FDI, Domestic Investment and Economic Growth: A Theoretical Framework

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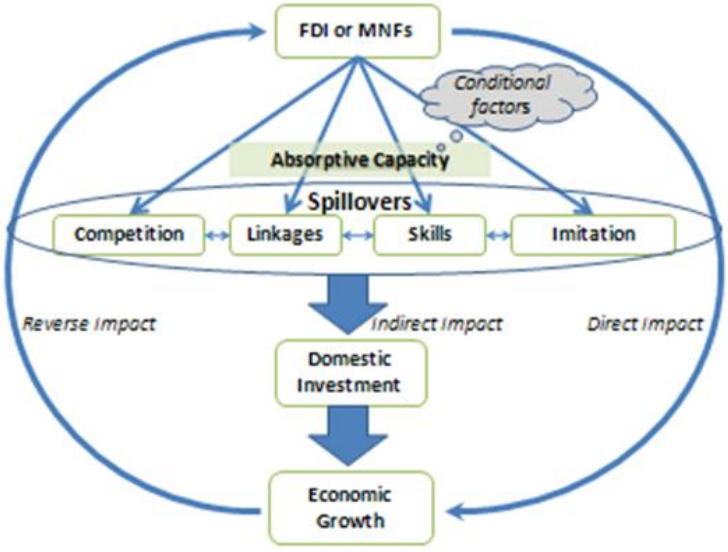
2.1 Introduction

The accumulation of capital is often referred to the amassment of objects of value, the increase in wealth or the creation of wealth. Conventional wisdom posits capital formation as pre-requisites for economic growth and development.[1] The present study concentrates on the impacts of foreign capital formation (or FDI) on a host country's domestic investment and growth, outcomes. In this vein, existing literature proposes several channels between FDI and economic growth. These are shown in figure 2.1.

Figure 2.1: Channels from FDI to economic growth



Source: Author

The above figure depicts the FDI-growth nexus. The nature of the relationship is decomposed into three main impacts, namely: (1) the *direct impact*; (2) the *indirect impact*; and (3) the *reverse impact*. The *direct impact* is shown by the arrow flowing directly from FDI to growth. In a production function, i.e. Q = f(L, K), this implies that FDI directly causes output through amassment of tangible assets (or increase in K). The *direct impact* of FDI is explained using the

[1] For instance, non-financial and financial capital formation is usually needed for economic growth, since additional production usually requires additional investment to enlarge the scale of production.

neoclassical model in section 2.2.1. However, indentifying the *direct impact* only gives a partial understanding of the FDI-growth nexus. Thus, it is important to see beyond the *direct impact* of FDI. In section 2.2.2, the new growth theorists are reviewed to justify the importance of the *indirect impact* associated with FDI.

Moreover, the *indirect impact* is shown in the figure by four arrows emanating from FDI to a "ring of spillovers".[2] The four arrows represent four main channels of FDI spillovers, namely: competition; linkages, skills, imitation. The "ring of spillovers" implies the total spillovers generated by FDI, which is assumed to depend on the absorption capacity.[3] Note, absorption capacity is said to be determined by a *cloud* of conditional factors, which are discussed in section 2.5.1. From the figure, the *indirect impact* is shown by the filled arrow moving from the "ring of spillovers" to domestic investment and, finally, to economic growth, this is explained in section 2.2.3. Finally, the *reverse impact* is said to occur if instead economic growth leads to FDI. The existence of reverse impact has been shown by studies that have investigated causality between FDI and economic growth.[4]

The chapter is organized as follows:

Section 2.2: Gives an overview of the theoretical literature. The literature is interpreted in terms of the direct and indirect impacts of FDI.

Section 2.3: Deals with the empirical literature on FDI, domestic investment and growth. In addition, it justifies grounds for FDI spillovers and the role absorptive capacity in determining FDI spillovers

Section 2.4: Provides an assessment of the literature on economic growth and/or domestic investment. This section paves the way forward of this study

Section 2.5: Proposes a new theoretical model to explain the relationship between FDI, domestic investment and economic growth.

Section 2.6: Summarises the main findings of the study, commenting on some implications.

[2] The term "ring of spillovers" is put forward in this study to imply strong positive correlation among the four channels of spillovers

[3] Where, absorptive capacity is defined as a measure that determines a country's ability to generate and/or absorb FDI spillovers.

[4] For example, Choe (2003), Chakraborty (2004), Gao (2005), Blomstrong et al. (1996), have shown that economic growth robustly causes FDI.

2.2 Theoretical Review

2.2.1 The Direct Impact – A Neoclassical Model

Early studies on economic growth commonly used the aggregate production function approach.[5] They attempted to describe the relationship between an economy's output and tangible primary inputs (or capital and labour). In particular, the seminal papers of Solow (1956, 1957) formed the basis for much of applied growth analysis within the neoclassical model. Notably, these studies integrated the aggregate production function using macroeconomic data. The role of investment in this framework can be summarized by the following two equations.

The first equation depicts an aggregate production function showing the relationship between output (Y), capital input (K), labour input (L), and "Hicks-neutral" technology[6] (A):

$$Y = A*f(K,L) \qquad [1]$$

The second equation, commonly known as capital accumulation equation, explores the relationship between investment in tangible assets (I), and capital stock (K):

$$\Delta K_t = I_t - \alpha K_{t-1} \qquad [2]$$

Where Δ represents a discrete change, α is depreciation, and I_t is the gross investment. It is worth noting, that the gross investment term can either be endogenously determined by profit maximizing firms or assumed to be some fixed proportion of output, say sY_t. Also, the neoclassical model assumes competitive factor markets and constant returns to scale where all inputs are paid their marginal products. Decomposition of the production function relates output growth as a weighted function of change in primary inputs (i.e. K and L) and multi factor or the famous cited as the "Solow residual" (or ΔlnA):

$$\Delta lnY = \beta_k \Delta lnK + \beta_L \Delta lnL + \Delta lnA \qquad [3]$$

Where β_k is capital's share of output, is β_L labour's share of output, and the neoclassical assumptions imply $\beta_k + \beta_L = 1$. The technology term, A, is assumed to be exogenous to the model and is described in equation [4]:

[5] See Cobb Douglas (1928), Tinbergen (1942), and Solow (1956, 1957).

[6] Following Hicks (1932), a technological innovation is Hicks neutral if the ratio of marginal product of capital to marginal product of labour is unchanged for a given capital to labour ratio. That is, Y = A*f(K,L)

$$A = A_0 e^g \qquad [4]$$

The appealing simplicity of this neoclassical framework has made it the backbone of applied and theoretical work on capital accumulation and economic growth. Equation [2] and [3] show the direct link between investment in tangible assets and economic growth. In particular, in this model capital accumulation contributes to economic growth in proportion to capital's share of national output. Despite its popularity, however, the neoclassical model leads to several troubling results. First, because capital accumulation is subject to diminishing returns, without exogenous technical progress steady growth in per capital income cannot be realised. This is a major flaw of the model since it does not explain technical progress at all. Moreover, despite being totally unexplained, Solow (1957) attributed 90% of U.S per capita output growth to exogenous technical progress. Other limitations of the neoclassical model are associated with the definition of the term capital accumulation. The Solow's model considers investment to be purely in tangible assets. Recently, much more has been discussed on the definition of capital itself. For instance, Mankiw (1995) stated that "there is an increasing consensus that the role of capital in economic growth should be broadly interpreted" (p. 308). In addition, Jorgenson (1996) contended: "Investment is the commitment of current resources in the expectation of future returns and can take a multiplicity of forms…" (p. 57).

