags in time \( t \), \( c_0, c_1 \) and \( c_2 \) are constant parameters, \( e_{t-1} \) is the error correction, \( u \) is the random disturbance, error, or stochastic term, and \( \Delta FDIN_{U.S.} \) is foreign direct investment from the United States to the technology sector of Costa Rica.
Granger Causality

\[
\text{IMP}_t = b_0 + \sum_{j=1}^{p} b_j \text{IMP}_{t-j} + \sum_{j=1}^{p} c_j \text{FDI}_{N-U.S.t-j} + u_t,
\]

where \( \text{IMP}_t \) is imports to the technology sector of Costa Rica in time \( t \), \( \text{IMP}_{t-j} \) is imports to the technology sector in time \( t-j \), \( b_0, b_j \) and \( c_j \) are constant parameters, \( u \) is the random disturbance, error, or stochastic term, and \( \text{FDI}_{N-U.S.t-j} \) is foreign direct investment from the United States to the technology sector of Costa Rica in time \( t-j \).

To test Hypothesis 5, there is a positive significant relationship between inflow of Local Investment to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period, regression analysis was applied as follows:

\[
\text{EXP} = \beta_1 + \beta_4 \text{DI} + u,
\]

where \( \text{EXP} \) is exports from the technology sector of Costa Rica, \( \text{DI} \) is Domestic Investment to the technology sector of Costa Rica, \( \beta_1 \) the unknown constant parameter, parameter \( \beta_4 \) is the slope coefficient, and \( u \) is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation

\[
\Delta \text{EXP}_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \Delta \text{EXP}_{t-j} + \beta_t + \gamma \text{EXP}_{t-1} + u_t,
\]

where \( \Delta \text{EXP}_t \) is exports from the technology sector of Costa Rica lags in time \( t \), \( \gamma \text{EXP}_{t-1} \) is exports from the technology sector of Costa Rica in time \( t-1 \), \( \alpha_0, \alpha_j, \beta_t \)
and \( Y \) are constant parameters, and \( u \) is the random disturbance, error, or stochastic term.

Cointegration, Long-Run Relationship and Error Correction

\[
(41) \quad \hat{e}_t = \text{EXP}_t - \hat{b}_0 - \hat{b}_1 \text{D}_t,
\]

where \( \hat{e}_t \) is the estimated long-run relationship, \( \hat{b}_0 \) and \( \hat{b}_1 \) are estimators of the true parameters \( b_0 \) and \( b_1 \), \( \text{EXP}_t \) is exports from the technology sector of Costa Rica and \( \text{D}_t \) is domestic investment to the technology sector of Costa Rica.

\[
(42) \quad \Delta \text{EXP}_t = c_0 + c_1 + \Delta \text{D}_t + c_2 e_{t-1} + u_t,
\]

where \( \Delta \text{EXP}_t \) is exports from the technology sector of Costa Rica lags in time \( t \), \( c_0, c_1 \) and \( c_2 \) are constant parameters, \( e_{t-1} \) is the error correction, \( u \) is the random disturbance, error, or stochastic term, and \( \Delta \text{D}_t \) is domestic investment to the technology sector of Costa Rica.

Granger Causality

\[
(43) \quad \text{EXP}_t = b_0 + \sum_{j=1}^{p} b_j \text{EXP}_{t-j} + \sum_{j=1}^{p} c_j \text{D}_{t-j} + u_t,
\]

where \( \text{EXP}_t \) is exports from the technology sector of Costa Rica in time \( t \), \( \text{EXP}_{t-j} \) is exports from the technology sector of Costa Rica in time \( t-j \), \( b_0, b_j \) and \( c_j \) are constant parameters, \( u \) is the random disturbance, error, or stochastic term, and \( \text{D}_{t-j} \) is domestic investment to the technology sector of Costa Rica in time \( t-j \).
To test Hypothesis 6, there is a negative significant relationship between inflow of Local Investment to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period, regression analysis was applied as follows:

\[(24) \quad \text{IMP} = \beta_1 - \beta_4 \text{DI} + u,\]

where IMP is imports to the technology sector of Costa Rica, DI is Domestic Investment to the technology sector of Costa Rica, $\beta_1$ is the unknown constant parameter, parameter $\beta_4$ is the slope coefficient, and $u$ is the random disturbance, error, or stochastic term.

Unit Root - Regression Equation

\[(31) \quad \Delta\text{IMP}_t = \alpha_0 + \sum_{j=1}^{P} \alpha_j \Delta\text{IMP}_{t-j} + \beta_1 + \gamma \text{IMP}_{t-1} + u_t,\]

where $\Delta\text{IMP}_t$ is imports to the technology sector of Costa Rica lags in time $t$, $\gamma \text{IMP}_{t-1}$ is imports to the technology sector in time $t-1$, $\alpha_0$, $\alpha_j$, $\beta_1$ and $\gamma$ are constant parameters, and $u$ is the random disturbance, error, or stochastic term.

Cointegration, Long Run Relationship and Error Correction

\[(44) \quad e_t = \hat{\text{IMP}}_t - \hat{b_0} - \hat{b_1} \text{DI}_t,\]

where $e_t$ is the estimated long-run relationship, $\hat{b_0}$ and $\hat{b_1}$ are estimators of the true parameters $b_0$ and $b_1$, IMP$_t$ is imports to the technology sector of Costa Rica and DI$_t$ is domestic investment to the technology sector of Costa Rica.
\[ \Delta \text{IMP}_t = c_0 + c_1 - \Delta \text{DI}_t + c_2 e_{t-1} + u_t, \]

where \( \Delta \text{IMP}_t \) is imports to the technology sector of Costa Rica lags in time \( t \), \( c_0, c_1 \) and \( c_2 \) are constant parameters, \( e_{t-1} \) is the error correction, \( u \) is the random disturbance, error, or stochastic term, and \( \Delta \text{DI}_t \) is domestic investment to the technology sector.

