The Determinants and Impacts of Foreign Direct Investment

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Abstract

Some theories on the determinants and the impacts of foreign direct investment (FDI) are reviewed and critically assessed. Two empirical investigations follow this review. The first uses simultaneous equation models to test the effects of some US macroeconomic variables on their FDI inflows. The second analyzes the relationship between FDI inflows and outflows among developed countries, using a variety of panel data models.

As novelty, the investigation of the determinants of the location of FDI inflows shows the central role played by the expectations about the future growth rate of the US economy. The assumption that foreign investors does not base the decision of FDI on the current growth rate but instead form adaptive expectations more than doubles the determination coefficient of the econometric model. Beside the adjustment of foreign investors to their forecast errors, the size of the US economy measured by the gross domestic product turns out to be the most important determinant of their FDI inflows. Even though the bulk of FDI takes place among developed countries, the panel data analysis reveals some heterogeneity that is fixed over time.

Keywords: cointegration, foreign direct investment, panel data models, simultaneous equation models, two-stage least squares, VAR.

JEL classification: C32, C33, F21, F23.

Résumé

Quelques théories sur les déterminants et les impacts des investissements directs étrangers (IDE) sont passées en revue et évaluées de façon crituque. Deux études empiriques suivent cette revue. La première utilise des modèles d'équations simultanées pour tester les effets de certaines variables macroéconomiques américaines sur leurs flux d'IDE. La seconde analyse la relation entre les flux entrants et sortants d'IDE entre les pays développés, à l'aide de divers modèles de données de panel.

Comme nouveauté, l'étude des déterminants géographiques des flux entrants d'IDE montre le rôle central joué par les anticipations concernant le taux de croissance futur de l'économie américaine. L'hypothèse selon laquelle les investisseurs étrangers ne fondent pas leur décision d'IDE sur le taux de croissance actuel mais forment plutôt des anticipations adaptatives fait plus que doubler le coefficient de détermination du modèle économétrique. Outre l'ajustement des investisseurs étrangers à leurs erreurs de prévision, la taille de l'économie américaine mésurée par le produit intérieur brut s'avère être le déterminant le plus important de leurs flux d'IDE. Même si la majeure partie des IDE a lieu entre pays développés, l'analyse des données de panel révèle une certaine hétérogénéité qui se fixe dans le temps.

Mots clés : cointégration, investissement direct étranger, modèles de données de panel, modèles d'équations simultanées, moindres carrés en deux étapes, VAR.

Classification JEL : C32, C33, F21, F23.

Non-Technical Summary

Motivation Firms could expand their activities abroad by exporting their products, licensing their activities, or making foreign direct investment (FDI). But, since 1960, their preference for FDI is continuously growing. In 2000, the world FDI flows became 24 times as great as in 1985. Several theories have attempted to explain this growing phenomenon and its impacts. But, none of them turns out to be entirely satisfactory.

Objectives The first objective of this dissertation is to review and assess critically the main theories of FDI. Second, it seeks to test empirically some of these theories, mainly those relating FDI inflows to some pertinent macroeconomic variables of the host countries.

Methodology The empirical investigations consist in estimating the macroeconomic determinants of FDI inflows and in analyzing the relationship between FDI inflows and outflows among developed countries. Economic growth, which is a main determinant of FDI inflows, is also one of its main impacts. For this reason, this research has used simultaneous equation models in order to take into account the mutual dependence between FDI inflows and the economic growth of the host country.

Data The annual panel data are from the United Nations Conference on Trade and Development (UNCTAD). The quarterly data on the US economy are from the economic database of the Federal Reserve Bank of Saint Louis. The sample period ranges from 1970 to 2019.

Key Contributions Previous related studies tested the impact of the *current* economic growth rate on FDI inflows. The novelty in this dissertation is to consider rather the *expected* economic growth rate of the host country as the real determinant of the flows of FDI it receives. The explanatory power of the proposed econometric model is almost doubles that of a model without expectations, for the US economy.

Findings The hypothesis that foreign investors base the decision of FDI on their adaptive expectations of the future economic growth rate of the US economy raises the determination coefficient of the proposed econometric model from 26.9% to 65.7%.

Thus, the adjustment of foreign investors to their forecast errors plays a substantial role in the dynamics of FDI inflows. The size of the US economy measured by the gross domestic product also contributes significantly to the long-run and the short-run dynamics of the flows of FDI into the US. Moreover, using various panel data methods of estimation, this dissertation confirms the existence of a positive relationship between FDI inflows and FDI outflows among developed countries. In some of these countries, this positive relationship is found to be a long-run equilibrium relationship. In most developed economies, FDI inflows and FDI outflows are mutually dependent variables.

Sommaire Non-Technique

Motivation Les firmes peuvent étendre leurs activités à l'extérieur de leurs pays en exportant leurs produits, en octroyant des licences ou en effectuant des investissements directs étrangers (IDE). Mais, depuis 1960, leur préférence pour les IDE augmente constamment. En 2000, les flux mondiaux d'IDE étaient 24 fois aussi importants qu'en 1985. Plusieurs théories ont essayé d'élucider ce phénomène grandissant et ses impacts. Mais, aucune d'elles ne se révèle entièrement satisfaisante.

Objectifs Le premier objectif du présent mémoire est de faire une revue et une évaluation critique des principales théories sur les IDE. En un second lieu, il se propose de tester empiriquement certaines de ces théories, principalement celles reliant les flux entrants d'IDE à des variables macroéconomiques pertinentes du pays récipiendaires.

Methodologie Les études empiriques consistent à estimer les déterminants macroéconomiques des flux entrants d'IDE et à analyser de la relation entre les flux entrants et les flux sortants d'IDE parmi les pays développés. La croissance économique qui est l'un des principaux déterminants des flux entrants d'IDE, est également un de ses principaux impacts. Pour cette raison, la présente recherche s'est servie des modèles d'équations simultanées en vue de prendre en considération la dépendance mutuelle entre les flux entrants d'IDE et la croissance économique du pays d'accueil.

Données Les données de panel annuelles proviennent de la Conférence des Nations Unies sur le commerce et le développement (CNUCED). Les données trimestrielles sur l'économie des États-Unis proviennent de la base de données économique la Réserve fédérale de Saint Louis. La période d'échantillonnage s'étend de 1970 à 2019.

Contributions majeures Des études antérieures connexes ont testé l'impact du taux de croissance économique *actuel* sur les flux d'IDE. La nouveauté dans ce mémoire est de considérer plutôt le taux de croissance économique *attendu* du pays hôte comme le véritable déterminant des flux d'IDE qu'il reçoit. Le pouvoir explicatif du modèle économétrique proposé est plus du double de celui d'un modèle sans attentes, pour l'économie américaine.

Résultats L'hypothèse selon laquelle les investisseurs étrangers fondent la décision d'IDE sur leurs attentes adaptatives du futur taux de croissance économique de l'économie américaine augmente le coefficient de détermination du modèle économétrique proposé de 26,9% à 65,7%. Ainsi, l'ajustement des investisseurs étrangers à leurs erreurs de prévision joue un rôle substantiel dans la dynamique des flux d'IDE. La taille de l'économie américaine, mesurée par le produit intérieur brut, contribue également de façon significative à la dynamique de long terme et de court terme des flux d'IDE vers les États-Unis. Par ailleurs, en utilisant diverses méthodes d'estimation des données de panel, le présent mémoire confirme l'existence parmi les pays développés d'une relation positive entre les flux entrants et les flux sortants d'IDE. Dans certains de ces pays, cette relation positive s'avère être une relation d'équilibre de long terme. Dans la plupart des économies développées, les flux entrants et les flux sortants d'IDE sont des variables mutuellement dépendantes.

Ad maiorem Dei gloriam!

In memory of my parents

Renate Ayivor

and

Alfred Accolley,

and in memory of

Brian Phillips, father of my friend John

who helped me finance this MSc Economics program.

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Some Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lag
BIC	Bayesian Information Criterion
DO	Degree of Openness
EEC	European Economic Community
EC	European Community
FBL	Foreign Bank Lending
FDI	Foreign Direct Investment
FDII	Foreign Direct Investment Inflows
FDIO	Foreign Direct Investment Outflows
FIRA	Foreign Investment Review Act
FPI	Foreign Portfolio Investment
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GNP	Gross National Product
IMF	International Monetary Fund
LC	Labor Cost
LDC	Least Developed Country
MEC	Marginal Efficiency of Capital
M&A	Merger and Acquisition
MNC	Multinational Corporation
NAFTA	North American Free Trade Agreement
NEP	National Energy Program
OECD	Organization for Economic Cooperation and Development
OLI	Ownership, Location, and Internalization
OLS	Ordinary Least Squares
PLC	Public Limited Company
pp	Percentage point
R&D	Research and Development

REER	Real Effective Exchange Rate
TB	Trade Balance
TNC	Transnational Corporation
TNO	Transnational Operation
UNCTAD	United Nations Conference on Trade and Development
VAR	Vector Autoregression
2SLS	Two- Stage Least Squares

Introduction

> The European empires have almost vanished. In their place is a single empire of footloose corporate capital dominated by the United States.
> – Ransom (2001)

The first object of this introductory chapter is to give an overview of the concept of foreign direct investment (FDI): what it means and encompasses. Secondly, it provides some information on how FDI flows are aggregated. A brief history of FDI is thereafter presented. The outline of the dissertation is given in Section 4.

1 Definitions

FDI is an investment made abroad either by establishing a new production facility or by acquiring a minimum share of an already existing company. [1] Unlike foreign bank lending (FBL) and foreign portfolio investment (FPI), FDI is characterized by a significant degree of influence or a control of the investor on the management of an enterprise (OECD 2008, p 22; IMF 2014, p 149). In most cases, the relationship between the investor and the direct investment enterprise (which might be a subsidiary, an associate, or a branch) covers a relatively long period of time.

A direct investor may be an individual, a firm, a multinational company (MNC), a financial institution, or a government. But, FDI is the essence of MNCs, which are so called because part of their production is made abroad. [2] Furthermore, MNCs are the major source of FDI, as they generate about ninety-five percent of world FDI flows.

When the setting-up of a new site abroad is financed out of capital raised in the direct investor's country, FDI is referred to as a greenfield investment. The use of the term greenfield FDI has been extended to cover any investment made abroad by establishing new productive assets, no matter whether there has been a transfer of funds from the

[1] FDI is associated with production abroad, which cannot be confined to manufacturing abroad.

[2] A MNC is an enterprise operating facilities of production abroad. An enterprise is called MNC if at least twenty-five percent of its world output is made outside its country of origin. The terms MNC, multinational enterprise, and transnational corporation (TNC) are used interchangeably. According to UNCTAD (2009), there are about 82,000 TNCs operating about 810,000 foreign affiliates.

investor' s country (the home or source country) to the host country. Another type of FDI is the cross-border or international merger and acquisitions (M&A). A cross-border M&A (also known as foreign takeover or brownfield FDI) is the transfer of the ownership of a local productive activity and assets from a domestic to a foreign entity (UNCTAD, 1998, pp 212-4).

Industrial organization explanations distinguish between three types of cross-border M&A: horizontal, vertical, and conglomerate FDI (Caves, 1971). Horizontal FDI is a M&A made abroad in order to produce the same general line of product as at home. Its purpose is to gain market share in the recipient country and to reduce competition. On the other hand, vertical FDI is an expansion abroad either backward or forward along the supply chain. The backward vertical FDI is a merger with a foreign firm or its acquisition in order to extract raw materials, to produce intermediate goods, or to manufacture final outputs. As for the forward vertical FDI, it consists in controlling the distribution process abroad. Conglomerate FDI is the acquisition of an unrelated business abroad.

Profits not repatriated by direct investors but kept in a host country to finance future ventures constitute a type of FDI called reinvested earnings (Kenwood and Lougheed, 2014, p 253). It often happens that a foreign affiliate of a MNC undertakes direct investment abroad. Such an investment is called indirect FDI, because it represents "an indirect flow of FDI from the parent firm's home country (and a direct flow of FDI from the country in which the affiliate is located)" (UNCTAD, 1998, p 145). Reinvested earnings along with equity investment and inter-company loans represent another breaking down of FDI. They are referred to as the financial instrument components of FDI.

FDI can also be classified into three other categories: export-oriented FDI, market-development FDI, and government initiated FDI (Reuber, 1973, pp. 72-81). The purpose of an export-oriented FDI is either to extract raw materials or to manufacture component parts or finished goods at a lower cost for export to the investor's home country or elsewhere. This is a vertical extension backwards of the activities of the firm. In making an export-oriented FDI, the investor seeks to maintain or to increase its market share through the sale of cheap goods. The purpose of a market-development FDI, which is sometimes called import-replacement FDI, is to produce locally goods and services for sale in the recipient country. The determinants of such an investment are the local market size, the trade policy of the host country, *etc.* A horizontal FDI is a type of market-development FDI. A government-initiated FDI is one initiated and subsidized by the recipient country. Such an opportunity is provided by less developed countries (LDCs) in order to relieve unemployment, reduce disparities between regions in the host country, reduce the deficit of the balance of payments, *etc.*

Non-success in the activities of a foreign affiliate, unfavorable changes in the FDI policy of the recipient country, strategic reasons, and other factors can lead MNCs to divestment (*i.e.* the withdrawal of an affiliate from a foreign country).

2 The Compilation of FDI Flows

The available statistics on the flows of FDI between a country and the rest of the world are classified into two main categories: FDI inflows (or FDI inward flows) and FDI outflows (or FDI outward flows). A country's gross FDI inflows at the end of a given period are the total amount of direct investment it received from non-resident investors during that period of time. [3] On the other hand, a country's gross FDI outflows are the value of all greenfield and M&A FDI made abroad by its residents during a given period of time.

As one can see, aggregate FDI flows are based on the concept of residence and not on the one of nationality. A direct investment made in Southampton, England by one Mr. Phillips, living in Thessaloniki (Greece) for the last three years, is regarded and recorded as an outflow of FDI from Greece to the United Kingdom (UK), though the investor is a British national. An investment made in France by a firm from the United States of America (henceforth: United States or US) through its affiliate in the Republic of Ireland (an indirect FDI) is not considered as an outward flow of FDI from the US to France but as one from Ireland to France.

According to the guidelines of the IMF (2014), an investment abroad should be recorded by the home country as an outward flow of FDI and by the recipient country as an inward flow of FDI provided the foreign investor owns at least 10 percent of the ordinary shares or voting power of the direct investment enterprise. A divestment made by a foreign investor is deduced from the gross FDI inflows of the recipient country and from the gross FDI outflows of the source country. Therefore, net FDI inflows are equal to gross FDI inflows minus divestment by foreign investors, and net FDI outflows equal gross FDI outflows minus divestment made abroad.

The value of all the productive assets held by the non-residents of a country make up what is called FDI inward stock or position. FDI outward stock is the net value of all the productive assets held abroad by the residents of a country. In practice, the compilation of FDI data is not as simple as presented herein OECD (2008); IMF (2014). Governments, especially in LDCs, face difficulties in collecting FDI data, because they do not have "adequate statistics gathering machinery" (South Centre, 1997). Even in developed countries, the accuracy and the reliability of FDI statistics are questioned (Casella et al., 2023) As an example, bilateral FDI data do not always reflect the real economic ties between the ultimate investing and the recipient countries, due to phantom FDI that transits through a third-party country called offshore financial center in order to avoid tax. Furthermore, some countries have accounting conventions different from the guidelines of the IMF (2014). These facts explain the discrepancies between world FDI inflows and world FDI outflows which normally should be equal. The statistics on the flows of FDI can be found in the balances of payments.

[3] Investments made in a host country by an affiliate out of funds borrowed locally are not recorded in the FDI statistics South Centre (1997).

3 A Brief History of FDI

The idea to produce abroad goes back a long way. As a matter of fact, several activities similar to nowadays' FDI took place in the remote past. During the third millennium before Christ, Sumerian merchants, established in the southern part of Mesopotamia (current Iraq), realized the necessity of having representatives based abroad to receive, to stock and to sell their commodities (Lipsey, 2001a). During the fourteenth century, the Hanseatic League which was a guild of German cities' merchants set up trading posts in Bergen (Norway), Bruges (Belgium), London (UK), and Novgorod (Russia). During the same period, there were about one hundred Italian banks involved in multinational operations (Hirst et al., 2015). The seventeenth and eighteenth centuries witnessed the emergence of colonial companies such as the Dutch and British East India Companies, the Muscovy Company, the Royal Africa Company, the Hudsons Bay Company, and the Virginia Company (Hirst et al., 2015). The Virginia Company was chartered in 1606 by King James I to establish the first permanent English settlement in Jamestown (State of Virginia in the current US) (Lipsey, 2001a).

By the end of the nineteenth century to the first two decades of the twentieth century, quite a few European companies were enjoying extracting minerals, running farms, manufacturing goods in overseas territories in Africa, America, Asia, and Australia. Some American and European companies operating affiliates abroad before the First World War included: Lever, Singer General Electric, Courtaulds, Nestlé, Michelin, Hoechst, Orenstein & Koppel, and Edison (Dunning 1970, p 2; Foreman-Peck 1995, p 138).

It is worthwhile to stress here that, before World War I, direct investment abroad was an activity less important than FPI. In 1914, this latter accounted for 90 percent of all international capital movements (FBL, FDI, FPI, government loans, grants...). The major providers of the £9,500m invested abroad in 1914 were Great Britain (43 percent), France (20 percent), and Germany (13 percent) (Kenwood and Lougheed, 2014). The main recipients of these funds were other developed countries in North America and Europe. The only main determinant of international capital movement was interest rate differentials. Investments (especially portfolio investments) were made in countries offering high interest rates. Investors from the US, contrary to other capital exporters, leaned towards direct investments (Lipsey, 2001a).

The Depression of 1929 and World War II caused downturns in international business activities. After World War II, official gifts and loans, followed by direct investments made up the most important international capital flows (Södersten and Reed, 1994, p 468). In the early 1960s, the term MNC was introduced in the economic literature to refer to those firms operating in more than one country. At the same time, the frontier between FDI and FPI was drawn (Hirst et al., 2015).

From 1970 to 1984, the world FDI inflows increased slowly (see Figure 1). In 1984, the world FDI inflows quadrupled compared to 1970. From 1985 to 2000, there was a fast growth in the world FDI flows that became about 24 times as great. Figure 1 also shows the impacts of the world major crises on FDI, especially the early 2000s recession that followed the bursting of the dot-com bubble and the Great Recession that followed the financial crisis of 2007-2008.

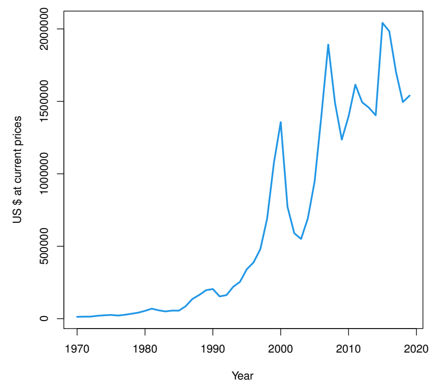


Figure 1: FDI Inflows, World, 1970-2019 (50 Years), US $ at Current Prices in Millions, Data Source: UNCTAD.

There has been a high concentration of the inward flows of FDI in developed countries, as the upper panel of Figure 2 shows. On average, they received 67.5 percent of the world FDI. The percentage of the world FDI received by the *transition economies* was negligible before 1990. The transition economies consist of countries of Central and Eastern Europe and the former Soviet Union. After the collapse of the communist bloc in 1990, they started opening their economies to foreign investors. Then, the share of the world FDI they received exceeded that of the LDCs and reached the historical high of 7.9% in 2008.

4 The Outline of the Dissertation

The rest of this dissertation consists of four chapters. In Chapter 1, some theories of FDI are surveyed and critically discussed. Chapter 2 breaks down the benefits and the costs of FDI to both home and host countries. Chapter 3 tests empirically some theories of FDI. Chapter 4 discusses some FDI policies and concludes this dissertation.

Theories of FDI can be classified into two main categories according to the level of the analysis: the microeconomic and the macroeconomic theories of FDI. The micro-level explanations justify FDI by the desire of firms to maximize profits, the imperfection of markets, *etc*. The macroeconomic explanations seek to find out a meaningful relationship between the flows of FDI and some macroeconomic variables such as the economic growth rate (*i.e.* the real growth rate of the gross domestic product), the exchange rate, *etc.*

Chapter 3 aims at testing empirically some propositions advanced by economists to explain FDI. It consists of two empirical investigations: economic growth is mainly targeted in the first one while the second one focuses on the relationship between the inward and the outward flows of FDI. In the literature, economic growth turns to be a determinant as well as an effect of FDI. On the one hand, some researches have

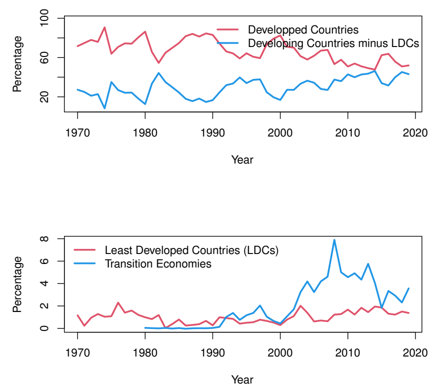


Figure 2: Percentage of the World FDI Inflows Received by the Developed Economies, the Developing Economies, and the Transition Economies, 1970-2019 (50 Years), Data Source: UNCTAD.

confirmed that a high rate of economic growth attracts FDI. On the other hand, there are investigations proving that FDI contributes significantly to economic growth in recipient countries. This leads to postulate a feedback relationship between these two variables. The postulated feedback effect will be tested for after estimating simultaneously the structural equations of FDI and economic growth, using the two-stage least squares (2SLS) and the cointegrated vector autoregression (VAR) methods. These empirical investigations are carried out using data related to the US economy. This country has been selected because of the availability over a long period of time of its data on FDI and the other macroeconomic variables of interest. The second empirical investigations are a panel data analysis of the inward and the outward flows of FDI among developed countries. It has been observed that the bulk of FDI takes place among developed countries. To verify this observation, this research estimates a variety of bivariate linear models using the data of 16 developed countries.

Summary

1. FDI is an investment made abroad either by establishing a new production facility or by acquiring a minimum share of an already existing company.

2. The main financial instrument components of FDI are: equity investment, debt, and reinvested earnings. FDI can also be classified into greenfield FDI and cross-border M&A.

3. Aggregate FDI data are classified into two categories: FDI inward flows and FDI outward flows.

4. To produce or to invest abroad is an activity going back a long way. It is growing continuously with a sharp rise observed between 1985 and 2000

CHAPTER 1

The Determinants of FDI

> The need for a theory of direct foreign investment depends on whether there are observable patterns in international ownership and meaningful distinctions between source countries and host countries.
> – Aliber (1993)

There are several ways whereby firms could expand their activities into a foreign country. They could export the goods they produce, franchise or license their activities and methods of production to a foreign business, or make FDI. But, what one has been observing since the late 1960s is their leaning towards FDI. Production abroad has become a more and more important activity. There have been increases in world FDI flows, as indicates Figure 1 on page 5. This growth took a phenomenal pace from 1985 to 2000. What are then the motivations underlying firms decisions to settle subsidiaries abroad? Furthermore, most FDI has taken place in the advanced industrial countries. Why do some countries receive more FDI than others? This research provides answers for such questions, through a survey and an assessment of the economic literature.

The first theories on FDI appeared in the 1960s. Before that period, there were researches explaining and appraising capital movements between countries, but they did not isolate FDI from such other international capital as FBL, and FPI. The main reason was that what would be called later FDI was not a so important activity as it has become with the emergence of MNCs (see Section 3).

Theories on the determinants of FDI can be classified into two broad categories: the micro-level and the macro-level theories. The micro-level theories focus on the circumstances that lead a firm to produce abroad, whereas the macro-level theories try to find out the aggregate variables that determine the level of FDI into or from a country. The eclectic paradigm picks up from both types of theories to explain FDI.

1.1 The Microeconomic Determinants of FDI

How and why does a firm become a multinational corporation? Why does a firm go on increasing its international involvement? The internationalization model of the Uppsala school, the product-cycle hypothesis of Vernon, and the imperfect market paradigm try to provide answers for such questions.

1.1.1 The Internationalization Model of Uppsala School

This model elaborated by Johanson and Wiedersheim-Paul (1975) from the University of Uppsala (Sweden) states that generally a MNC does not commence its activities by making gigantic FDI. First, it operates in the domestic market and then gradually expands its activities abroad. They called this gradual mutation the *establishment chain*.

The establishment chain is comprised of four stages. During the first stage, the MNC-to-be produces and sells its goods and services only at home. It does not undertake any regular export activity, because of lack of expertise and a tendency to avoid risks. During the second stage, the firm starts its international involvement by exporting its goods and services to neighboring countries and countries it knows well *via* independent representatives (agents). The psychic distance between the home country of the firm and a given country (*viz* differences in language, culture, political system, level of education, level of industrial development, *etc*) influences strongly its decision to export. At this stage, the size of the potential market is expected to play a less important role compared to its psychic distance. The firm enters the third stage of the establishment chain when it begins establishing sales subsidiaries abroad. The size of the potential market can be a determining factor in the choice of where to establish the first sales subsidiaries. The firm may decide to start selling in small markets that are (may be) similar to the domestic one or in large markets. The fourth stage is the setting up or the acquisition of manufacturing facilities abroad. The establishment of manufacturing facilities abroad is influenced by several forces: psychic distance, tariffs, non-tariff barriers, transport costs, etc. It follows that it is hard to observe any correlation between the establishment of manufacturing facilities and psychic distance.

Johanson and Wiedersheim-Paul (1975) warned that firms, especially those with extensive experience from other foreign markets, are not expected to follow the whole four-stage process to become MNCs. Skips in stages can be observed. Johanson and Wiedersheim-Paul tested empirically their internationalization model using data of four Swedish MNCs, which are Sandvik, Atlas Copco, Facit, and Volvo. They identified the moments when each of the four firms established agencies, sales subsidiaries, and production facilities abroad. They selected twenty host countries that were all common to these four firms. Then, they ranked these countries according to their psychic distance from Sweden. They used the gross national product (GNP) to proxy the host countries' market size. For each of the four firms, they computed the Spearman correlation coefficient, first, between the time order of establishments and the order of psychic distance and, second, between the time order of establishments and the market sizes. [1] They

[1] The correlation of Spearman between two variables, say X and Y, is computed by (1) sorting the observations on each of these two variables, (2) assigning to each observation its rank in its own sample, and (3) using instead these ranks to estimate the intensity of their relation, $\text{cov}(\text{rk}_X, \text{rk}_Y)/[\text{sd}(\text{rk}_X)\text{sd}(\text{rk}_Y)]$, where the operators cov, s.d, rk denote respectively the covariance, the standard deviation, and the rank variable.

found a high and positive correlation between the order of establishment of the agencies and psychic distance, for Sandvik, and Atlas Copco. This bears out the predictions of the internationalization process model: firms establish independent representatives, first, in neighboring countries or in countries they are acquainted with. Regarding the internationalization process of Facit and Volvo, there was no evidence of a relationship between the establishment of agencies and psychic distance. As for the market size, it is positively correlated with the time order of the establishment of subsidiaries, in the case of Sandvik and Atlas Copco. These firms established their sales subsidiaries, first, in small markets. The correlation coefficients between the market size and the time order of the establishment of sales subsidiaries were low for Facit and Volvo.

Welch and Luostarinen (1988) made a survey of some empirical studies confirming the predictions of the Uppsala school. First, they referred to the results of an investigation conducted by Reijo Luostarinen on about 75 percent of the Finnish industrial companies engaged in a foreign operation of any kind in 1976. In this sample, 65 percent of the firms had only non-investment marketing operations abroad (*i.e.* exports and sales through agents), 33 percent moved from non-investment marketing operations to the establishment of production facilities abroad. Only 2 percent of the firms began producing abroad without any prior foreign operation. Then, Welch and Luostarinen pointed out the results of a research undertaken by Jorma Larimo on Finnish MNCs over the sample period 1980-82: 13 percent of the firms observed started their foreign operations by building plants abroad and the remaining 87 percent followed somehow the establishment chain. FDI by Japanese firms in South East Asia also reflected the evolutionary and sequential build-up of foreign commitment advanced by the Nordic Researchers (see Yoshihara, 1978).