2.2.2 Beyond the Direct Impact – The New Growth Theory

> A developing economy that succeeds in permanently increasing its saving (investment) rate will have a higher level of output than if it had not done so, and must therefore grow faster for a while. But it will not achieve a permanently higher rate of growth of output. More precisely: the permanent rate of growth of output per unit of labor input is independent of the saving (investment) rate and depends entirely on the rate of technological progress in the broadest sense.
>
> *Robert M. Solow (1987)*[7]

Although the contribution of Solow (1956, 1957) to the theory of economic growth has been rewarded with Noble Prize in 1987, the new growth theory devoted a lot of efforts in improving the Solow's model. The fact that the neoclassical model reported a sizeable impact of technological progress on economic growth, the challenge for the new school was to explore the determinants and impacts of technological progress. The new growth theory mainly focused on

[7] Robert M. Solow (1987) in Nobel lectures, Economics 1981-1990, Editor Karl-Göran Mäler, World Scientific Publishing Co., Singapore

the creation of technological knowledge and its transmission. In particular, it emphasized on incentives that drive innovation, invention, and creation as a main engine of growth.[8]

Seminal studies of the new growth school comprised Arrow (1962), Shell (1966) and was reviewed by Romer (1986, 1990), Lucas (1988), Grossman and Helpman (1991). The models generally assumed constant returns to scale to inputs (i.e. capital and labour) and the level of technology was assumed to depend on a set of inputs. For instance, Arrow (1962) explained investment in tangible assets as generators of spillovers, i.e. technology is a direct function of capital. He used past gross investment to derive a learning-by-doing model. The can model can be written in simplified form as equation 5.[9]

$$Y_i = A(K)*f(K_i, L_i) \qquad [5]$$

Where: i – represents firm-specific variables capital (K_i) and labour (L_i),
K – refers to the aggregate capital stock, and
$A(K)$ – is the technology function.

In contrast, Romer (1986) specified technological progress, A(.), as a function of the stock of research and development. Romer (1986) assumed investment in knowledge to generate natural externalities. He stated: "The creation of new knowledge by one firm is assumed to have a positive external effect on the production possibilities of other firms because knowledge cannot be perfectly patented or kept secret" (p. 1003). Moreover, Lucas (1988) modeled A(.) as a function of the stock of human capital and stated that "I want to consider the external effect. Specifically, let the average level of skill or human capital…also contribute to productivity of all factors" (p. 18). Additionally, Coe and Helpman (1995) explained A(.) as dependent on the research and development stock of international trading partners. They stated that "when a country has free access to all inputs available in the world economy, its productivity depends on the world's R&D experience" (p. 862). Finally, Barro (1990) claimed that capital and government services are complementary inputs in order to generate constant returns to scale. He also pointed out that increasing capital alone is subject to diminishing returns.

[8] See Aghion and Howitt (1998) for a detailed survey of the new growth theory.
[9] Adapted from Romer (1994) who simplified the evolution of the endogenous growth models.

The glass-ceiling between the neoclassical model and the new growth theory is the technology function. While the former assume technological progress to be exogenous, the latter explains technological progress as a form of investment spillover arising from different sources, for example: tangible capital, human capital, or research and development expenditures. More importantly, however, both the neoclassical and the new growth models defined capital accumulation (or formation, in the latter's case), as key ingredients to growth. Based on the arguments, it can be deduced that if FDI contributes to both growth (d*irect impact*) and domestic investment (*indirect impact*), then its overall impact can be substantial. Thus, depending on the size and level of spillover it creates, FDI represents a potential source for sustainable growth and development. The next section devotes attention to explain the indirect impact of FDI. In other words, the existence of FDI spillovers, as depicted in figure 2.1, are scrutinized.

2.2.3 The Indirect Impact or FDI Spillovers

According to Lipsey (2002), the main reason to examine FDI spillovers from MNFs to indigenous firms is to understand the contribution of inward FDI to host country economic growth. Country level experiences suggest two types of FDI spillovers, namely: negative and positive.

a. Negative Spillovers

Early theories on FDI and spillovers on host economies were advocated by the dependency theorists. Basically, dependency scholars viewed FDI from the developed countries as harmful to the long-term economic growth of developing nations. Previous studies on FDI, such as Singer (1950) and Prebisch (1968) claimed that the target countries of FDI receive very few benefits, because most benefits are transferred to the multinational firm's (MNF) country. Bos *et al.* (1974) identified other factors that caused the negative effects of FDI on growth, such as: price distortions due to protectionism; market monopolization; and, natural resources depletion. Dependency scholars' contended that MNFs are "imperialist predators" that exploited developing countries and caused underdevelopment of the world economy periphery.[10] More recently, UNCTAD (1999) supported this view and argued that MNFs had often been involved in the exploitation of natural resources and, therefore, FDI can be assumed to be of an extractive nature.

[10] Ghosh (2001) and Brewer (1990) survey influential studies of the dependency school.

However, empirical studies does not warrant the views expressed by the dependency school. Hein (1992), using data from 41 lower and upper middle income African, Central American, Latin American, East Asian, and Caribbean countries between the 1960s and 1970s, does not support the dependency theory. He showed that Latin American countries that pursued import substitution strategies and restricted entry of foreign investment in the 1970s showed poor economic performance. In contrast, East and Southeast Asian countries that encouraged foreign investment inflows witnessed rapid economic growth during the 1970s and 1980s. Moreover, Firebaugh (1998) found that LDCs with greater rates of foreign investment tend to exhibit faster rates of both long run and short-run economic growth. The contradicting results contributed to the critics of the dependency school and helped to shift attention from the negative effects of FDI to the potentials of FDI.

b. Positive Spillovers

Models on FDI and positive-spillovers emerged in 1970s. The seminal study by Hymer (1976) postulated international differences across firms at scientific and technological levels as a source of technology transfer and spillovers. By assuming FDI to represent the transfer of a "package" in which capital, management, and new technology are all combined, Hymer characterized FDI as an international extension of industrial organization theory. Caves (1971, 1974) and Kindleberger (1984) extended the industrial organization theory of FDI to emphasize on the behaviour of MNFs. According to them, MNFs face alien-territory disadvantages when going international.[11] Therefore, a firm only undertakes production in an alien territory only when it enjoys some advantage over potential domestic competitors. Other theoretical works mainly include Koizumi and Kopecky (1977), Findlay (1978), Das (1987), and Wang and Blomstrom (1992). Koizumi and Kopecky (1977) pioneered a model to explain technology transfer from a parent firm to its subsidiary. In this case, technology transfer was assumed to be a positive function of the level of foreign capital stock in the host country.

Similar to the convergence theory, Findlay (1978) explained that technology transfer tends to converged between developed and developing countries. His model assumed technology transfer to depend on two factors: first, the relative development gap between the home and the host

[11] Such disadvantages usually include geographic distance and cultural differences in comparison to indigenous firms

countries; and second, the share of FDI stock to domestic private capital stock. Das (1987) developed a model to address the transfer of technology from a parent firm to its subsidiary abroad using a price-leadership model from oligopoly theory. The core assumption in this model is that domestic firms' efficiency is an increasing function of the MNFs business activities, i.e. the larger the scale of MNF operation the greater the opportunity for domestic firms to learn. Wang and Blomstrom (1992) developed a model to explain technology transfer from a parent company to its foreign subsidiaries. Wang and Blomstrom (1992) showed that technology transfer is positively related to the efficiency of a indigenous firms' and the level operation risks in the host country (i.e. political instability, poor macroeconomic environment). However, they concluded that some technology transfer always takes place irrespective of the subsidiary's active learning effort. Finally, Walz (1997) incorporated FDI into an endogenous growth framework to show that production activities of MNFs in low-wage countries improve productive efficiency. In addition, FDI tends to encourage domestic R&D.

According to Blomstrom and Kokko, (1998) spillovers occur when the entry or presence of MNF contributes to the productivity or efficiency benefits of indigenous firms. The literature identifies four main channels of technological spillovers from MNFs to indigenous firms, namely: (i) *"learning by watching"*; (ii) *competition*; (iii) *labour mobility*; and (iv) *linkage*.