Granger Causality

\[ \text{IMP}_t = b_0 + \sum_{j=1}^{p} b_j \text{IMP}_{t-j} + \sum_{j=1}^{p} c_j \text{DI}_{t-j} + u_t, \]

where \( \text{IMP}_t \) is imports to the technology sector of Costa Rica in time \( t \), \( \text{IMP}_{t-j} \) is imports to the technology sector in time \( t-j \), \( b_0, b_j \) and \( c_j \) are constant parameters, \( u \) is the random disturbance, error, or stochastic term, and \( \text{DI}_{t-j} \) is domestic investment to the technology sector of Costa Rica in time \( t-j \).

To test Hypothesis 7, there is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1980 to 2007 period, regression analysis was applied as follows:

\[ \text{EXP} = \beta_1 + \beta_2 \text{FDI}_{\text{U.S.}} + \beta_3 \text{FDI}_{\text{N-U.S.}} + \beta_4 \text{DI} + u, \]

where \( \text{EXP} \) is exports from the technology sector, \( \text{FDI}_{\text{U.S.}} \) is Foreign Direct Investment from the United States, \( \text{FDI}_{\text{N-U.S.}} \) is Foreign Direct Investment from non-United States countries to the technology sector of Costa Rica, \( \text{DI} \) is domestic investment.
investment to the technology sector of Costa Rica, and $\beta_1, \beta_2, \beta_3$ and $\beta_4$ are the unknown constant parameters. The parameters $\beta_2, \beta_3$ and $\beta_4$ are the slope coefficients, and $u$ is the random disturbance, error, or stochastic term.

To test Hypothesis 8, there is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1980 to 2007 period, regression analysis was applied as follows:

$$IMP = \beta_1 - \beta_2 \text{FDI}_{\text{U.S.}} - \beta_3 \text{FDI}_{\text{N-U.S.}} + \beta_4 \text{DI} + u,$$

where $IMP$ is imports to the technology sector of Costa Rica, $\text{FDI}_{\text{U.S.}}$ is Foreign Direct Investment from the United States, $\text{FDI}_{\text{N-U.S.}}$ is Foreign Direct Investment from non-United States countries to the technology sector of Costa Rica, $\text{DI}$ is domestic investment to the technology sector, and $\beta_1, \beta_2, \beta_3$ and $\beta_4$ are the unknown constant parameters. The parameters $\beta_2, \beta_3$ and $\beta_4$ are the slope coefficients, and $u$ is the random disturbance, error, or stochastic term.

**Evaluation of Research Methods**

Internal validity refers to the ability to draw confident causal outcomes from research (Babbie, 2007; Johnson, 2001; Schram, 2005). Strong internal validity is connected with dependable measures of variables and a forceful justification that causally connects independent variables to dependent variables (Babbie, 2007; Schram, 2005). External validity addresses the ability to generalize the study to other populations and
other situations (Babbie, 2007; Schram, 2005). The internal and external validity of this study is addressed by reviewing the strengths and weaknesses in research design, population and sampling, measurement, and the method of data analysis.

**Internal Validity (Reliability - Strengths).**

Internal validity refers to the ability to draw confident causal outcomes from research. Strong internal validity is not only in connection with dependable measures of variables, but also a forceful justification that causally connects independent variables to dependent variables (Johnson, 2001, Babbie, 7 Chattfield, 2004; Enders, 2004; Schram, 2005, Engle, 2008).

1. Quantitative research design: This quantitative, non-experimental causal correlational (explanatory) analysis tests the relationship between dependent and independent variables. Quantitative analysis permits statistical analyses ranging from simple descriptive statistics to complex inferential statistics (Babbie, 2007; Johnson, 2001; Salvatore & Reagle, 2004; Chattfield, 2004; Enders, 2004; Engle, 2008).

2. Measurement: Institutions providing data covering a wide range of possibilities are available for finding and checking the answers to the researcher's questions. These secondary data were obtained and recorded globally with standardized processes over years, providing consistent data for time series and cross countries' analysis (World Bank, 2006; Engle, 2008).

3. Method of data analysis: Time series and regression analysis is used. Since macroeconomic indicators are collected by time order, time series analysis can
explain that over time data may have internal auto-correlation and other tendencies that should be accounted for. A time series approach allows researchers to investigate patterns of explanatory variables across a large number of countries over the years. It has the advantage of generalization, where it yields insights applicable across different contexts (Johnson 2001; Perkins & Neumayer, 2005). For regression analysis, the equation involves parameters for the use of standard techniques to find linear relationships that best fit the data (Engle, 2008; Harrell, 2001). Therefore, time series and regression analysis are justified in causally connecting independent variables to dependent variables.

**Internal Validity (Reliability - Weaknesses).**

1. Quantitative research design: Quantified analysis may easily over-simplify data by aggregation, comparison, and summarization data to meet data analysis standards, which result in a direct misreading of real phenomena (Babbie, 2007; Cavana, Delahaye, & Sekaran, 2001). Quantification reflects an outcome with a probability of error \( p \leq .05 \) normally in this study) rather than signifying a true fact (Babbie, 2007; Sekaran, 2003). Quantification, moreover, generalizes the phenomena of the real world in ignoring individual specific circumstances (Stephen & Pfaffman, 2001; Babbie, 2007; Sekaran, 2003).

2. Non-experimental studies: One of the disadvantages of utilizing a non-experimental study is unrecognized confounding variables. When testing the
effect of a possible factor of influence on a variable, investigators have to sense the inter-influence between variables. It is difficult, however, to master all known or unknown variables in social sciences subjects, including issues surrounding economic growth and environmental deterioration.

3. Limited variables: This research used secondary data from the World Bank; therefore, analysis is limited to what already exists. This existing data may not correspond exactly with research questions answered and research hypotheses tested (Babbie, 2007; Johnson, 2001).

4. Measurement: All the variables in this study were presented by yearly aggregation which was less valuable in explaining the diversity of individual variable changes and characteristics.