As for Millington and Bayliss (1990), the internationalization model of the Uppsala school holds true just for the firms without any prior international experience. They investigated the factors underlying fifty transnational operations (TNOs), that is, joint ventures and/or subsidiaries, in the European Community (EC) by 50 UK manufacturing pubic limited companies. Out of these 50 UK firms, 10 had no previous experience in the EC market before setting up a manufacture. They did not follow the establishment chain, but moved directly from product development to the establishment of factories abroad. Millington and Bayliss referred to this long jump as discrete strategy. Other 28 corporations jumped straight from the intermediate stages of the establishment chain (*i.e.* licensing, direct exports or exports through agents) to manufacturing abroad.

Millington and Bayliss argued that there should be factors other than the market-based experiential knowledge influencing firms' decision to establish plants abroad. One of the factors they mentioned is called *formal planning*. The model they advanced is a life cycle model based on the international development of the firm rather than the market or product. In the outset of its internationalization, the firm tends to follow the establishment chain, that is, it relies on market experience and incremental adjustment. As the firm's international experience increases, it bases its decision to produce abroad on formal planning and systematic searches. The TNO becomes part of the strategic objectives of the parent company and the decision to produce abroad is taken after appraising and comparing many overseas production opportunities. In its final stage of

Box 1.1: The International Involvement of the Firm

What is meant by internationalization and how can that be measured? Welch and Luostarinen (1988) proposed a broad and more acceptable definition of internationalization. It is "the process of increasing involvement in in international operations".

This definition does not confine internationalization to outward international operations by the firm (*viz* exports, FDI), but it takes into account as well its inward international operations such as imports.

Various indices are used to gauge the degree of transnationality or internationalization of a firm. For a given firm, one may consider either one of the following three ratios or their combinations (UNCTAD, 1998, pp 43-4):

- foreign assets / total assets
- foreign sales / total sales
- foreign employment / total employment

The UNCTAD uses a combination of these three ratios to produce the list of the largest TNCs. None of these indices measures perfectly the degree of transnationality of a firm.

At a national level, the international involvement of a country is measured by the trade to gross domestic product (GDP) ratio, which is equal to (exports+imports)/GDP (Hirst et al., 2015, chap 2). This ratio is also called degree of openness to trade.

development, the firm can skip easily the first stages of the establishment chain due to its international experience.

The conclusion of the studies of Millington and Bayliss (1990) raises some questions. Their sample consists of 50 out of the 405 UK PLCs that made FDI in the EC market. How representative is this sample and can the results be extrapolated to the other firms? Besides, the investigations focused only on TNOs by UK firms in the EC market. Are the UK and the EC markets that distant from each other? The concept of psychic distance between home and host country advanced by Johanson and Wiedersheim-Paul (1975) as a reason for the step-wise internationalization process of the firm seems not to be an issue in the studies of Millington and Bayliss. This weakens their criticism of the Nordic studies. Finally, their studies are on a specific TNO by a UK firm and not on the evolution of a firm over time.

Neither the establishment chain nor the forward planning hypothesis explains *why* a firm goes multinational. They describe merely *how* a firm goes multinational. It is important to have a look at theories providing answers for this question.

1.1.2 The Product-Cycle Hypothesis

This theory explains the innovation of high-income and labor-saving products in the US and the shift of their production to other countries. Vernon (1966) related the three stages of development of a product (*i.e.* its introduction, maturation, and standardization) to the choice of its production location.

The Introduction of the New Product This stage is the embodiment of the knowledge of scientific principles into a new marketable product in the hope of reaping some monopoly profit. Vernon (1966) assumes that domestic entrepreneurs are the first to spot the need for a new high-income and labor-saving product in the US. He predicts that they will built the first plants for the production of this good in the US. The reason is not necessarily to avoid international transport costs or US import duties. There are forces stronger than these elements that influence the decision of the producers of a new good intended for the US to operate at home, for example, the need for an effective communication with the market. As long as the new product is not yet standardized (*viz* its input requirements, its processing, and final specification are not uniform and can hardly be fixed in advance), the producer needs a location where communication with its economic environment (*i.e.* customers, suppliers, and business rivals) is swift and easy.

The Maturing Product The product becomes somewhat standard, as its demand increases. Shifts of the locations of the manufacturing facilities within the US may follow the product maturation. Demand for the new high-income and labor-saving product starts appearing outside the US, as soon as its existence becomes known. This demand will grow quickly in other developed countries provided it has a high income elasticity of demand or it is a good substitute for high labor cost. At this stage, will the producer go on exporting from the US or will he build plants abroad? A careful decision is made after weighting the two alternatives. Direct investment can substitute exports to a developed country, providing the marginal cost of the production of the maturing item in the US plus its transportation cost is higher than the average cost of its prospective production in the recipient country. As the maturing product manufactured by the parent firm in the US costs more than one made by a foreign subsidiary, its export to LDCs will be from a recipient country. If the labor cost difference between the US and the recipient country turns out to be very significant and can compensate the shipping cost of the item to the US, the foreign subsidiary will start supplying also the US market. This initial investment abroad by a US firm will be regarded by its rivals at home as a menace to the *status quo*. They find their share of the market at stake and will challenge the pathfinder investor by investing abroad in the same area.

The Standardized Product When the product reaches an advanced stage of standardization, unskilled labor can be substituted to skilled labor and LDCs may prove to be attractive production locations. The high-income and labor-saving product will be made finally in LDCs and exported to the US.

Taking into account the changes occurred in the international environment after 1966, Vernon (1979) admitted that the product-cycle hypothesis lost part of its explanatory and predictive power.

The first of those major changes was that innovating firms spread their networks of

foreign subsidiaries around the world. For instance, in 1950, 138 out of 181 US-based MNCs had each manufacturing subsidiaries in less than 6 countries and the other 43, in between 6 and 20 countries. In 1970, among the same 181 US-based MNCs, only 9 had each manufacturing facilities in less than 6 countries. Each of the 172 remaining were operating subsidiaries in at least 6 countries. Like the US-based MNCs, those headquartered in Europe also spread their networks of foreign subsidiaries. In 1950, 116 out of 135 European MNCs had each foreign subsidiaries in less than 6 countries. In 1970, they were just 31 to still have foreign subsidiaries each in less than 6 countries.
The second major change Vernon (1979) pointed out was that the income gap between the US and the other developed countries shrank after 1970. For example, in the late 1970s, the *per capita* income in France and Germany nearly equated that of the US, whereas it was less than its one-third in 1969. Besides, the difference between the US market size and that of other developed countries declined partly due to the formation of the European Economic Community (EEC).

All these changes questioned some of the assumptions and predictions of the product-cycle hypothesis. However, the model still fits some small firms and even some big MNCs in the US, and some other enterprises headquartered abroad.

1.1.3 The Imperfect Market Paradigm

A perfectly competitive market is a model made up, *inter alia*, of a large number of small firms that supply an identical product. Each firm has complete information about the market (price, supply level, production methods, technology, marketing strategies, and other knowledge). Thus, if all markets were perfectly competitive, no FDI could take place and international trade would be the only way to service foreign markets. Hence the view that, in essence, FDI flows are occasioned by some deviations from the model of perfect competition. These deviations could be: (1) a disequilibrium in the markets of goods, factors, and foreign exchange, (2) some distortions imposed by the government, (3) some imperfections of the market structures, and (4) some market failures (Calvet, 1983).

The Market Disequilibrium Hypothesis FDI would be an equilibrating capital flow from countries with overvalued currency, low rate of return on physical capital, high labor cost, or relatively advanced technology to countries with the opposite of any of these characteristics. FDI flows would take place until these conditions are equalized internationally. For example, (1) firms in countries where the rate of return on physical capital is low will invest in countries with high yields until the payoffs are brought to equilibrium, (2) in the pursuit of cost minimization, FDI would flow from countries where the labor cost is high to countries where the labor cost is low.

The Government-Imposed Distortion Hypothesis Such distortions as tariffs, non-tariff barriers to trade (*e.g.* import quotas), taxes, and antitrust law are major causes of FDI. For example, foreign firms could consider establishing a subsidiary in a protected market when their exports are restricted, as explained in Box 1.2.

The Hypothesis of Market Structure Imperfections These explanations are also referred to as the industrial organization theories of FDI, as they consider industrial concentration (*i.e.* the size of a firm relative to that of its industry or the degree to which few firms dominate the activities of an industry) as a determinant of FDI. Caves (1971) researched on the characteristics intrinsic to the industries in which FDIs tended to occur. Breaking down the FDI made by MNCs into horizontal and vertical investments, he found that the former occurred in industries characterized by oligopoly with product differentiation in both the home and the host countries, whereas the latter tended to take place in industries characterized by oligopoly, not necessarily differentiated, in the home market. [2] For Penrose (1956) and Caves (1971), the causes of the expansion abroad of a firm are the same as those of its domestic expansion. The knowledge of servicing the domestic market can be used at little or no cost in other national markets. According to Hymer (1970), firms undertake FDI because they possess some special assets yielding higher return on foreign markets only through foreign production. These special assets could be the knowledge about how to serve a market and how to differentiate products (through advertising and slight changes in the products' shape) (Caves, 1971). These explanations of FDI emphasize the advantages specific to home country firms and say little about the characteristics specific to the recipient countries. They do not explain either greenfield FDI.

The Market Failure Hypothesis Markets fail to allocate resources efficiently for three reasons: the presence of externalities, public goods, and economies of scale. Externalities mean that economic agents are not facing the correct prices for their actions. A public good is one that is nonrival (*i.e.* its use by one agent does not reduce the amount available to the others) and nonexclusive (*i.e.* it is uneasy and costly to prevent people from using it). There are economies of scale, when the average cost of production (*i.e.* the cost per unit of output) decreases and the scale of production increases. MNCs invest massively in research and development (R&D) to produce technological and managerial knowledge. The development of new knowledge by a firm generates internal economies of scale and can create positive externalities. Knowledge is partially nonexclusive, as it cannot be perfectly patented or kept secret. As knowledge is also nonrival, any other competitor can use it to conceive new designs or ideas without rewarding its inventors. Given the market of knowledge is difficult to organize due to the public good nature of this an intangible asset, innovating firms would prefer servicing foreign markets *via* internal channel (*i.e.* FDI) over external modes (*i.e.* exporting their production or licensing their activities). Internalization secures knowledge at lower costs and avoids its dissipation to competitors.

[2] Oligopoly is a market structure that consists of a small number of firms producing homogeneous or differentiated goods. Oligopolists are interdependent in the sense that the optimal decision of each firm influences and is influenced by the choice of the other firms. This creates opportunity for both conflict and cooperation.

Box 1.2: Trad Diversion and FDI

A customs union is an agreement between at least two countries to remove trade barriers in visible goods (*i.e.* physically tangible goods) and invisible goods (*i.e.* services) among themselves and to set a common external tariff on imports from non-member countries. Until Viner (1950), customs union was believed to be undoubtedly welfare improving. He distinguished between the trade creating and the trade diverting effects resulting from a customs union formation.

To illustrate this, consider three countries producing each a commodity X but at different costs. The table below presents the cost of the good before and after the formation of a customs union between countries A and B. Before the unionization, country A imposed a tariff of 100% on the imports of commodity X from both counties B and C. This protected the industry of country A from competition from both countries B and C. On the other hand, consumers in county A were penalized because forced to take the good X produced domestically at a higher price. After the trading alliance between countries A and B, both agreed on a tariff of 100% on imports from country C. This enables country B to specialize in the production of X and to supply it to country A at a lower price ($ 14). Thus, there is a replacement of an expensive domestically produced item by a cheaper import from a partner country. This is an internal trade creation brought about by the formation of the customs union. The prejudice undergone by producers of good X in country C is referred to as trade diversion.

The view sustained herein is that trade creation and trade diversion are only short-term effects. The formation of a customs union between countries A and B may represent a triggering event leading some producers in country C to start planning to make an horizontal FDI into country A in order to avoid the tariff barriers. This investment is referred to as tariff-jumping FDI. Given firms in country C produce the good X at the lowest cost ($ 12), it can be argued that they have a superior knowledge, a more advanced technology, or other ownership advantages over their business rivals of countries A and B. The need for producers in country C to avoid the dissipation of their knowledge to competitors or to protect the quality of their product may offer them a reason to choose to internalize their ownership advantages. The customs union between countries A and B represents a larger market to serve and may become a location advantage attracting firms from country C. If they produce good X in country A, their market will comprise both consumers in countries A and B, because goods produced in country A can be exported duty-free to country B.

When a producer of good X from country C builds the first plants in country A in response to the trading alliance, other producers from the same country will follow its lead. As a consequence, the initial trade creating and trade diverting effects occasioned by the alliance between countries A and B will be canceled. Besides, the good X will now be exported to country B from country A. This is a new trade creating effect resulting from the horizontal FDI made in country A by producers from country C. By introducing FDI in the model of Viner (1950), this analysis predicts that the trade creating and the trade diverting effects will be reversed, when producers from a non-member state start making horizontal FDI into one of the countries forming a customs union. According to some empirical investigations, the growth of US FDI has not been affected by the formation of the EEC (Scaperlanda, 1967) or the European Free Trade Association (d'Arge, 1969). Schmitz (1970) disagreed with both conclusions.

Price of Good X Before and After Trading Alliance ($)

Country	A	B	C
Unit cost	20	14	12
Price in country A before the trading alliance	20	28	24
Price in country A after the trading alliance	20	14	24

1.2 The Macroeconomic Determinants of FDI

How some macroeconomic variables such as the exchange rate, the market size, and the rate of economic growth are likely to determine the flows of FDI into a country is presented here. In analyzing the effects of any of these determinants on FDI inflows, it is assumed that the other determinants remain constant.

1.2.1 Exchange Rate

The level of the exchange rate, its volatility and its expected change all influence FDI decision. A MNC can diversify its locations or choose between competing recipient countries. In these cases, the covariance or the correlation of the exchange rates of the home currency with each of the potential recipient countries are also instrumental in the FDI decision. Box 1.3 provides a definition of exchange rate.

1.2.1.1 The Level of the Exchange Rate

There is a negative relationship between FDI flows into the US and the value of the US dollar, *ceteris paribus*. For Aliber (1993), if the US dollar becomes more and more undervalued, investments in plant and equipment in the US by foreign investors should increase. He argued that change in the effective foreign exchange value of the US dollar is a proxy for the anticipated returns on investment in the US. A continuous depreciation of the US dollar would mean an increase in the anticipated profit rate associated with investment in the US, which will appeal to foreign investors (see Box 1.4, for an illustration). When the US dollar goes down, comparative advantage shifts in favor of the US because they become a low-cost place for the production of many items. Klein and Rosengren (1994) confirmed the existence of a negative relationship between the flows of FDI into the US and the value of its currency. They regressed the inflows of FDI from seven countries (Canada, France, Germany, Japan, the Netherlands, Switzerland, and the UK) on the bilateral real exchange rates of the US dollar. They found that a depreciation of the US currency was associated with a significant increase in the overall inflows of FDI. But, breaking down the FDI inflows into M&A and real estate purchases, only the response of the former type turned out to be significant. Moghadam et al. (2019) also found that the depreciation of the currencies of six Southeast Asian nations (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) against the US dollar had a positive and significant impact on M&A. But, unlike Klein and Rosengren, they found a negative and significant impact of the depreciation of the exchange rates of the recipient countries on the flows of greenfield FDI they received.

Cushman (1985) demonstrates that the various components of FDI do not respond the same way to a change in the level of the real exchange rate. In the case of a backward vertical FDI or more generally an export-oriented FDI (*i.e.* the production abroad of an intermediate good), Cushman predicts that an increase in the real sport exchange rate will reduce the exports of the intermediate good from the foreign subsidiary to the home country. The reason is that the increase in the real exchange rate will raise

Box 1.3: The Spot Exchange Rate

The Nominal Exchange Rate

Let $p_{h,t}$ denotes the price level in the home currency at time t and $p_{f,t}$ the price level in a foreign currency. According to the theory of purchasing power parity, the cost in the home currency of a common reference basket of goods equals its cost in the foreign currency,

$$p_{h,t} = s_t p_{f,t} \Rightarrow s_t = \frac{p_{h,t}}{p_{f,t}}$$

where s_t denotes the nominal spot exchange rate, that is, the home currency price of a unit of the foreign currency. This way of expressing the exchange rate (*i.e.* a unit of the foreign currency in terms of the currency of the home country) is referred to as a direct quote. Thus, a rise in s_t indicates an appreciation of the foreign currency and a depreciation of the domestic currency.

The Real Exchange Rate

The concept of real exchange rate helps quantify the deviation of the nominal spot exchange rate from the purchasing power parity,

$$q_t = \frac{s_t p_{f,t}}{p_{h,t}}$$

where q_t denotes the real exchange rate. According to purchasing power parity, the real exchange rate should equal or should fluctuate around one (Krugman et al., 2017). An increase in q_t indicates a real depreciation in the home currency.

The Real Effective Exchange Rate

The real effective exchange rate (REER) is an index that measures the international competitiveness of a country and the strength of its currency on the foreign exchange market. It is computed as a weighted geometric average of the bilateral exchange rates of the currency of a country vis-à-vis its trading partners and is adjusted for price differential

$$\text{REER}_{h,t} = \text{REER}_{h,t-1} \times \prod_{f=1}^{F} \left(\frac{e_{f,t}}{e_{f,t-1}} \frac{p_{h,t}}{p_{h,t-1}} \frac{p_{f,t-1}}{p_{f,t}} \right)^{w_{f,t}},$$

$$\sum_{f=1}^{F} w_{f,t} = 1,\ 0 < w_{f,t} < 1$$

where $e_{f,t}$ denotes the nominal exchange rate quoted indirectly (*i.e.* a unit of the domestic currency in terms of the foreign currency) and the time-varying parameter $w_{f,t}$ denotes the trade weight. Klau and Fung (2006) describe the weighting methodology used by the Bureau for International Settlement that publishes a narrow and a broad estimate of the REER. The narrow estimate is computed using a basket of 27 currencies and the broad REER 61.

A rise in the REER indicates: (1) a real appreciation of the domestic currency relative to its trading partners (*i.e.* on average, more foreign currencies can be obtained for each unit of the domestic currency) and (2) a decrease in international price competitiveness (*i.e.* exports have become more expensive and imports cheaper).

the costs in the currency of the home country of the foreign capital and labor. This induced increase in the costs of the foreign inputs will lower FDI. On the other hand, Cushman predicts a positive relationship between the level of the real exchange rate and the forward vertical FDI (*i.e.* the manufacturing and the distribution abroad of a final output using an intermediate good produced at home). The reason is that an appreciation of the currency of the recipient country will increase the exports of the intermediate good to the foreign subsidiary and will raise the demand of foreign capital. When manufacturing in the recipient country aims instead at replacing its imports of the final good from the home country, Cushman predicts that an increase in the level of the real exchange rate will discourage FDI. The reason is that manufacturing at home for export becomes more profitable than producing abroad, because the appreciation of the currency of the recipient country makes the domestic capital and labor relatively cheaper.

The level of exchange rate can affect FDI either through labor variables (Cushman, 1987) or through the channel of the wealth of firms (Froot and Stein, 1991; Blonigen, 1997).

Cushman (1987) tests for the impacts of the real wage and the productivity of labor on the flows of FDI between the US and five industrialized countries (Canada, France, Germany, Japan, and the UK) over the period 1963-1981. The estimates from his empirical investigations indicate *inter alia* that: (1) a rise in the real wage in the recipient country or a cut in its labor productivity reduces significantly the flows of FDI it receives, and (2) a rise in the real wage in the source country or a cut in its labor productivity stimulates its FDI outflows. The empirical investigations of Cushman (1987) reveal also that: (1) the growth in the foreign labor productivity is the single most important variable contributing to the growth in the stock abroad of US physical assets and (2) even though some FDI flowed from high labor cost countries to the US, the rise in the labor productivity in theses countries worked against the growth of FDI into the US.

Froot and Stein (1991) relate the level of the exchange rate, the net wealth of foreign firms, and FDI. They sustained that an increase in the net wealth of foreign firms stimulates their demand for FDI. A firm can finance an asset either with its net wealth or with external funds (*e.g.* debts). The latter option costs more than the former, because of the default risk the external creditor is exposed to. As a matter of fact, the firm may make profit and will be able to repay its debt or may lose money and will become insolvent. Given the firm does not disclose its cash flows, which is called informational asymmetry, it costs the external creditor to verify them. For this reason, the interest rate on external funds is higher than the risk-free interest rate. Thus, the higher the share of the internal funds (*i.e.* the net wealth) in an FDI project, the lower will be its total cost of capital. The appreciation of the currency of the home country raises the value in the currency of the recipient country of the net wealth of the foreign firms and the share of internal funds in its FDI project. This lowers the cost of external funds and allows the foreign firm to bid more aggressively. While the asymmetry of information between the foreign firm and its external creditor is central in the explanations of Froot and Stein (1991), Blonigen (1997) relies instead on the assumption that the market of goods is segmented (*i.e.* a firm can produce and sell goods only in its own market). However, both domestic and foreign firms have equal opportunity to purchase firm-specific assets (*i.e.* process technology, product innovation, and managerial skills) in the domestic market. These firm-specific assets are not location-specific and can be used to boost productivity either abroad or in the domestic market, depending on which firm wins the bid. Thus, a depreciation of the domestic currency makes no difference for the firm bidding at home for a firm-specific asset. But, it raises the valuation of the foreign firm and increases the likelihood of an acquisition FDI, since it will pay for the firm-specific asset in the domestic currency.

Klein and Rosengren (1994) regressed the flows of FDI from seven industrialized countries (Canada, France, Germany, Japan, the Netherlands, Switzerland, and the UK) into the US on (1) the bilateral real exchange rate of the US dollar, (2) a relative wage term, measured by the ratio of the index of wage costs in the US to the index of wage costs in each of the countries in the sample, and (3) a relative wealth term, measured by the ratio of the US stock market index to the stock market index of each of the seven countries. The coefficients on the real exchange rate and the relative wealth term are both negative and statistically significant, when the overall inflows or the M&A is used as a measure of FDI. On the other hand, the relative wage term does not enter with a significant coefficient in any of the regressions. According to Klein and Rosengren, these results give empirical support to the imperfect market hypothesis. There are two limitations in the assessment of Klein and Rosengren (1994). First, the use of the relative wage in the empirical investigations of Klein and Rosengren means that in the FDI inflow equations the coefficient on the real wage in the US and the one on the foreign real wage are equal but opposite in sign. This restriction may be questionable, since it is rejected by the hypothesis test performed by Cushman (1987). Second, the econometric model used by Klein and Rosengren omits the productivity of labor, which is, according to Cushman (1987), the most important variable whereby the level of exchange rate affects FDI.

1.2.1.2 The Expected Change in the Exchange Rate

The expectation about the future exchange rate can be based either on the random walk model or on the mean reversion hypothesis. According to the random walk model, the current spot exchange is equal to the past spot rate plus a stochastic disturbance. Thus, the best predictor of the future spot exchange rate is the current spot exchange rate. [3] This prediction implies that movements in the exchange rate should not affect the present discounted value of the future stream of profits of a project of FDI, expressed the currency of the home country. Therefore, exchange rate expectations should not affect the timing of FDI. As for the mean reversion hypothesis, the spot exchange rate fluctuates around a constant mean (or expected value). This hypothesis suggests that a large depreciation of a currency creates the expectation of its future appreciation. Thus,

[3] Let s_t denote the spot exchange rate at time t. According to the random walk model, $s_t = s_{t-1} + \varepsilon_t$, where the stochastic disturbance ε_t follows a normal distribution, $\varepsilon_t \sim \mathcal{N}(0, \sigma^2)$. It follows that $\mathrm{E}_t s_{t+T} = \cdots = \mathrm{E}_t s_{t+1} = s_t$, where E_t denotes the expectation conditional on the information available at time t.

the flows of FDI into a country would rise when foreign investors sense its spot exchange rate (*i.e.* a unit of the currency of the recipient country in terms of the currency of the home country) is weaker than its expected value. This timing lowers the initial cost of the FDI in the currency of the home country and creates the opportunity to raise the value of the repatriated future profits, as the foreign investors expect an appreciation of the currency of the recipient country after its initial depreciation.

Chakrabarti and Scholnick (2002) use FDI data to make inference about how foreign investors form and update their exchange rate expectations. To make the inference about the long-term exchange rate expectations, Chakrabarti and Scholnick regressed the annual inflows of FDI from the US to 20 OECD countries on the mean, the standard deviation, and the skewness over the preceding year of the change in the monthly exchange rate of the recipient countries (*i.e.* a unit of US dollar in terms of the currencies of the other OECD countries). [4] While the standard deviation, which is a measure of volatility, captures the attitude of foreign investors towards risk, the skewness, which is a measure of the asymmetry of a distribution, indicates the presence of large disturbances in the exchange rate time series. Thus, a positive change in the exchange rate is a depreciation of the currency of the recipient country and a positive skewness indicates the presence of some large depreciation in the exchange rate time series. Chakrabarti and Scholnick found that the skewness of the change in the exchange rate had a statistically significant positive effect on FDI inflows. This means that a large depreciation of the currency of the recipient country will increase the flows of FDI it receives. This result is consistent with the prediction made from the hypothesis of mean reversion in the exchange rate. Chakrabarti and Scholnick found only in two of the various specifications of their econometric model that the standard deviation of the change in the exchange rate had a significant negative impact on FDI inflows. They found that the average depreciation of the currency of the recipient country had not the expected significant positive effect on its FDI inflows. It is worth noting that Chakrabarti and Scholnick (2002) used the nominal exchange rate where Cushman (1985) and some other authors used the real exchange rate.

Cushman (1985) investigated theoretically the response of FDI to the *risk-adjusted* expected change in the real exchange rate. He defined the latter variable as the difference between the expected future change in the real exchange rate and the market price of risk times the standard deviation of the future change in the real exchange rate, $\mathrm{E}(q_{t+1}/q_t) - \gamma \times \mathrm{s.d.}(q_{t+1}/q_t)$. Thus, its rise may result from an increase in the expectation of the future change in the real exchange rate or a decrease in its standard deviation. The estimation of the first and the second moments of the future change in the real exchange rate is subjective, and a positive market price of risk ($\gamma > 0$) implies the firm contemplating FDI is averse to risk. According to Cushman, the theoretical impact on FDI of the risk-adjusted expected change in the real exchange rate is ambiguous.

[4] The skewness of a time series s_t ($t = 1, \ldots, T$) is a measure of the deviation of its distribution from a symmetric distribution. Its estimator is $\sum_{t=1}^{T}(s_t - \bar{s})^3/(T\hat{\sigma}^3)$, where $\bar{s}$ denotes the sample average $\sum_{t=1}^{T} s_t/T$ and $\hat{\sigma}$ denotes the sample standard deviation $\left[\sum_{t=1}^{T}(s_t - \bar{s})^2/(T-1)\right]^{1/2}$. A negative estimate indicates the left tail of the distribution of s_t is longer (*viz* the sample has some negative outliers, that is, abnormally low values). On the other hand, a positive estimate indicates the right tail is longer.

For instance, when a firm intends to produce an output abroad using an intermediate good manufactured at home, a rise in the expected change in the real exchange rate (*i.e.* an expected real appreciation of the currency of the recipient country) raises FDI because it will lower the cost of the foreign capital financed with domestic funds. On the other hand, when a firm intends to manufacture abroad its intermediate good, the effect on FDI of an increase in the expected change in the real exchange rate is uncertain. Cushman (1985) tested for the impact of the expected change in the real exchange rate using data on the flows of FDI from the US to Canada, France, Germany, Japan, and the UK from the year 1963 through 1978. He found a negative and highly significant effect. Theoretically, a negative impact on FDI of the expected change in the real exchange rate occurs in the following two situations: (1) when the firms reduce both the manufacturing abroad of their intermediate goods and the production at home of their final output or (2) when the firms replace the production abroad of their final output with exports.