(i) Competition

The second spillover channel occurs if the presence of MNFs increases competition locally. Suppose that the presence of MNFs increases domestic competition, then, to stay competitive, indigenous firms are forced to use existing resources more efficiently or to adopt new technologies. This ensures that indigenous firms operate more efficiently than in the absence of MNF (Kokko, 1994, 1996; Wang and Blomstrom, 1992; and Perez 1998). De Mello (1997, 1999) argued that FDI tends to promote the use of more advance technologies by indigenous firms.

Caveat 1

However, the competition channel may also work in a reverse way. For instance, Ram and Zhang (2002) pointed out that FDI may negatively affect domestic firms, since domestic firms will struggle to compete with the powerful MNFs. This argument is indeed valid for developing countries where local firms may be weak in responding competitively to MNFs. In contrast, the

local firms in industrialized countries are in a better situation to reply more competitively. In practice, the impact of FDI on local competition and/or market structure depends on the size of the technology, gap and the entry and exit behaviour in the market.[12]

(ii) Linkages

FDI-spillover arising from linkages may occur in two ways. First, MNF can have productivity spillover on indigenous firms in the same industry (horizontal spillovers). Second, MNF can have productivity spillover on indigenous firms in upstream and downstream industries, also known as vertical (or forward and backward), spillovers. These linkages effects have been discussed by Lall (1978) and Clare (1996). Borensztein et al. (1998) argued that FDI increases the range and quality of intermediate goods, which in turn increases productivity. Blomstrom and Kokko (1996) provide a survey of studies addressing "complementary activities" arising through backward linkages.

Caveat 2

There is much evidence of the existence of backward linkages and a suspicion about the significance of forward linkages. In addition, linkages between MNF and indigenous firms are very likely to be subject to time, the skill level of local entrepreneurs, supply and purchasing practices, and local content.

(iii) Skills

FDI also causes spillovers through the know-how and skills that it brings into the host country. By transferring knowledge, FDI increases the stock of knowledge in the host country through labour training, transfer of skills, and the transfer of managerial and organizational best practices. It can be argued that spillover effect occurs when workers and managers employed in foreign affiliates who have been trained with advanced technical and managerial skills move to other domestic firms or open their own enterprises (Fosfuri, 1996). Theoretical work has generally predicted positive effects of FDI presence on domestic firms' productivity through the labour mobility channel (Kaufmann, 1997; Haaker, 1999; Fosfuri, Motta, and Rønde, 2001; Glass and Saggi, 2002).

[12] Presence of MNF with advantages on technology and know-how may harm indigenous firms and result in the, so-known, 'market stealing effects'.

Caveat 3

While it is agreed that MNFs firm generates positive spillovers via the labour mobility channel, it can be argued that instead of training local workers, MNFs may skim the market of well-trained workers and free-ride on previous training provided by domestic firms.

(iv) Imitation or "Learning by Watching"

The simplest example of spillover is conceivably the case where an indigenous firm improves its productivity by imitating the technology used by MNFs. The imitation effect is also known as demonstration effect or learning-by-watching effect (Gunther, 2002). According to Wang and Blomstrom (1992) as new technologies are introduced by MNFs, indigenous firms experience MNFs actions, skills or techniques and 'imitate' or adopt these techniques resulting in higher productive efficiency. Jenkins (1990, p. 213) notes that "over time, where foreign and local firms are in competition with each other, producing similar products, on the same scale and for the same market, there is a tendency for local firms to adopt similar production techniques to those of the MNFs. Indeed this is part of a general survival strategy, whereby in order to compete successfully with the MNFs local capital attempts to imitate the behavior of the MNFs". Blomstrom and Kokko (1996) provide a survey of previous studies investigating the demonstration effect of FDI on indigenous firms.[13]

Caveat 4

It is important to note that the learning-by-watching effect depends crucially on factors such as the legal system (patents/license), regulations, infrastructure, human capital, and the complexity of the MNFs technology.

2.3 Empirical Review

2.3.1 FDI, Economic Growth & Domestic Investment

On one hand, the influence of FDI on economic growth has been usually assessed through econometric model specifying the rate of growth of real GDP or GDP per capita as a function of the stock or inflow of FDI. On the other hand, the link between FDI and domestic investment been assessed through the crowding-in/crowding-out hypothesis. In both cases, evidence shows

[13] Examples of previous studies include Riedel (1975), Swan, (1973), Tilton (1971), and Lake (1979).

mixed findings on the impacts of FDI on growth and domestic investment. Some important findings are discussed below.

Borensztein *et al.* (1998) studied the effect of FDI on economic growth in a cross country regression framework; they utilized data on FDI flows from developed countries to 69 less developed countries for the two decades, the 1970s and 1980s. Their findings suggest that "FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment". Blomström, Lipsey, and Zejan (1994) found that, among developing countries, from 1960 to 1985, ratios of FDI inflow to GDP in a five- year period were positively related to growth in the subsequent five- year period. They report that the positive impact of FDI on growth is larger in those countries that exhibit higher levels of per capita income. Borensztein, De Gregorio, and Lee (1995) found that FDI inflows marginally affected growth for a sample of 69 developing. Balasubramanyam, Salisu and Sapsford (1996) used a cross-country study procedure to analyse 46 LDCs, in 1970-85. Their results suggest that FDI enhances growth in those cases in which the host country has adopted trade liberalization policies. Zhang (2001) documents similar result.

The panel data analysis of Bengoa *et al.* (2003) for a sample of 18 Latin American countries for 1970-99 shows that FDI is positively correlated with economic growth in the host countries. Borensztein et al. (1995), using a panel data of 69 countries from 1970-1989, found that a minimum human capital threshold was necessary for FDI to have a positive impact on growth. They also found that FDI contributed more to growth than domestic investment. De Gregorio (1992) finds a positive and significant impact of FDI and growth in a panel of 12 Latin American countries over the period 1950-1985.

Country-specific studies that have explore the link between FDI and economic growth includes Mattaya and Veeman (1996) on Malawi; Kabarsi et al. (2000) on Egypt; Ouattara (2005) on Senegal. De Mello (1999) adopted time series and panel data analysis on a sample of OECD and non-OECD countries for the period 1970-90. He claimed that FDI has a positive impact on growth whenever FDI and domestic investment are complements. Roy and Van den Berg (2006) apply a time series data to a simultaneous equation model (SEM) that explicitly captures the bi-directional relationship between FDI and growth in the US. Their findings reveal that FDI plays

a significant, positive and economically important impact on growth. The SEM estimates also reveal that FDI growth is income inelastic. Their findings imply that even in the case of a technologically advanced country such as the U.S gains from FDI are very substantial in the long run. Other studies investigating the FDI-growth nexus, including Lipsey (2000), have mostly concluded that FDI promote growth. For instance, De Mello (1997), Oliva and Rivera-Batiz (2002), and Choe (2003) find significant relationship between FDI and Growth. However, as shown by De Mello (1999) and Nair-Reichert and Weinhold (2001), the direction of the causality is unclear. Dees (1998) found that FDI played an important role in promoting economic growth in China.

Chakraborty and Basu (2002), looking at the case study of India from 1974 to 1996 also found that FDI had a positive and significant impact on growth, both in the short and long run. Finally, Zhang (2001) looking at East-Asia and Latin America from the 1960s to 1997 found mixed evidence on the impact of FDI on growth. While FDI was found to be growth enhancing in the long run in Taiwan, Mexico, Hong Kong, Malaysia, and Indonesia, this was not the case in Columbia, Argentina, Brazil, Korea, Malaysia, Thailand and Singapore (however in Singapore FDI has a positive impact of growth in the short run).