5. Extraneous variables: Other variables, such as human capital, average years of education, GDP, trade barriers, export taxes, subsidies and other factors, may have influenced exports other than the factors included in this study.

6. Missing data due to variability: Any variables, including macroeconomic indicators, foreign direct investment and trade (imports and exports) were excluded if potential outliers were present over the twenty-year period. This might affected the accuracy (reliability) of the variables.

**External Validity Strengths.**

External validity addresses the ability to generalize the study to other populations and other situations (Johnson, 2001, Babbie, 2007; Schram, 2005, Engle, 2008).
1. Homogeneity: Costa Rica is homogeneous in both transactional processes and the time of transformation, which means that fewer external variables are available (Paus, 2003). The political stability and sound economic system started in 1948 and it has homogeneous economic development strategies to attract foreign direct investment to stimulate economic growth and expansion during their economic development process (Alfaro et. al, 2004; Paus, 2003; Rodriguez-Clare, 2003).

2. Sampling: All data available for FDI, imports and exports of the Costa Rica's technology sector for the period 1995 to 2008 constitutes the sample. As a result, there is no sampling bias question which causes most external validity issues (Babbie, 2007).

External Validity Weaknesses.

1. Country characteristics: this study is limited to Costa Rica and cannot be generalized to other countries.

2. Exports from technology sector: This research focuses on exports from the technology sector and results cannot be generalized with reference to other sectors.

Although the IMF definition has been accepted by most countries and by UNCTAD for reporting FDI data, there are inter-country variations in defining and measuring FDI, since every country does not follow IMF guidelines. In general, the IMF guidelines are followed by industrial countries but not completely by many developing
countries, since several parts in the IMF’s FDI definition do not fall under the scope of what FDI should be and also, certain countries have difficulties compiling data.

For data sources and related data collection procedure, it is important to distinguish between surveys and balance of payments statistics, for both data collection methods possess strengths and weaknesses. However, statistics based on balance of payments transactions collected by national banking systems do not provide a complete picture of all FDI flows (Stephan & Pfaffman, 2001).

**Trustworthiness of Data.**

Secondary data (Costa Rica) was employed in this research for the period 1995 to 2008. The Development Data Group (DECDG) in the Development Economics Vice Presidency of the World Bank performs statistical and data analysis, working directly with the World Bank’s regions and sectors, following professional standards in data collection, compilation, and dissemination, to ensure that all data users can have confidence in the quality and integrity of the data produced. The majority of member countries prepare this data from their statistical systems, and the quality of this data is supervised, monitored and supported by the World Bank (World Bank, 2008). According to the World Bank (2007):

> WDI is an indispensable source of information for the development community, researchers, nongovernmental organizations, journalists, and academics. The statistics found in the WDI will also be of vital importance to those in the private sector who are analyzing business opportunities in developing countries and emerging markets. The flexibility of the WDI data allows the researcher to
investigate data trends to test hypotheses by focusing on individual research.

Every volume is a product of the staff of the Development Data Group of the World Bank’s Development Economics Vice Presidency, and the judgments therein do not necessarily reflect the views of the World Bank’s Board of Executive Directors or the countries they represent.

The choice of indicators for the WDI has been shaped by staff in the International Finance Corporation, the Multilateral Investment Guarantee Agency, and five of the World Bank’s thematic networks. World Development Indicators (WDI) is the World Bank's statistical annual data compilation of economic and social development. The WDI includes data from 150 economies with populations of more than 1 million, 50 small economies with populations between 30,000 and 1 million, and 27 smaller economies that are current members of the World Bank. These data are presented in six sections with 900 indicators in over 80 tables. The sections are: World View, People, Environment, Economy, States and Markets, and Global Links. The WDI is maintained by the World Bank, and as a critical source of data on the global economy, it includes statistical data on pollution, energy production, poverty, trade, labor, health, education, exports, government debt, and telecommunications. To retrieve data, there is a systems interface supported in seven languages that can be exported to standard formats such as Excel, which helps in the research of global economies.

The World Bank produces WDI annually and the majority of the data originates from national statistical agencies, supplemented with data from censuses administered by field workers, household surveys, international statistical agencies, nongovernmental organizations, and the private sector.
Chapter 5: Analysis of Data

Introduction

This chapter describes and analyzes the data used to find the impact of foreign direct investment on Costa Rica's exports and imports of the technology sector for the period of 1995-2008. The data analysis showed the relationship between foreign direct investment, imports of technology sector goods and services and exports of the technology sector goods and services in Costa Rica. This analysis focused on the relationship between FDI and Costa Rica host country technology sector exports and imports using data sets for the period 1995 to 2008.

Organization of Data Analysis

During the research, data related to the technology sector was not available earlier than 1995, therefore this study only investigated the relationship between FDI and exports of the technology sector and FDI and imports of the technology sector of Costa Rica from the year 1995 to 2008.

Costa Rica started to design mechanisms destined to promote and establish a technology sector during the early 90s. These mechanisms were linked to strategic actions to attract foreign investment and destined to position the country as an international services platform. As a result, many MNEs began to relocate and several established subsidiaries under a new business friendly economic environment (Alfaro et al., 2004; Cinde, 2010; Paús 2005; Rodriguez-Clare, 2001).

Even though Costa Rica's foreign direct investment, imports and exports data is available since 1980, specific data related to the technology sector of Costa Rica was difficult to obtain and seldom published by government, IMF and World Bank reports.

Description, Analysis, Explanations and Interpretation of Results

This research examined the relationship between FDI and the growth of technology sector exports of the host country, Costa Rica, using data sets for the period 1995 to 2008, specifically investigating the relationship between foreign direct investment to the technology sector and its exports, and between foreign direct investment and imports to the technology sector. Table 4.1 presents the results of Step 1, Unit Root Test, Table 4.2 presents Step 2, Vector Auto Regression and Step 3 presents Granger results.