1.2.1.3 The Volatility of the Exchange Rate

The volatility of the exchange rate is measured by its standard deviation (the expressions volatility, uncertainty, and risk are used interchangeably). As said earlier, according to Cushman (1985), it affects FDI through the risk-adjusted expected change in the real exchange rate, $\text{E}(q_{t+1}/q_t) - \gamma \times \text{s.d.}(q_{t+1}/q_t)$. Thus, its theoretical impact on FDI is also ambiguous but the opposite of that of the expected change in the real exchange rate.

Cushman (1985) regressed the flows of FDI *from* the US to Canada, France, Germany, Japan, and the UK on several macroeconomic variables including the standard deviation of the future change in the exchange rate, for the period 1963-1978. The other way around, Cushman (1988) explained FDI flows *into* the US from the latter five industrialized countries, over the period 1963-1986. In both empirical studies, an increase in the volatility of the future change in the exchange rate turns out to stimulate FDI. Thus, the estimate of the impact of the volatility of the exchange rate is the opposite of the one of its expectation, as predicted. This positive relationship indicates that producing abroad is a good substitute for exports when the volatility of the exchange rate is high.

1.2.1.4 The Covariance of the Exchange Rates

Let $s_{i,t+1}$ denotes the future nominal value of the currency of the potential recipient country i ($i = 1, 2$) in terms of the currency of the home country. Bénassy-Quéré et al. (2001) predicts that, if the covariance of the exchange rates of the two potential recipient countries is negative, that is, $\text{cov}(s_{1,t+1}, s_{2,t+1}) < 0$, costs tend to decrease in one country, when they increase in the other due to the appreciation of its currency. Thus, FDI in the two potential recipient countries are complements, since the MNC can reduce the overall risk on its profit by producing in the two locations. On the other hand, if $\text{cov}(s_{1,t+1}, s_{2,t+1}) > 0$, diversifying production locations is unnecessary and the MNC will transfer its activities from the country with the worse conditions to the one with better conditions. Bénassy-Quéré et al. tested their prediction on a panel of 42 developing countries receiving FDI from 17 developed countries over the period

1984-1996. They found the estimate of the interdependence effect to be negative and statistically significant.

1.2.2 Market Size

When the market of the recipient country is large enough, foreign firms are more likely to recover the cost of their investment and make profit. The size of a market is measured by the number of potential consumers and their living standards, hence the use of the gross national product (GNP) or the gross domestic product (GDP) (*i.e.* the size of the population times the *per capita* income) as a proxy for this variable.

Many empirical investigations have borne out the role played by the size of the market of the recipient country as a determinant of FDI. Testing for the determinants of US direct investments in the EEC, Scaperlanda and Mauer (1969) found the size of this market, measured by the GNP, to be the only significant variable. This finding was robust to the various specifications of their econometric model. Earlier in 1968, Messrs, Bandera and White also found the size of the market of the recipient country to be the most influential determinant of US direct investment into various European countries (Dunning, 1970). Lunn (1980) confirmed this finding, but ruled out that the GNP of the EEC was the only significant variable. Using a data set covering 84 developed and developing countries, Li and Liu (2005) also found the market size along with its growth rate to be the most important determinants of FDI. In some regressions run by Lipsey (2001b), the coefficient associated to the lagged values of GDP was negative, which meant a negative impact of lagged market size on FDI inflows. Moghadam et al. (2019) found that the market size measured by the growth of GDP *per capita* had a positive long-run effect on the flows of greenfield FDI into six Southeast Asian countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam), but had a negative effect on M&A. The latter finding means, when the size of their domestic market is expanding, local entrepreneurs are less inclined to sell their businesses to foreign firms.

Figure 1.1 relates the nominal GDP, as a measure of the market size, to the nominal FDI inflows of some of the world's most populous countries. It reveals a positive relationship between these two variables, particularly in Brazil, China, India, and Mexico. However, in the cases of Japan, its FDI inflows are independent of the size of its market.

The market size could be a determinant of both FDI inflows and outflows, that is, a larger country may simultaneously attract and generate more FDI. Nigh (1985) found a positive and significant relationship between the size of the US market and their FDI outflows. But, Tallman (1988) showed that the size of the home country was not always significantly or positively related to FDI flows into the US. Globerman and Shapiro (1998, 1999) showed that the size of the Canadian market was a significant determinant of its FDI inflows and outflows.

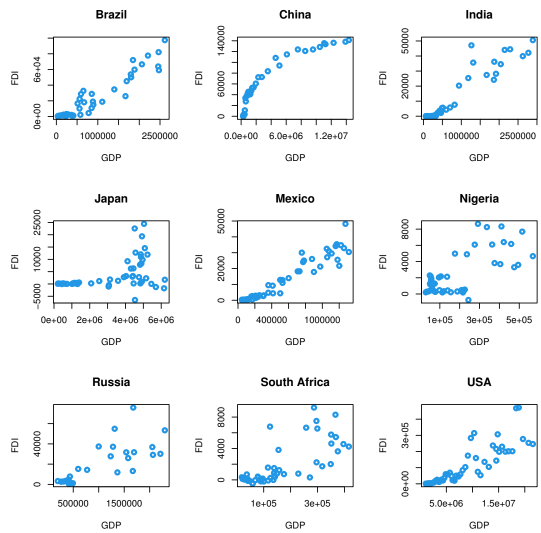


Figure 1.1: Scatter Plot of GDP and FDI Inflows into some Populous Countries, 1970-2019 (50 Years), US $ at Current Prices in Millions, Data Source: UNCTAD.

1.2.3 Economic Growth

Another determinant of international production is the growth rate of the real GDP in the host country. According to some empirical studies, the growth rate of the real GDP, also known as the economic growth rate, is positively related to FDI. Aliber (1993) argues that changes in the relationship between economic growth rates in different countries impact on the pattern of international capital movement. Capital will move from countries experiencing a slowdown or a downturn to those with higher economic growth rates. Over the period 1950-58, US investments in manufacturing industries in Europe were directed to faster-growing countries (Dunning, 1970, p 299). Li and Liu (2005) found that the growth rate of the real GDP was one of the two important determinants of FDI inflows in both developed and developing economies. Lipsey (2001b) confirmed the positive relationship between economic growth in the developed countries and their annual inward FDI. But, for him, economic growth was a factor attracting FDI only over short periods. This view was based on the fact that, economic growth did not explain significantly FDI when he used 5-year interval data instead of annual data. Scaperlanda and Mauer (1969) produced empirical evidence rejecting the hypothesis that the economic growth rate was a determinant of US investment in the EEC.

This dissertation is skeptical about the results of some of of the econometric studies confirming or rejecting economic growth rate as a determinant of FDI, for two reasons. First, some of the models tested are not correctly specified. Economic growth could be a determinant as well as an impact of FDI. These studies have failed to take into account this dual role played by economic growth. So, their conclusions are likely to be biased. Secondly, their regressions are likely to be spurious, since no test for *stationarity* has

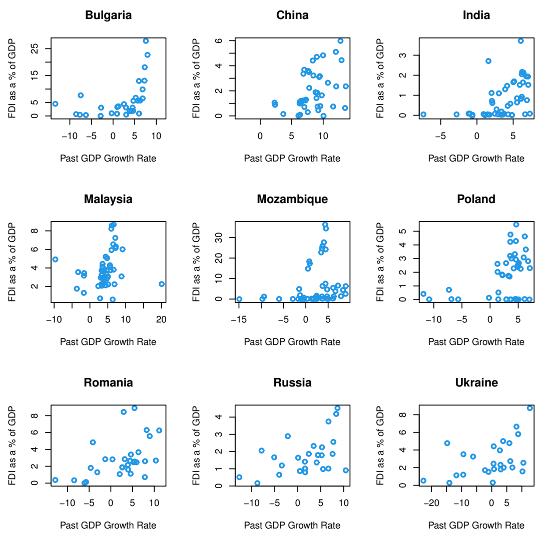


Figure 1.2: Scatter Plot of the Real GDP *Per Capita* Growth Rate and the Share of FDI inflows in the GDP of some Emerging Economies, 1971-2019 (49 Years), Data Source: UNCTAD.

been performed to check the order of integration of the variables in their models. [5] The economic growth rate is often a stationary variable whereas FDI inflows and the other explanatory variables in these models may be of any order of integration. Tests for stationarity performed on FDIs flows into some developed countries reveal an order of integration ranging from 0 to 2 (see Table A.2).

Li and Liu (2005) tested for simultaneity in the relationship between FDI inflows and economic growth. They used the data of 84 countries over the sample period 1970-1999. They concluded that FDI and economic growth became increasingly interdependent, since they detected endogeneity in the relationship between these two variables only in the second half of the sample period (*i.e.* from 1985 to 1999). Chowdhury and Mavrotas (2006) studied the causal relationship between FDI inflows and economic growth, using the data of Chile, Malaysia, and Thailand over the period 1969-2000. While GDP turned out to cause FDI in Chile, both variables are found to be mutually dependent in Malaysia and Thailand. Chakraborty and Basu (2002) also found the evidence of unidirectional causality running from GDP to FDI into India.

Figure 1.2 plots the FDI inflows of some emerging economies as a percentage of their GDP against their past economic growth rate. All the panels in this figure reveal that growth rate of the real GDP *per capita* in the selected countries attracts FDI. One can also notice the very high proportions of FDI inflows in the GDP of Bulgaria and Mozambique that are associated with growth episodes. Unreported exploratory analyses have not revealed any clear positive relationship between FDI inflows and economic

[5] See subsection A, for a brief introduction to the concept of stationarity.

growth rate in such other countries as Brazil, the Czech republic, Mexico, Saudi Arabia, and South Africa.

1.2.4 Some Other Macroeconomic Determinants of FDI

There are other factors pointed to as determinants of FDI. Some of them are: the degree of openness, the labor cost, privatization, trade linkages and borders, the risk and macroeconomic stability, and FDI policies (Holland and Pain, 1998; UNCTAD, 1998; Wheeler and Mody, 1992; Blonigen, 2005; Faeth, 2009).

Degree of Openness The degree of openness,, also known as trade ratio, is the sum of exports and imports as a share of GDP. Lipsey (2001b) and Li and Liu (2005) found that a rise in the degree of openness of a recipient country was associated with a significant increase in its FDI. Blonigen and Piger (2014) found little empirical support for the contribution of the degree of openness to inward FDI. While M&A tended to increase significantly with the openness to trade of some Southeast Asian countries, the latter variable had a negative and weak impact on greenfield FDI (Moghadam et al., 2019). These authors argue that cross-border M&A is an export-oriented FDI hence its positive association with trade openness and greenfield FDI is an import-replacement investment that may become unattractive when competition with international suppliers increases.

Trade Linkages and Borders Büthe and Milner (2008) found that, over the time period 1970-2000 and among 122 developing countries, those that were members of the World Trade Organization and signatories of some Preferential Trade Agreements attracted more FDI. Brainard (1997) found that the overseas production (precisely, the share of the total sales of some MNCs accounted for by the sales of their affiliates in 27 countries) was relatively high when trade barriers and transport costs were high. Box 1.2 shows how the formation of a customs union can lead to a tariff-jumping FDI.

Political risk Tight political relationship between two countries stimulates FDI both ways, while international or domestic conflict events produce the opposite effect. As far as cooperation between home and target countries is concerned, Nigh (1985) found that it had a significant positive impact on the outflows of FDI from the US. Tallman (1988) showed that it increased also the flows of FDI into the US. According to Nigh, conflicts between home and target countries had a negative effect on FDI outflows from the US. He also found that conflicts within LDCs had a negative effect on the flows of manufacturing FDI they received from the US. Conversely, Tallman, showed that conflicts within other Western industrialized countries encouraged FDI from these economies into the relatively stable US. The reason is that conflicts at home create a poor business climate, which makes returns on investment uncertain and leads firms to seek to escape risk by producing abroad. Aguiar et al. (2012) found instead that countries with lower levels of political risk made more FDI into Brazil. As pointed out by Thomas and Grosse (2001), the sign of the relationship between the level of political risk in the source countries and FDI inflows seems to depend also on the relative stability of the recipient country itself.

Climate risks Climate risks are physical and transitional. The physical risks consist of the destructive effects of extreme weather events, while the transitional risks result from the increased awareness of the latter threats and the political will to mitigate them. Climate risks are increased by the concentration in the atmosphere of of greenhouse gases. Gu and Hale (2023) built a two-country model in which greenhouse gas emission (henceforth: emission) is considered as an input, the physical climate risks as the expectations of future natural disasters, and the transition risks as exogenous policies that raise the costs of emissions. They used this model to predict the amount of FDI and the number of foreign affiliates of a MNC. Their model predicts that both the amount of FDI and the number of foreign affiliates decrease when the physical or the transition risks rise. Using country-industry level data, they found that a decrease in the intensity of emissions (*i.e.* greener technology) in the target country raised its inflows of FDI and that extreme weather events led to a reduction in the outflows of FDI. Barua et al. (2020) considered instead temperature and precipitation as climate variables and investigated their impacts on FDI inflows, using a panel data covering 80 countries over two decades. They found, *inter alia*, that global warming (*i.e.* an increase in temperature at the world level and in the long-run) reduced FDI inflows and precipitation had the opposite effect.

Interest Rate Blanchard and Acalin (2016) observed unexpected increases in the quarterly FDI flows into and from emerging countries in response to decreases in the US monetary policy rate. This effect of the interest rate turns out to be stronger on FDI than on FPI. Blanchard and Acalin showed that these FDI inflows are largely funds that only transit through emerging countries, due to their favorable corporate tax conditions and their tight control on non-FDI flows. But, why the flows of FDI transiting through emerging countries tend to increase only when the US policy rate decreases? Box 1.4 shows how the level of the interest rate in both the home and the host countries can influence FDI decision.

Inflation Rate Schneider and Frey (1985) tested the hypothesis of a negative relationship between FDI inflows and inflation. The reason underlying this hypothesis is that a high inflation rate is a sign of economic tension in the recipient country and reveals the inefficiency of monetary and fiscal policies. For each of the years 1976, 1979, and 1980, they found a significant negative impact of inflation on FDI inflows across 54 developing countries. Sayek (2009) studied the role of inflation in the investment decision of a MNC. In his model, a rise in the domestic or the foreign inflation rate lowers the net returns on investment as a tax would (henceforth: inflation tax) and a MNC seeks to minimize these negative effects by shifting the location of production across home and host countries (henceforth: investment-smoothing). He shows that the investment-smoothing behavior of the MNC facing inflation tax differs depending on whether its FDI is horizontal or vertical, whether its financing source is domestic or foreign, and on the substitutability between the factors of production.

Labor Cost Cheap labor is one of the main reasons of the relocation of manufacturing plants and customer service call centers to developing countries. Schneider and Frey (1985) and Summary and Summary (1995) found a negative and significant impact of the labor cost in developing countries on their FDI inflows. Higher wages in Canada relative to the US or the UK tend to decrease significantly its FDI inflows and have the opposite effect on its FDI outflows (Globerman and Shapiro, 1999).

1.3 The Eclectic Paradigm

Dunning (1979) reviewed and assessed the main theories explaining the *raison d'être* of FDI: the international capital theory, the industrial organization theory, the location theory, the product-cycle hypothesis, and the property rights theory, *inter alia*. He found none of these theories entirely cogent: they succeeded only partially at providing answers to the questions of how, why, where and when of FDI. Then, he proposed an eclectic approach that took from the aforementioned theories to build a model capable of accounting thoroughly for the causes of FDI, that is, what motivates a firm to service a given market and why should that be through FDI and not through exports for instance. According to the eclectic paradigm, three conditions are essential for FDI: Ownership, Location, and Internalization (OLI) advantages.

Ownership advantage The first condition for FDI is that the firm must have a net ownership advantage over the other firms serving the foreign market. This ownership advantage may be a product or process differentiation ability, a monopoly power, a better resource capacity or usage, a trademark protected by a patent, or an exclusive, favored access to product markets *etc* (Hymer, 1970; Caves, 1971).

Internalization advantage The internal market for knowledge consists in producing only for oneself this input instead of buying it from an independent supplier (Buckley and Casson, 2009). Then, this knowledge could flow exclusively between a parent firm and its subsidiaries. According to Dunning (1979), the second condition for FDI requires that the firm prefer internalizing its ownership advantages rather than externalizing them. This means that the firm possessing ownership advantages must deem producing abroad more profitable than selling or leasing its activities to foreign firms. A firm might prefer internalizing its ownership advantages in order to avoid the costs of enforcing property rights, to protect the quality of its products, to control the supplies and the conditions of the sales of its inputs, or to control market outlets. Calvet (1983) argued that internalization could mean the substitution of hierarchical relations for contractual modes of transacting.

Location advantage Finally, the firm possessing both an ownership advantage and an internalization incentive will produce abroad only if it can combine these assets with some other factor inputs outside its home country. Factors determining the location of production include the price, the quality and the productivity of such inputs as

Box 1.4: The Necessary and the Sufficient Conditions for FDI

Prior to producing abroad, a firm appraises the returns on this project. It tries to see what it will add to its revenues and market value. A way it does that is by comparing, first, the expected rate of return on the FDI project to that on exporting goods produced at home. If producing abroad is more profitable than exporting, then the FDI project is feasible. This first comparison is what can be called the necessary condition for FDI (Aliber, 1993, pp 181-2).

To illustrate this algebraically, let Π_t be the expected net income (in foreign currency) at time t from the FDI project, Π_t^* the net income from exporting goods manufactured at home, and s_t the spot exchange rate (*i.e.* a unit of foreign currency in terms of the domestic currency). The initial cost of both investments is I_0 and T denotes their life. The rate which makes the sum of the discounted revenues from an investment equal to its initial cost is called marginal efficiency of capital (MEC). The MEC of the FDI project, ρ, is determined by solving the following equation.

$$I_0 = \sum_{t=1}^{T} \frac{s_t \Pi_t}{(1+\rho)^t}$$

A depreciation of the foreign currency (*i.e.* a rise in s_t) will raise the MEC of the FDI project and make this option more attractive.

The MEC of the alternative export project, ρ^*, is defined from the following relation.

$$I_0 = \sum_{t=1}^{T} \frac{\Pi_t^*}{(1+\rho^*)^t}$$

Now, let r be the long-run interest rate at time 0 in the home country. Producing abroad is preferable to selling abroad goods produced at home, only if

$$\rho > \rho^* > r \quad \text{or}$$
$$\rho > r > \rho^*.$$

Each firm looks forward to reaping the highest possible return from his investment. It will prefer carrying out the FDI only if the return on this project is greater than the one on both direct investment at home and portfolio investment at home.

If the necessary condition is met, the firm compares then the expected rate of return from its FDI project, ρ , to the one competitors in the target country may expect from a similar investment. If it attaches a higher value to its project than its competitors in the target country do, it will carry out his FDI project. This is the sufficient condition for FDI (Aliber, 1993, p 182).

Let ρ_f be the rate of return that a firm in the target country is awaiting from an investment similar to the FDI inflow project and r_f be the long-run interest rate in this country. The sufficient condition for FDI can be specified as follows.

$$\rho > \rho_f > r_f \quad \text{or}$$
$$\rho > r_f > \rho_f$$

The above relations can also be used to explain why economic agents invest in portfolio abroad instead of making FDI. *Ceteris paribus*, all depends on the levels of both rates of returns. If the long-run interest rate abroad is greater than the anticipated rate of return from the FDI project, it is more profitable to invest in portfolio abroad.

To finish with, it is important to point out that it is unlikely that, in the short-run, the profits of a foreign affiliate of a MNC be greater than the one of its competitors from the recipient country. One of the reasons is that foreign affiliates undergo cost of economic distance that their competitors from the recipient country do not incur. These costs result from the fact that they are operating in a cultural and economic environment different from theirs. In these circumstances, MNCs rely on some offsetting advantages such as trademark, managerial skills, and know-how to carry out their FDI.

labor, energy, and materials, transport and communication costs, infrastructure, psychic distance, and government intervention.

The OLI advantages are not static, as they may change over time. Responding to the comment "Internalization appears to be emerging as the Caesar of the OLI triumvirate." made by Ethier (1986), Dunning (1998) compared the OLI framework to a three-legged stool to stress that none of the three conditions for FDI was more important than another. However, Dunning and Lundan (2008) reckoned that the emergence of new forms of doing business, particularly the network MNCs, presented a fundamental challenge to the OLI paradigm. As a matter of fact, firms have been downsizing the property and equipment assets they own to increase the use of contractual services for their supply. They even began to outsource such knowledge generating activities as R&D, to concentrate on the internalization of those in which they possessed unique skills and capabilities. Besides, the geographic location of the sources of supply of these tangible and intangible assets are becoming more widely spread. To explain these new form of doing business, Dunning and Lundan suggested incorporating in the OLI triad of variables the institutional factors affecting both the determinants and the outcomes of the activities of MNCs.

Summary

1. According to the internationalization model of the Uppsala School (also referred to as the Nordic Researchers), firms operate first in the domestic market and then expand little by little their activities to countries they are acquainted with.

2. The product-cycle hypothesis of Vernon explains the shift of the production of high-income and labor-saving goods from the US to other countries. In the early stages of the introduction of these goods, US firms produce them at home. As these goods mature and become standardized, they will set up subsidiaries abroad to produce them at lower costs and then import them into the US.

3. According to the industrial organization theories of FDI, firms go multinational for the same reasons as they expand domestically: they possess some superior knowledge that cannot be acquired easily by their competitors. Such other imperfections as disequilibrium in markets, barriers to trade, externalities, and scale economies are also fillips to international production.

4. Both the level and the volatility of the real exchange rate determine FDI. Their impacts vary depending on whether FDI is horizontal or vertical. In general, foreign firms are more inclined to acquire assets in a country when its currency is weak or highly volatile.

5. The size of the recipient country and its growth appeal to foreign investors. Other location factors that attracts FDI include: the degree of openness of the recipient country, its political risk, the abundance of skilled labor, and the easy access to energy sources.

6. According to the eclectic paradigm of Dunning, three conditions are essential for production abroad: firm-specific ownership advantage, internalization incentive, and country specific location advantage.

CHAPTER 2

The Impacts of FDI

> Yet relatively little emphasis has fallen on what might seem the two principal economic features of direct investment by the international corporation: (a) it ordinarily effects a net transfer of real capital from one country to another; and (b) it represents entry into a national industry by a firm established in a foreign market.
> – Caves (1971)

FDI brings benefits and costs to both home and host countries. These impacts, which may be economic, environmental, political, or sociocultural, depend on the type of FDI– greenfield or M&A, horizontal or vertical. Some of these possible impacts are presented in this chapter. The impacts of FDI on the host countries are dealt with in Section 2.1 and Section 2.2 presents its impacts on home countries.

2.1 The Impacts of FDI on the Host Country

FDI impacts *inter alia* on the productive capacity of the recipient country and its relationship with the rest of the world.

2.1.1 Economic Growth

Let $Y_t = F(K_t, L_t, A_t)$ be the aggregate output, where the variables K_t, L_t, and A_t designate respectively the physical capital stock, the labor input, and the technology level at time t. The growth over time in the aggregate output is

$$\frac{\Delta Y_{t\cdots}}{Y_t} = s_{Kt}\frac{\Delta K_t}{K_t} + (1 - s_{Kt})\frac{\Delta L_t}{L_t} + \left(\frac{\Delta Y_t}{\Delta A_t}\frac{A_t}{Y_t}\right).\frac{\Delta A_t}{A_t}, \tag{2.1}$$

where $s_{Kt}$is the share of the physical capital in the aggregate output and Δ is the difference operator.

FDI is said to contribute to economic growth in the recipient countries. This can be through adding to the physical capital stock in the host country, creating new jobs, or diffusing new technologies and ideas, as relation (2.1) suggests.

2.1.1.1 The Contribution to Growth through Physical Capital Accumulation

The contribution of FDI to economic growth through physical capital is uncertain for two reasons. The first reason is that FDI can be either a greenfield investment or a cross-border M&A. As mentioned in the introductory chapter, a cross-border M&A, which is a mere transfer of ownership, does not add to the host country's physical capital stock, unlike a greenfield FDI. The second reason is that FDI may *crowd out* or *crowd in* domestic investment. FDI crowds out domestic investment when MNCs displace their competitors in the host country. On the other hand, FDI crowds in domestic investment when the presence of MNCs stimulates the host country firms or when both foreign-owned and domestically-owned firms are engaged in complementary activities.

Lipsey (2001b) reviewed some studies confirming that FDI flows into Canada increased gross fixed capital formation (GFCF). He came up himself with the same finding for Canada, using more recent data. Breaking down the Canadian data, Hejazi and Pauly (2001) found that the positive impact of FDI inflows on GFCF took place mainly in non-service industries. Hejazi and Pauly also found that the positive impact of FDI inflows on GFCF in Canada was independent of the home country of the investors. As home country, they distinguished between the US and the UK, and the rest of the world. [1] A part from Canada, Lipsey (2001b) found no evidence that inflows of FDI provide a source of financing for capital formation in developed countries as a whole.

Borensztein et al. (1998) neither bore out nor ruled out the possibility that FDI inflows contribute to economic growth by increasing the physical capital stock in the host country. They estimated the determinants of GFCF, using various econometric models that included FDI as explanatory variable. They found that a one-dollar increase in the net inflow of FDI from developed countries is associated with a much higher increase in the total investment in the 69 developing economies of their sample. Even though this evidence suggests a crowding-in effect of FDI, it is not robust to some other specifications of their model (*i.e.* the effect of FDI on GFCF became statistically insignificant as new variables were added to the model).

Figure 2.1 plots the inward flows of FDI as a percentage of the GFCF in some emerging economies. FDI represented 82.7% of the GFCF of Bulgaria in 2006 and 94% of the investment in Singapore in 2017. Blanchard and Acalin (2016) argued that a large proportion of the FDI flows into emerging economies were actually funds en route to other countries, but transited through these foreign affiliates due to favorable corporate tax conditions.

[1] The US and the UK are two important investment partners of Canada. Between 2016 and 2019, they accounted respectively for 45.1% and 6% of the stock of FDI inflows of Canada. The UK comes third behind the Netherlands.

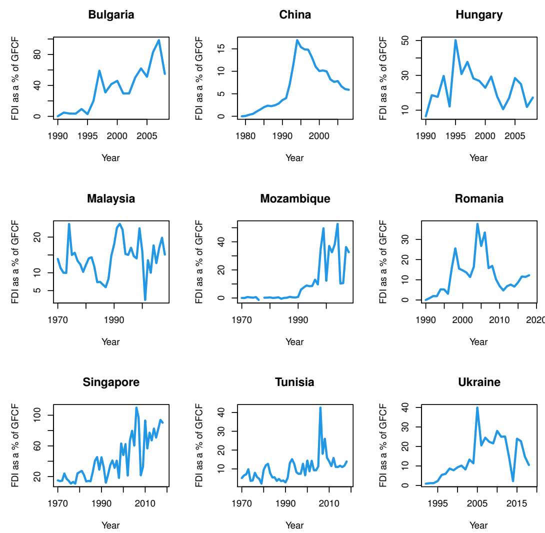


Figure 2.1: FDI inflows as a Percentage of the GFCF of some Emerging Economies, 1970-2018 (49 Years), Data Source: UNCTAD.

