CESIS

Electronic Working Paper Series

Paper No. 58

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(JIBS)

January 2006

The Royal Institute of technology
Centre of Excellence for studies in Science and Innovation
http://www.infra.kth.se/cesis/research/publications/working papers
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January 17, 2006

ABSTRACT

This paper discusses and models the potential of FDI inflows to affect host country economic growth. The paper argues that FDI should have a positive effect on economic growth as a result of technology spillovers and physical capital inflows. Performing both cross-section and panel data analysis on a dataset covering 90 countries during the period 1980 to 2002, the empirical part of the paper finds indications that FDI inflows enhance economic growth in developing economies but not in developed economies.

Keywords: foreign direct investment, economic growth, developing economies, developed economies
JEL classification: F21, F23, O40

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1. Introduction

Explaining economic growth is one of the fundamental questions in economics and has generated a large body of research. While the failure of the Solow model (Solow, 1956) to explain the large differences in income levels between countries has been attributed to differences in technology, it was endogenous growth theory as presented in Romer (1986, 1990) and Lucas (1988) that addressed the relationship between technology and growth in detail. The importance of technology for economic growth provides an important link between FDI inflows and host country economic growth. It is theoretically straightforward to argue that inflows of FDI have a potential for increasing the rate of economic growth in the host country. Inflows of physical capital resulting from FDI could also increase the rate of economic growth, but it is argued in this paper that the most important effect comes from spillovers of technology. MNE operations in the host country can result in technology spillovers from FDI, whereby domestic firms adopt superior MNE technology which enables them to improve their productivity. Technology spillovers thereby generate a positive externality allowing the host country to enhance its long-run growth rate.

Despite the straightforwardness of the argument, empirical evidence on a positive relationship between FDI inflows and host country economic growth has been elusive. When a relationship between FDI and economic growth is established empirically, it tends to be conditional on host country characteristics such as the level of human capital, see for example De Mello (1999) and Borensztein et al. (1998). The difficulty in showing a positive effect from FDI on economic growth provides a strong incentive for further empirical studies. Neo-classical models of economic growth only allow FDI to have a level effect on growth due to diminishing returns to capital. However, the endogenous growth theory provides a framework for studying the link between FDI and economic growth, making it possible to take the characteristics of FDI into account and thereby improve the chances of confirming the theoretical relationship by empirical evidence.

The paper argues that technology spillovers from MNEs to domestic firms provide the most important link for a positive effect from FDI on economic growth. But are there differences in the growth-enhancing effect of FDI between different types of host countries such as developed, developing and transition economies? Furthermore, is there a threshold level of technology that host countries need to achieve in order for FDI to have a positive effect on economic growth?

Are there other host country characteristics affecting the ability of FDI to enhance the rate of economic growth?

The aim of the paper is to analyse whether FDI inflows have a positive effect on host country economic growth using macro level data. The second objective is to investigate whether there is a difference in the growth enhancing ability of FDI inflows between developed and developing economies. The paper contributes to the mixed results of earlier empirical research by the finding that FDI inflows have a positive effect on host country economic growth in developing but not in developed economies.

There exists a surprisingly limited number of earlier empirical studies of the relationship between FDI and host country economic growth on the national level employing a rigorous econometric framework. While there is a large and increasing number of micro-based studies, such as Aitken and Harrison (1993), that analyse the productivity enhancing effect of FDI on individual firms, the focus of this paper is the possibility of detecting FDI effects on economic growth on the macro level. Consequently, the literature review limits itself to this type of research. For an overview of the micro-based studies, see Keller (2004).

Balasubramanyam et al. (1996) analyse how FDI affects economic growth in developing economies. Using cross-section data and OLS regressions he finds that FDI has a positive effect on economic growth in host countries having an export promoting strategy but not in countries having an import substitution strategy. Another study based on developing economies is Borensztein et al. (1998), which examines the role of FDI in the process of technology diffusion and economic growth. The paper concludes FDI has a positive effect on economic growth, but the magnitude of the effect depends on the amount of human capital available in the host country. Olofsdotter (1998) provides a similar analysis. Using cross-sectional data, she finds that an increase in the stock of FDI is positively related to growth, and the effect is stronger for host countries with a higher level of institutional capability as measured by the degree of property rights protection and bureaucratic efficiency in the host country.

In contrast to the preceding studies, De Mello (1999) only finds weak indications of a positive relationship between FDI and economic growth despite using both time series and panel data fixed effects estimations for a sample of 32 developed and developing countries.

Zhang (2001) and Choe (2003) analyse the causality between FDI and economic growth. Zhang uses data for 11 developing countries in East Asia and Latin America. Performing co-integration and Granger causality tests, Zhang (2001) finds that in five cases economic growth is enhanced by FDI but host country conditions such as trade regime and macroeconomic

stability are important. According to the findings of Choe (2003), causality between economic growth and FDI runs in either direction but with a tendency towards growth causing FDI; there is little evidence of FDI causing host country growth.