Extract from Melitz (2005), "Individual countries like China and the Republic of Korea have been successful at managing export-oriented FDI in ways that encourage the development of local content and industrial upgrading (UNCTAD, 2002). Conversely, countries like Costa Rica and Mexico, which have attracted export-oriented FDI effectively but have been less active in managing it, have not been able to create significant linkages with local firms"

2.3.2 FDI Spillovers

A central question in the empirical literature has constantly been whether FDI complements or replaces domestic investment. Development economists such as Rosenstein–Rodan (1961) and Chenery and Strout (1966), showed that a unit increase in foreign investment produces and equal increase in private investment. But, Rahman (1968), Griffin and Enos (1970) showed that if investment depends on income, then changes in foreign investment expenditure would cause greater changes in domestic investment, *via* the accelerator mechanism. Recent findings on the links between FDI and domestic investment includes: Fry (1992); Borensztein et *al.* (1998);

Bosworth and Collins (1999); Agosin and Mayer (2000); Lipsey (2000); Braunstein and Epstein (2004).

Most macroeconomic and industry-level find positive correlations between FDI and productivity growth. According to Blomstrong and Kokko (1997), the evidence for spillovers seems to become stronger as MNFs source more of their inputs locally. However, the empirical evidence on FDI and its impact on host countries is ambiguous at both micro and macro level. For example, positive effects of FDI spillovers were reported as part of Caves (1974) pioneering work in Australia, and by Kokko (1994) in Mexico. However, Haddad and Harrison (1993) findings in Morrocco and Aitken and Harrison (1999) in Venezuela do not support the positive spillovers hypothesis. Hanson (2001) argues that the evidence that FDI generates positive spillovers for host countries is weak.

Studies such as, Aitken et al. (1997), Aitken and Harrison (1999), and Saggi (2000) provide mixed evidence that FDI generates positive spillovers for local firms. Kokko et al. (1996) studied Uruguayan manufacturing plants to explore the existence of technology spillovers. They find a positive spillover effect only in the sub-sample of locally-owned plants with moderate technological gap vis-à-vis foreign firms. Other recent work at the microeconomic level, reported positive results for FDI and productivity spillovers (Lipsey and Sjoholm, 2005; Blalock and Gertler, 2005). Yudayeva et al. (2000), Castellani and Zanfei (2001), and Haskel et al. (2002) for example find positive evidence for the existence of spillover benefits from FDI. Conversely, Aitken and Harrison (1999) for Venezuelan firms and Djankov and Hoekman (2000) for Czech Republic firms report negative and insignificant spillovers, respectively.

In a review of micro data on spillovers from MNF to indigenous firms, Lipsey (2002) revealed that there is evidence of positive effects. Lipsey (2002) stated: "*Evidence on spillovers of superior foreign productivity to domestically- owned firms is mixed... However, the mixed story for spillovers, combined with the strong evidence for superior productivity in foreign-owned firms, suggests that overall productivity is improved by the presence of foreign-owned operations...*"

2.3.3 The Role of Absorptive Capacity

The literature often points to the importance of absorptive capacity when determining a country's ability to benefit from FDI. In other words, it is argued that FDI generates "growth effects" only when the business environment/climate is suitable. For instance, if the host economy is not endowed with adequate human capital, public infrastructure, financial institutions, legal environment and the likes, spillovers that may potentially arise from FDI are simply not realised. Blomstrong et *al.* (1992) argued that host country has to be able to absorb new technologies associated with FDI so as to benefit from the FDI. "The host country requires, however, adequate human capital, economic stability and liberalized markets to benefit from long-term capital flows" (Bengoa et *al.*, 2003, p. 529). In fact, controlling for absorptive capacity has been very important in many empirical studies on the FDI-growth link (for example, Blonigen and Wang, 2005; Borensztein et *al.*, 1998; De Mello, 1999). In this section, we explore four main indicators of absorptive capacity.

Human Capital Stock

In a very influential paper, Borensztein et *al.* (1998) tested the effect of FDI on economic growth in a cross-country regression framework and suggested that FDI is a crucial tool in transferring technology, but the effectiveness of FDI depends on the stock of human capital in the host country.[14] They reported that FDI positively contribute to growth only in countries where human capital is above a certain threshold. And, for the host countries with very low levels of human capital the direct effects of FDI on growth is negative. Balasupramanyam et *al.* (1999) looked at the same cross-section and found that the positive impact of FDI on growth was conditional on a certain threshold level of human capital endowments in the host country. They also show that FDI is complementary to domestic investment. Recently, Li and Liu (2005) made a panel data analysis for 84 countries over the period 1970-99 and observed that the interaction of FDI with human capital exerted a strong positive effect on economic growth.[15]

[14] See also World Bank (2001), Mody and Wang (1997) and Hermes and Lensink (2003), which find the same result using a different set of countries.

[15] Agrawal (2000) also finds that there exist complemetarity and linkage effects between FDI and domestic investment in South Asian countries. See also Makki and Somwaru (2004) in which FDI is shown to affect domestic investment positively.

Financial Development

The role of financial market is searched by Alfaro *et al.* (2002). They found, using various measures of financial development, that the existence and size of local financial markets is an important determinant of the extent to which FDI affects growth. This argument, which they trace back to Goldsmith (1969), is based on the assumption that in the absence or weakness of local financial markets, local firms are unable to take advantage of the various kinds of knowledge that they gain from the presence of foreign firms. Hermes and Lensink (2003) argue that the development of the financial system of the recipient country is an important precondition for FDI to have positive impact on growth. Durham (2004) examines institution and financial development as absorptive capacity that determines the degree of technology spillovers. Also, Alfaro et al. (2004) revealed similar results.

Trade

The efficiency of FDI in promoting growth can be increased by export promotion policy and decreased by import substitution policy. The study of the interaction between FDI and growth, given trade strategies, is commonly cited as the Bhagwati's hypothesis[16]. According to Bhagwati (1978), the growth effects of FDI could be favorable or unfavorable, depending on the incentives offered by host- country trade policies. Similarly, Balasubramanayam, Salisu, and Sapsford (1996) found that in 10 to 18 export promoting (developing) countries, higher inward FDI flows were associated with faster growth. Moreover, they argued that in export promoting countries, FDI rather than domestic investment drives growth. OECD (1998) supported that the beneficial impact of FDI is enhanced in an environment characterized by an open trade regime and macroeconomic stability.

Public Infrastructure

The effect of infrastructure investments on growth and development has received much attention since the work of Aschauer (1989). According to Praufer and Tondl (2007), apart from contributing independently to growth, infrastructure is likely to be a conditional factor for FDI to

[16] Bhagwati (1978, 1985) hypothesis: "with due adjustments for differences among countries for their economic size, political attitudes towards FDI and stability, both the magnitude of FDI flows and their efficacy will be greater in countries pursuing the export promotion (EP) strategy than in countries pursuing the import substitution strategy (IS)".

produce growth effects. A good infrastructure can be considered as a complement for FDI. If FDI meets a poor telecommunication infrastructure, poor transport, and unreliable electricity provision, it may not produce a high productivity impact. In contrast, public infrastructure, such as educational institutions, roads, port and airport, and R&D collaborations, can significantly support potential spillovers. In addition, other studies, i.e. Acemoglu et al. (2001), Hall and Jones (1999), Rodrik et al. (2002), found that the quality of institutions is an important prerequisite for growth.