2.1.1.2 The Contribution to Growth through Job Creation

FDI can affect positively the level of employment in the host countries. Greenfield FDI entails the creation of new jobs in the host country. M&A FDI does not necessarily produce such effect in the short run. The presence of MNCs increases the demand for skilled labor. According to Borensztein et al. (1998), FDI and skilled labor (measured by the educational attainment) are complementary factors. They found the developing countries with the highest level of FDI and skilled labor to grow faster than the others. Driffield and Taylor (2000) precised that the skilled jobs created in the UK by foreign firms were offered to people previously employed elsewhere in the host country but not to the unemployed workers. Generally, foreign-owned firms attract the skilled labor by offering higher salary than domestic firms (Driffield and Girma, 2003; Lipsey, 2007). The unemployed labor benefits from the positions left within local firms by those recruited by the foreign firms. FDI can also have negative effects on employment. This may occur when capital-intensive FDI induces more labor-intensive local firms to close down (South Centre, 1997).

2.1.1.3 The Contribution to Growth through Productivity Growth

FDI is also said to boost productivity or the level of technology in the host country by generating externalities (or spillovers). [2] The spillovers take place through four possible

[2] The spillover hypothesis means $\Delta A_t/A_t$ in (2.1), which is a measure of productivity growth, depends on such variables as the share of the inward flows of FDI in the GDP, the growth rate of the foreign physical capital stock, or the the growth rate of the productivity in the foreign sector.

channels: imitation/demonstration, competition, linkages, and/or training (Blomström and Kokko, 1998; Hermes and Lensink, 2003; Lensink and Morrissey, 2001; Gorg and Strobl, 2001)

Given foreign-owned firms possess some special assets such as advanced technologies and organizational skills over domestic firms, the latter may find it cheaper to imitate or copy the former rather than innovating. Domestic firms may become more productive by so doing. In this case, FDI is said to generate spillover through the channel of imitation. FDI is said to generate spillover through the competition channel, when the competition between foreign and domestic firms induces the latter to upgrade their technology or to adopt new methods of production. Technology or knowledge spillover arises through the channel of linkages mostly in instances where domestic firms supply foreign firms with raw materials and/or intermediate goods. This backward linkage (or complementarity) may lead foreign firms to provide technical assistance to their local suppliers or to encourage them to upgrade their technologies in order to raise the quality of their products. In adopting new methods of production in response to the presence of foreign firms, domestic firms also train their staff to their efficient use. This induced investment in human capital is the training channel of the knowledge spillover. The various skills acquired while working for foreign-owned firms may also spillover through the training channel as employees move to domestic firms or start their own businesses. In fact, these four channels are not independent of each other.

There are empirical investigations confirming that FDI is instrumental to economic growth through stimulating technological progress. Driffield (2001) used the growth rate of various variables to measure spillovers: the sales of foreign firms (output spillovers), the foreign capital stock (investment spillovers), the foreign-owned research and development undertaken in the host country (R&D spillovers), and the lagged productivity in the foreign sector (catching-up effects). According to him, the growth rate of the sales of foreign firms and that of the foreign capital stock would encompass any spillover taking place through the channel of demonstration. Driffield only found evidence of the catching-up effects in the UK, which means the spillovers of FDI into the UK stem from the productivity advantage exhibited by foreign firms

For Borensztein et al. (1998) and Jyun-Yi and Chih-Chiang (2008), the interaction of FDI with human capital (measured by the average years of schooling) is important in explaining its effect on growth through spillovers. They found the spillover effect of FDI to hinge on the presence of a threshold level of educated labor able to assimilate the advanced technologies. As for Lensink and Morrissey (2001), the positive effect of FDI on growth is not conditional on the level of human capital. They came up with this finding after introducing into the model used by Borensztein et al. the volatility of FDI inflows. Lensink and Morrissey also found that the volatility of FDI has a negative impact on growth. Some empirical investigations carried out by Carkovic and Levine (2005) also were not in favor of the hypothesis of complementarity between FDI and human capital. According to Li and Tanna (2019), improving institutions in developing countries is more important than human capital development.

In the literature, other conditions in the recipient country are pointed to as a prerequisite for the growth effect of FDI *via* technology spillover. Some of these conditions, also known as absorptive capacity, are the level of financial development, the level of economic development, and the trade openness. Hermes and Lensink (2003) came up with the empirical evidence that the development of the domestic financial system is a necessary condition for FDI to generate externalities that increase output. A reason is that it is easier for entrepreneurs facing financing-constraints to start their own businesses when the local financial markets are more developed. Thus, an increase in the number of domestic suppliers of intermediate goods and in their interaction with foreign-owned firms will favor spillover through backward linkages (Alfaro et al., 2010). Carkovic and Levine (2005) carried out the same experiment, but they got ambiguous results. Across countries, FDI appeared to have positive effects mainly in financially developed countries. This evidence was not found applying dynamic panel estimators to the data. Carkovic and Levine also investigated the hypotheses of complementary relationship between, on the one hand, FDI and economic development and, on the other hand, FDI and trade openness. None of these two hypotheses found empirical support. Jyun-Yi and Chih-Chiang (2008) also confirmed that the relationship between FDI and economic growth does not vary with the degree of the volume of trade. According to the evidence they produced using the data of 62 countries averaged over the period 1975-2000, the initial GDP (used as a measure of economic development) influenced the relationship between FDI and economic growth. After a review of the literature, Lipsey (2004) concluded that no universal relationships between FDI and the productivity of local firms are evident.

2.1.2 Trade

FDI and trade can be complements or substitutes. Both activities are complementary in situations where a firm exports an intermediate good produced at home to its foreign subsidiary (forward vertical FDI) or imports an input from its foreign subsidiary (backward vertical FDI). They are substitutes when a firm duplicates its activity abroad, replacing its exports with production in the recipient country (horizontal FDI). Thus, the theoretical impacts of FDI on trade (*i.e.* on exports and imports) are ambiguous. For instance, while horizontal FDI decreases the imports of the host country, which improves its trade balance, forward vertical FDI increases its imports of intermediate goods.

FDI could add new industries to the economic fabric of a recipient country by transferring the technological, management, and marketing knowledge behind innovative products. As examples, US affiliates contributed to the development of the industry of electronics in East Asia and firms from Korea and Taiwan started plywood manufacturing in Indonesia (Lipsey, 2007). The activities of foreign firms in developing countries may promote their exports. The share of China in world merchandise exports rose from 1.8% in 1990 to 13.1% in 2019, while its share of wold FDI inflows stock increased from .9% to 4.9% (see Figure 2.2). Over the same period, Singapore received almost as much FDI as China, but its merchandise exports did not increase the same way. In 2019, Singapore accounted for 2% of world merchandise exports.

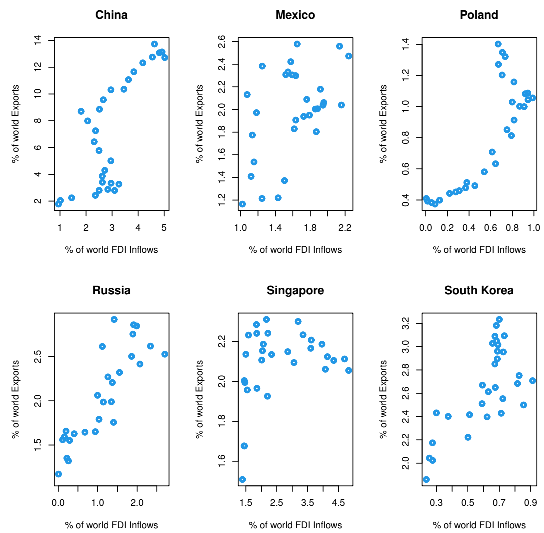


Figure 2.2: Scatter Plot of the Shares of World FDI inflows Position and World Merchandise Exports of some Emerging Economies, 1990-2019 (30 Years), Data Source: UNCTAD.

2.2 The Impacts of FDI on the Home Country

Some of the commonly discussed home country impacts of FDI are those on domestic capital formation, employment, and trade.

2.2.1 Gross Fixed Capital Formation

Does investment made abroad come at the expense of domestic capital formation? Hejazi and Pauly (2001) found no statistically significant impact of FDI outflows from Canada on its domestic GFCF, over the period 1983-1995. But, distinguishing between recipient countries, they found that: (1) FDI outflows to the US stimulated GFCF in Canada, because of the complementary between these two neighboring economies, (2) FDI outflows to the UK had no significant impact back home, and (3) FDI outflow to the rest of the world reduced GFCF in Canada, which could mean a diversion of production to low-cost locations in the rest of the world.

Feldstein (1995) found a negative effect of FDI outflows on GFCF in 17 member countries of the Organization for Economic Cooperation and Development (OECD). They regressed the share of GFCF in GDP on the shares of the gross national savings, FDI outflows, and FDI inflows, using data of the 1970s and 1980s. Desai et al. (2005) confirmed the findings of Feldstein, using more recent data and a larger sample (20 OECD countries over the 1980s and 26 countries over the 1990s). But, regressing alternatively the domestic capital expenditures of US MNCs on their foreign capital expenditures, Desai et al. (2005) found strong evidence of complementary relationship between domestic and foreign investment. An increase in the capital spending abroad of US MNCs is associated with a much greater increase in their capital spending at home.

The OECD cross-section regressions suggest that domestic and foreign investment are substitutes, whereas the US MNCs time series regressions suggest they are rather complements. According to Desai et al. (2005), the firm-level evidence is likely to be more reliable than the cross-country estimates. They sustain that financial resources are not fixed, as foreign affiliates of MNCs could borrow from local sources or use their internal capital markets to finance their investment projects, which does not divert economic resources form domestic investment. Besides, MNCs combine domestic and foreign activities to produce more final output at a cost lower than what would be possible if all their production took place in a single country. This, the interaction between the domestic and the foreign physical capital of MNCs comes instead from the maximization of their worldwide production process.

2.2.2 Employment

According to Blomström et al. (1997), production abroad affects negatively employment in home countries. The reason is that, for a given level of home output, shifting the labor-intensive production stages to LDCs means fewer employees are needed in the home country. The findings of Blomström et al. for the US economy were the opposite of those for Sweden. To explain the positive relationship between FDI outflows and employment in Sweden, Blomström et al. tested whether producing abroad induced a need for additional supervisory, management, marketing, and R&D personnel in the parent firms. They found that white-collar employment within Swedish parent firms did not increase with foreign production, contrary to blue-collar employment. Masso et al. (2008) found a positive relationship between FDI outflows and employment in Estonia.

2.2.3 Trade

The theoretical impacts of FDI on international trade in the home country are also ambiguous. Forward vertical FDI will raise the exports of intermediate goods to the recipient country, while horizontal FDI will have the opposite effect. The empirical evidence is also not conclusive. Lipsey (2007) reviewed some empirical studies relating FDI outflows to the exports of the home country. It transpires from this review that in some cases FDI tends to add to the exports of the home country and in other cases it has the opposite effect. The substitutability or the complementarity between the two variables may depend, *inter alia*, on whether FDI is horizontal or vertical, on the type of product sold abroad (good or service), and the level of development of the recipient country.

Summary

❶ FDI can provide financing for capital formation, create jobs, and boost productivity in the recipient country.

❷ The contribution to growth of FDI through physical capital accumulation is uncertain. FDI inflows can crowd out (*i.e.* displace) or crowd in (*i.e.* stimulate) investment by the firms of the recipient country.

❸ The presence of MNCs increases the demand for skilled labor. The open positions in the foreign affiliates are filled generally by people already employed and attracted by the higher salary offered.

❹ The impact of FDI inflows on productivity operates through four possible channels: imitation, competition, linkages, or training. The effectiveness of this impact depends on the absorptive capacity of the recipient country, which include the level of human capital, the level of financial or economic development, and the openness to trade.

❺ The impacts of FDI on trade in both the home and the host countries are ambiguous. They may depend on the type of FDI (horizontal or vertical), the type of product (good or service), and the level of development of the host country.

CHAPTER 3

The Empirical Investigations

> In many areas of Economics, different econometric studies reach conflicting conclusions and given the available data, there are frequently no effective methods for deciding which conclusion is correct.
> – Blaug and Mark (1992)

Two investigations are carried out in this chapter. The first investigation aims at finding the macroeconomic determinants the FDI flows into the US. The second one analyzes the relationship between the inflows and the outflows of FDI among developed countries.

3.1 A Simultaneous-Equation Model of FDI Inflows

Is there any significant influence of such macroeconomic variables as the economic growth or the labor cost on FDI flows into the US? Does the size of their domestic market attract foreign direct investors? This section provides answers to these questions. The econometric models to estimate, the methods of estimation, the results, and the hypothesis to test are presented below.

3.1.1 The Econometric Models

The initial objective of this empirical investigation is to test six hypotheses: the size of the market and its expected growth, the degree of openness to trade, the level of the exchange rate, the real interest rate, and the labor cost as determinants of FDI flows into the US. The degree of openness is defined in Box 1.1 and the real effective exchange rate in Box 1.3. The econometric model to estimate is the following equation:

$$\begin{aligned} FDII_t = \alpha_0 + \alpha_1 \Delta GDP_t^e + \alpha_2 GDP_t + \alpha_3 DO_t + \alpha_4 REER_t \\ + \alpha_5 R_t + \alpha_6 LC_t + u_t \end{aligned} \tag{3.1}$$

where $FDII_t$, GDP_t, DO_t, $REER_t$, R_t, LC_t, and u_t denote respectively FDI inflows, the real GDP, the degree of openness, the real effective exchange rate, the real interest

Table 3.1: The Expected Sign of the Parameters of Model (3.1)

Parameter	α_1	α_2	α_3	α_4	α_5	α_6
Regressor	ΔGDP_t^e	GDP_t	DO_t	$REER_t$	R_t	LC_t
Expected Sign	$+$	$+$	$+$	-	$+$ or -	-

See Chapter 1, for a review of the relevant literature.

rate, the labor cost, and the error term at time t $(t = 1 \ldots, T)$. The symbol Δ is the first-difference operator and the superscript e denotes expectations. Thus, the variable ΔGDP_t^e denotes the expectations formed at time t for the growth in the real GDP at time $t+1$. The error term u_t is assumed to have a mean of zero, a constant variance, and to be serially uncorrelated. Table 3.1 indicates the expected sign of the parameters of model (3.1).

The literature puts forth the *current* growth of the real GDP of the recipient country as a determinant of its FDI inflows (Aliber, 1993; Li and Liu, 2005). This research sees differently the relationship between FDI and economic growth. FDI is not an instantaneous decision made by MNCs that prospect for fast growing economies. They will consider investing in a country only if it shows a history of real GDP growth or if it is expected to grow faster. There are two reasons underlying this hypothesis. First, as mentioned in the introductory chapter, FDI is characterized by a long-term relationship between the direct investor and his enterprise. Since FDI is not quite liquid, it should result from a carefully planned project rather than an instantaneous decision. Second, a one-off high economic growth, say, during a period of recovery or after a lockdown of the recipient country does not mean that its economy is expanding or will grow sustainably.

This research assumes that the expectations of economic growth are adaptive, that is, foreign investors update their current guess with a fraction λ of their previous period's forecast error,

$$\Delta GDP_t^e = \Delta GDP_{t-1}^e + \lambda \left(\Delta GDP_t - \Delta GDP_{t-1}^e\right), \; 0 < \lambda < 1 \tag{3.2}$$

where λ denotes the adjustment parameter. The expected change in the real GDP equals its current growth, when the latter parameter is restricted to one $(\lambda = 1)$, and expectations are then said to be naive. Equation (3.2) can be written as an infinite-lag distribution with geometrically declining weights

$$\begin{aligned}[1-(1-\lambda)\mathrm{L}]\, \Delta GDP_t^e = \lambda \Delta GDP_t \Rightarrow \\ \Delta GDP_t^e = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j \Delta GDP_{t-j}\end{aligned}$$

where L denotes the lag operator (Maddala, 1992, pp 408-10; Greene, 2000, p 567).

The hypothesis to be tested herein is the influence of the expected economic growth or the history of this variable on FDI inflows. The mechanism of adaptive expectations serves this purpose, because it expresses the expected real GDP growth as a weighted average of the entire past history of the observed changes in this variable.

Substituting (3.2) into (3.1) gives

$$\begin{aligned} FDII_t = {} & \alpha_0 + \alpha_1 \lambda \Delta GDP_t + \alpha_1(1-\lambda)\Delta GDP^e_{t-1} + \alpha_2 GDP_t + \alpha_3 DO_t \\ & + \alpha_4 REER_t + \alpha_5 R_t + \alpha_6 LC_t + u_t. \end{aligned} \tag{3.3}$$

Since the expected change in the real GDP is not an observable variable, (3.3) can be transformed into a simpler econometric model following Koyck (1954). The Koyck transformation will consist in removing ΔGDP^e_{t-1} by subtracting from (3.3) $(1-\lambda)$ times the relation (3.1) lagged one period, which gives.

$$\begin{aligned} FDII_t - & (1-\lambda)FDII_{t-1} \\ & = \alpha_0\lambda + \alpha_1\lambda\Delta GDP_t + \alpha_2 GDP_t - (1-\lambda)\alpha_2 GDP_{t-1} \\ & \;\; + \alpha_3 DO_t - (1-\lambda)\alpha_3 DO_{t-1} + \alpha_4 REER_t - (1-\lambda)\alpha_4 REER_{t-1} \\ & \;\; + \alpha_5 R_t - (1-\lambda)\alpha_5 R_{t-1} + \alpha_6 LC_t - (1-\lambda)\alpha_6 LC_{t-1} \\ & \;\; + u_t - (1-\lambda)u_{t-1} \end{aligned}$$

Rearranging the above model gives

$$\begin{aligned} FDII_t = {} & \beta_0 + \beta_1 \Delta GDP_t + \alpha_2 GDP_t + \beta_2 GDP_{t-1} + \alpha_3 DO_t + \beta_3 DO_{t-1} \\ & + \alpha_4 REER_t + \beta_4 REER_{t-1} + \alpha_5 R_t + \beta_5 R_{t-1} \\ & + \alpha_6 LC_t + \beta_6 LC_{t-1} + \varphi FDII_{t-1} + \upsilon_t, \end{aligned} \tag{3.4}$$

where $\beta_i = \alpha_i\lambda$, for $i = 0, 1$, $\beta_i = -(1-\lambda)\alpha_i$, for $i = 2, \ldots, 6$, $\varphi = 1 - \lambda$. and $\upsilon_t = u_t - (1-\lambda)u_{t-1}$.

The hypothesis that foreign investors form their expectations based on the adaptive rule (3.2) implies outwardly that FDI decisions follow an autoregressive distributed lag (ARDL) process. Actually, the distributed-lag components of (3.4) differ from the modeling approach of Nigh (1985), Tallman (1988), and Lipsey (2001b), among others, for whom FDI decisions take some time to react to their determinants. In (3.4), the sensitivity of FDI to the lag explanatory variables is not β_i ($i = 2, \ldots, 6$) as it looks like but zero. As an example,

$$\begin{aligned} \frac{\partial FDII_t}{\partial GDP_{t-1}} & = \beta_2 + \frac{\partial FDII_t}{\partial FDII_{t-1}} \frac{\partial FDII_{t-1}}{\partial GDP_{t-1}} \\ & = -(1-\lambda)\alpha_2 + (1-\lambda)\alpha_2 = 0. \end{aligned}$$

The explanatory variables in relation (3.4) are not all exogenous. The regressor ΔGDP_t and consequently GDP_t are not only determinants, but are also endogenous variables explained by FDI inflows. Biased and inconsistent estimates could be obtained if the feedback between FDI inflows, ΔGDP_t, and GDP_t is not taken into account while fitting (3.4) to data. To prevent this, one of the following two models will be added to relation (3.4)

$$\Delta GDP_t = \gamma_0 + \gamma_1 FDII_t + \gamma_2 \Delta G_t + \gamma_3 \Delta TB_t + \upsilon_t \tag{3.5a}$$

Table 3.2: Description of the Data Used to Measure the Variables of the Econometric Models (3.4)-(3.5)

Variable	Measure	Units
DO_t	Share in the nominal GDP of the sum of the nominal exports and imports of goods and services	Percent
$FDII_t$	Share in the trend nominal GDP of the rest of the world FDI in US (assets, transactions)	Percent
G_t	Share in the trend nominal GDP of nominal government total expenditures	Percent
GDP_t	Real gross domestic product	Logarithm
LC_t	Total unit labor cost index: manufacturing	Logarithm
R_t	3-month treasury bill secondary market rate net of the inflation rate	Percent
$REER_t$	Real narrow effective exchange rate	Logarithm
TB_t	Share in the trend nominal GDP of the nominal net exports of goods and services	Percent

$$GDP_t = \gamma_0 + \gamma_1 FDII_t + \gamma_2 G_t + \gamma_3 TB_t + w_t \tag{3.5b}$$

where the variables G_t and TB_t denote respectively the total government spending and the trade balance (*i.e.* exports minus imports). The variables v_t and w_t are stochastic disturbances that have a mean of zero and a constant variance.

The econometric models (3.5) will help test the effect of FDI inflows on economic growth. Most of the time, ΔGDP_t is a stationary variable whereas $FDII_t$ is trended. In this case, it will be nonsense to regress the former variable on the latter as (3.5a) suggests. A way of dealing with this issue is to replace $FDII_t$ in (3.5a) with $\Delta FDII_t$, which amounts to estimating instead (3.5b).

3.1.2 The Data and the Methods of Estimation

The data used are extracted from the economic database of the Federal Reserve Bank of St Louis and relate to the US economy. Most of them are quarterly and the sample period ranges from 1970:Q1 to 2019:Q4 (200 observations). Table 3.2 describes the data used to measure each of the variables. The data on the nominal FDI inflows, government spending, and trade balance have been divided by the quadratic trend of the nominal GDP defined in Box 3.1. Doing so ensures their respective variability is not due to a common factor driving simultaneously all the macroeconomic aggregates in the same direction. Since GDP_t is measured on the logarithmic scale, its absolute change ΔGDP_t represents the economic growth rate. The data on the nominal interest rate and the inflation rate are monthly observations that have been averaged over quarters.

Table A.1 presents the results of the augmented Dickey-Fuller (ADF) test for stationarity. With the exception of the growth rate of the real gross domestic product, all the variables turn out to be integrated of order one. For this reason, the econometric models to estimate will consist of (3.4) and (3.5b).

The models (3.4) and (3.5b) cannot be estimated directly by the ordinary least squares (OLS) method, because of the simultaneous relations between the variables

$FDII_t$, ΔGDP_t, and GDP_t. One of the assumptions underlying the OLS method is that regressors are independent and uncorrelated with the error term, otherwise the estimators of the parameters of the model will be biased and inconsistent. [1] In relation (3.4), the regressors ΔGDP_t, and GDP_t are likely to be correlated with the error term u_t. A random increase in u_t will result in an increase in $FDII_t$ as (3.4) suggests, which could impact simultaneously on GDP_t (and consequently on ΔGDP_t) *via* relation (3.5b). Likewise, in relation (3.5b), the explanatory variable $FDII_t$ is likely to be correlated with the stochastic disturbance w_t. If w_t rises, GDP_t will go up and $FDII_t$ could also be affected.

There are other methods of estimation that help overcome these problems, which include the instrumental variable method, the two-stage least squares (2SLS) method, and the vector autoregression (VAR) modeling (see Maddala, 1992; Gujarati et al., 2011; Pesaran, 2015, among others). Models (3.4) and (3.5b) will be estimated using the 2SLS method and the VAR modeling.

After fitting the models to the data, cointegration (*i.e.* the existence of long run equilibrium relationships between the variables) will be tested for. The tests for cointegration will follow the method of Engle and Granger (1987) in the case of the 2SLS estimation and the procedure of Johansen (1988) in the case of VAR modeling.

3.1.3 The Two-Stage Least Squares Estimation

The first of the two stages is to estimate by OLS the *reduced-form equation* of all the endogenous variables appearing on the right-hand side (rhs) of the structural models (3.4) and (3.5b). These endogenous regressors are: $FDII_t$, GDP_t, and ΔGDP_t. The reduced-form equation of an endogenous variable is this latter expressed as a linear combination of all the predetermined variables of the system of simultaneous equations. The predetermined variables consist of: the lagged dependent variables, $FDII_{t-1}$ and GDP_{t-1}, the exogenous variables of the structural equation (3.4), $\mathbf{x}_t = [DO_t, REER_t, R_t, LC_t]$ and $\mathbf{x}_{t-1}$, and the exogenous variables of (3.5b), $\mathbf{z}_t = [G_t, TB_t]$. The reduced-form equations of $FDII_t$ and GDP_t are:

$$FDII_t = a_1 + \mathbf{x}_t'\mathbf{b}_1 + \mathbf{y}_{t-1}'\mathbf{c}_1 + \mathbf{z}_t'\mathbf{d}_1 + \varepsilon_{1,t} \tag{3.6a}$$

$$GDP_t = a_2 + \mathbf{x}_t'\mathbf{b}_2 + \mathbf{y}_{t-1}'\mathbf{c}_2 + \mathbf{z}_t'\mathbf{d}_2 + \varepsilon_{2,t} \tag{3.6b}$$

where $\mathbf{y}_{t-1} = [FDII_{t-1}, GDP_{t-1}, \mathbf{x}_{t-1}]$, $\mathbf{a}_i$, $\mathbf{b}_i$, and $\mathbf{c}_i$ $(i = 1, 2)$ are conformable vectors of coefficients, and $\varepsilon_{i,t}$ denotes the error term.

The second stage is to replace the endogenous variables on the rhs of the econometric models (3.4) and (3.5b) with their respective fitted mean values obtained after estimating the reduced-form equations (3.6a) and (3.6b). To estimate (3.4), the fitted mean values $\widehat{GDP}_t$ and its first-difference $\Delta\widehat{GDP}_t$ will be used as *instrumental variables* respectively

[1] Let $\hat{\beta}$ denote the estimator of the parameter β. An estimator is biased when its expected value is different from the true value of the parameter to estimate, that is, $\mathrm{E}(\hat{\beta}) \neq \beta$, where E denotes the expectation operator. An estimator is said to be inconsistent when it fails to converge to the true value of the parameter being estimated, as the sample size increases, that is, $\mathrm{plim}_{T\to\infty}\, \hat{\beta}_T \neq \beta$.

for GDP_t and ΔGDP_t. The fitted values from the reduced-form equation of $FDII_t$, $\widehat{FDII}_t$, will be used as an instrument to estimate (3.5b). An instrumental variable (or instrument) for an endogenous regressor is a variable that is highly correlated with this latter but independent from the error term of the structural equation.

3.1.3.1 The First-Stage Regressions: the Estimation of the Reduced-Form Equations

Tables 3.3, through 3.6 display the OLS estimates of the coefficients of the reduced-form equations (3.6a)-(3.6b). Two types of reduced-form equations have been fitted to the data: one based on (3.2), the hypothesis of adaptive expectations, (henceforth: the unrestricted model) and the other one based on the hypothesis of naive expectations (henceforth: the restricted model). The hypothesis of naive expectations means the parameter λ and consequently the vector of coefficients $\mathbf{c}_i$ $(i = 1, 2)$ are set respectively to one and zero.

The Unrestricted Reduced-Form Equations of FDI Inflows Only two coefficients in the unrestricted reduced-form equation (3.6a) are statistically significant: those on the government size, G_t, and the lagged dependent variable, $FDII_{t-1}$. As the first upper block of Table 3.3 shows, the absolute value of their t-ratios are greater than their 5% critical value, $t_{5\%}(186)$. However, the statistic of the Breusch-Godfrey test indicates the presence of first-order serial correlation in the residuals (see Appendix B.1.2 for a description of this test). The statistic of the Breusch-Godfrey test, which equals 12.734, is greater than its 5% critical value, $\chi^2_{5\%}(1) = 3.84$. This implies that the t-ratios are estimated with bias. To correct this, the transformation of Cochrane and Orcutt (1949) has been applied to (3.6a), as shown in relation (B.8). Table 3.4 reports the estimates of the transformed unrestricted reduced-form equation. The search procedure of Hildreth and Lu (1960), described in Appendix B.1.4, suggests setting the value of the autocorrelation coefficient, ρ, at .45. The Breusch-Godfrey test performed on the transformed model has detected no autocorrelation. It occurs on the basis of the statistic of the test of Breusch-Pagan that neither model (3.6a) nor its Cochrane-Orcutt transformation suffers from the presence of autoregressive conditional heteroskedasticity (ARCH) effects in their residuals (this test is described in Appendix B.2.1). However, the test of White, which is more general than the one of Breusch-Pagan, reveals heteroskedasticity in the transformed model. For this reason the t-ratios resulting from the OLS estimation have been replaced in Table 3.4 with those computed using the heteroskedasticity-consistent standard errors of White (1980) described by relation (B.15).