To analyze data, terms used for imports (I) and exports (E) variables where:

a. FDI_US is Foreign Direct Investment to the technology sector from the US

b. FDI_NUS is Foreign Direct Investment to the technology sector from Non United States countries

c. DI is Domestic investment to the technology sector.
<table>
<thead>
<tr>
<th>Research Question Number</th>
<th>Research Question</th>
<th>Hypothesis Number</th>
<th>Hypothesis</th>
<th>Unit Root Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1</td>
<td>Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H1</td>
<td>There is a positive significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for the 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ2</td>
<td>Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H2</td>
<td>There is a negative significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ3</td>
<td>Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H3</td>
<td>There is a positive significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ4</td>
<td>Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H4</td>
<td>There is a negative significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ5</td>
<td>Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H5</td>
<td>There is a positive significant relationship between Local Investment in the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ6</td>
<td>Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H6</td>
<td>There is a negative significant relationship between Local Investment to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ7</td>
<td>Is there a positive relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H7</td>
<td>There is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
<tr>
<td>RQ8</td>
<td>Is there a negative relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H8</td>
<td>There is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>Time series is not stationary</td>
</tr>
</tbody>
</table>
### Table 4.2. Step 2 - Vector Auto Regression

<table>
<thead>
<tr>
<th>Research Question Number</th>
<th>Research Question</th>
<th>Hypothesis Number</th>
<th>Hypothesis</th>
<th>Vector Auto Regression (VAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1</td>
<td>Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector in Costa Rica?</td>
<td>H1</td>
<td>There is a positive significant relationship between FDI from the United States to the technology sector in Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=24.772</td>
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<td>Lag = 3</td>
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<td>AIC = 0.8506</td>
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<td>R² = 1.908848</td>
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<td></td>
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<td>Coefficient = 1.42433</td>
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<tr>
<td>RQ2</td>
<td>Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H2</td>
<td>There is a negative significant relationship between FDI from the United States to the technology sector in Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=14.532</td>
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<td>Lag = 1</td>
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<td>AIC = 0.7592</td>
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<td>R² = 0.7827</td>
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<td>Coefficient = 0.6982</td>
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<td>RQ3</td>
<td>Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H3</td>
<td>There is a positive significant relationship between FDI from the United States to the technology sector in Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=24.772</td>
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<td>Lag = 3</td>
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<td>AIC = 0.9436</td>
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<td>R² = 5.338</td>
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<td>H4</td>
<td>There is a negative significant relationship between FDI from the United States to the technology sector in Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=14.532</td>
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<td>Lag = 1</td>
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<td>AIC = 0.7592</td>
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<td>R² = 0.7491</td>
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<td>Coefficient = 0.885</td>
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<tr>
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<td>Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H5</td>
<td>There is a positive significant relationship between Domestic Investment in the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=24.772</td>
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<td>AIC = 0.955</td>
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<td>R² = 3.445</td>
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<td>H6</td>
<td>There is a negative significant relationship between Domestic Investment in the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>AIC=14.532</td>
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<td>R² = 1.498</td>
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<td>Coefficient = 0.569</td>
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<td>H7</td>
<td>There is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>AIC=24.772</td>
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<td>FDI_NUS = 2.554</td>
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<td>RQ8</td>
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<td>H8</td>
<td>There is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>AIC=14.532</td>
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<td>R² = FDI-US = -1.269</td>
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<td>Hypothesis Number</td>
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<tr>
<td>RQ1</td>
<td>Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H1</td>
<td>There is a positive significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for the 1995 to 2008 period.</td>
<td>No</td>
</tr>
<tr>
<td>RQ2</td>
<td>Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H2</td>
<td>There is a negative significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for the 1995 to 2008 period.</td>
<td>No</td>
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<td>RQ3</td>
<td>Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H3</td>
<td>There is a positive significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>No</td>
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<td>Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H4</td>
<td>There is a negative significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for the 1995 to 2008 period.</td>
<td>No</td>
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<td>RQ5</td>
<td>Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H5</td>
<td>There is a positive significant relationship between Local Investment to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>No</td>
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<td>RQ6</td>
<td>Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica?</td>
<td>H6</td>
<td>There is a negative significant relationship between Local Investment to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.</td>
<td>No</td>
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<td>RQ7</td>
<td>Is there a positive relationship between Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H7</td>
<td>There is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>No</td>
</tr>
<tr>
<td>RQ8</td>
<td>Is there a negative relationship between Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?</td>
<td>H8</td>
<td>There is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1995 to 2008 period.</td>
<td>No</td>
</tr>
</tbody>
</table>

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Summary

This study used an empirical approach to analyze the relationship between FDI, imports and exports. Macroeconomic time series have unit roots and by using OLS (ordinary least squares) which may generate spurious correlation (two variables trending over time, tend to have high correlation, even if they are not related) when regressing non-stationary time-series. When spurious correlation happens, Granger causality test (Granger, 1979) results may be misleading. Thus, because the aim of this research was to identify causality relationships, it tested each individual time series for unit roots before applying the Granger causality test (Granger, 1969, 1988). For this reason, Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979; Greene, 1997) and Phillips and Perron (PP) (Phillips & Perron, 1988) tests determined if time series are $I(0)$ (Nelson & Plosser, 1982, McCallum, 1993; Cribari-Neto, 1996; Libanio, 2004; Johnson, 2006b; Aksoy & Leon-Ledesma, 2008).

Lumsdaine and Papell’s (LP) model was not applied to detect two-time structural breaks in the unit root analysis, because the time horizon was too narrow for reliable estimates of breaks using LP Test and the estimates would be highly biased. Therefore, the result of stationarity of each time series by using the LP approach does not replace the result from ADF and PP tests. (Lumsdaine & Papell, 1997).
Chapter 5: Findings, Conclusions and Implications

Introduction

Costa Rica received increasing flows of FDI since the mid-1980s mostly because of liberalization of trade between United States and Costa Rica and efforts to attract foreign investment. Other factors included are Costa Rica's political and economic stability, and the benefits linked to the free trade zone structure. As a result, during the mid 1990s Costa Rica received the largest FDI destined to high-tech companies and international services (CINDE, 2010; Procomer, 2006; World Bank 2006).