2.4 Assessment of the Literature

2.4.1 Solving the Puzzle

The previous sections have been devoted to explain the impacts of FDI on economic growth, both theoretically and empirically. And, after a grasp of existing arguments it can be argued that FDI positively causes economic growth in two main ways that are, directly through capital accumulation and indirectly *via* spillovers on domestic investment. However, empirical studies have drawn two important concerns, namely:

a. *Reverse Impact*

For the FDI-Growth nexus, the literature does point to some *reverse impact* from growth to FDI (as depicted in figure 2.1). For instance, if factors that promote economic growth also promote FDI, then a strong positive correlation between the two could imply that economic growth causes FDI. Some studies that have hypothesized the direction of the relationship between FDI and economic growth revealed that economic growth robustly causes FDI as well as domestic investment (i.e. Choe, 2003; Chakraborty, 2004; Gao, 2005; and Blomstrong et al., 1996). In contrast, Blomstoerm, Lipsey and Zejan (1994) examining the empirical relationship between economic growth and FDI, found that there is a unidirectional relationship between FDI inflows and the growth of per capita GDP for all developed countries over the period 1960-1985. In the same vein, Dritsaki et al. (2004) found a unidirectional relationship between FDI and economic growth for Greece, with direction from FDI to growth.

In addition, for FDI and domestic investment, the *reverse impact* may also exist. For instance, if indigenous firms have more accurate information on local business opportunities than MNFs,

then domestic investment may act as a signal about the state of the economy to FDI or MNF.[17] Thus, domestic investment may cause FDI. Studies, for example Mataya and Veeman (1996) highlighted that "aggregate level studies has mainly focused on the determinants of private investment, however, such studies, often did not addressed the causality between FDI and domestic investment". The investigation of causality is indeed important as one can plausibly argue that domestic investment causes FDI. However, empirical findings have showed little support to this argument.

b. ***Spillovers: Crowding-out v/s Crowding-in***

Many studies have focused on the spillover effects of FDI, as discussed earlier. Some have showed doubts regarding the spillover effects of FDI on domestic investment. For example, Rodrik (1999) stated: "today's policy literature is filled with extravagant claims about positive spillovers from FDI but the evidence is sobering." Similarly, Haddad and Harrison (1993), Aitken and Harrison (1999), Djankov and Hoekman (2000), and Konings (2001), failed to find spillovers from FDI to domestic investment.[18] According to Fry (1992) and Lipsey (2000) it is important to ensure to ensure that FDI does not crowd out domestic firms or negatively affect domestic investment.

2.4.2 Unsolved Issues

After carefully analyzing the literature it can be argued that empirical findings on FDI, domestic investment and growth are inconclusive. The results tend to vary across countries mainly because of differences in national policies, the response of domestic enterprises, the type of FDI, and the econometric methodology employed (De Mello, 1999; Agosin and Mayer, 2000). From the debate it can be deduced that FDI spillovers appear to be the goal behind the 'global' pursuit of FDI, especially among developing countries. Over decades, many countries have adopted cut-down tax policies and FDI promoting reforms with a view to realize the growth agenda, thus, justifying figure 2.1.

Although the existing literature provides sufficient evidence on FDI as a generator of spillovers, it does not explain how the spillovers are absorbed by domestic firms. Few studies have argued

[17] This is particularly true in developing countries where market failure is predominant and information is incomplete or asymmetric.

[18] Haddad and Harrison (1993) studied Morocco, Aitken and Harrison (1999) studied Venezuela, Djankov and Hoekman (2000) studied Czech Republic, and Konings (2001) examined Poland and Bulgaria.

that absorptive capacity represent some conditional factors that determine the *indirect impact* of FDI. Different proxies have been used to measure absorptive capacity, including measures of human capital, financial development, physical infrastructure, openness, etc. However, no unanimous measurement of FDI absorption capacity is found in the existing literature. This shows that absorptive capacity may have been purely explained in terms of proxy variables that fit very well in complex econometric analysis. The question that remains is: *What determines the national FDI absorption capacity level?*

This leaves room for improvements in the design of a reliable yardstick that may help to better measure the absorption of FDI spillovers. A better estimation of the ability of domestic firms to absorb new technologies associated with FDI may help to improve prediction on whether FDI positively or negatively affects domestic investment. Given FDI, a high (low) absorptive capacity ensures crowding-in (crowding-out) impact on domestic investment. This implies that absorptive capacity critically determine the overall impact of FDI on growth. From a policy perspective, developing a sound measure of FDI absorptive capacity may help to unfold the following question:

- *When does FDI promote industrial expansion and economic development?*

In the next section, a game theoretical framework is developed to simulate the direct and indirect impacts of FDI on growth, while controlling for absorptive capacity. The main motivation is to explain that the impact of FDI may be insignificant, or even negative, in countries where absorptive capacity is below a certain threshold. This study coins the term "absorptive capacity gap" to define deviation from a minimum threshold as explained in part *2.5.2*.

2.5 A Proposed Framework for FDI and Economic Growth

2.5.1 Developing an Absorptive Capacity Gap Measure

The absorptive capacity gap is defined as the proportionate deviation in absorptive capacity index from its median point. The absorptive capacity index mainly consists of four fundamental elements in a given country, namely: (1) the ability to invest (i.e. access to credit); (2) the ability to learn & create (i.e. education level); (3) the ability to move & communicate (i.e. public infrastructure); (4) the ability to trade (i.e. openness). The absorptive capacity index mainly reflects a country's ability to absorb FDI spillovers and is denoted as Z.

$$Z = \frac{1}{4}(CREDIT + EDU + INFRA + OPEN)$$

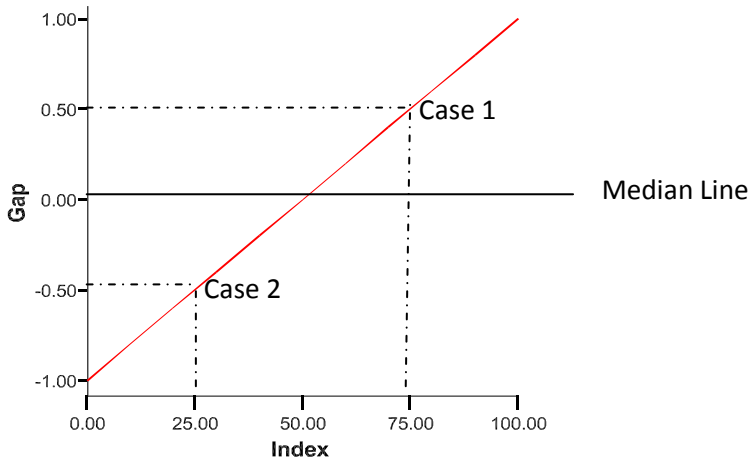
From the equation the absorptive capacity index represents the average of four indicators measured as: (1) CREDIT – domestic credit to GDP, which is a measure of financial development; (2) EDU – the education index is used to measure human capital (this is as per the UN declared measure); (3) INFRA – physical infrastructure, which is measured by public investment (expressed over GDP) in existing stock of public infrastructure, i.e. road and transport networks, telecommunication, ports and airports, etc; (4) OPEN – the openness measure, which is measured by export relative to GDP to capture export orientation. From the absorptive capacity index, the gap measure is derived as:

$$\theta = \left(\frac{Z-\bar{Z}}{\bar{Z}}\right)$$

Where, $\bar{Z}$ is defined as the threshold median line; and θ denotes the absorptive capacity gap measure.

The absorptive capacity gap measure gives the proportionate deviation in Z from the median, which is defined at 0.5. In particular, the gap gives the difference between the actual absorptive capacity level and the threshold level to see if the gap is positive or negative. Note, that the gap is positive (or negative) when Z is higher (lower) than the median threshold. The relationship between the index and the gap is given in figure 2.2.

Figure 2.2: Relationship between the absorptive capacity index and gap

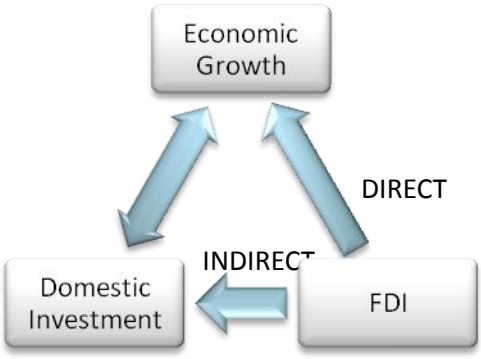


The figure depicts two cases. Case 1: translating an absorptive capacity index of 0.75 into gap yields 0.5. Case 2: translating an absorptive capacity index of 0.25 into gap yields -0.5. Thus, for all values below the median the absorptive capacity gap is negative, *vice-versa*. Since the absorptive capacity gap measure lies in the range $-1 \leq \theta \leq 1$, it amply caters for cases of perfect 'crowding-out' and perfect 'crowding-in'. Case 1 and 2 are used in the next section to explain conjunction and disjunction sets, respectively.