The Restricted Reduced-Form Equations of FDI Inflows The vector of parameters $\mathbf{c}_1$ in (3.6a) has been set to zero, which exclude from this reduced-form equation all lagged variables. The first upper block of Table 3.5 shows the estimates of the restricted reduced-form coefficients of FDI inflows. Most of them are statistically significant, unlike those of the unrestricted reduced-form equations. However, the test of Breusch-Godfrey reveals the presence of serial correlation of order 2 in the residuals: the statistic of this

Table 3.3: The Reduced-Form Equations of the Unrestricted Model ($0 < \lambda < 1$)

Regressor	$\widehat{FDII}_t$		$\widehat{GDP}_t$	
	coef	t-ratio	coef	t-ratio
Intercept	-9.628	-1.807	.051	1.046
GDP_{t-1}	.482	.531	.979	118.076
DO_t	.096	.915	.002	2.280
DO_{t-1}	-.034	-.333	-.001	-2.021
$REER_t$	1.191	.491	-.000	-.011
$REER_{t-1}$	-.067	-.027	.017	.759
R_t	.019	.258	.003	3.823
R_{t-1}	.027	.349	-.004	-5.275
LC_t	1.172	.273	-.108	-2.747
LC_{t-1}	-.716	-.172	.128	3.350
G_t	-8.676	-2.553	-.065	-2.102
TB_t	-.028	-.516	-.000	-.738
$FDII_{t-1}$	.202	2.804	-.000	-.515
R^2	.422		.9997	
$\bar{R}^2$	.385		.9997	
Breusch-Godfrey (1) stat	12.734		.518	
Breusch-Pagan stat	.177		.186	
White stat	101.388		92.962	
ADF (1) stat	-7.641		-8.191	

Critical values: $t_{2.5\%}(186) = 1.973$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(90) = 113.14$

Table 3.4: The Transformed Reduced-Form Equation of the Unrestricted Model ($0 < \lambda < 1$): Dependent Variable $FDII_t - \rho FDII$

Regressor	coef	White t-ratio
Intercept (original)	-4.563	-1.081
$GDP_{t-1} - \rho GDP_{t-2}$	.206	.481
$DO_t - \rho DO_{t-1}$	.141	1.618
$DO_{t-1} - \rho DO_{t-2}$	-.114	-1.398
$REER_t - \rho REER_{t-1}$	2.136	.860
$REER_{t-1} - \rho REER_{t-2}$	-1.600	-..618
$R_t - \rho R_{t-1}$	.003	.080
$R_{t-1} - \rho R_{t-2}$	.014	.321
$LC_t - \rho LC_{t-1}$	1.860	.534
$LC_{t-1} - \rho LC_{t-2}$	-1.561	-.464
$G_t - \rho G_{t-1}$	-4.435	-1.492
$TB_t - \rho TB_{t-1}$	-.021	-.606
$FDII_{t-1} - \rho FDII_{t-2}$	.594	9.410
ρ	-.450	
R^2	.676	
$\bar{R}^2$	.655	
Breusch-Godfrey (1) stat	.003	
Breusch-Pagan stat	.008	
White stat	115.200	
ADF (1) stat	-9.781	

Critical values: $t_{2.5\%}(185) = 1.973$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(90) = 113.14$

Table 3.5: The Reduced-Form Equations of the Restricted Model ($\lambda = 1$)

Regressor	$\widehat{FDII}_t$		$\widehat{GDP}_t$	
	coef	t-ratio	coef	t-ratio
Intercept	-9.424	-2.950	4.492	17.069
DO_t	.101	4.476	.039	20.852
$REER_t$	1.679	2.870	.410	8.506
R_t	.037	1.639	-.033	-17.710
LC_t	.919	2.443	.596	19.236
G_t	-11.785	-3.975	-1.653	-6.769
TB_t	-.047	-.996	-.024	-6.189
R^2	.396		.977	
$\bar{R}^2$	.377		.977	
Breusch-Godfrey (2) stat	21.504		142.744	
Breusch-Pagan stat	.063		95.789	
White stat	38.855		106.8885	
ADF (1) stat	-6.541		-4.594	

Critical values: $t_{2.5\%}(192) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(27) = 40.11$

test, which equals 21.504, is greater than its 5% critical value, $\chi^2_{5\%}(2) = 5.99$. The iterative Cochrane-Orcutt transformations performed to correct the restricted reduced-form equation from autocorrelation yields a coefficient of determination, R^2, of .321 (see Table 3.6). Thus, the coefficient of determination of the unrestricted reduced-form equation of FDI inflows is almost the double of that of the restricted one. This gives a first credit to the hypothesis (3.2) that justifies the inclusion of the lagged variables in (3.6a). The joint test of significance of the regression coefficients (*i.e.* the F-test, described in Appendix C) confirms this preliminary conclusion: the statistic of the F-test, which equals 33.8, is greater than its 1% critical, $F_{1\%}(6, 185) = 2.9$. This means that the vector of coefficients $\mathbf{c}_1$ is not null.

The Reduced-Form Equations of the Real GDP Most of the coefficients of model (3.6b) are statistically significant and its measure of goodness-of-fit, the R^2, is very close to one (see the second block of Table 3.3). Besides, the three diagnostic tests show that the residuals of this regression are neither serially correlated nor heteroskedastic. The high value of the coefficient of determination means that the fitted values of GDP_t that will be used as an instrument to estimate (3.4), the structural equation of FDI inflows, are almost the same as their actual values, $\widehat{GDP}_t \approx GDP_t$. As a consequence, estimating (3.4) either by OLS or by 2SLS will yield similar results. The reduced-form equation that results from imposing the restriction $\mathbf{c}_2 = 0$ on model (3.6b) is not well defined, as it suffers from serial correlation of order 2 and heteroskedasticity (see Table 3.5). The results of the iterative Cochrane-Orcutt transformations performed to correct for autocorrelation are not satisfactory, as the resulting model lost greatly explanatory power (They have not been reported herein, for this reason.). Even if the hypothesis of adaptive expectations has not added much to the R^2, it have fixed problems caused by omitted variables: in the absence of the lagged dependent variable, the reduced-form

Table 3.6: The Transformed Reduced-Form Equation of the Restricted Model ($\lambda = 1$): Dependent Variable $FDII_t^* - \widehat{\theta_2} FDII_{t-1}^*$

Regressor	coef	t-ratio
Intercept	-10.289	-3.297
$DO_t^* - \theta_2 DO_{t-1}^*$	.101	3.841
$REER_t^* - \theta_2 REER_{t-1}^*$	1.632	2.374
$R_t^* - \theta_2 R_{t-1}^*$	.036	1.396
$LC_t^* - \theta_2 LC_{t-1}^*$	.922	2.087
$G_t^* - \theta_2 G_{t-1}^*$	-11.566	-3.360
$TB_t^* - \theta_2 TB_{t-1}^*$	-.048	-.874
θ_1	.201	
θ_2	-.053	
R^2	.321	
$\bar{R}^2$	.300	
Breusch-Godfrey (1) stat	.036	
Breusch-Pagan stat	.003	
White stat	38.425	
ADF stat	-7.306	

Critical values: $t_{2.5\%}(192) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(27) = 40.11$
$X_t^* = X_t - \theta_1 X_{t-1}$

equation of the real GDP suffers from autocorrelation.

3.1.3.2 The Second-Stage Regressions: the Estimation of the Structural Equations

The fitted values of the reduced-form equations have been used as instruments to estimate the models (3.4) and (3.5b).

With the exception of ΔGDP_t, all the other variables in the structural equation (3.4) are $I(1)$, that is, integrated of order one (see Appendix A). For this reason, the parameters of this econometric model will be estimated in two steps, in order to test for cointegration. The first step will involve only the $I(1)$ variables and the second one only $I(0)$ variables (Engle and Granger, 1987)

$$\begin{aligned} FDII_t = \beta_0 &+ \alpha_2 \widehat{GDP}_t + \beta_2 GDP_{t-1} + \alpha_3 DO_t + \beta_3 DO_{t-1} \\ &+ \alpha_4 REER_t + \beta_4 REER_{t-1} + \alpha_5 R_t + \beta_5 R_{t-1} \\ &+ \alpha_6 LC_t + \beta_6 LC_{t-1} + \varphi FDII_{t-1} + \upsilon_{1,t}^* \end{aligned} \tag{3.7a}$$

$$\upsilon_{1,t}^* = \beta_1 \Delta\widehat{GDP}_t + \upsilon_{2,t}^*, \tag{3.7b}$$

where $\upsilon_{2,t}^* = \alpha_2 e_{2,t} + \beta_1 \Delta e_{2,t} + \upsilon_t$. The error term υ_t^* depends on $e_{2,t}$, the sample residual of the reduced-form equation (3.6b), because GDP_t has been replaced in (3.4) with $\widehat{GDP}_t + e_{2,t}$ and ΔGDP_t with $\Delta\widehat{GDP}_t + \Delta e_{2,t}$.

The structural equation (3.7) will be estimated by constrained optimization using the function *constrOptim* of the software R. OLS method cannot be used directly because the parameters α_i and β_i are proportional, $\beta_i/\alpha_i = \varphi$ ($i = 2, \ldots, 6$), and the adjustment parameter is constrained, $0 < \lambda = 1 - \varphi < 1$. [2] Given β_i $(i = 1, \ldots, 6)$ is a function of α_i and λ, only the underlying parameters will be estimated.

The structural coefficients of (3.5b) will be estimated by running the following OLS regression

$$GDP_t = \gamma_0 + \gamma_1 \widehat{FDII}_t + \gamma_2 G_t + \gamma_3 TB_t + w_t^*, \tag{3.8}$$

where $w_t^* = \gamma_1 \hat{\nu}_{1,t} + w_t$. Recall that the reduced-form equations of the dependent explanatory variable $FDII_t$ have been estimated following the Cochrane-Orcutt procedure, due to serial correlation in the residuals $e_{1,t}$ (see Tables 3.4, 3.6). For this reason, $\widehat{FDII}_t$, the instrument for FDI inflows in (3.8), includes the predicted residuals. Thus, $\hat{\nu}_{1,t}$ in (3.8) denotes the residuals from estimating (3.6a) by the method of Cochrane-Orcutt.

The ADF test confirms that the residuals $\hat{\nu}_{1,t}$ and $e_{2,t}$ are stationary: the absolute value of the test statistics reported in Tables 3.3 through 3.6 are greater than 3.17, the critical value suggested by Engle and Granger (1987). The residuals from fitting (3.7) and (3.8) are respectively $\hat{v}_{2,t}^* = \hat{\alpha}_2 e_{2,t} + \hat{\beta}_1 \Delta e_{2,t} + \hat{v}_t$ and $\hat{w}_t^* = \hat{\gamma}_1 \hat{\nu}_{1,t} + \hat{w}_t$. But, the actual residuals that must be used to compute the standard errors and the t-ratios of the coefficients of these structural equations are respectively $\hat{v}_t$ and $\hat{w}_t$. For this reason, the standard errors of, say, the structural coefficients γ_i computed using the standard deviation of the residuals $\hat{\gamma}_1 \hat{\nu}_{1,t} + \hat{w}_t$ need to be multiplied by s.d.$(\hat{w}_t)$/s.d.$(\hat{\gamma}_1 \hat{\nu}_{1,t} + \hat{w}_t)$ (Maddala, 1992; Gujarati et al., 2011). Alternatively, one can apply directly the inverse of this correction factor, that is s.d.$(\hat{\gamma}_1 \hat{\nu}_{1,t} + \hat{w}_t)$/s.d.$(\hat{w}_t)$, to the t-ratios. Likewise, the coefficient of determination, R^2, will be computed using the actual residuals $\hat{v}_t$ and $\hat{w}_t$.

When $\varphi > 0$, which corresponds to the hypothesis of adaptive expectations, and when $\varphi = 0$, which corresponds to the hypothesis of naive expectations, both (3.7) and (3.8) will be referred to respectively as unrestricted and restricted structural equations, in the same way as the reduced-form equations.

The Unrestricted Structural Equations of FDI Inflows The first upper block of Table 3.7 displays their estimates for the unrestricted model. The test of Box-Pierce and that of Ljung-Box both indicate that the residuals from this estimation are serially correlated: their statistics $Q_{\text{BP}}(2)$ and $Q_{\text{LB}}(2)$, which equal respectively 13.334 and 13.602, exceed 5.99, their 5% critical value (see Appendix B.1.3 for a description of these two tests). The conclusion of these tests question the reliability of the t-ratios and call for a Cochrane-Orcutt transformation of the model. Moreover, the model suffers from multicolinearity, as the correlation between the degree of openness, its first lag, and the predicted value of the real GDP from the reduced-form equation are close to one. Therefore, the degree of openness and its lag have been dropped from the model, as multicolinearity affects the sign and the statistical significance of the affected coefficients. The first upper block of Table 3.8 presents the estimate of the coefficients of the transformed unrestricted model. As expected, the coefficient on the market size is positive and statistically significant: a one-percent increase in the real GDP raises

[2] Alternatively, one can apply the OLS method for each value of λ in a sequence defined between 0 and 1, to choose the estimates of the coefficients α_i that yield the lowest residual sum of squares.

the share of FDI inflows in trend GDP by 2.146 percentage points (pp), *ceteris paribus*. The coefficient on the real effective exchange rate is positive, which means that a real appreciation of the US dollar stimulates the flows of FDI they receive. This result, which is at odds with the explanation of Aliber (1993) and the findings of Klein and Rosengren (1994), is not however statistically significant. The impact of the cost of capital is the most modest but still statistically significant: an increase of one percentage point in the real interest rate raises the share of FDI inflows in the trend GDP by only .083 pp, *ceteris paribus*. The sign of this impact indicates the timing of FDI: foreign investors acquire productive assets in the US at the very moment that domestic firms are less inclined to invest due to the increase in the rental cost of capital. Unlike domestic firms, foreign investors could finance their investment with internal funds or capital raised in the source countries. The coefficient on the labor cost is negative as expected, but not statistically significant. The impact of the expected growth rate of the real GDP is positive, but only significant from a level of 16.2%. However, current and past real GDP growth rates turn out to play an important role in the formation of the expectations of foreign investors, as the estimate of the parameter λ is statistically significant. Correcting the model for serial correlation raises its explanatory power from .4 to .657. The transformed model passes the augmented Engle-Granger test for cointegration: the residuals υ_t are (1) stationary, according to the ADF test, and (2) independently distributed, according to the tests of Box-Pierce and Ljung-Box. This means there is a long-run equilibrium relationship between FDI inflows, the market size and its expected growth rate, the degree of openness, the real effective exchange rate, and the rental price of the capital and labor inputs. The test for exogeneity indicates that the real GDP and its growth rate need not be treated as endogenous in the structural equation of FDI inflows (see Appendix C.2 for a description of this test and its results).

The Restricted Structural Equations of FDI Inflows The coefficient on the degree of openness is unexpectedly negative, due to the perfect colinearity between this variable and the fitted values of the reduced-form equation of the real GDP (see the second upper block of Table 3.7). Once this issue is fixed by removing the degree of openness from the list of regressors, the sign of all the other coefficients α_i become similar to those of the unrestricted model (see Table 3.8). Applying Cochrane-Orcutt transformations has not eliminated completely serial correlation. Besides, in the absence of the mechanism of adaptive expectations, the R^2 that measures the goodness-of-fit of the model shrinks from .657 to .269. The joint significance test confirms that the lagged variables in the unrestricted structural equation of FDI inflows add to its explanatory power: the F statistic, which equals 35.1 far exceeds the 1% critical value of the test, 2.9.

The Structural Equations of the Real GDP The coefficient on FDI inflows is positive, in both the unrestricted and the restricted models. So is the one on government expenditures. On the other hand, trade balance turns out to have a negative impact on the real GDP. This impact is the most modest and the most unstable: in absolute

Table 3.7: Structural Equations of the Variable $FDII_t$

Parameter	Variable	Unrestricted Model		Restricted Model	
		coef	t-ratio	coef	t-ratio
I(1) Variables					
α_0	Intercept	-17.151	-5.449	-29.493	-4.720
α_2	$\widehat{GDP}_t$	1.651	1.795	4.762	3.465
α_3	DO_t	.043	.892	-.095	-1.461
α_4	$REER_t$	.901	1.068	-.529	-.599
α_5	R_t	.085	1.989	.195	3.643
α_6	LC_t	-.600	-.942	-2.224	-2.782
λ	$\Delta GDP_t - \Delta GDP^e_{t-1}$	.755	10.985	1	
I(0) Variable					
α_1	ΔGDP^e_t	2.716	.550	2.836	1.648
R^2		.400		.313	
$\bar{R}^2$		.361		.291	
$Q_{\text{BP}}(2)$		13.334		34.160	
$Q_{\text{LB}}(2)$		13.602		34.778	
Breusch-Pagan stat		.089		.0002	
White stat		27.892		26.631	
ADF (1) stat		-7.637		-6.229	

Critical values: $t_{2.5\%}(191) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(27) = 40.11$, $\chi^2_{5\%}(35) = 49.80$

Table 3.8: Transformed Structural Equations of the Variable $FDII_t$

Parameter	Variable Transformed	Unrestricted Model		Restricted Model	
		coef	z-score	coef	t-ratio
I(1) Variables					
α_0	Intercept	-26.176	-19.979	-22.050	-6.147
α_2	$\widehat{GDP}_t$	2.146	3.334	2.841	5.413
α_4	$REER_t$	.423	.490	.433	.655
α_5	R_t	.083	1.876	.134	3.326
α_6	LC_t	-.666	-.903	-1.320	-2.143
λ	$\Delta GDP_t - \Delta GDP^e_{t-1}$	.381	6.869	1	
I(0) Variable					
α_1	ΔGDP^e_t	3.680	.987	1.210	.734
θ_1		-.435		.245	
θ_2				-.064	
R^2		.657		.269	
$\bar{R}^2$		.639		.250	
$Q_{\text{BP}}(4)$		.327		15.429	
$Q_{\text{LB}}(4)$		.335		15.783	
Breusch-Pagan stat		.001		.000	
White stat		26.048		21.074	
ADF (1) stat		-9.861		-7.315	

Critical values: $t_{5\%}(192) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(4) = 9.49$, $\chi^2_{5\%}(27) = 40.11$

Table 3.9: Structural Equations of the Variable GDP_t

Parameter	Variable	Unrestricted Model		Restricted Model	
		Value	t-ratio	Value	t-ratio
γ_0	Intercept	7.491	20.134	7.313	16.047
γ_1	$\widehat{FDII}_t$	.381	7.612	.489	7.074
γ_2	G_t	3.582	3.244	3.972	2.9504
γ_3	TB_t	-.072	-3.615	-.042	-1.648
R^2		.353		.040	
$\bar{R}^2$		.347		.030	
$Q_{\text{BP}}(2)$		64.607		45.411	
$Q_{\text{LB}}(2)$		65.775		46.244	
Breusch-Pagan stat		.002		.013	
White stat		27.309		18.328	
ADF (1) stat		-5.273		-5.770	

Critical values: $t_{5\%}(195) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(9) = 16.92$

value, the response of the real GDP to a percentage-point change in the trade balance is 71% higher in the unrestricted model. The test for exogeneity indicates that FDI inflows should indeed be treated as an endogenous variable in the structural equation of the real GDP (see Table C.4). However, both the original and the transformed models suffer severely from serial correlation. But, there is no sign of heteroskedasticity detected.

3.1.4 The Cointegrated VAR

Given GDP_t and ΔGDP_t are both explanatory variables in (3.4), this econometric model can be written only in terms of the $I(1)$ variables.

$$\begin{aligned} FDII_t = \beta_0 &+ (\beta_1 + \alpha_2)GDP_t + (\beta_2 - \beta_1)GDP_{t-1} + \alpha_3 DO_t + \beta_3 DO_{t-1} \\ &+ \alpha_4 REER_t + \beta_4 REER_{t-1} + \alpha_5 R_t + \beta_5 R_{t-1} \\ &+ \alpha_6 LC_t + \beta_6 LC_{t-1} + \varphi FDII_{t-1} + \upsilon_t \end{aligned} \tag{3.9}$$

The VAR modeling is a generalization of of (3.9), the structural equation of FDI inflows, that takes the form of an ARDL process under the hypothesis that the expectations about the future economic growth rate are adaptive. To represent the VAR model compactly, all the $I(1)$ variables of the simultaneous equations are collected into the $k \times 1$ vector $\mathbf{y}_t$, which gives

$$\mathbf{A}_0\mathbf{y}_t = \mathbf{A}_1\mathbf{y}_{t-1} + \cdots + \mathbf{A}_p\mathbf{y}_{t-p} + \boldsymbol{\varepsilon}_t,$$

where $\mathbf{A}_i$ $(i = 1, \ldots, p)$ is an $k \times k$ matrix of parameters, $\boldsymbol{\varepsilon}_t$ an $k \times 1$ vector of residuals, and $\mathbf{y}_t = [FDII_t, GDP_t, REER_t, R_t, LC_t, G_t, TB_t]'$, which means $k = 7$. As explained earlier, the degree of openness to trade was dropped due to its perfect colinearity with the logarithm of the real GDP.

VAR models of various lag length have been estimated using the function *VARselect* of the R package *vars* (Pfaff et al., 2008). The AIC suggests a VAR model of order 2, while other information criteria suggest a process of order 1. The $VAR(2)$ model has the advantage of representing the error correction mechanism of the variables in terms of both adjustment effects and impact multipliers. One can use the equality $\mathbf{y}_{t-i} = \Delta\mathbf{y}_{t-i} + \mathbf{y}_{t-i-1}$ $(i = 0, 1, 2)$, to transform the $VAR(2)$ into a vector error correction model.

$$\begin{aligned} \mathbf{A}_0\mathbf{y}_t = \mathbf{A}_1\mathbf{y}_{t-1} + \mathbf{A}_2\mathbf{y}_{t-2} + \varepsilon_t \Rightarrow \\ \mathbf{A}_0\left(\Delta\mathbf{y}_t + \mathbf{y}_{t-1}\right) = \mathbf{A}_1\mathbf{y}_{t-1} + \mathbf{A}_2\left(\mathbf{y}_{t-1} - \Delta\mathbf{y}_{t-1}\right) + \varepsilon_t \end{aligned} \tag{3.10}$$

After rearranging (3.10), one gets

$$\Delta\mathbf{y}_t = \mathbf{\Pi}\mathbf{y}_{t-1} - \mathbf{A}_0^{-1}\mathbf{A}_2\Delta\mathbf{y}_{t-1} + \boldsymbol{\epsilon}_t, \tag{3.11}$$

where $\mathbf{\Pi} = \mathbf{A}_0^{-1}\mathbf{A}_2 + \mathbf{A}_0^{-1}\mathbf{A}_1 - \mathbf{I}_k$, $\boldsymbol{\epsilon}_t = \mathbf{A}_0^{-1}\varepsilon_t$, and $\mathbf{I}_k$ denotes the identity matrix of order k.

There could exist up to r $(r \leq k)$ cointegration relationships between the k variables in the vector $\mathbf{y}_t$. In that case, the $k \times k$ matrix $\mathbf{\Pi}$ in (3.11) can be decomposed into the product of two $k \times r$ matrices, $\mathbf{\Pi} = \boldsymbol{\alpha\beta}'$ such that the r linear combinations $\boldsymbol{\beta}'\mathbf{y}_{t-1}$ are stationary.

$$\Delta\mathbf{y}_t = \boldsymbol{\alpha\beta}'\mathbf{y}_{t-1} - \mathbf{A}_0^{-1}\mathbf{A}_2\Delta\mathbf{y}_{t-1} + \boldsymbol{\epsilon}_t \tag{3.12}$$

In (3.12), $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are referred to respectively as adjustment (weighting, feedback, or error correction) matrix and matrix of cointegrating vectors. While $\boldsymbol{\beta}$ contains the long-run multipliers, the matrix $-\mathbf{A}_0^{-1}\mathbf{A}_2$ consists of the impact multipliers also known as short-run effects.

Two types of test can be performed to determine the number of cointegrating relationships r: the maximum eigenvalue and the trace tests (Johansen, 1991). To perform these tests, first of all, the matrix $\mathbf{\Pi}$ is estimated either by maximum likelihood or by OLS. Then, the eigenvalues of this matrix are computed. The equation to compute eigenvalues is $\det(\hat{\mathbf{\Pi}} - \mu\mathbf{I}_k) = 0$, where μ denotes the eigenvalue and det, the determinant operator. While the maximum eigenvalue test is based on the estimated $(r_0 + 1)$th largest eigenvalues, the trace test uses the $k - r_0$ smallest eigenvalues. The null hypothesis of both tests is $\mathrm{H}_0 : \ r \leq r_0$. The alternative hypothesis is $\mathrm{H}_A : \ r = r_0 + 1$ for the maximum eigenvalue test and $\mathrm{H}_A : \ r_0 < r < k$ for the trace test. If the estimated eigenvalues are sorted out in decreasing order $\hat{\mu}_1 > \hat{\mu}_2 > \cdots > \hat{\mu}_k$, the statistic of the maximum eigenvalue test is $\mu_{\max}(r_0) = -T\ln(1 - \hat{\mu}_{r_0+1})$ and the one of the trace test is $\mu_{\text{trace}}(r_0) = -T\sum_{j=r_0+1}^{k}\ln(1 - \hat{\mu}_j)$.

Table 3.10 displays the statistics of the two Johansen tests, computed using the software Microfit, for the cointegrating $VAR(2)$ model with restricted intercept and no trend (Pesaran and Pesaran, 2010). According to these two tests, the null hypothesis of 3 or fewer cointegrating relationships cannot be rejected against the alternative of 4 or more long-run equations. Therefore, r can be set at 2, to estimate the FDI inflows and the GDP equations.

Table 3.10: Statistics from Johansen Cointegration Tests for the $VAR(2)$ Model

	Eigen Test		Trace Test	
H_0	Test stat.	5% crit. val.	Test stat.	5% crit. val.
$r = 0$	103.67	46.47	250.00	132.45
$r \leq 1$	53.46	40.53	146.32	102.56
$r \leq 2$	41.30	34.40	92.86	75.98
$r \leq 3$	19.87	28.27	51.56	53.48
$r \leq 4$	14.58	22.04	31.69	34.87
$r \leq 5$	14.24	15.87	17.10	20.18

Tables 3.11 and 3.12 display the estimates of the matrices $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$, and $\mathbf{A}_0^{-1}\mathbf{A}_2$ of the vector error correction model 3.12. Some identifying restrictions have been imposed on the matrix of long-run coefficients $\boldsymbol{\beta}$.

Table 3.11 shows the maximum likelihood estimates of the two cointegrating vectors in $\boldsymbol{\beta}$, after imposing two identifying constraints and some over-identifying restrictions on each of them. The normalizing constraints set to -1 the coefficient on the rhs variable of each of the two cointegrating relationships. The other just-identifying restrictions set to 0 a coefficient in each of the two cointegrating vectors in such a way that they remain linearly independent. The long-run coefficients in the equation of FDI inflows are all correctly signed: for example, the coefficient on the real GDP is positive and the one on the real effective exchange rate is negative as expected. Compared to the 2SLS estimation (see Table 3.8), the estimate of the long-run coefficient on the real GDP, which equals 5.964, seems to capture also the effect of the economic growth rate, which is consistent with the ARDL model (3.9). In the long-run equation of the real GDP, only the coefficient on FDI inflows bears the expected sign. The ratios of the long-run coefficients to their standard errors are not all high enough to conclude they are statistically significant. As it is the case in Table 3.8, the real GDP enters significantly the long-run equation of FDI inflows, but no other variable turns out to be significant this time.