Important to mention that Intel was the first technological MNE that significantly invested in Costa Rica's technology sector in 1998, which boosted exports from and imports to this sector in 1998, solidifying what is now called the High-Tech Cluster. This cluster started with Remec, Baxter, Sawtech, Abbott, Boston Scientific, Roche and Pfizer. This cluster has more than 30 MNEs, including Intel and now generates more than 80% of the investment destined to this sector (Cinde, 2010; Procomer, 2010; The World Bank Group/MIGA, 2006).

Summary of the Study

This research was an attempt to provide an examination of the relationship of foreign direct investment (FDI) from the United States, Non-US partners and local investment to Costa Rica Technology Sector, with a focus on the relationship between FDI inflows and Costa Rican technology sector exports, describing the significance of FDI on the technology sector, for it may complement exports or substitute imports.

The proportion of FDI influx to Costa Rica from the Unites States was diminishing since 2005, where the United States FDI participation in 2005 was 69.7%
and by 2008 was reduced to 60.4%. Most non-United States FDI was directed to the industrial and services sector and contributed to high tech research and local development activities.

The following research questions guided the study:

1. Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica?
2. Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?
3. Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica?
4. Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica?
5. Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica?
6. Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica?
7. Is there a positive relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?
8. Is there a negative relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica?

The hypotheses presented were concerned with the general impact of FDI from Costa Rica's trading partners of exports from the technology sector of Costa Rica:

H1: There is a positive significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.

H2: There is a negative significant relationship between inflow of Foreign Direct Investment from the United States to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H3: There is a positive significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.

H4: There is a negative significant relationship between inflow of Foreign Direct Investment from the non-United States countries to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H5: There is a positive significant relationship between inflow of Local Investment to the technology sector of Costa Rica and exports from the technology sector in Costa Rica for 1995 to 2008 period.
H6: There is a negative significant relationship between inflow of Local Investment to the technology sector of Costa Rica and imports to the technology sector in Costa Rica for 1995 to 2008 period.

H7: There is a positive significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and exports from technology sector in Costa Rica from 1995 to 2008 period.

H8: There is a negative significant relationship between Foreign Direct Investment from the United States and from non-United States countries and local investment to the technology sector and imports to technology sector in Costa Rica from 1995 to 2008 period.

In order to collect data to answer research questions, several reports from the World Bank, IMF and Costa Rica Central Bank and government entities reports and information were utilized. The SAS Software and STATA, Data Analysis and Statistical software was utilized in the data analysis. In this research study, all variables were presented to answer the research questions. Inferential statistics, which include time series and regression analysis, ANOVA and independent t-test, were utilized to test hypotheses.

The study used a causal correlational approach to analyze the relationship between FDI, imports and exports, and respective regression equations. A first step tested time series data for stationarity using Augmented Dickey-Fuller and Phillipe-Pherron.
Lumsdaine and Papell was not applied to detect two-time structural breaks in the unit root analysis, because the time horizon was too narrow for reliable estimates of breaks and estimates would be biased. The second step was cointegration testing and finally, the third step is the Granger causality test addressed in terms of a VAR (vector auto regression) system.

In addition, while analyzing data for the research, the technology sector showed important productive activity for the Costa Rican economy, because the technology sector (TIC) continues to be the most dynamic, for the number of active companies by 2008 reached 271, growing approximately 6.33% per year, technology exports stabilized around 22% of total Costa Rican exports, imports decreased during the period 2005-2008, where 70% of these imports were made by manufacturing companies with high value added, excluding capital goods, and FDI from non-United States countries increased dramatically during the same period.

Also, cumulative FDI to the TIC increased 10.1%, where the major recipient was the TIC service sector; workforce grew 10.4% in the technology sector to around 53,000 in 2008, being TIC services sector the main employer with 42%. According to Procomer and Central Bank, TIC generated a net benefit to Costa Rica of around 4.5% of GDP and the country is going through a technological transformation associated to the use of information technology and communications in the technology sector.

Costa Rica was able to diversify exports during the last decade, and was able to capitalize on MNE's global production strategies by creating commercial incentives to attract investment to the technology sector which is heavily oriented to exports.
Conclusions

Does Foreign Direct Investment from the United States, non-United States partners, and local investment affect exports from the technology sector in Costa Rica? And, does Foreign Direct Investment from the United States, non-United States partners, and local investment affect imports to the technology sector in Costa Rica?

Because limited research related to FDI and exports from the technology sector this study intended to fill a void in the literature by using data from 1995 to 2008, including a three step Granger technique to explore the relationships between FDI, exports, and imports.

Results of the study were varied and the most surprising was that on the relationship between domestic investment (hypothesis 5 and 6) suggests an export-platform, because domestic investment to the technology sector of Costa Rica caused technology sector exports to increase and it's imports to decrease.

As shown in Table 4.3 and what follows below is a discussion of these results.

For research question 1, Is there a positive relationship between Foreign Direct Investment from the United States to the technology sector and exports from the technology sector in Costa Rica? There is no significant relationship between FDI from United States and exports from the Costa Rica's technology sector in the period 1995-2008.

For research question 2, Is there a negative relationship between Foreign Direct Investment from the United States to the technology sector and imports to the technology sector in Costa Rica?
sector in Costa Rica? FDI from United States does not cause Costa Rica's Technology Sector imports to decrease. There is no significant relationship between FDI from United States and imports to the Costa Rica's technology sector in the period 1995-2008.

For research question 3, Is there a positive relationship between Foreign Direct Investment from non-United States countries to the technology sector and exports from the technology sector in Costa Rica? FDI from non-United States countries cause Costa Rica's Technology Sector exports to increase. There is a significant relationship between FDI from non-United States countries and exports from the Costa Rica's technology sector in the period 1995-2008.