2.5.2 Translating to Compound Statements

Figure 2.3 is used to explain the link between FDI and growth, it is a simpler form of figure 2.1. Figure 2.3 shows the *direct impact* through the arrow flowing FDI to growth. The *indirect impact* is shown by the arrow flowing from FDI to domestic investment, then to growth.

Figure 2.3: FDI, domestic investment and economic growth



To explain the figure some fundamental aspects on statements formulation are reviewed below. An *inference* is a list of *statements* divided into *premises* and *conclusions*. Statements of inferences are assertive if they can be assigned either of two truth values (true or false). An inference is valid if it has no counterexamples.[19] Elementary or simple statements can be transformed into compound statements by applying the syntactical operations "and", "or", "not", "if…then".

[19] A counterexample to an inference is a case in which all its premises are true but its conclusion false.

The letters A, B, C,… are called statement letters and are used to denote elementary statements. Symbols are used to denote logical operators and are interpreted as follows:

$\wedge$ - for "and" (conjunction)
$\vee$ - for "or" (disjunction)
$\dashv$ - for "not" (negation)
$\rightarrow$ - for "if…then" (implication)

A statement or propositional statement is defined by two 'rules of formation':

1. Any statement letter is a statement.
2. If A and B are statements, so are $(A \wedge B)$, $(A \vee B)$, $(A \rightarrow B)$, $(\dashv A)$. Here A and B are called the conjuncts in the conjunction $(A \wedge B)$ and the disjuncts in the disjunction $(A \vee B)$. Also, A is called the antecedent and B the consequent in the implication $(A \rightarrow B)$.

Compound statements can be derived by combining statement letters with logical operators, for example, $(A \wedge B)$; $\{(A \wedge B) \vee C\}$; $\{(A \rightarrow B) \vee C\}$; $\dashv\{(A \rightarrow B) \vee C\}$. The rules adopted for the formulation of compound statements are:

- ✓ $A \wedge B$ is true if A and B are both true, and false if at least one of A and B is false.
- ✓ $A \vee B$ is true if at least one of A and B is true, and false if both A and B are false.
- ✓ $\dashv A$ is true if A is false, and false if A is true.
- ✓ $A \rightarrow B$ is false when A is true and B is false, but true in all other cases.[20]

The impact of FDI can now be explained in terms of the following statements:

S1: *A* denotes FDI (*Note: FDI is assumed to be exogenous*).

S2: *B* ($\dashv$B) denotes rise (fall) in domestic investment.

S3: *C* ($\dashv$C) shows high growth (low growth).

S4: $^{+}\theta$ ($^{-}\theta$) represents positive (negative) absorptive capacity gap.

[20] The idea is that the compound statement $A \rightarrow B$ is false only when the truth values of A and B constitute a counterexample to the validity of the inference from A to B, or when A is true and B is false. In all other cases, $A \rightarrow B$ is declared true.

Now, the impact of FDI on growth can be summarized in terms of the following propositions.

Proposition 1: **Conjunction** – FDI *and* domestic investment are complements when the absorptive capacity gap is positive. In other words, they are the conjuncts in the conjunction (A $\wedge$ B) given $^{+}\theta$, i.e. the crowding-in hypothesis holds.

Proposition 2: **Disjunction** – FDI and domestic investment are substitutes if the absorptive capacity gap is negative. That is, they are in the disjunction (A $\vee$ B) given $^{-}\theta$. Then, the crowding-out hypothesis holds.

Proposition 3: **Implication 1 –** *if* conjunction holds (*proposition 1*, refers) *then* FDI contributes to domestic investment, or the implication (A $\rightarrow$ B) applies.

Proposition 4: **Implication 2 –** *if* disjunction applies (*proposition 1*, refers), *then* FDI replaces domestic investment, or (A$\rightarrow^{\dashv}$B) occurs.

Proposition 5: **Implication 3** – *if* (A $\rightarrow$ B), *then* (B$\rightarrow$ C). In other words, if conjunction holds then higher domestic investment contributes to high growth.[21]

Proposition 6: **Implication 4** – *if* (A $\rightarrow^{\dashv}$B), *then* ($^{\dashv}$B$\rightarrow^{\dashv}$C). In other words, if disjunction holds, then lower domestic investment results to lower growth.

Proposition 7: **Deductions** – The overall impact of FDI is assessed by summing the *direct impact* and the *indirect impact*. The *direct impact* is given by the straight forward implication (A$\rightarrow$ C). The *indirect impact*, however, is illustrated in terms of two scenarios.

Scenario 1: Conjunction

Given A $\wedge$ B

$$\left.\begin{array}{l} A \rightarrow B \\ \underline{B \rightarrow C} \\ A \rightarrow C \end{array}\right\} \text{Crowding-in}$$

Scenario 1: Disjunction

Given A $\vee$ B

$$\left.\begin{array}{l} A \rightarrow \dashv B \\ \underline{\dashv B \rightarrow \dashv C} \\ A \rightarrow \dashv C \end{array}\right\} \text{Crowding-out}$$

Scenario 1 states: *if* (A$\rightarrow$B) $\wedge$ (B$\rightarrow$C), *then* (A$\rightarrow$C). That is, "*if"* FDI contributes to domestic investment "*and"* domestic investment contributes to growth, "*then"*

[21] This proposition contends that domestic capital accumulation leads to higher growth, as discussed in the theoretical literature earlier.

FDI also contributes to growth. In this case, the direct impact and indirect impact are both positive, reinforcing the overall impact of FDI on growth. *Scenario 2* states: *if* $(A \rightarrow \neg B) \wedge (\neg B \rightarrow \neg C)$, *then* $(A \rightarrow \neg C)$. Or, "*if"* FDI replaces domestic investment "*and"* lower domestic investment brings to lower growth, "*then"* FDI indirectly leads to lower growth. In this case, the overall impact of FDI on growth depends on the net impact, or the difference between the *direct impact* and *indirect impact*. Thus, the net impact of FDI can be negative, positive, or neutral.

Based on the above it can be argued that the impact of FDI critically depends on whether *proposition 1* and *2* holds. In the next section, a game theoretical model is developed to simulate the impact of FDI based on the conjunction/disjunction propositions.

2.5.3 The game structure

The illustration assumes a non-cooperative game structure in which players do not have the option of planning as a group (cooperation) in advance of choosing their actions.[22] To simulate the impact of FDI, two players are assumed, namely: (1) multinational firms (**MNF**); and (2) domestic firms (**DF**). The absorptive capacity gap is assumed to control for conjunction and disjunction between the two players. The interactions between the two players are described in an extensive form to explain the strategies of the game.