Table 3.12 displays the OLS estimates of the adjustment effects, $\boldsymbol{\alpha}$, and the impact multipliers, $\mathbf{A}_0^{-1}\mathbf{A}_2$. The variables $ecm_{\mathrm{FDII},t-1}$ and $ecm_{\mathrm{GDP},t-1}$ are the residuals of the two cointegrating relationships, *viz* the estimate of the linear combinations $\boldsymbol{\beta}'\mathbf{y}_{t-1}$. The share of FDI inflows in trend GDP and the log of the real GDP are respectively above their long-run values, when $ecm_{\mathrm{FDII},t-1}$ and $ecm_{\mathrm{GDP},t-1}$ are positive. The error correction term of FDI, $ecm_{\mathrm{FDII},t-1}$, has a positive and significant effect on its own short-run dynamics. The estimate of the effect of $ecm_{\mathrm{FDII},t-1}$ turns out to be the same as that of the adjustment coefficient of the model of adaptive expectations, λ, reported in Table 3.8, that is .381. The real GDP contributes significantly to the short-run dynamics of FDI inflows only through its impact multiplier which is very high. The real effective exchange rate has no significant effect on FDI inflows in the long run (Tables 3.8 and 3.11) and in the short run (Table 3.12). The error correction model for FDI inflows has a much higher explanatory power than that for the real GDP. In the error correction model for the real GDP, the impact multiplier of FDI inflows plays no significant role, unlike its

Table 3.11: Estimates of Restricted Cointegrating Vectors of the $VAR(2)$ Model

Variable	FDI inflows		GDP	
	coef	SE	coef	SE
Intercept	-36.098	18.205	10.519	1.645
$FDII_t$	-1.000		.126	.176
GDP_t	5.964	1.792	-1.000	
$REER_t$	-.308	1.474	.000	
R_t	.391	.336	.000	
LC_t	-4.264	4.060	.000	
G_t	.000		-.858	3.968
TB_t	.000		-.035	.075

SE: Standard error

Table 3.12: Estimates of Error Correction Models Based on the Cointegrating $VAR(2)$

Variable	$\Delta FDII_t$		ΔGDP_t	
	coef	t-ratio	coef	t-ratio
$ecm_{\text{FDII},t-1}$	.381	5.269	-.001	-1.815
$ecm_{\text{GDP},t-1}$	.072	.980	.064	5.743
$\Delta FDII_{t-1}$	-.369	-5.654	-.001	-1.604
ΔGDP_{t-1}	12.432	1.654	.204	2.725
$\Delta REER_{t-1}$	1.281	.632	-.011	-.549
ΔR_{t-1}	-.172	-2.199	.229	.294
ΔLC_{t-1}	4.791	1.163	-.083	-2.022
ΔG_{t-1}	-34.483	-2.599	-.227	-1.723
ΔTB_{t-1}	-.492	-2.710	-.004	-1.966
R^2	.422		.183	
$\bar{R}^2$	.397		.149	
Breusch-Godfrey test	.387		1.139	
Breusch-Pagan test	3.683		.405	
ADF (1) stat	-11.336		-9.403	

Critical values: $t_{2.5\%}(188) = 1.973$, $t_{5\%}(188) = 1.653$, $\chi^2_{5\%}(1) = 3.84$

adjustment effect. When the share of FDI inflows in trend GDP is one percentage point above its long-run value (*i.e.* when $ecm_{\text{FDII},t-1} = 1$ pp), the real GDP will fall by .001 pp over the next quarter, *ceteris paribus*. Thus, 99.9% of this equilibrium error will subsist, which will give rise to another downward adjustment of .001 pp (*i.e.* $-.001 \times .999$ pp) over the following quarter. After two quarters, $.999^2$ of the initial disequilibrium still persists.

3.2 The Panel Data Analysis of FDI Inflows and Outflows

According to the theory of factor-endowments, if factor prices fail to equalize, capital will move from capital-abundant countries to countries poorly endowed with capital where its marginal productivity is higher. Also this theory predicts that two-way FDI can never occur. The reality is the complete opposite. International production does not follow the above pattern. Flows of FDI from the developed countries to the least

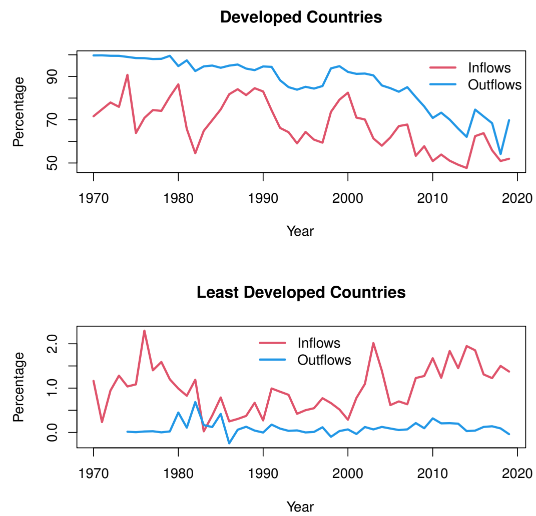


Figure 3.1: Percentage of the World FDI Flows in/from the Developed Countries and the Least Developed Countries, 1970-2019 (50 Years), Data Source: UNCTAD.

developed countries are non-significant. Besides, most FDIs take place among the developed countries. The world's major sources of FDI flows prove to be as well the major receivers of FDI (see Figure 3.1).

There is a positive relationship between the flows of FDI received by a country and the FDI made abroad by its residents. This observation was tested and confirmed by Lipsey (2001b). The slope parameter obtained by Lipsey after regressing pooled annual FDI outflows on pooled annual FDI inflows was positive and highly statistically significant, for developed countries. This investigation purports to further the work of Lipsey (2001b) using various econometric techniques to estimate the bivariate relation: panel data models and cointegration analysis.

3.2.1 The Model and the Data

The general specification of the econometric model is:

$$FDIO_{it} = \alpha_i + \beta_i FDII_{it} + u_{it}, \tag{3.13}$$

where the variables $FDII_{it}$, $FDIO_{it}$, and u_{it} designate respectively the inflows and the outflows of FDI, and the error term. The subscripts i ($i = 1, \ldots, N$) and t ($t = 1, \ldots, T$) denote the country and the time period. The error term u_{it} is assumed to have a constant variance and to be uncorrelated with the explanatory variable $FDII_{it}$. It is also assumed to be uncorrelated over time and across countries.

The data on the inflows and the outflows of FDI used to estimate (3.13) have been retrieved from the database of UNCTAD. They are annual and cover the time period

1970-2019 ($T = 50$). The sample consists of 16 developed countries ($N = 16$), which are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, New Zealand, Spain, Sweden, the UK, and the US. [3] All the time series are denominated in US dollar. On average, these 16 countries altogether received 60.5% of world FDI inflows and made 81.4% of the world FDI outflows. Note that the average shares of the world FDI flows into and from all developed countries are 67.5% and 87.3%, respectively.

On average, the time series are integrated of order one, that is, they are not stationary but their first differences are (see Tables A.2 and A.3). The FDI inflows of Denmark, Germany, Japan, and Sweden are stationary. So are the FDI outflows of Australia, New Zealand, and the UK. On the other hand, the FDI flows into Finland and the UK and the FDI from from the Netherlands are integrated of order 2.

3.2.2 The Methods of Estimation and the Findings

Seven procedures have been used to estimate the parameters of model (3.13): (1) the mean group (2) the least square dummy variable, (3) the within-group (4) the first-difference, (5) the pooled, (6) the between-group, and (7) the random-effect estimator (for further details, see Pesaran and Smith, 1995; Greene, 2000; Gujarati et al., 2011, among others). The pooled estimator assumes the absence of country-specific effects and maintain all the parameters of (3.13) constant. The least square dummy variable and the within estimators, which are referred to as fixed-effect methods, both assume the individual effects are time-invariant and captured by shifts in the intercept term across countries. The random-effect estimator treats the country-specific effect as a stochastic disturbance. For this reason, this method is called the error-component model.

3.2.2.1 The Mean Group Estimates

An intuitive approach to estimate (3.13) is simply to run N separate OLS regressions and to average the estimates of each parameter. Figure 3.2 plots the slope parameters estimated for each of the 16 countries in the panel. Their average is 1.112, which confirms a positive relationship between FDI inflows and outflows among developed countries.

Given the results of the tests for stationarity (Tables A.2 and A.3), one can conclude that some of the slope parameter estimates in Figure 3.2 are invalid and misleading, as they result from regressing a stationary variable on a trended variable or *vice versa*. That is particularly the case of Japan, which exhibits the highest slope parameter estimate simply because its FDI outflows is an $I(1)$ variable and its FDI inflows is stationary.

To avoid spurious results, new estimates are produced making sure the explained and the explanatory variables in each of the N regressions are both either stationary or integrated of the same order (see Table 3.13). In each of the developed countries with

[3] The Federal Republic of Germany (West Germany) and the Democratic Republic of Germany reunified in 1990. To balance the panel (*i.e.* to ensure each country has the same number of observations), the data of Germany prior to its reunification have been supplemented with those of the former Federal Republic of Germany. The Democratic Republic of Germany was a centrally planned and a closed economy.

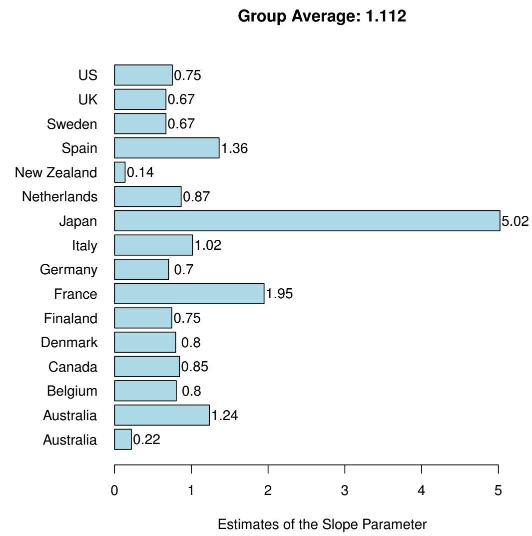


Figure 3.2: Bar Plot of the Mean Group Estimate of the Slope Parameter of Model (3.13)

Table 3.13: Panel Data Analysis: FDI Inflows, Statistics from ADF Unit Root Tests with Intercept but no Trend

	Variable		Intercept		Slope		R^2	Cointegration	
Country	Explained	Explanatory	Est.	t-ratio	Est.	t-ratio		Lags	τ-stat
Australia	$\Delta FDIO_{1t}$	$\Delta FDII_{1t}$	-257	-.19	.507	6.11	.431	1	-5.607
Austria	$FDIO_{2t}$	$FDII_{2t}$	1 107	1.46	1.235	9.39	.640	1	-3.110
Belgium	$FDIO_{3t}$	$FDII_{3t}$	3 294	1.340	.804	12.088	.748	1	-3.790
Canada	$FDIO_{4t}$	$FDII_{4t}$	7 053	2.542	.846	9.724	.656	1	-2.992
Denmark	$\Delta FDIO_{5t}$	$\Delta FDII_{5t}$	315	.527	.674	7.644	.545	9	-3.638
Finland	$FDIO_{6t}$	$\Delta FDII_{6t}$	3 244	3.790	.4847	3.022	.145	1	-2.958
France	$FDIO_{7t}$	$FDII_{7t}$	2 766	.556	1.9479	8.671	.602	1	-3.608
Germany	$\Delta FDIO_{8t}$	$\Delta FDII_{8t}$	1 872	.484	.165	1.636	.034	1	-5.647
Italy	$FDIO_{9t}$	$FDII_{9t}$	3 709	1.408	1.0158	6.098	.425	1	-3.128
Japan	$\Delta FDIO_{10,t}$	$\Delta FDII_{10,t}$	4 320	1.631	1.0097	2.440	.093	1	-4.794
Netherlands	$\Delta FDIO_{11,t}$	$FDII_{11,t}$	-7 733	-1.034	.4247	2.456	.095	12	-1.009
New Zealand	$FDIO_{12,t}$	$\Delta FDII_{12t}$	305	2.239	.112	1.287	.013	1	-7.748
Spain	$FDIO_{13,t}$	$FDII_{13,t}$	-1 402	-.424	1.363	9.653	.653	1	-3.768
Sweden	$\Delta FDIO_{14,t}$	$FDII_{14t}$	-203	-.133	.077	.737	.010	1	-4.927
UK	$FDIO_{15,t}$	$\Delta^2 FDII_{1t}$	45 094	4.106	-.157	-1.093	.004	1	-3.003
US	$FDIO_{16,t}$	$FDII_{16,t}$	28 265	1.623	.753	7.206	.510	3	-1.899
Critical values:				$t_{5\%}(48) = 1.68$					3.34

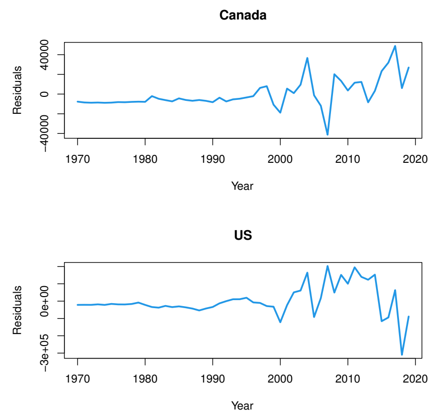


Figure 3.3: Cointegration Test: Residuals from Regressing FDI Outflows on FDI Inflows, Canada and the US, 1970-2019 (50 Years)

the exception of the UK, there is a positive relationship either between FDI inflows and FDI outflows or between their first differences. The model explains at least 50% of the variability observed in the explained variable in Belgium, Canada, Austria, France, and the US. To test for cointegration (*i.e.* to check whether this positive association is a long-run equilibrium relationship), the ADF test for stationarity has been performed on the residuals of the individual country regressions. The FDI inflows and outflows of Belgium, France, and Spain, which are all integrated of order 1, turn out to be cointegrated. For each of these three countries, the absolute value of the ADF test statistic (the τ-statistic) is greater than its 5% asymptotic critical value, which equals 3.34.

The absence of cointegration between FDI inflows and outflows in Canada and the US came as a surprise. To understand it, Figure 3.3 plots the residuals of the regression for these two countries. It transpires that the regression residuals, which were stable in both countries, started wandering only from 1999. Thus, there is a break in the equilibrium relationship between FDI inflows and outflows that dates back to beginning of the 21st century. The acceleration of globalization and the recent major crises contributed to the volatility of both flows of FDI in Canada and the US.

The Granger test for causality has been performed for each of the 16 countries (for some details on this test, see Appendix C.1). This test reveals that, in most developed countries (precisely, in 9 cases out 16), FDI inflows and outflows are mutually dependent. They are independent in Belgium, New Zealand and the UK. In the case of Finland, Japan, Sweden, and the US, there is a unidirectional causality running from FDI inflows to FDI outflows.

3.2.2.2 The Least Squares Dummy Variable Estimates

It appears in Table 3.13 that there are more disparity across countries in the estimates of the intercept term than in those of the slope parameter. One can estimate parsimoniously

Table 3.14: Estimates of Model (3.13) by the Least Squares Dummy Variable Method

Parameter	Model (3.14a) Estimate	Model (3.14a) t-ratio	Model (3.14b) Estimate	Model (3.14b) t-ratio
Constant term			-8 469.835	-1.70
Dummy Variable				
Australia	-8 469.835	-1.70		
Austria	2 502.035	.50	10 971.870	1.56
Belgium	4 035.173	.81	12 505.008	1.79
Canada	8 626.071	1.73	17 095.907	2.44
Denmark	2 441.832	.49	10 911.668	1.56
Finland	1 265.819	.25	9 735.654	1.39
France	21 869.838	4.39	30 339.673	4.33
Germany	23 822.390	4.767	32 292.226	4.61
Italy	6 146.029	1.24	14 615.864	2.09
Japan	43 519.140	8.79	51 988.975	7.41
Netherlands	16 287.308	3.25	24 757.144	3.53
New Zealand	-665.906	-.13	7 803.929	1.11
Spain	8 017.905	1.61	16 487.740	2.36
Sweden	5 590.294	1.13	14 060.129	2.01
UK	10 232.215	1.99	18 702.051	2.65
US	26 359.649	4.24	34 829.484	4.52
Slope Parameter	.769	23.50	.769	23.50
R^2	.656		.571	
$\bar{R}^2$	.648		.562	
dw_p	1.086		1.086	
White stat	233.891		233.891	
Critical values:	$t_{5\%}(783) = 1.65$, $\chi^2_{5\%}(2) = 5.99$			

the model assuming that the slope parameter is the same for all the countries and that only the intercept changes. To capture the shift in the intercept across countries, dummy variables can be introduced in model (3.13) in two different ways.

$$FDIO_{it} = \sum_{i=1}^{N} \alpha_i D_{ij} + \beta FDII_{it} + u_{it} \tag{3.14a}$$

$$FDIO_{it} = \alpha_1 + \sum_{i=2}^{N} \delta_i D_{ij} + \beta FDII_{it} + u_{it}, \tag{3.14b}$$

where the dummy variable $D_{ij} = 1$i if $i = j$ and 0 otherwise. While the model (3.14a) has N dummy variables (one for each country), model (3.14b) has $N - 1$ dummy variables and an intercept term. One has to drop one of the N dummy variables in order to introduce an intercept term into (3.14b), otherwise the cross-product of the matrix of regressors (which consists of the variable $FDII_{it}$, the dummy variables, and the intercept term) could not be inverted. That is what is called the dummy variable trap. [4]

Table 3.14 reports the estimates of the parameters of models (3.14a) and (3.14b). The estimate of the parameter α_i $(i = 2, \ldots, N)$ of model (3.14a) equals the sum of the estimates of α_1 and δ_i of (3.14b), $\hat{\alpha}_i = \hat{\alpha}_1 + \hat{\delta}_i$. This means Australia is used as reference

[4] The OLS estimator of the vector of parameters $\boldsymbol{\beta}$ for a model $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{u}$ is $\hat{\boldsymbol{\beta}} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}$.

country to estimate the individual fixed effects in model (3.14b). For this reason, the parameter δ_i is referred to as a differential intercept coefficient. The estimate of the slope parameter, which is the same for both models, is positive and statistically significant. All the dummies do not contribute significantly to the models. The determination coefficient, R^2, indicates that model (3.14a) provides a better fit to the data.

Two diagnostic tests have been performed on the regression residuals: the panel data Durbin-Watson test for autocorrelation and the White test for heteroskedasticity. The Durbin-Watson test statistic proposed by Bhargava et al. (1982) for panel data is

$$dw_p = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}(\hat{u}_{it} - \hat{u}_{i,t-1})^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{u}_{it}^2},$$

where $\hat{u}_{it}$ denotes the regression residuals. The value of the statistic dw_o reported in Table 3.14 is approximately 1, which implies the presence of an autocorrelation of .5 (see Appendix B.1). The value of the statistic of the test of White turns out to be greater than its 5% critical value, which means the model suffers from heteroskedasticity.

3.2.2.3 The Within-Group Estimate

The only parameter of interest in the least squares dummy variable model (3.14) is the slope, β. It is this parameter that indicates whether or not the relationship between FDI inflows and outflows is positive. A way of estimating directly the slope parameter without caring for the country-specific effects α_i or δ_i is to run a within-group regression. This consists in running a regression through the origin (*i.e.* a regression without any intercept term) using the deviation of the variables from their individual means. The results of this regression are displayed below

$$\begin{gathered}
\widehat{FDIO_{it} - \overline{FDIO}_i} = .769(FDII_{it} - \overline{FDII}_i) \\
t\text{-ratio} = (23.74) \\
\text{robust } t\text{-ratio} = (7.95), \quad t_{5\%}(783) = 1.65 \\
\bar{R}^2 = .413,\ dw = 1.086, \text{White stat} = 59.49,
\end{gathered} \tag{3.15}$$

where $\overline{FDII}_i = \sum_{t=1}^{T} FDII_{it}/T$ and $\overline{FDIO}_i = \sum_{t=1}^{T} FDIO_{it}/T$. The estimate of the slope parameter in (3.15) is exactly the same as those reported in Table 3.14.

The test of White detects the presence of heteroskedasticity. This implies that t-ratio could be misleading, because it is based on a wrong expression of the variance of the residuals. Therefore, the robust t-ratio of White (1980) has been computed. Even though the robust t-ratio is lower, the slope parameter is still statistically significant.

3.2.2.4 The First-Difference Estimate

Another way of doping out the time-invariant individual effects and to estimate directly the slope parameter is to run a regression on the first-difference of the variables. Taking the first-difference of model (3.14) gives

$$\Delta FDIO_{it} = \beta \Delta FDII_{it} + v_{it}, \tag{3.16}$$

where $v_{it} = \Delta u_{it}$. The estimate of the slope parameter reported in (3.17) is statistically significant, but much lower than those from the previous methods.

$$\begin{aligned} \Delta \widehat{FDIO}_{it} &= .286 \Delta FDII_{it} \\ t\text{-ratio} &= (6.59), \quad t_{5\%}(782) = 1.65 \\ \bar{R}^2 &= .051, dw = 2.554, \text{ White stat} = 2.23 \end{aligned} \tag{3.17}$$

The statistic of the White test is lower than 5.99, its 5% critical value, which indicates that the variance does not depend on the explanatory variable or its square. The value of the Durbin-Watson statistic points to a negative first-order autocorrelation in the residuals, as $d_L = 1.88$ and $d_U = 1.89$ (see Table B.1).

3.2.2.5 The Pooled Estimates

Now, its assumed that the intercept term is the same for all the N countries in the panel.

$$FDIO_{it} = \alpha + \beta FDII_{it} + u_{it}, \tag{3.18}$$

$$\begin{aligned} \widehat{FDIO}_{it} &= 9667.471 + .821 FDII_{it} \\ t\text{-ratio} &= (6.81) \qquad (29.23) \\ \text{robust } t\text{-ratio} &= (6.92) \qquad (8.73), \quad t_{5\%}(798) = 1.65 \\ R^2 &= .517, \bar{R}^2 = .516, dw = .996, \text{ White stat} = 223.74 \end{aligned} \tag{3.19}$$

The OLS estimates of the two parameters of the model (3.18), which are reported in (3.19), are positive and statistically significant. But, its determination coefficient, R^2, and adjusted determination coefficient, $\bar{R}^2$, are lower than those of (3.14b), the least squares dummy variable model. Since model (3.18) is a restricted version of model (3.14b), one can perform a joint significance test to check which of the two is more plausible. The null and the alternative hypotheses of this test described in Appendix C are respectively $\mathrm{H}_0: \ \delta_2 = \cdots = \delta_N = 0$ and $\mathrm{H}_A: \ \delta_2 \neq 0, \ldots,$ or $\delta_N \neq 0$. Given the values of R^2 reported in Table 3.14 and in relation (3.19), the test statistic, F, equals 6.48. The test statistic is greater than its 5% critical value, which is $F_{5\%}(15, 783) = 1.68$. This means that the null hypothesis of a pooled regression model cannot be accepted.

3.2.2.6 The Between-Group Estimates

This method is also known as cross-section estimator. It consists in running a regression using individual country means. For each of the N countries, the variables $FDII_{it}$ and $FDIO_{it}$ are averaged over the sample period. Then, these two sets of N averages are used to estimate the following model.

$$\overline{FDIO}_i = \alpha + \beta \overline{FDII}_i + \bar{u}_i, \tag{3.20}$$

The results of this regression are:

$$\begin{aligned}\widehat{\overline{FDIO}}_i &= 7542.243 + ..926\overline{FDII}_i \\ t\text{-ratio} &= (1.92) \qquad\qquad (7.88), \quad t_{5\%}(14) = 1.76 \\ \bar{R}^2 &= .803,\ \text{White stat} = 1.07\end{aligned} \tag{3.21}$$

Once again, the positive relationship between the inward and the outward flows of FDI between developed countries is confirmed. The estimates of the two parameters of model (3.20) are positive and statistically significant. The coefficient of determination is very high. To test for heteroskedasticity, White test has been performed by regressing the square of the residuals on the explanatory variable $\overline{FDII}_i$ and its square. The value of the statistic of the White test is 1.07, which is lower than 5.99, its 5% critical value. This means the variance does not depend on the explanatory variable $\overline{FDII}_i$ and its square.

3.2.2.7 The Random-Effect estimates

Now, it is assumed that the country-specific effect, α_i, consists of a common population average, α, and a country-specific (or idiosyncratic) disturbance, ε_i. The disturbance term, ε_i, is identically and independently distributed with a mean value of zero and variance of σ_ε^2. Since ε_i is unobserved, it makes up with u_{it} in (3.13) a composite error term.

$$FDIO_{it} = \alpha + \beta FDII_{it} + w_{it}, \tag{3.22}$$

with $w_{it} = \varepsilon_i + u_{it}$. The variance-covariance matrix of of w_{it} is

$$\mathbf{\Sigma} = \text{var}(\varepsilon_i \mathbf{i}_T + u_{it}) = \sigma_\varepsilon^2 \mathbf{i}_T \mathbf{i}_T' + \sigma_u^2 \mathbf{I}_T. \tag{3.23}$$

where $\mathbf{i}_T$ and $\mathbf{I}_T$ are respectively a $T \times 1$vector of ones and the T-dimensional identity matrix. Observe that there will be no difference between the random-effect model (3.22) and the pooled regression model (3.18), if the variance of the country-specific error component, σ_ε^2, is zero. But, for $\sigma_\varepsilon^2 > 0$, the composite error terms w_{it} are autocorrelated. The off-diagonal elements of the variance-covariance matrix, which are all equal to σ_ε^2 according to (3.23), are positive. As a consequence,

$$\begin{aligned}\text{corr}(w_{it}, w_{is}) &= \frac{\text{E}[(\varepsilon_i + u_{it})(\varepsilon_i + u_{is})]}{\sqrt{\text{E}(\varepsilon_i + u_{it})^2 \text{E}(\varepsilon_i + u_{is})^2}}, \quad t \neq s \\ &= \frac{\text{E}(\varepsilon_i^2 + \varepsilon_i u_{is} + \varepsilon_i u_{it} + u_{is} u_{it})}{\text{E}(\varepsilon_i + u_{it})^2} \\ &= \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_u^2},\end{aligned} \tag{3.24}$$

where corr and E denote respectively the correlation and the expectation operators. Note that the second and the third lines of (3.24) follow from the assumptions that the two components of w_{it} are mutually independent, are neither contemporaneously nor serially correlated, and have a constant variance. Given the autocorrelation of w_{it}, the OLS estimators of (3.22) will be inefficient (*i.e.* the variance of the OLS estimator is no longer the smallest of all possible unbiased estimators). A way of correcting the model for autocorrelation is to run a feasible generalized least squares regression. This consists in estimating the following transformed model by OLS (see Appendix B.1).

$$FDIO_{it} - \theta\overline{FDIO}_i = \alpha(1-\theta) + \beta\left(FDII_{it} - \theta\overline{FDII}_i\right) + \epsilon_{it}, \tag{3.25}$$

The transformed model (3.25) results pre-multiplying (3.22) by the inverse of the variance-covariance matrix, for each cross-sectional unit.

$$\mathbf{\Sigma}^{-1} = \frac{1}{\sigma_u^2}\left[\left(\mathbf{I}_T - \frac{1}{T}\mathbf{i}_T\mathbf{i}_T'\right) + +\frac{\psi}{T}\mathbf{i}_T\mathbf{i}_T'\right]$$
$$\text{with } \psi = \frac{\sigma_u^2}{\sigma_u^2 + T\sigma_\varepsilon^2} \text{ and } \theta = 1 - \psi^{\frac{1}{2}}$$

To evaluate ψ, one can use the variance of the residuals from the within estimation as a measure of σ_u^2 (σ_u^2=1 200 324 924). The measure of σ_ε^2 is obtained from the between regression as follows.

$$\begin{aligned}
\sigma_{\bar{u}}^2 &= \frac{1}{N}\sum_{i=1}^{N}\left(\overline{FDIO}_i - \alpha - \beta\overline{FDII}_i\right)^2 = \frac{1}{N}\sum_{i=1}^{N}\left(\varepsilon_i + \bar{u}_i\right)^2 \\
&== \frac{1}{N}\sum_{i=1}^{N}\varepsilon_i^2 + \frac{1}{N}\sum_{i=1}^{N}\bar{u}_i^2 \\
&== \frac{1}{N}\sum_{i=1}^{N}\varepsilon_i^2 + \frac{1}{T^2}\sum_{t=1}^{T}\left(\frac{1}{N}\sum_{i=1}^{N}u_{it}^2\right) \\
&= \sigma_\varepsilon^2 + \frac{\sigma_u^2}{T}
\end{aligned} \tag{3.26}$$

The first line of (3.26) follows from the fact that the average of the random-effect model across time periods is $\overline{FDIO}_i = \alpha + \beta\overline{FDII}_i + \varepsilon_i + \bar{u}_i$. Its second line expresses the independence of the idiosyncratic disturbance, ε_i, from u_{it}. Given the variance of the residuals from the within regression, σ_u^2, and that from the between regression, $\sigma_{\bar{u}}^2$, are known ($\sigma_{\bar{u}}^2$ = 146 328 406), it follows that σ_ε^2 = 122 321 907, $\psi = .164$ and $\theta = .595$. Relation (3.27) shows the OLS estimates of the transformed random-effect model (3.25).

$$\begin{aligned}
\widehat{FDIO_{it} - \theta\overline{FDIO}_i} &= 4\ 246.414 + .781\left(FDII_{it} - \theta\overline{FDII}_i\right) \\
t\text{-ratio} &= (3.356) \quad (24.795), \quad t_{5\%}(766) = 1.65 \\
\bar{R}^2 &= .434
\end{aligned} \tag{3.27}$$

The estimate of the intercept term is therefore 10 483.89, that is 4 246.414/(1-.595).