For research question 4, Is there a negative relationship between Foreign Direct Investment from non-United States countries to the technology sector and imports to the technology sector in Costa Rica? FDI from non-United States countries does not cause Costa Rica's Technology Sector imports to decrease. There is no significant relationship between FDI from non-United States countries and imports to the Costa Rica's technology sector in the period 1995-2008.

For research question 5, Is there a positive relationship between Domestic Investment to the technology sector and exports from the technology sector in Costa Rica? Costa Rica's domestic investment causes Technology Sector exports to increase. There is a significant relationship between Costa Rica's domestic investment and exports from the Costa Rica's technology sector in the period 1995-2008.

For research question 6, Is there a negative relationship between Domestic Investment to the technology sector and imports to the technology sector in Costa Rica? Costa Rica's domestic investment cause Technology Sector imports to decrease. There is
a significant relationship between Costa Rica's domestic investment and imports to the Costa Rica's technology sector in the period 1995-2008.

For research question 7, Is there a positive relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica? FDI from United States does not cause exports to increase. However, FDI from non-United States countries and Costa Rica's domestic investment cause Technology Sector exports to increase. There is a significant relationship among FDI from non-United States countries, Costa Rica's domestic investment and exports from the Costa Rica's technology sector in the period 1995-2008. Also, there is no significant relationship between FDI from United States and exports from the technology sector.

For research question 8, Is there a negative relationship among Foreign Direct Investment from the United States, non-United States countries and domestic investment to the technology sector and exports from the technology sector in Costa Rica? FDI from United States, FDI from non-United States countries and Costa Rica's domestic investment cause Technology Sector imports to decrease. There is a significant relationship among FDI from United States, FDI from non-United States countries and Costa Rica's domestic investment and imports to the Costa Rica's technology sector in the period 1995-2008.

Results suggested that Costa Rica is in route to have an export-platform, less dependent on United States' foreign direct investment and is using FDI from other countries and local investment. This research supports results from studies by Monge-
González et al. (2005,) and Rodríguez-Clare (2001,) where Costa Rican policies attracted FDI, exports increased and impacts were more evident after the second part of 1990s.

It seems that FDI for manufacturing was decreasing during the last 10 years, because FDI was redirected to other sectors, such as tourism, real estate and technology (Banco Central; Procomer, 2007). MNEs investment was more evident in the technology sector in 1998 after Intel broke ground in Costa Rica bolstering development within the country, supporting findings from Blomstron & Kokko (1999) where productive collaboration between domestic economy and technological externalities generated backward linkages. Also, indirectly Costa Rica is following the proposed classification by Dunning (1977) where MNEs looked for investment in infrastructure to acquire assets, such as offices, manufacturing or distribution, to be more competitive (asset seeking), looked to penetrate other markets (market seeking), looked to obtain lower raw materials (resource seeking) and looked to improve productivity converting same raw materials at a lower cost (efficiency seeking).

According to OECD (2004, pg.68), Costa Rica is a success story, even though it is small economy, Costa Rica was able to increase and diversify exports, and attract significant FDI. Among many MNEs, Intel invested $300 million, employed 950 employees and was a cornerstone for establishing a high-tech hub in the country (The World Bank Group/MIGA, 2006).

From the data analysis, FDI to Costa Rica increased 7% in 2008 year over the previous year and from $328 million in 1995 to $1.606 million in 2008. The United States continues to be the largest investor (60.4% in 2008), however, non-US countries
had been increasing FDI to the technology sector steadily from the year 2000 and more evident by 2005. These countries included Canada, China, Israel, Korea, Mexico and Spain. Domestic investment in the technology sector increased exponentially from $17 million in 1995 to $646 million in 2008. This FDI composition change is mainly driven by the MNEs international expansion economic conditions, fiscal and tax regulations and exports, leaving behind traditional agriculture and textile economic activity, which used to be 20% to 60% of exports in 2008, and converting productive capacity to high technology products. A significant aspect of the development of the Costa Rican system has been the shift of economic activity and corporations. In the 1980s textile manufacturing companies had the majority of the total economic activity, by the second half of the 1990s this began to change, where low value added textile MNEs abandoned Costa Rica looking for other geographical areas in the region with lower production costs (Banco Central, 2010).

The review of literature suggests that Costa Rica’s competitiveness in the international market has been due to the advances in the technology sector. In 2008 TIC generated $1,606 million, almost 30% of total exports and generated more than 11,000 jobs (CINDE, 2010; CAMTIC, 2008; Procomer, 2007; Procomer-Comex, 2006)

The major obstacle identified in this research was the availability of data related to the technology sector. Costa Rica needs a more granular reliable database with information and evolution of the Technology Sector. to allow policy makers to assess results of their export or import policies and investment initiatives to make the necessary adjustments in due time when conditions change. Costa Rica is in an excellent position to incentivize local investment to access other markets via exports of goods and services
using its current technological platform and international treaties with commercial allies and its ability to compete freely in the global technology environment. The strong political backing and policies continue to be strong and export-led growth strategies (like clustering) continue to be a success. The greatest impact is institutional support for foreign assistance and current domestic programs to sustain exports.

Within the technology sector, the local software industry is seen as an important promoter of economic growth and it plays a relevant role in Costa Rican technology policy and is seen as an engine for export growth, especially in software development. At the same time, internal TIC processes to promote software growth seems uncoordinated and FDI is seen as a threat to small and medium domestic firms that are able to export.

Limitations of the Study

Costa Rican exports of some technological services and products are difficult to quantify, for they do not go through customs, therefore data collection from reliable sources is difficult. When employees from Costa Rica travel to an overseas location to perform technological duties, he or she carries a computer with the software inside that was previously sold.