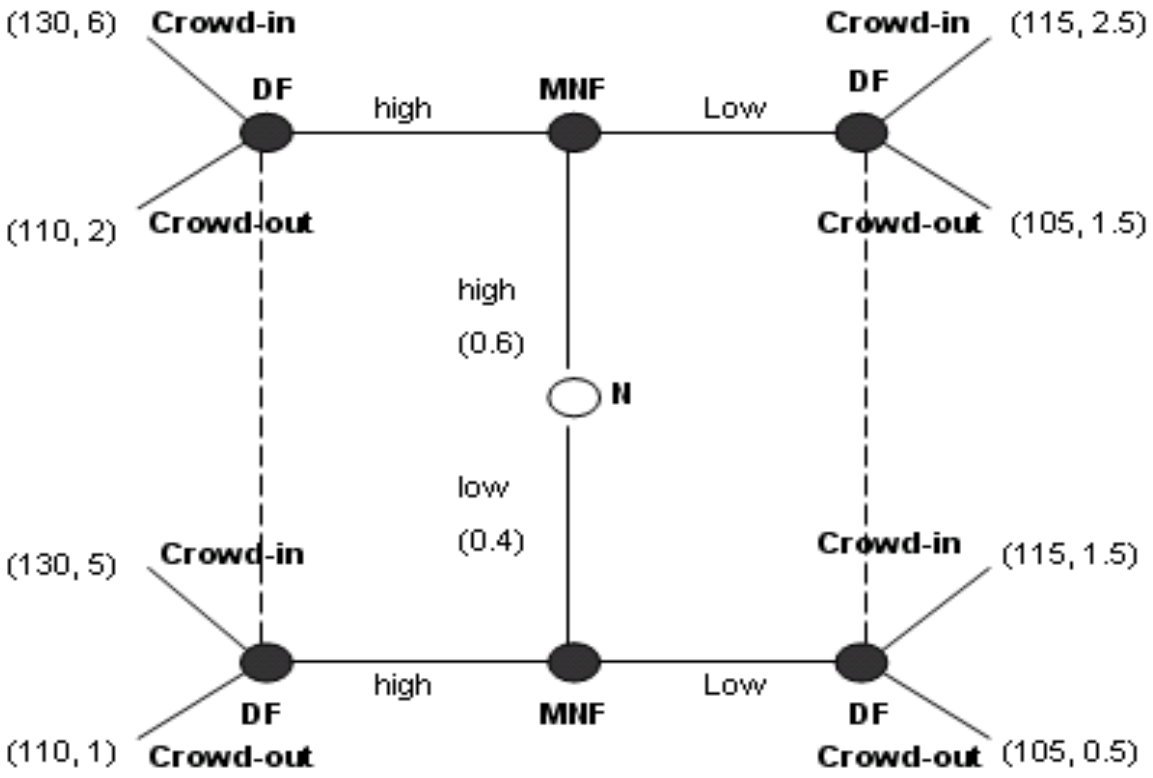
The Extensive Form

Extensive form games are generally arranged in terms of sequence to explain players timing of actions or 'positions'.[23] Nodes (or dots) are used to show positions. In figure 2.4, an open dot is used to depict the initial position of the game, represented by Nature (**N**). All the remaining nodes are filled-in. Each node gives a 'position' of the game and is labeled with the player's taking the move. In other words, each node gives the identity of the player who must choose an action if that position in the game is reached. Finally, arrows are used to show actions emanating from one node to another.

[22] Kreps, David. 1990. "Game theory and economic modeling." Oxford University press.
[23] Positions are defined a decision point for a player in choosing some action.

The game begins with the open dot in the centre of figure 2.4, labeled as **N**. Note two arrows emanate from **N**, one marked high and one low. Both high and low are determined by natural forces that are assumed exogenous. The high and low scenarios are assigned probability values ϕ and $(1-\phi)$, respectively. Where, ϕ is assumed to be 0.6. For example, when **N** is high, then the arrow moves to the solid node in the top-centre of the figure with a probability of 0.6. If, on the other hand, **N** is low, then the arrow moves to the solid node in the bottom-centre with a probability of 0.4.[24] More importantly, **N** is assumed to capture the international business cycle.

Figure 2.4: Non-cooperative game, an extensive form



Source: Author

Similarly, **MNF**, representing the size of FDI inflows, is assumed to be either high or low (*Note: high and low are depicted in terms of left and right arrows, respectively*). **N** may affect **MNF** investment behaviour in different ways, namely:

- If **N** is high and **MNF** is high, then both are equal to $20.
- If **N** is low and **MNF** is low, then both are equal to $10.

[24] In the present context, high (low) refers to high (low) FDI

- If **N** is high and **MNF** is low, then foreign firms are said to under-invest (or over-save) by $10.
- If **N** is low and **MNF** is high, then foreign firms are said to over-invest (or dis-save) by $10.

The above conditions are set in order to derive the payoff for **MNF**. Notably, when **N** and **MNF** are not same, then either under-investment or over-investment applies. In case of under-investment, **MNF** save part of their investment yielding some interest. For over-investment, **MNF** dis-save in order to invest, thus, forgoing some interest. Note, the interest rate is assumed at 10% in both cases.

To explain how the actions of **MNF** influence the second player, **DF**, *Proposition 7* is recalled. For instance, **DF** may contract its activities (crowd-out or dis-invest); secondly, **DF** may expand its activities (crowd-in or invest). To explain 'crowd-in' (conjunction) and 'crowd-out' (disjunction) the absorptive capacity gap measure is used, the measure is already discussed in part *2.5.1*. The gap assumes two values, positive and negative. In particular, positive gap $(\theta > 0)$ enforces conjunction, whereas negative gap $(\theta < 0)$ validates disjunction. Since the absorptive capacity gap measure lies in the range $-1 \leq \theta \leq 1$, the present study assumes two gap values as shown in figure 2.2 earlier, namely, $\theta = 0.5$ and $\theta = -0.5$. Finally, the nodes labeled **DF** are joined by two dotted lines to show the information set enjoyed by the player. Here, **DF** has a complete information set, that is all positions are revealed to **DF**.

Figure 2.4 is summarized in terms of three positions:

Position 1 – **N** depicts some exogenous forces that determine the size of **MNF** activities (or FDI flows), which we call Nature (**N**), representing the international business cycle.

Position 2 – The second position describes **MNF**, to imply FDI in a given country, as high or low. Note, since the determinants of FDI are not explored within the framework, some discretionary forces are assumed to decide whether it is high or low.

Position 3 – The last position of the game is occupied by domestic firms, **DF**. It precisely captures the response of **DF** following **MNF** moves. Here, two actions are possible 'crowd-in' and 'crowd-out'.

To explain the framework, assume that **N** is high; **MNF** is high; and **DF** alternatively satisfies 'crowd-in' or 'crowd-out'. Given that **N** is high, the arrow points to the top-centre node showing **MNF** position. Then, from **MNF** the arrow alternatively moves to the top-left or top-right of the **DF** node.

To obtain the payoffs, two restrictions are imposed:

- First, a scalar factor is assumed to explain the impact of investment on growth. The scalar factor is similar to the investment multiplier and is equal to 1.[25] Note, the same scalar value is assumed for both players.

- Second, the rate return to **MNF** is assumed to equal the growth rate in output. Thus, return to FDI is computed by multiplying the growth rate and the initial amount of FDI. Note, initial output is assumed at $ 100.

The payoffs, given in figure 2.4, show the outcomes of the game, and are computed as follows.[26] On one hand, assume the top left quadrant, where **N** is high; **MNF** is high; and **DF** satisfies 'crowd-in'. Thus, if **N** is high, the probability 0.6 applies and **MNF** is high implies FDI of $20. Given conjunction (or 'crowd-in'), **DF** increases by $10 (i.e., $20×0.5). Then, total investment sums to $30, which increases domestic output to $130 (i.e., $100 + $30). The payoff to **MNF** is estimated at $6 (i.e $20×30%). The payoff for this path is given by (130, 6) in the figure. On the other hand, if player **DF**'s response is altered to 'crowd-out', then **DF** decreases by $10 when **MNF** is $20, leading to lower domestic output of $110 (i.e., $120 - $10). **MNF** return is, thus, $2 (i.e., 20×10%) given output of $110 and the payoff in terms of domestic output and **MNF** return is given by (110, 2).