3.2.2.8 Fixed Effects versus Random Effects

The random-effect model is based on the assumption that the individual effects are independent of the explanatory variable (*i.e.* ε_i is independent of $FDII_{it}$). The hypothesis

Table 3.15: Hausman Test: Fixed Effects versus Random Effects

Estimator	$\hat{\beta}$	$\widehat{\text{var}}(\hat{\beta})$	$(\hat{\beta}_{FE} - \hat{\beta}_{RE})^2$	$\widehat{\text{var}}(\hat{\beta}_{FE}) - \widehat{\text{var}}(\hat{\beta}_{RE})$	Test statistic
Within	.769	.001	.00013	5.751e-05	2.421
First-Difference	.286	.002	.2448	.0008974	272.843
Random-Effect	.781	.001			
Critical values:					$\chi^1_{5\%}(1) = 3.84$

of fixed effects can tested against the alternative of random effects using the Hausman test. Since the model only has one response parameter, β, the statistic of this test is

$$\frac{\left(\hat{\beta}_{FE} - \hat{\beta}_{RE}\right)^2}{\widehat{\text{var}}(\hat{\beta}_{FE} - \widehat{\text{var}}(\hat{\beta}_{RE})} \sim \chi^2(1)$$

where $\hat{\beta}_{FE}$ and $\hat{\beta}_{RE}$ designate respectively the estimate of β from the fixed-effect and the random-effect method, and $\widehat{\text{var}}$ the estimate of their variance. Table 3.15 reports the results of the Hausman test. It turns out that there is no significant difference between the estimates from the within and the random effect methods, since the test statistic is lower than its critical value. On the other hand, comparing the estimates of the first-difference and the random-effect methods leads to the opposite conclusion.

Note that the first-difference method of estimation is a filter that removes from the model any type of heterogeneity across countries, whether fixed or random. Assume this heterogeneity is random, taking the first-difference of (3.22) eliminates both the constant population average, α, and the idiosyncratic disturbance, ε_i.

$$\Delta FDIO_{it} = \Delta\alpha + \beta\Delta FDII_{it} + \Delta\varepsilon_i + \Delta u_{it} \Rightarrow \text{ model } (3.16)$$

The first-difference method also eliminates any other time-invariant variable from the model and, by so doing, helps avoid omitted-variable bias in the estimator of β. [5] Thus, the large difference between the estimate of β from the first-difference method and those from the within and the random-effect methods that appears in Table 3.15 may be due to omitted variables in the specification of (3.13) or to autocorrelation in the residuals of (3.17). For this reason, one cannot conclude from the Hausman test that the random-effect method is more appropriate than the first-difference method.

Summary

❶ The impacts of six US macroeconomic variables on the flows of FDI they received between 1970:Q1 and 2019:Q4 have been investigated. These variables are: the real GDP (a proxy

[5] Consider the model $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{u}$. The OLS estimator of the vector of parameters $\boldsymbol{\beta}$ is $\hat{\boldsymbol{\beta}} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}$. This estimator is wrong if the true model is instead $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}\boldsymbol{\eta} + \mathbf{u}$. Thus, evaluating the estimator of $\boldsymbol{\beta}$ derived from the model with the omitted variables gives $\hat{\boldsymbol{\beta}} = (\mathbf{X}'\mathbf{X})^{-1}[\mathbf{X}\boldsymbol{\beta} + \mathbf{Z}\boldsymbol{\eta} + \mathbf{u}] = \boldsymbol{\beta} + (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}\boldsymbol{\eta} + (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{u}$. The expected value of the latter expression, which equals $\boldsymbol{\beta} + (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}\boldsymbol{\eta}$, is different from the true value of the parameter by the amount $(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}\boldsymbol{\eta}$ called omitted-variable bias.

Box 3.1: The Quadratic Trend of the Nominal GDP

The quadratic trend of the nominal GDP is the exponential of the fitted mean value of the econometric model

$$\ln \text{GDP}_t = d_0 + d_1 t + d_2 t^2 + \epsilon_t,$$

where t denotes the time period and ϵ_t the residual. The Ordinary Least Squares estimates of the coefficients of this model are displayed in the table below.

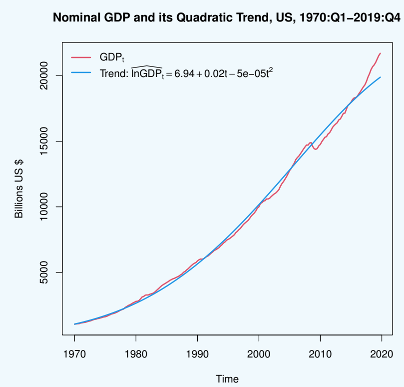
The three diagnostic test statistics in the above table (Breusch-Godfrey, Breusch-Pagan, and White) are described in Appendix B. The residuals of this regression are the cyclical component of the GDP, a measure of business cycle. The diagnostic tests reveal that these residuals are serially correlated and heteroskedastic. These are features of business cycles, which are defined as pervasive and persistent fluctuations of the economy.

The fitted values of the regression are plotted in the figure below.

OLS Estimates: GDP Quadratic Trend

Variable	coef	t-ratio
Intercept	6.936	859.50
t	.025	136.23
t^2	-5.220e-05	-58.45
R^2	.998	
$\bar{R}^2$	.998	
Breusch-Godfrey (2) stat	190.087	
Breusch-Pagan stat	164.893	
White stat	49.852	

Critical values: $t_{2.5\%}(197) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(5) = 11.07$



for market size) and its expected growth rate, the degree of openness, the real effective exchange rate, the cost of the capital and the labor inputs.

❷ Assuming the expectations about the future real GDP growth rate are adaptive, the econometric model has been transformed into an ARDL process, following Koyck. Given the simultaneity between the dependent variable and some of the regressors, the resulting structural VAR model has been estimated by 2SLS and by maximum likelihood following the procedure of Johansen.

❸ The mechanism of adaptive expectations boosts the explanatory power of both the reduced-form and the structural equations of FDI inflows. It also help fix serial correlation in the reduced-form equation of the real GDP.

❹ The 2SLS estimate of the coefficients on the market size and the expected economic growth rate are positive, as expected. Those on the real effective exchange rate and the rental price of capital (*i.e.* the real interest rate) are also positive, while labor cost has a negative impact on FDI.

❺ The explanatory power of the structural equation of FDI inflows shrinks from 65.7% to 26.9%, in the absence of the hypothesis that the economic growth rate expected by foreign investors follows an adaptive expectations process. Thus, even though the coefficient attached to the expected economic growth rate is significant only from a level of 16.2%, the adjustment of foreign investors to their forecast error turns out to play a central role in the dynamics of FDI inflows.

❻ According to the 2SLS estimations, FDI into the US have in turn a positive impact on their real GDP. Further statistical tests confirm that FDI inflows should not be treated as exogenous in the structural equation of the real GDP. However, the hypothesis of a feedback between FDI inflows, the real GDP or its growth rate cannot be accepted. The explanation is that FDI is determined by the expected and not the current economic growth rate.

❼ The procedure of Johansen confirms the existence of long-run equilibrium relationships involving FDI inflows and the real GDP. A comparison to the 2SLS estimates suggests that the long-run multipliers of the real GDP captures also the impact of the economic growth rate on FDI inflows.

❽ Various panel data methods of estimation confirm the positive relationship between FDI inflows and outflows among developed countries. The test for causality reveals that, in most of these countries, these two variables are mutually independent. The statistical tests performed confirm the existence of heterogeneity across countries. This heterogeneity is fixed over time.

❾ The analysis of the panel data reveals a long-run equilibrium relationship between the inflows and the outflows FDI in many developed countries. But, since 1999, a structural break in the data has affected this cointegrating relationship in Canada and the US.

CHAPTER 4

Discussion

> . . . in the recent years there has been what is tantamount to a sea-change in the attitude of developing countries towards FDI. Increasingly, they now welcome all FDI and compete with one another to attract it.
> – South Centre (1997)

This chapter discusses the FDI policies of some countries and concludes this dissertation. Government policies toward FDI can be formal or informal and may aim at attracting more flows or protecting national sovereignty.

4.1 The FDI Policies of Some Countries

The FDI policies of Canada, China, and developing countries are reviewed. In 1979, Canada was the destination of 12.7% of the world FDI, while the share of China was practically zero. The picture of the situation completely changed in 1994, with China receiving 13.2% of the world FDI due to greater economic liberalization and Canada 3.2% (see Figure 4.1). China is now the world's major recipient of FDI (Oecd, 2021).

4.1.1 Canada

Canada is a major recipient of FDI, especially from the US, its southern neighbor. The Canadian government has had an ambivalent attitude towards FDI inflows. Policy measures were adopted to foster and deter FDI into Canada. Some of these policy measures were: the Foreign Investment Review Act (FIRA), the National Energy Program (NEP), the Investment Canada Act, the Canada-US Free Trade Agreement (FTA), and the North American Free Trade Agreement (NAFTA).

The FIRA, adopted in December 1973, required the review through an application process of some inflows of acquisitions and greenfield FDI above a certain size. Its implementation started in April 1974 with the review by the Foreign Investment Review Agency of the new acquisitions and control of Canadian firms by foreign producers.

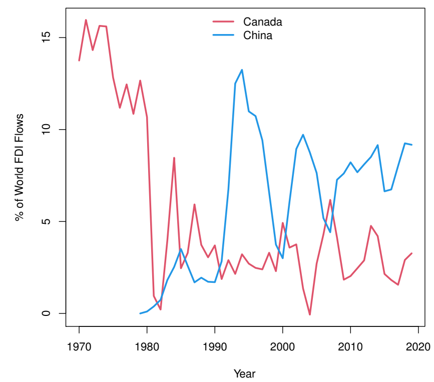


Figure 4.1: Percentage of the World FDI Inflows into Canada and China, 1970-2019 (50 Years), Data Source: UNCTAD.

The review of new greenfield FDIs into Canada became operative from October 1975. Globerman and Shapiro (1998, 1999) investigated the impacts of Canadian government policies on both FDI inflows and outflows. They concluded that the FIRA had no statistically significant impact on any of these two flows of FDI. It succeeded at restricting FDI only in the manufacturing sector.

The NEP was announced in October 1980. One of its objectives was to secure at least 50 percent Canadian ownership in the oil and gas sector. In 1985, the Canadian government relaxed its FDI policy. The Investment Canada Act which came into effect in June 1985 allowed foreign firms to invest in exempt sectors without filing any application with the government. They simply had to declare ventures that were above a certain size. The FTA, negotiated in 1987, gave US investors that established facilities in Canada the same rights as Canadian entrepreneurs, as regards investment in non-exempt sectors. The FTA was extended to Mexico in 1994 and became NAFTA. The FTA and NAFTA have had positive impacts on FDI inflows and outflows (Globerman and Shapiro, 1999).

4.1.2 China

Zhang and Corrie (2018) distinguished four main stages in the evolution of the industrial and the regional FDI encouragement policy of China. For long, international joint venture was the only way for a foreign firm to produce in China and the Chinese partner was assigned by the government (Lau and Bruton, 2008).

Stage 1 To catch up with developed countries, China opened its doors to FDI in 1979, after promulgating the Law on Chinese-Foreign Joint Ventures. In the wake of this reform, the State Council, which is the Chinese central government, established four special economic zones along the Southeastern coast and granted experimentally some autonomy to their local governments and tax incentives to Chinese-foreign joint-venture enterprises. In 1980, China joined the World Bank and the International Monetary Fund. In 1982, while Mexico followed by other developing countries were unable to service their foreign debts, which caused a global financial crisis, the Chinese economy was booming, due to an excessive capital construction investment (Chang, 1984). Such building materials as cement, steel, and wood ran short.

Stage 2 In 1983, China regulated the implementation of its Law on joint ventures. Under some conditions, it welcomed FDI in six industries, including energy development, the building material, chemical and metallurgical. International joint ventures were allowed provided, *inter alia*, they adopted advanced technologies and scientific management, they helped expand exports and increase income in foreign currency. Export tariffs were cut in 1985. Yao (2006) found that both exports and FDI were instrumental in the economic growth of China. Even though China encouraged exports, the international joint-venture products that it urgently needed or usually imported could be mainly sold on the domestic market. China enlarged its four initial special economic zones and installed new ones in coastal cities. A high proportion of the FDI inflows was made by the Chinese diaspora in Taiwan, Hong Kong, Macao, and Singapore (Lawler and Seddighi, 2001; Lau and Bruton, 2008; Zhang and Corrie, 2018).

Stage 3 In June 1992, China promulgated the Decision to Accelerate the Development of the Tertiary Industry, which later opened to FDI such activities as accounting, advertising, consulting, and training. It also opened up 13 border areas and 18 capital cities in the inland provinces and established free-trade zones. The share of world FDI into China soared to reach a historic high in 1944 (seep Figure 4.1).

Stage 4 China finally became a member of the World Trade Organization in December 2001 and instituted the BRIC along with Brazil, Russia, and India in June 2009. To tailor FDI inflows to the needs of its economy, the Chinese government started in 2002 publishing periodically the Catalog for the Guidance of Foreign Investment Industries. New special economic zones were established in the mid-west areas and the vast majority of the industries of the Chinese economy is opened to FDI. Foster (2011) deemed the regional FDI policy of China was skewed in favor of the richest Eastern Region and the poor West attracted less. As a matter of fact, the mid-west of China, which accounts for 83.4% of its national territory and 60% of its population, receives less than 18% of its FDI inflows (Zhang and Corrie, 2018).

4.1.3 Developing Countries

The rapid development of China through FDI and exports arouses admiration and is proposed as a model to developing countries (Yao, 2006, among others). Some of them are competing to attract FDI by promoting internationally their economies and offering fiscal incentives to foreign investors. But, the geographical distribution of FDI inflows still remains uneven (Amirahmadi and Wu, 1994). In a sample of 15 developing countries, Yasmin et al. (2003) found that the upper middle-income group attracted more

FDI than the lower middle, and the lower-income groups. The latter were disadvantaged by their large trade deficit and their lower living standard, *inter alia*. For Yasmin et al., to increase sustainably their FDI inflows, developing countries have to improve their political environment, as the disparity in their attractiveness stems from their institutional and structural differences. Habib and Zurawicki (2002) sustained that corruption is an obstacle to FDI. Kapuria-Foreman (2007) showed that FDI into developing countries increased with such components of economic freedom as the protection of property rights and the reduction of government intervention, while Kok and Ersoy (2009) stressed the role of communication measured by the number of telephone mainlines.

One thing is to attract FDI and another is to accelerate economic growth through it. According to the literature, FDI contributes to growth only if the recipient country has some absorptive capacity. The absorptive capacity includes: a threshold level of educated labor (Borensztein et al., 1998; Jyun-Yi and Chih-Chiang, 2008) and the level of financial development (Hermes and Lensink, 2003; Alfaro et al., 2010).

4.2 Conclusion

This dissertation has reviewed and assessed critically the literature on the determinants and impacts of FDI. This has led to revisit, *inter alia*, the concept of trade creation/diversion of Viner (1950) and the conditions for FDI of Aliber (1993). This dissertation argues that the prediction that the formation of a customs union could replace cheap imports from a nonmember country with a relatively expensive good produced by a trading partner overlooks the possibility of tariff-jumping FDI. This dissertation also models the necessary and sufficient conditions for FDI of Aliber using the concept of marginal efficiency of capital. This has helped link the decision of FDI or FPI to some of its determinants, which are the interest rate in both the home and the host countries, and the exchange rate.

Two empirical investigations have been undertaken herein. The first one tested the response of FDI inflows into the US to some macroeconomic variables. The second one analyzed the relationship between FDI inflows and outflows in developed countries. The first investigations reconsider the hypothesis that the current economic growth rate of the host country determines its FDI inflows and makes room for adaptive expectations in the decision of foreign investors. Its main contribution is to show the importance in the dynamics of FDI inflows of the adjustment of foreign investors to errors in their forecast of the future economic growth rate. The hypothesis of a positive relationship between FDI inflows and outflows was tested before using a simple regression model. The main contribution in this dissertation is to confirm this finding, using various panel data methods of estimation, cointegration analysis, and a test for causality to rule out cases of spurious regression and to detect some sources of heterogeneity.

Econometric Appendices

A Testing for Stationarity

A random time series Y_t ($t = 1, \ldots, T$) is said to be weakly stationary or covariance stationary if

1. $\mathrm{E}(Y_t) = \mathrm{E}(Y_{t-1}) = \mu < \infty$,
2. $\mathrm{var}(Y_t) = \mathrm{E}(Y_t - \mu)^2 = \gamma_0 < \infty$,
3. $\mathrm{cov}(Y_t, Y_{t-k}) = \mathrm{E}(Y_t - \mu)(Y_{t-k} - \mu) = \gamma_k < \infty$, $k = 1, 2, \ldots$,

where the operators E, var, and cov denote respectively the mathematical expectation, the variance, and the covariance. The first and the second conditions for weak stationarity require the mean and the variance of the time series to be constant numbers. The third condition requires the autocovariances to depend only on the time interval between two observations.

There are several ways of testing for stationarity (see Gujarati et al., 2011; Studenmund, 2021, among others). The most popular of these tests is the Dickey-Fuller unit root test. The Dickey-Fuller unit root test for stationarity assumes that a time series follows an autoregressive process of order 1

$$Y_t = \delta + \rho Y_{t-1} + \varepsilon_t \tag{A.1}$$

where ε_t denotes the residual. If the parameter ρ is equal to 1, Y_t is non-stationary and is said to have a unit root or to be a random walk time series. On the other hand, if the parameter ρ is less than 1, Y_t is stationary. An alternative specification of relation (A.1) is obtained by subtracting Y_{t-1} from both sides of this relation, which gives

$$\Delta Y_t = \delta + \pi Y_{t-1} + \varepsilon_t, \tag{A.2}$$

where Δ is the first-difference operator (*i.e.* $\Delta Y_t = Y_t - Y_{t-1}$) and $\pi = \rho - 1$. The null hypothesis H_0 and the alternative hypothesis H_A of the Dickey-Fuller unit root test are

$\mathrm{H}_0:\ \pi = 0$ (unit root),

$\mathrm{H}_A:\ \pi < 0$ (stationarity).

The test statistic, which is called Dickey-Fuller τ-statistic, is the estimate of π divided by its standard error. The standard error (s.e.) of the estimate of π is

$$\text{s.e.}(\hat{\pi}) = \sqrt{\left(\frac{1}{T-3}\sum_{t=2}^{T} e_t^2\right)\left(\sum_{t=2}^{T} Y_{t-1}^2\right)^{-1}},$$

where $\hat{\pi}$ and e_t denote respectively the estimate of π and the residuals from estimating (A.2).

The critical values are given by most of the econometric packages offering the Dickey-Fuller tests. For a given level of significance (*i.e.* for a given probability of rejecting by mistake the null hypothesis of unit root), if the absolute value of the τ-statistic is less than the critical value, the null hypothesis of non-stationarity is accepted. Otherwise, the alternative hypothesis of stationarity cannot be rejected.

If it happens that Y_t is found to be non-stationary, another unit root test can be performed on its first difference . If a time series is non-stationary but its $d-th$ difference is stationary, it is said to be integrated of order d or to follow an $I(d)$ process.

Assume now that Y_t follows an autoregressive process or order p

$$Y_t = \delta + \rho_1 Y_{t-1} + \cdots + \rho_p Y_{t-p} + \varepsilon_t. \tag{A.3}$$

Unit root occurs in a higher order autoregressive model when $\sum_i \rho_i = 1$, that is, when the autoregressive parameters sum to unity. To estimate $\sum_i \rho_i - 1$ in one go, the autoregressive model (A.3) can be specified as follows through linear transformations

$$\Delta Y_t = \delta + \pi Y_{t-1} + \cdots + \varrho_{p-2}\Delta Y_{t-p+2} + \varrho_{p-1}\Delta Y_{t-p+1} + \varepsilon_t. \tag{A.4}$$

where $\pi = \rho_1 + \cdots + \rho_p - 1$, $\varrho_{p-1} = -\left(\rho_{p-1} + \rho_p\right)$, and $\varrho_{p-1} = -\rho_p$.

Tests for stationarity based on relation (A.4) are called augmented Dickey-Fuller (ADF) unit root tests. One of the following two statistics can be used to optimally choose the number of lags to include in (A.4): the Akaike information criterion (AIC), or the Schwartz Bayesian information criterion (BIC).

$$AIC(p) = \ln\left(\frac{1}{T'}\sum_{t=1}^{T'} e_t^2\right) + 2\frac{p+1}{T'}$$
$$BIC(p) = \ln\left(\frac{1}{T'}\sum_{t=1}^{T'} e_t^2\right) + \frac{p+1}{T'}\ln(T'),$$

where T' denotes the length of the time series after adjusting for the missing observations. The maximum number of lags, p, is chosen so as to minimize either $AIC(p)$ or $BIC(p)$. Herein, the ADF tests have been performed in the software R using the package 'urca' (Pfaff et al., 2016). This package, which stands for unit root and cointegration analysis, selects the number of lags to include in the ADF tests using either the lowest AIC or the lowest BIC. One can include a time trend in either (A.2) or (A.4), and even drop the intercept term from these equations.

Table A.1: Simultaneous Equation Model of FDI Inflows: Statistics from ADF Unit Root Tests

Country	Type	Level		First-Difference	
		Lags	τ-statistics	Lags	τ-statistics
DO_t	Drift	2	-1.999	1	-8.430
$FDII_t$	No drift, no trend	3	-1.719	2	-12.015
G_t	Drift	4	-2.211	2	-5.402
GDP_t	Trend	1	-1.197	1	-6.957
LC_t	Trend	2	-3.432	1	-6.471 8
R_t	Drift	8	-1.692	7	-4.894
$REER_t$	Drift	1	-2.390	1	-9.167
TB_t	Drift	1	-1.824	7	-9.273

5% critical value: -1.95 (no drift and trend), -2.88 (drift), -3.43 (trend).

Stationarity can also be tested for panel data, that is, for cross-sectional time series Y_{it} $(i = 1, \ldots N,\, t = 1, \ldots, T)$. There are tests such as the two Levin and Lin tests (LL1 and LL2) and Im et al. test. The Im et al. test, which is more general, is designed for *heterogeneous* panels. The model to estimate in order to test for unit root in the case of heterogeneous panels is given by

$$\Delta Y_{it} = \delta_i + \pi_i Y_{i,t-1} + \cdots + \varrho_{i,p_i-2}\Delta Y_{i,t-p_i+2} + \varrho_{i,p_i-1}\Delta Y_{i,t-p_i+1} + \varepsilon_{it}.$$

The test hypotheses are

$$\mathrm{H}_0: \ \pi_i = 0 \text{ (for all } i),$$

$$\mathrm{H}_A: \ \pi_i < 0 \text{ (for } i = 1, 2, \ldots, N_1),\ \pi_i = 0 \text{ (for } i = N_1 + 1, N_1 + 2, \ldots, N).$$

The panel is said to be heterogeneous because, in thee alternative hypothesis, π_i is allowed to differ across the units of the panel. Separate unit root tests are performed for each of the cross sections. Then, the average of the τ-statistics of the cross units is computed $\bar{\tau}_{NT} = \sum_{i=1}^{N} \tau_{iT}(p_i)/N$. This average is assumed to be normally distributed. Its mean and variance have been tabulated by Im et al. (2003) after some Monte Carlo simulations. The test statistic is therefore $\tau^* = \sqrt{N}[\bar{\tau}_{NT} - \mathrm{E}(\tau_T)]/\sqrt{\mathrm{var}(\tau_\mathrm{T})}$. If the test statistic, τ^* is less than its critical value, the null hypothesis of stationarity is accepted: otherwise, it is rejected

In running regressions on time series, it is important to make sure that all the variables have the same order of integration. Otherwise, the results of the regression will be spurious. This is a necessary condition for cointegration (*i.e.* a long-run equilibrium relationship between variables). For the investigations in Chapter 3, ADF unit root tests have been performed on all the time series. The criterion used to select the lag length is the BIC. The statistics as well as the critical values are reported in the tables below.

Table A.2: Panel Data Analysis: FDI Inflows, Statistics from ADF Unit Root Tests with Intercept but no Trend

	Level		First-Difference	
Country	Lags	τ-statistics	Lags	τ-statistics
Australia	1	-1.229	2	-6.374
Austria	1	-2.620	2	-5.938
Belgium	1	-2.713	2	-5.470
Canada	1	-2.878	4	-5.647
Denmark	1	-3.228	4	-5.555
Finland	11	-1.134	10	-1.997
France	1	-2.218	1	-4.965
Germany	1	-3.137	1	-6.049
Italy	1	-1.928	2	-6.477
Japan	1	-3.246	1	-5.846
Netherlands	11	.823	12	-2.992
New Zealand	1	-2.473	1	-5.166
Spain	1	-2.423	1	-5.980
Sweden	1	-3.214	1	-5.826
UK	1	-2.862	10	-1.020
US	1	-2.154	5	-5.778
Average τ_{iT} ($\bar{\tau}_{NT}$)		-2.290		-5.067
5% critical value		-2.93		-2.93

Table A.3: Panel Data Analysis: FDI Outflows, Statistics from ADF Unit Root Tests with Intercept but no Trend

	Level		First-Difference	
Country	Lags	τ-statistics	Lags	τ-statistics
Australia	1	-3.834	1	-5.852
Austria	1	-2.151	2	-5.810
Belgium	1	-2.525	2	-5.422
Canada	1	-.860	2	-5.943
Denmark	4	-1.533	3	-6.714
Finland	1	-2.696	1	-5.405
France	1	-2.918	1	-4.483
Germany	1	-2.318	5	-5.271
Italy	1	-2.433	1	-6.575
Japan	2	1.894	1	-5.812
Netherlands	5	.194	2	-2.321
New Zealand	1	-7.951	2	-8.994
Spain	2	-1.777	1	-6.423
Sweden	1	-2.093	2	-5.170
UK	1	-3.149	1	-5.617
US	2	-1.369	1	-6.832
Average τ_{iT} ($\bar{\tau}_{NT}$)		-2.220		-5.790
5% critical value		-2.93		-2.93

B Diagnostic Tests

This section explains the tools used to test for serial correlation and heteroskedasticity. Consider the linear regression model

$$y_t = \mathbf{x}_t^{'}\boldsymbol{\beta} + u_t, \tag{B.1}$$

where $\mathbf{x}_t$ and $\boldsymbol{\beta}$ are respectively $k \times 1$ vectors of explanatory variables and parameters. The error terms u_t ($t = 1, \ldots, T$) are all assumed to have a mean of zero and a constant variance σ_u^2, in addition to being independent of each other. These assumptions are violated when u_t turns out to follow an autoregressive process (serial correlation) or when u_t^2 turns out to be determined by some variables (heteroskedasticity).