This research uses secondary data from the World Bank, Costa Rica Central Bank and Government agencies and is limited to what is available from 1995 to 2008. This existing data may not correspond exactly with research questions to be answered and research hypotheses to be tested (Babbie, 2007; Johnson, 2001).
Recommendations for Further Research

To capture potential benefits of FDI to the technology sector, it is necessary to perform surveys related to production, local investment and exports of existing companies. This will help to develop a specific strategy to establish priorities and define roles of the different sectors to achieve these priorities. Government needs to be proactive in setting up an infrastructure capable of taking the technology sector into new areas for supporting science and technology and capitalize on the current strong domestic investment.

Another important factor, not in scope of this research, but very important for future analysis is the human capital impact on TIC. A diversified skilled human capital is needed to cope with the rapid ever changing global technological environment.

Productive linkages between MNEs and local suppliers of inputs and services are increasing fast and would be important to review and analyze what role small and medium sized firms play in the technology sector and export performance.


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Williamson, O. (1976). Franchise bidding for natural monopolies—In general and with respect to CATV. *Bell Journal of Economics, 7* (Spring), 73-104.


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Appendix 1

Literature about the Relationship between FDI, Imports and Exports
## Literature Reviewed about the Relationship between FDI, Imports and Exports

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Type of Data</th>
<th>Countries</th>
<th>Empirical Approach</th>
<th>Assumptions</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aitken and Harrison (1999)</td>
<td>Panel data 4000 Firms Plant Level 1976-1989</td>
<td>Venezuela</td>
<td>Theoretical Modeling, Causality Analysis</td>
<td>near MNEs exhibit higher levels of productivity related to others located in regions without FDI</td>
<td>No impact or negative FDI impact on domestic owned plants, except in firms previously owned by foreign firms</td>
</tr>
<tr>
<td>Al-Irani and Al-Shamsi (2007)</td>
<td>Panel data 1980-2002</td>
<td>6 developing countries from GCC</td>
<td>Bidirectional causality analysis</td>
<td>FDI effect on GDP growth</td>
<td>Evidence indicates FDI is an important factor affecting GDP growth in GCC countries</td>
</tr>
<tr>
<td>Alfaro (2003)</td>
<td>Cross Country data 1981-1999</td>
<td>Developing countries</td>
<td>Causality analysis</td>
<td>FDI benefits host country across economic sectors</td>
<td>FDI in primary sector tend to have negative effect on growth, positive for manufacturing sector and ambiguous for service sector</td>
</tr>
<tr>
<td>Alguacil et al. (2002)</td>
<td>Quarterly data 1970-1992</td>
<td>Spain</td>
<td>Time series VAR with Granger causality</td>
<td>FDI causes exports</td>
<td>Positive long-term Granger causality from FDI to Exports</td>
</tr>
<tr>
<td>Balasubramonian et al. (1996)</td>
<td>Cross section data 1970-1995</td>
<td>46 developing countries</td>
<td>OLS method</td>
<td>FDI effect on economic growth in developing countries</td>
<td>FDI affects economic growth, but is limited to host countries adopting export promotion policies</td>
</tr>
<tr>
<td>Basu, Chakraborty and Rosen (2003)</td>
<td>Country specific panel data</td>
<td>23 countries</td>
<td>Co-integrated vector causality</td>
<td>FDI and economic growth</td>
<td>Trade openness is a crucial determinant for FDI impact on economic growth</td>
</tr>
<tr>
<td>Bengoa and Sanchez-Robles (2003)</td>
<td>Panel data 1970-1999</td>
<td>18 Latin American countries</td>
<td>Regression analysis comparing FDI fixed and random effects on economic growth</td>
<td>FDI effects from technology spillovers</td>
<td>FDI has positive effect on economic growth. Magnitude depends on host country conditions</td>
</tr>
<tr>
<td>Blomstrom and Kokko (1997)</td>
<td>Country specific</td>
<td>Mexico</td>
<td>Causality</td>
<td>FDI has positive effect on economic growth</td>
<td>Foreign Direct Investment has positive impact on economic growth when country has low income per capita</td>
</tr>
<tr>
<td>Blomstrom and Wolff (1994)</td>
<td>Cross section 1970</td>
<td>Mexico</td>
<td>Causality analysis</td>
<td>FDI effects domestic industry growth</td>
<td>Higher foreign direct investment share in an industry led to higher productivity growth in domestic firms</td>
</tr>
<tr>
<td>Brainard (1997)</td>
<td>Industry level data 1989</td>
<td>27 countries</td>
<td>Two Stage Least Squares Regression (2SLS)</td>
<td>FDI effects on exports</td>
<td>Predominant substitution effect</td>
</tr>
<tr>
<td>Busse and Groizard (2008)</td>
<td>Cross country and panel data 1994-2003</td>
<td>Top 20 most regulated countries</td>
<td>Standard cross country regression model and OLS</td>
<td>Relationship between FDI and income growth rate</td>
<td>Host country characteristics can lead to positive FDI impact on growth rates</td>
</tr>
</tbody>
</table>

**Type of Data**
- Panel data
- Cross section data
- Country specific panel data
- Quarterly data
- Cross country and panel data
- Country specific data
- Industry level data
- Panel data

**Countries**
- Venezuela
- 6 developing countries from GCC
- Developing countries
- Spain
- 46 developing countries
- 23 countries
- 18 Latin American countries
- Indonesia
- Mexico
- 69 developing countries
- 27 countries
- Top 20 most regulated countries
- 72 developing and developed countries
- Venemela
- 6 developing countries
- Developing countries
- Spain
- 46 developing countries
- 23 countries
- 18 Latin American countries
- Indonesia
- Mexico
- 69 developing countries
- 27 countries
- Top 20 most regulated countries
- 72 developing and developed countries