Now, imagine the bottom-left quadrant. In this case, **N** plays low, **MNF** plays high and 'crowd-in' holds for **DF**. As explained earlier, **MNF** will dis-save by $10 in order to invest $20 gap, which implies forgoing an interest of $1 (i.e. $10×10%). The loss in interest is taken into account when comparing the net return of **MNF**. The payoff for growth and **MNF** is, therefore, given by (130, 5). Note, the return to **MNF** is $5 due to the interest foregone. Additionally, when

[25] Investment multiplier is commonly referred to the change in national income which results given a unit change in investment.

[26] For each set of payoff given in brackets, the payoff for *DF* precedes that of *MNF*.

'crowd-out' holds for **DF**, the payoff is (110, 1) due to interest foregone from over-investment. The remaining payoffs for the bottom and top right quadrants can be computed using same reasoning.

The Strategic Form

A strategic game is commonly defined as a situation in which players simultaneously interact. Generally, a strategic game is based on identifying: (1) the players (or decision-makers); (2) the strategies; and (2) the payoffs derived by players' for each possible outcome. An essential feature of this definition is that each player's payoff depends on the other players' actions. In the present case, two players are assumed **MNF** and **DF** and the strategies of each player are given below.

Four possible strategies exist for **MNF**, namely:

*M_1: if **N** chooses high, give high; if **N** chooses low, give high;*

*M_2: if **N** chooses high, give high; if **N** chooses low, give low;*

*M_3: if **N** chooses high, give low; if **N** chooses low, give high;*

*M_4: if **N** chooses high, give low; if **N** chooses low, give low.*

At the same time, **DF** has two choice situations representing two information sets, shown by the two dotted lines. In each situation, the player has two possible actions resulting in four possible strategies.

*D_1: if **MNF** gives high, invest; if **MNF** gives low, invest;*

*D_2: if **MNF** gives high, invest; if **MNF** gives low, disinvest;*[27]

*D_3: if **MNF** gives high, disinvest; if **D** gives low, invest;*

*D_4: if **D** gives high, disinvest; if **D** gives low, disinvest.*

From the above, a strategic form game can be built to show each player's payoff pertaining to each strategy. Note, **MNF** chooses its strategy from the list M_1 to M_4 and **D** from the list D_1 to D_4. The strategic form game is shown in table 2.1. The payoffs given in the table represent expected returns, to each player, as a result of each strategy. For each player, the expected returns are assessed using probability values assigned to nature (**N**). In addition, the expected payoffs depend on the size of FDI (high or low) and the responses in domestic investment (invest

[27] The term disinvest is used to refer to reduction in capital investment.

or disinvest). Note that invest and disinvest refer to crowd-in and crowd-out (or conjunction and disjunction), respectively.

Table 2.1: The game in strategic form

DF Strategy \ MNF Strategy	M_1	M_2	M_3	M_4
D_1	130, 5.6	124, 4.2	121, 3.5	115, 2.1
D_2	130, 5.6	120, 3.8	115, 2.9	105, 1.1
D_3	110, 1.6	112, 1.8	113, 1.9	115, 2.1
D_4	110, 1.6	108, 1.4	107, 1.3	105, 1.1

Suppose that **MNF** chooses strategy M_1 and **DF** chooses D_1. Then, the expected payoff for the strategies is given by:

$E(D_1) = (0.6 \times 130) + (0.4 \times 130) = 130$;

$E(M_1) = (0.6 \times 6) + (0.4 \times 5) = 5.6$; and

$E(D_1, M_1) = (130, 5.6)$

Since the first and second outcomes are respectively assigned probabilities of 0.6 and 0.4, the expected returns sum to \$130 and \$5.6. Note, the payoff *(130, 5.6)* corresponds to the cell *(D_1, M_1)* in table 2.1.

The Dominance Strategy and Nash equilibrium

In non-cooperative game theory two so-called solutions are often used, namely: dominance arguments, and equilibrium analysis. Dominance is a method of eliminating weak strategies.[28] The implicit assumption of the dominance argument is that both players will avoid a strategy that will give the worse payoff no matter what the other player does. Based on this, recursive dominance can be applied to eliminate one or more strategies for any one player and then one or more strategies can be eliminated for the other player.

On one hand, it can be argued that **MNF** does not have a dominant strategy. This is mainly because the payoffs for **MNF**, thus, the strategies are influenced by the action of **DF**. For

[28] Weak strategies are strategies that yield relatively low payoffs.

instance, if **DF** chooses D_1 it is more profitable for **MNF** to choose M_1; and if **DF** chooses D_3, then the best strategy for **MNF** is M_4. On the other hand, the dominant strategy for player **DF** is clearly D_1. In particular, D_1 always and everywhere leads to, at least, higher payoff for **DF** than the other strategies. Therefore, **DF** will always prefer strategy D_1, irrespective of the strategy chosen by **MNF**.

The main limitation with the dominance argument is that it does not explain equilibrium between the two players. Due to this pitfall, the Nash equilibrium is explored to explain expected outcome of the game. In this case, each player assumes the other player to aim at maximising its own payoff. With reference to table 2.1, if **MNF** knows that **DF** will always choose strategy D_1, then it will always play strategy M_1. Therefore, strategy (D_1, M_1) is the Nash equilibrium and neither of the two players will deviate from their respective strategies.

As per the objective set in the present study, the Nash equilibrium confirms that the best outcome occurs when conjunction holds. Conversely, whenever disjunction holds, strategy D_4 refers, the worst payoff is realised for both players.

2.5.3 Implications for FDI and growth

The game illustrated earlier can be summarised to represent the impact of FDI on growth. On one hand, M_1 and M_4 represent high and low FDI scenario, respectively. In addition, a moderate FDI scenario applies for strategies M_2 and M_3.[29] Thus, the following is true: high FDI refers to M_1; low FDI refers to M_4; and moderate FDI refers to the average of M_2 and M_3. On the other hand, conjunction applies if strategy D_1 is true; disjunction holds if D_4 is true; and if either D_2 or D_3 holds then conjunction and disjunction may occur simultaneously.

The growth outcomes pertaining to the level of FDI and complementarity between FDI and domestic investment are summarised in table 2.2. The findings reported above confirm the Nash equilibrium. In other words, economic growth is highest if both high FDI and conjunction holds. Conversely, the lowest growth outcome is realised if both low FDI and disjunction holds. Although the figures reported above may not at all represent growth rates experienced by countries, i.e. 30% economic growth rate, it helps in understanding the impact of FDI on

[29] Both M_2 and M_3 result to the moderate FDI scenario because they represent combinations of both high and low FDI.

economic growth. In particular, it confirms that economic growth rates are highest when FDI leads to spillovers and industrial expansion in a host country.

Table 2.2: Explaining Growth Scenarios

	Growth Outcomes		
Scenario	*High FDI*	*Moderate FDI*	*Low FDI*
Conjunction	30%	22.5%	15%
Undetermined	20%	15%	10%
Disjunction	10%	7.5%	5%

2.6 Conclusion and policy implications

The straight forward finding of the 2-player game model is that FDI leads to higher economic performance if and only if conjunction holds. On the other hand, if disjunction applies then economic growth is always and everywhere lowest. Therefore, pure conjunction results to the first-best scenarios, a mix of conjunction and disjunction leads to the second-best scenarios, and pure disjunction reveals the third-best scenarios. Thus, for a country which emphasises on FDI in order to serve its domestic growth agenda, it is important to ensure that FDI does not crowd-out domestic firms or domestic investment. This paper appeals to public policy decisions on the need to improve human capital stock, public infrastructure, financial markets, and trade competitiveness (emphasizing on exports). The main contribution of the paper is in terms of the development of an absorption capacity index. It provides scope for future empirical research to test whether countries with higher absorption capacity achieve higher growth performance given some level of FDI. In other words, this may help to encourage policy decisions on FDI. Since many countries are competing for FDI using generous FDI incentives, it is important to assess the extent of FDI spillovers or absorption prior to the award of FDI incentives.

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