B.1 Serial Correlation

Four tests are used herein to detect serial correlation: the Durbin-Watson, the Breusch-Godfrey, the Box-Pierce, and the Ljung-Box tests. A way of correcting a model from serial correlation is also described.

B.1.1 The Durbin-Watson Test

The Durbin-Watson test is used to detect first-order correlation between error terms. Specifically for this test, it is assumed that $\mathbf{x}_t$ in model (B.1) contains no lagged dependent variable. The Durbin-Watson test is performed by running the following regression

$$u_t = \rho u_{t-1} + \varepsilon_t, \tag{B.2}$$

where the stochastic disturbance ε_t has a zero mean and a constant variance, $\sigma_{\varepsilon_t}^2$. The test hypotheses are:

$\mathrm{H}_0: \ \rho = 0$ (absence of first-order serial correlation),

$\mathrm{H}_A: \ \rho \neq 0$ (presence of first-order serial correlation).

The test statistic is

$$\begin{aligned} dw &= \frac{\sum_{t=2}^{T}(\hat{u}_t - \hat{u}_t)^2}{\sum_{t=1}^{T} u_t^2} \\ &\approx 2\frac{\sum_{t=2}^{T} \hat{u}_t^2 - \sum_{t=2}^{T} \hat{u}_t \hat{u}_{t-1}}{\sum_{t=1}^{T} \hat{u}_t^2} = 2(1 - \hat{\rho}), \end{aligned} \tag{B.3}$$

where $\hat{\rho}$ designates the OLS estimator of the autoregressive coefficient ρ in (B.2) and $\hat{u}_t$ the sample residuals from model (B.1). The link established in (B.3) between the Durbin-Watson statistic and $\hat{\rho}$ results from approximating $\sum_{t=2}^{T} \hat{u}_{t-1}^2$ by $\sum_{t=2}^{T} \hat{u}_t^2$. Thus, it occurs that dw equals 2 in the absence of autocorrelation. It equals 0 or 4 respectively when the error terms are positively or negatively correlated. The two critical values of

Table B.1: Durbin-Watson Test: Decision Rule

dw	Decision
$[0, d_L]$	Positive serial correlation (H_0 is rejected).
$]d_L, d_U[$	The test is inconclusive.
$[d_U, 4 - d_U]$	Neither positive nor negative serial correlation.
$]4 - d_U, 4 - d_L[$	The test is inconclusive.
$[4 - d_L, 4]$	Negative serial correlation (H_0 is rejected).

the test, d_L and d_U, are reported in most econometrics textbooks. The decision rule is presented in Table B.1.

Taking the square of both sides of (B.2), it appears that, in the case of first-order autocorrelation, the variance of u_t equals

$$\text{var}(u_t) = \rho^2 \text{var}(u_{t-1}) + \text{var}(\varepsilon_t).$$

If $0 < \rho < 1$, the variance of u_t is stationary (see a definition of stationarity in Section A) and it can be expressed as follows.

$$\text{var}(u_t) = \frac{\text{var}(\varepsilon_t)}{1 - \rho^2} \text{ or } \sigma_u^2 = \frac{\sigma_\varepsilon^2}{1 - \rho^2} \tag{B.4}$$

This means that the variance of u_t is no longer minimal. Thus, the standard errors and the t-ratios of the parameters from the OLS regression could lead to incorrect conclusions.

B.1.2 The Breusch-Godfrey Test

This test is more general than that of Durbin-Watson, as it can detect serial correlation of higher order. The test statistic is computed by means of the following auxiliary regression model

$$\hat{u}_t = \mathbf{x}_t' \boldsymbol{\delta} + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \cdots + \rho_p \hat{u}_{t-p} + \varepsilon_t, \tag{B.5}$$

where $\hat{u}_t$ denotes the residuals obtained from fitting model (B.1). The hypotheses to test are

$$\text{H}_0: \ \rho_1 = \rho_2 = \cdots = \rho_p = 0 \ \text{ (absence of serial correlation of order } p\text{)},$$

$$\text{H}_A: \ \rho_1 \neq 0, \ldots, \text{ or } \rho_p \neq 0 \ \text{ (presence of serial correlation of order } p\text{)}.$$

The coefficient of determination of the auxiliary regression (B.5) is used to compute the statistic of the Breusch-Godfrey test, which equals $(T - p)R^2$. This statistic follows the Chi-squared (χ^2) distribution with p degrees of freedom. The null hypothesis of no serial correlation of order p is rejected when $(T - p)R^2 > \chi_\alpha^2(p)$, where α denotes the level of significance of the test and $\chi_\alpha^2(p)$, the $1 - \alpha$ quantile of the chi-squared distribution with p degrees of freedom.

B.1.3 The Tests of Box-Pierce and Ljung-Box

These two tests check for the overall significance of the successive autocorrelation coefficients of the residuals. Their null hypothesis is that the regression residuals are independently distributed. The statistic of the test of Box and Pierce (1970) is

$$Q_{\mathrm{BP}}(p) = T\sum_{k=1}^{p}\hat{\rho}_k^2 \sim \chi^2(k). \tag{B.6}$$

The null hypothesis of the test is accepted if $Q_{\mathrm{BP}}(p) \leq \chi^2_\alpha(p)$, where α denotes the level of significance of the test. As for the test of Ljung and Box (1978), its statistic is

$$Q_{\mathrm{LB}}(p) = T(T+2)\sum_{k=1}^{p}\frac{\hat{\rho}_k^2}{T-k} \sim \chi^2(k) \tag{B.7}$$

and the null hypothesis is rejected if $Q_{\mathrm{LB}}(p) > \chi^2_\alpha(p)$.

B.1.4 Correcting for Serial Correlation

A way of correcting a model from serial correlation is to perform the transformation of Cochrane and Orcutt (1949).

In the case of first-order serial correlation, this transformation consists in subtracting from both sides of the original model ρ times its first lag.

$$y_t - \rho y_{t-1} = (\mathbf{x}_t - \rho\mathbf{x}_{t-1})'\boldsymbol{\beta} + \varepsilon_t \tag{B.8}$$

To fit the transformed model (B.8), the OLS estimate obtained from (B.3) is often assigned to ρ. Hildreth and Lu (1960) suggested running the regression (B.8) repeatedly, for values of ρ between -1 and 1, in order to select the estimate of $\boldsymbol{\beta}$ that yields the lowest residual sum of squares.

In the case of higher-order serial correlation, the transformation of Cochrane and Orcutt can be applied either in one go or by steps. Assume a serial correlation of order 2, that is, $u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \varepsilon_t$, which implies

$$\begin{aligned}\varepsilon_t &= (1 - \rho_1\mathrm{L} - \rho_2\mathrm{L}^2)u_t \\ &= (1-\theta_1\mathrm{L})(1-\theta_2\mathrm{L})u_t\end{aligned} \tag{B.9}$$

where L denotes the lag operator. The coefficients of the lag polynomial, ρ_1 and ρ_2, are related to θ_1 and θ_2 as follows $\rho_1 = \theta_1 + \theta_2$ and $\rho_2 = \theta_1\theta_2$. Given (B.9), the econometric model (B.1) can be written as follows.

$$\begin{aligned}y_t &= \mathbf{x}_t'\boldsymbol{\beta} + (1-\rho_1\mathrm{L}-\rho_2\mathrm{L}^2)^{-1}\varepsilon_t \\ &= \mathbf{x}_t'\boldsymbol{\beta} + \left[(1-\theta_1\mathrm{L})(1-\theta_2\mathrm{L})\right]^{-1}\varepsilon_t\end{aligned} \tag{B.10}$$

Applying the Cochrane-Orcutt transformation in one go consists in multiplying both sides of the above model by the lag polynomial, which gives.

$$y_t - \rho_1 y_{t-1} - \rho_2 y_{t-2} = (\mathbf{x}_t - \rho_1\mathbf{x}_{t-1} - \rho_2\mathbf{x}_{t-2})'\boldsymbol{\beta} + \varepsilon_t \tag{B.11}$$

Applying the Cochrane-Orcutt transformation in two steps can be done in the following way.

$$1^{st} \text{ step: } y_t - \theta_1 y_{t-1} = (\mathbf{x}_t - \theta_1 \mathbf{x}_{t-1})' \boldsymbol{\beta} + u_t - \theta_2 u_{t-1}$$

$$y_t^* = \mathbf{x}_t^{*'} \boldsymbol{\beta} + u_t - \theta_2 u_{t-1} \tag{B.12a}$$

$$2^{nd} \text{ step: } y_t^* - \theta_2 y_{t-1}^* = (\mathbf{x}_t^* - \theta_2 \mathbf{x}_{t-1}^*)' \boldsymbol{\beta} + \varepsilon_t. \tag{B.12b}$$

B.2 Heteroskedasticitty

The two tests for heteroskedasticity performed herein are: the test of Breusch-Pagan and that of White.

B.2.1 The Breusch-Pagan Test

The general auxiliary regression model of the Breusch-Pagan test is

$$\hat{u}_t^2 = \mathbf{z}_t' \boldsymbol{\gamma} + \varepsilon_t,$$

where $\hat{u}_t^2$ is used as a proxy for the variance. Replacing $\mathbf{z}_t$ with the lagged squared residuals, this test can be used to detect the presence of autoregressive conditional heteroskedasticity (ARCH). The ARCH effect of order one in the residuals of model (B.1) takes the form

$$\hat{u}_t^2 = \gamma_0 + \gamma_1 \hat{u}_{t-1}^2 + \varepsilon_t. \tag{B.13}$$

Thus, the hypotheses of the Breusch-Pagan test are:

$\mathrm{H}_0: \ \gamma_1 = 0$ (homoskedasticity),

$\mathrm{H}_A: \ \gamma_1 \neq 0$ (presence of ARCH effect of order 1 in the residuals).

Its statistic, $(T-1)R^2$, follows the χ^2 distribution with 1 degree of freedom. The null hypothesis of homoskedasticity is rejected, when $(T-1)R^2 > \chi^2_\alpha(1)$.

B.2.2 The White Test

Consider model (B.1). To test for heteroskedasticity, White (1980) proposed to regress its squared residuals on the explanatory variables $\mathbf{x}_t$, their squares, and their cross products

$$\hat{u}_t^2 = \mathbf{x}_t' \boldsymbol{\delta} + \sum_{i=1}^{k'} \sum_{j=i}^{k'} \gamma_{i,j} x_{i,t} x_{j,t} + \varepsilon_t. \tag{B.14}$$

where $k' = k - 1$, that is, the number of regressors excluding the intercept term. The coefficient of determination of the auxiliary regression (B.14) is used to compute the statistic of the test of White, which is $T \times R^2 \sim \chi^2_\alpha(K')$ where $K' = k' + (k'+1)k'/2$. The null hypothesis of homoskedasticity is rejected when $T \times R^2 > \chi^2_\alpha(K')$.

The variance of the parameters of model(B.1) are inconsistent in the presence of heteroskedasticity. To make heteroskedasticity-robust inference, the OLS covariance matrix, $(1/T)\sum_{t=1}^{T}\hat{u}_t^2\mathbf{x}_t\mathbf{x}_t^{'}$, can be replaced with the estimator of White (1980).

$$\widehat{\text{cov}}(\hat{\beta}) = \left(\sum_{t=1}^{T}\mathbf{x}_t\mathbf{x}_t^{'}\right)^{-1}\left(\sum_{t=1}^{T}\hat{u}_t^2\mathbf{x}_t\mathbf{x}_t^{'}\right)\left(\sum_{t=1}^{T}\mathbf{x}_t\mathbf{x}_t^{'}\right)^{-1} \tag{B.15}$$

The square root of the diagonal elements of relation (B.15) are referred to as heteroskedasticity-consistent standard errors.

C Some F-Tests

This test is used to compare two models, one of which is nested in the other. Consider the econometric models (C.1a) and (C.1b),

$$y_t = \mathbf{x}_{1,t}^{'}\boldsymbol{\beta}_1 + \mathbf{x}_{2,t}^{'}\boldsymbol{\beta}_2 + u_t \tag{C.1a}$$

$$y_t = \mathbf{x}_{1,t}^{'}\boldsymbol{\beta}_1 + v_t \tag{C.1b}$$

where $\mathbf{x}_{i,t}$ and $\boldsymbol{\beta}_i$ $(i = 1, 2)$ are $k_i \times 1$ vectors of explanatory variables and parameters, and u_t and v_t are error terms. The latter model that is determined only by $\mathbf{x}_{1,t}$ is nested in the former that has both $\mathbf{x}_{1,t}$ and $\mathbf{x}_{2,t}$ as explanatory variables. For this reason, (C.1a) is referred to as the unrestricted model and (C.1b) as the restricted model. F-test can be used to check the joint significance of the coefficients on the additional variables $\mathbf{x}_{2,t}$.

$$\text{H}_0: \ \boldsymbol{\beta}_2 = \mathbf{0}$$

$$\text{H}_A: \ \boldsymbol{\beta}_2 \neq \mathbf{0}$$

The statistic of the F-test is

$$\begin{aligned} F &= \frac{RSS_r - RSS_u}{RSS_u}\frac{T - k_1 - k_2}{k_2} \\ &= \frac{R_u^2 - R_r^2}{1 - R_u^2}\frac{T - k_1 - k_2}{k_2} \end{aligned} \tag{C.2}$$

where RSS_u and RSS_r denote respectively the residual sum of squares of the unrestricted and the restricted models, and R_u^2 and R_r^2 their respective coefficient of determination. The statistic F follows an F distribution with degrees of freedom k_2 and $T - k_1 - k_2$. When $F \leq F_\alpha(k_2, T - k_1 - k_2)$, the null hypothesis (*i.e.* the coefficients $\boldsymbol{\beta}_2$ on the additional variables are all zero) is accepted at the α level of significance, which means that the increase in the coefficient of determination that results from including the additional variables $\mathbf{x}_{2,t}$ is not significant. Otherwise, the alternative hypothesis is accepted.

Two applications of the F-test are presented below: the tests for causality and for exogeneity.

C.1 Testing for Causality

Consider the econometric model

$$FDIO_t = \alpha + \beta FDII_t + u_t, \tag{C.3}$$

where the variables $FDII_t$ and $FDIO_t$ denote respectively the foreign direct investment inflows and the foreign direct investment outflows at time t, and u_t is the stochastic disturbance. After estimating (C.3), the statistical significance of the slope parameter $\hat{\beta}$ or the goodness of fit of the model (measured by the coefficient of determination R^2) only informs about the correlation between the variables $FDII_t$ and $FDIO_t$. They do not say anything about whether one causes the other or whether both are mutually dependent. A way of finding out this is to perform the causality test of Granger (1969).

The unrestricted models to estimate for the causality test are.

$$FDII_t = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} FDII_{t-j} + + \sum_{j=1}^{p} \gamma_{1j} FDIO_{t-j} + u_{1t} \tag{C.4a}$$

$$FDIO_t = \alpha_2 + \sum_{j=1}^{p} \beta_{2j} FDII_{t-j} + + \sum_{j=1}^{p} \gamma_{2j} FDIO_{t-j} + u_{2t}. \tag{C.4b}$$

The restricted models to estimate are

$$FDII_t = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} FDII_{t-j} + u_{1t} \tag{C.5a}$$

$$FDIO_t = \alpha_2 + \sum_{j=1}^{p} \gamma_{2j} FDIO_{t-j} + u_{2t}. \tag{C.5b}$$

According to the unrestricted model (C.4a) $FDII_t$ is explained by its own past values and the past values of $FDIO_t$, whereas according to the restricted model (C.5a) $FDII_t$ is determined only by its own past values. The following two hypotheses are set in order to test whether $FDIO_t$ causes $FDII_t$

$\mathrm{H}_0: \ \gamma_{11} = \cdots = \gamma_{1p} = 0$ ($FDIO_t$ does not cause $FDII_t$),

$\mathrm{H}_A: \ \gamma_{11} \neq 0, \ldots,$ or $\gamma_{1p} \neq 0$ ($FDIO_t$ causes $FDII_t$).

Following (C.2), the test statistic is

$$F_1 = \frac{T-2p-1}{p} \frac{RSS_{r1} - RSS_{u1}}{RSS_{r1}} = \frac{T-2p-1}{p} \frac{R_{u1}^2 - R_{r1}^2}{1 - R_{u1}^2}$$

where RSS_{u1}, and R_{u1}^2 denote respectively the residual sum of squares and the determination coefficient of the unrestricted model (C.4a), whereas RSS_{r1} and R_{r1}^2 designate respectively the residual sum of squares and the determination coefficient of the restricted model (C.5a). This test statistic follows an F-distribution and its critical value for a given level of significance is denoted $F(p, T-2p-1)$. If $F_1 \leq F(p, T-2p-1)$, the restricted model (C.5a) is accepted, which means that $FDIO_t$ does not cause $FDII_t$. On the other hand, if $F_1 > F(p, T-2p-1)$, the unrestricted model (C.4a) is plausible.

To test whether $FDII_t$ Granger causes $FDIO_t$, a similar test is carried out, with (C.4b) as the unrestricted model and (C.5b) as the restricted model. The test hypotheses are:

$$\text{H}_0: \ \beta_{21} = \cdots = \beta_{2p} = 0 \ (FDII_t \text{ does not cause } FDIO_t),$$

$$\text{H}_A: \ \beta_{21} \neq 0, \ldots, \text{ or } \beta_{2p} \neq 0 \ (FDII_t \text{ causes } FDIO_t).$$

The test statistic becomes $F_2 = (T-2p-1)(RSS_{R2} - RSS_{U2})/(p.RSS_{U2})$ and the decision rules are the same as before.

After performing these two tests, one will end up with one of the following four cases:

- There is a unidirectional causality from $FDIO_t$ to $FDII_t$: the first test reveals that $FDIO_t$ Granger causes $FDII_t$ and the second test reveals that $FDII_t$ does not Granger cause $FDIO_t$.
- There is a unidirectional causality from $FDII_t$ to $FDIO_t$: the first test reveals that $FDIO_t$ does not Granger causes $FDII_t$, but the second test reveals that $FDII_t$ Granger causes $FDIO_t$.
- The variables $FDII_t$ and $FDIO_t$ are mutually dependent: the first test indicates causality from $FDIO_t$ to $FDII_t$ and the second test also indicates causality from $FDII_t$ to $FDIO_t$.
- The variables $FDII_t$ and $FDIO_t$ are independent: the two tests reject the existence of causality.

Table C.1 reports the statistics of the Granger causality test. The number of lags in the models has been selected using the BIC.

C.2 Testing for Exogeneity

Consider the econometric models (3.4) and (3.5b). To estimate these models using the 2SLS method, it has been assumed that the variables FDI inflows, $FDII_t$, and real GDP, GDP_t, are mutually dependent. To check this assumption, the test for exogeneity of Hausman can be performed on each of the two structural equations (see Maddala, 1992, p 395, among others). The purpose of the test for exogeneity performed on the structural equation (3.4) is to check whether the variable GDP_t should actually be treated as exogenous. To do this, the F-test will be carried out using (3.7) as a restricted model. The unrestricted model is given by relation (C.6).

$$\begin{aligned} FDII_t = {} & \beta_0 + \alpha_2 GDP_t + \beta_2 GDP_{t-1} + \alpha_3 DO_t + \beta_3 DO_{t-1} \\ & + \alpha_4 REER_t + \beta_4 REER_{t-1} + \alpha_5 R_t + \beta_5 R_{t-1} \\ & + \alpha_6 LC_t + \beta_6 LC_{t-1} + \varphi FDII_{t-1} + \eta_1 \widehat{GDP}_t + \upsilon_t^*, \end{aligned} \tag{C.6a}$$

Table C.1: Test for Causality between FDI Inflows and Outflows: F-Statistics

Country	Variables		Lag Length	Model (C.4a) vs (C.5a)			Model (C.4b) vs (C.5b)		
				R^2_{u1}	R^2_{r1}	F_1-stat	R^2_{u2}	R^2_{r2}	F_2-stat
Australia	$\Delta FDIO_{1t}$	$\Delta FDII_{1t}$	10	.940	.556	11.602	.941	.581	11.089
Austria	$FDIO_{2t}$	$FDII_{2t}$	12	.970	.646	11.536	.998	.6423	215.125
Belgium	$FDIO_{3t}$	$FDII_{3t}$	1	.244	.229	.887	.372	.367	.346
Canada	$FDIO_{4t}$	$FDII_{4t}$	3	.750	.559	10.187	.917	.827	14.551
Denmark	$\Delta FDIO_{5t}$	$\Delta FDII_{5t}$	12	.920	.511	5.088	.951	.552	8.177
Finland	$FDIO_{6t}$	$\Delta FDII_{6t}$	2	.464	.439	.982	.496	.221	11.488
France	$FDIO_{7t}$	$FDII_{7t}$	1	.391	.332	4.446	.612	.5222	10.613
Germany	$\Delta FDIO_{8t}$	$\Delta FDII_{8t}$	12	.965	.446	14.911	.954	.457	10.917
Italy	$FDIO_{9t}$	$FDII_{9t}$	11	.938	.507	10.163	.959	0.576	13.711
Japan	$\Delta FDIO_{10,t}$	$\Delta FDII_{10,t}$	2	.164	.115	1.242	.464	.136	12.884
Netherlands	$\Delta FDIO_{11,t}$	$FDII_{11,t}$	11	.976	.671	17.123	.988	.676	35.707
New Zealand	$FDIO_{12,t}$	$\Delta FDII_{12t}$	2	.258	.218	1.122	.351	.314	1.216
Spain	$FDIO_{13,t}$	$FDII_{13,t}$	12	.992	.601	56.911	.980	.697	15.570
Sweden	$\Delta FDIO_{14,t}$	$FDII_{14t}$	2	.350	.315	1.115	.531	.156	16.80
UK	$FDIO_{15,t}$	$\Delta^2 FDII_{1t}$	1	.357	.321	2.484	.312	.310	.123
US	$FDIO_{16,t}$	$FDII_{16,t}$	9	.882	.791	1.882	.947	.674	12.647

$$v_t^* = \beta_1 \Delta GDP_t + \eta_2 \Delta \widehat{GDP}_t + v_t \tag{C.6b}$$

where $\widehat{GDP}_t$ denotes the fitted value of GDP_t from the reduced-form equation. The test hypothesis is:

$$\text{H}_0: \ \eta_1 = \eta_2 = 0$$

$$\text{H}_A: \ \eta_1 \neq 0 \text{ or } \eta_2 \neq 0$$

Models (C.6) and (3.7) have been fitted by constrained optimization. The residuals sum of squares are collected and the F-ratio computed as seen in relation (C.2). If η_1 or η_2 proves to be statistically different from 0, then GDP_t is actually endogenous; otherwise it is not.

To check whether $FDII_t$ should be treated as an endogenous variable in the structural equation of GDP, the same procedure will be followed. The restricted model of the test will be (3.8). The unrestricted model and the hypotheses to test are the following.

$$GDP_t = \gamma_0 + \gamma_1 FDII_t + \gamma_2 G_t + \gamma_3 TB_t + \delta \widehat{FDII}_t + w_t \tag{C.7}$$

$$\text{H}_0: \ \delta = 0$$

$$\text{H}_A: \ \delta \neq 0$$

The estimates of the parameters of the models and the results of the diagnostic tests are displayed in Tables C.2 and C.3. The results of the tests for exogeneity of the variables $FDII_t$ and GDP_t are reported in Table C.4. The variable GDP_t can be treated as exogenous in the structural equation of FDI inflows, because the statistic F on the first row of Table C.4 is lower than the 5% critical value of the test, $F_{5\%}(2, 185) = 3.04$.

Table C.2: Transformed Structural Equations of the Variable $FDII_t$

Parameter	Variable Transformed	Unrestricted Model (C.6)		Restricted Model (3.7)	
		coef	z-score	coef	t-ratio
I(1) Variables					
α_0	Intercept	-26.257	-20.360	-26.176	-19.979
α_2	GDP_t	8.081	1.315		
	$\widehat{GDP}_t$			2.146	3.334
α_4	$REER_t$	.399	.461	.423	.490
α_5	R_t	.079	1.764	.083	1.876
α_6	LC_t	-.602	-.810	-.666	-.903
λ	$\Delta GDP_t - \Delta GDP^e_{t-1}$	.376	6.791	.381	6.869
η_1	$\widehat{GDP}_t$	-2.245	-.960		
I(0) Variable					
α_1	ΔGDP^e_t	-.439	-.064	3.680	.987
η_1	$\Delta\widehat{GDP}_t$	.337	.049		
ρ		-.445		-.435	
R^2		.663		.657	
$\bar{R}^2$		.643		.639	
$Q_{\mathrm{BP}}(4)$		.407		.327	
$Q_{\mathrm{LB}}(4)$		.417		.335	
Breusch-Pagan stat		.001		.001	
White stat		29.489		26.048	
ADF (1) stat		-9.953		-9.861	

Critical values: $t_{5\%}(192) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(4) = 9.49$, $\chi^2_{5\%}(27) = 40.11$

This conclusion is not surprising, as the coefficient of determination of the reduced-form equation of the real GDP is almost equal to one (see Table 3.3). This implies that estimating (3.4) using either the variable GDP_t or the fitted values of its reduced-form equation yields almost the same results. On the other hand, the variable $FDII_t$ cannot be treated as exogenous in the structural equation of the real GDP, as the F-statistic on the second row of Table C.4 is much greater than its 5% critical value, $F_{5\%}(2, 185) = 3.89$. However, the validity of this latter test might be questioned, because the residuals of the regressions suffer from serial correlation as the tests of Box-Pierce and Ljung-Box suggest (see Table C.3).

Table C.3: Structural Equations of the Variable GDP_t

Parameter	Variable	Unrestricted Model, (C.7)		Restricted Model (3.8)	
		Value	t-ratio	Value	t-ratio
γ_0	Intercept	7.491	34.997	7.491	20.134
γ_1	$FDII_t$	.002	.135		
	$\widehat{FDII}_t$			.381	7.612
γ_2	G_t	3.582	5.639	3.582	3.244
γ_3	TB_t	-.072	-6.284	-.072	-3.615
δ	$F\hat{D}II_t$	.379	10.968		
R^2		.787		.353	
$\bar{R}^2$		.783		.347	
$Q_{\text{BP}}(2)$		256.897		64.607	
$Q_{\text{LB}}(2)$		261.368		65.775	
Breusch-Pagan stat		53.368		.002	
White stat		49.730		27.309	
ADF (1) stat		-3.393		-5.273	

Critical values: $t_{5\%}(195) = 1.972$, $\chi^2_{5\%}(1) = 3.84$, $\chi^2_{5\%}(2) = 5.99$, $\chi^2_{5\%}(9) = 16.92$

Table C.4: Statistics of the Tests for Exogeneity

Structural Equation	R^2_U	R^2_R	F-ratio
$FDII_t$	.657	.663	1.46
GDP_t	.787	.353	391.07

$F_{5\%}(2, 185) = 3.04$, $F_{5\%}(2, 185) = 3.89$

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