**Assumptions**
- Near MNEs exhibit higher levels of productivity related to others located in regions without FDI
- Bidirectional causality analysis
- Causality analysis
- Time series VAR with Granger causality
- Co-integrated vector causality
- Regression analysis comparing FDI fixed and random effects on economic growth
- Causality analysis
- FDI has positive effect on economic growth
- Causality analysis
- Regression estimation using SUR technique
- Two Stage Least Squares Regression (2SLS)
- Standard cross country regression model and OLS
- OLS and generalized methods of moments

**Results**
- No impact or negative FDI impact on domestic owned plants, except in firms previously owned by foreign firms
- Evidence indicates FDI is an important factor affecting GDP growth in GCC countries
- FDI in primary sector tend to have negative effect on growth, positive for manufacturing sector and ambiguous for service sector
- Positive long-term Granger causality from FDI to Exports
- FDI affects economic growth, but is limited to host countries adopting export promotion policies
- Trade openness is a crucial determinant for FDI impact on economic growth
- FDI has positive effect on economic growth. Magnitude depends on host country conditions
- Foreign Direct Investment has positive impact on economic growth when country has low income per capita
- Higher foreign direct investment share in an industry led to higher productivity growth in domestic firms
- FDI and its effects on economic growth depend on human capital availability in host country
- Predominant substitution effect
- Host country characteristics can lead to positive FDI impact on growth rates
- Exogenous FDI does not exert robust influence on economic growth
## Literature Reviewed about the Relationship between FDI, Imports and Exports

<table>
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<th>Assumptions</th>
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<td>Chowdri and Marrotas (1994)</td>
<td>Cross country and panel data 1969-2000</td>
<td>3 developing countries</td>
<td>Granger causality analysis</td>
<td>FDI impact on GDP growth</td>
<td>FDI does not have positive impact in Chile but bidirectional causality in Malaysia and Thailand</td>
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<td>Clausing (2000)</td>
<td>Country level data 1977-1994</td>
<td>29 countries</td>
<td>Regression with and without fixed country effects based on gravity-type model</td>
<td>FDI affects exports</td>
<td>Complementarity effect from FDI to exports, especially when intra-firm trade is included</td>
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<tr>
<td>De Mello (1999)</td>
<td>Panel data 1970-1990</td>
<td>32 developed and developing countries</td>
<td>Time Series, regression analysis fixed effects</td>
<td>FDI effects from technology and improved management and organization</td>
<td>Evidence of economic growth enhancement due to FDI</td>
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<tr>
<td>Fu, Fu and Li (2008)</td>
<td>Interregional Area data</td>
<td>China</td>
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<td>Occur via FDI if distances increase from technologically advanced areas?</td>
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<td>Hale and Long (2007)</td>
<td>1500 Firm level data set</td>
<td>China</td>
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<td>Hansen and Rand (2006)</td>
<td>Cross country panel data 1970-2000</td>
<td>31 developing countries</td>
<td>Causal relationship, mean group estimator and model specification</td>
<td>FDI and growth</td>
<td>On average FDI has significant long run impact on economic growth irrespectively of development level</td>
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<td>Hickman and Djankov (1996)</td>
<td>Panel 1992-1996</td>
<td>Czech Republic</td>
<td>Causality analysis</td>
<td>FDI positively affect growth</td>
<td>Negative effect on local firms that do not have foreign partners</td>
</tr>
</tbody>
</table>
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<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Johnson (2006a)</td>
<td>Cross country data 1980-2002</td>
<td>90 developed and developing countries</td>
<td>Time series causality analysis</td>
<td>FDI have positive effect on economic growth as a result of technological spillovers</td>
<td>FDI enhance economic growth in developing countries but not developed economies</td>
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<td>Johnson (2006b)</td>
<td>Panel data 1980-2003</td>
<td>8 East Asian countries</td>
<td>Granger Causality, Time Series</td>
<td>Important for East Asian countries economies and FDI should increase export flows</td>
<td>Clear indication that FDI inflows cause exports. No clear link between FDI inflows and exports</td>
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<td>Khawar (2003)</td>
<td>Panel and cross country data</td>
<td>Africa, America, OECD</td>
<td>Regression estimation using OLS (ordinary least squares)</td>
<td>FDI effects on growth of income per capita</td>
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<td>Kagler (2006)</td>
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<td>UN Annual Manufacturing Census</td>
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<td>Evidence found on knowledge spillovers to local firms. FDI complements domestic investment through spillovers</td>
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<td>Kurut &amp; Volacic (2007)</td>
<td>Pooled data 1996-2004</td>
<td>12 Central &amp; Eastern (CEE) countries</td>
<td>Generalized Least Squares (GLS) estimation method</td>
<td>FDI may have an impact on exports.</td>
<td>FDI significantly contributed to higher exports</td>
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<td>Marchant et. al. (2002)</td>
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<td>Section and Time series. Full information maximum like hood method</td>
<td>Export growth is one of the key determinants of economic growth</td>
<td>Detected existence of relationship between export and investment</td>
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<td>Medina-Smith (2001)</td>
<td>Time series data 1950-1997</td>
<td>Costa Rica</td>
<td>EG two-step and the unrestricted correction model</td>
<td>Spillovers from FDI benefit local firms in host country</td>
<td>Industrialized countries in the 1990's. Transition economies experience spillovers showing a decline in recent years</td>
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<td>Panel data 1980-2003</td>
<td>Cameroon</td>
<td>Ordinary Least Squares Regression (OLS)</td>
<td>FDI inflows had a positive impact on the export growth of the Cameroon economy</td>
<td>FDI inflows contributed to higher supply capacity and spillover effects, thus</td>
</tr>
<tr>
<td>Author</td>
<td>Type of Data</td>
<td>Countries</td>
<td>Empirical Approach</td>
<td>Assumptions</td>
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<tr>
<td>Obhehefer and Pfaffemeyr (2007)</td>
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<td>Pradam (2008)</td>
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<td>FDI effects</td>
<td>Relationship between FDI and exports exist</td>
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<td>Zhang 2001</td>
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<td>Time Series, Granger causality analysis between FDI and economic growth</td>
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