Carkovic and Levine (2002) use a panel dataset covering 72 developed and developing countries in order to analyse the relationship between FDI inflows and economic growth. The study performs both a cross-sectional OLS analysis as well as a dynamic panel data analysis using GMM. The paper concludes that there is no robust link running from inward FDI to host country economic growth.

Finally, Bengoa and Sanchez-Robles (2003) investigate the relationship between FDI, economic freedom and economic growth using panel data for Latin America. Comparing fixed and random effects estimations, they conclude that FDI has a significant positive effect on host country economic growth but similar to Borensztein et al. (1998) the magnitude depends on host country conditions.

Table 1 presents an overview and summary of eight earlier empirical studies of FDI and host country economic growth. There are additional studies of FDI and economic growth, but the chosen studies are believed to be representative for approaches used and results found.

Table 1 Empirical studies of FDI and economic growth

Study	Type of data	Countries and time period	Empirical approach	Assumptions	Result
Balasubramanyam et al. (1996)	Cross-section	46 developing countries 1970-1985	OLS regressions	FDI effects from technology spillovers, stronger effects for export promoting than import substituting economies	FDI has a positive effect but only for export promoting host countries
Borensztein et al. (1998)	Cross-section	69 developing countries 1970-1989	Regression estimations using SUR technique	FDI effects through technology diffusion	FDI has a positive effect on growth but magnitude depends on availability of host country human capital
Olofsdotter (1998)	Cross-section	50 developed and developing countries 1980-1990	OLS regressions	FDI effects through technology spillovers	Increase in inward FDI stock has a positive effect on the

					growth rate
De Mello (1999)	Panel data and time series	32 developed and developing countries 1970-1990	Regression analysis, fixed effects	FDI effects from technology and improved management and organisation	Only weak evidence of FDI effects on economic growth.
Zhang (2001)	Time series	11 developing countries in East Asia and Latin America, varying time periods between 1957-1997	Analysis of causality between FDI and economic growth using Granger causality tests	There can be feedback effects from economic growth to FDI inflows	Evidence of growth enhancement from FDI, magnitude depends on host country conditions
Carkovic and Levine (2002)	Cross-section and panel data	72 developed and developing countries 1960-1995	Regression analysis using OLS as well as GMM	Earlier macroeconomic studies suggest a positive role for FDI in generating economic growth	FDI inflows do not exert a robust, independent influence on economic growth
Choe (2003)	Panel data	80 developed and developing countries, 1971-1995	Analysis of causality between FDI and economic growth	Rapid economic growth might lead to high FDI inflows	FDI Granger causes economic growth and vice versa but the

			using Granger causality tests		effects are more apparent from growth to FDI
Bengoa and Sanchez-Robles (2003)	Panel data	18 Latin American countries 1970-1999	Regression analysis, comparing fixed and random effects	FDI effects from technology spillovers	FDI has a positive effect on economic growth, magnitude depends on host country conditions

Source: Constructed by author

Four of the eight studies found that FDI had a positive effect on host country economic growth. Three of these studies reached the conclusion that the magnitude of the FDI effect depends on host country conditions such as human capital abundance and macroeconomic stability. What about the four studies that did not find a clear link between FDI and economic growth? Choe (2003) found little evidence of FDI affecting growth. The results rather suggest it is economic growth that generates FDI inflows. Carkovic and Levine (2002) were unable to confirm a relationship from FDI to economic growth despite performing both OLS and dynamic panel data regressions. Of the two remaining studies, De Mello (1999) only found weak evidence of a relationship while Balasubramanyam et al. (1996) concluded that the positive effect of FDI on growth was conditional on economic policy in the host country.

Four of the studies pool data for developed and developing economies. Interestingly, these pooled studies include three of those studies which did not find a link between FDI and economic growth. Blonigen and Wang (2004) argue it is inappropriate to pool developing and developed economies when investigating the link between FDI and economic growth. Using the original data from Borensztein et al. (1998) and adding observations from developed economies from which identical measures of the variables could be found, Blonigen and Wang (2004) explore the result of pooling developed and developing economies. When pooling the data, the statistically significant effect of FDI on growth disappears. The result puts into doubt all studies using pooled data, including Olofsdotter (1998), De Mello (1999), Carkovic and Levine (2002) and Choe (2003). The discussion in Blonigen and Wang (2004) and the diverging results found in existing empirical studies imply that there is scope for more research on the relationship between FDI and economic growth on the macro level. This paper follows the reasoning in Blonigen and Wang (2004) and separates the total dataset into two sub-samples covering developed and developing economies respectively.

The remaining part of the paper is structured as follows: Section 2 describes the channels through which FDI inflows affect host country economic growth. Section 3 formalises the discussion of the preceding section and models the relationship between FDI and economic growth. Section 4 discusses the data and provides the empirical analysis. Section 5 concludes.

2. FDI inflows and economic growth

FDI inflows can affect host country economic growth in several ways. The purpose of this section is to provide a description of the potential growth enhancing effect of FDI.

2.1. Firm-specific advantages, knowledge capital and externalities

Based on the ideas of Hymer (1960), it has been argued that MNEs have firm-specific advantages allowing them to operate profitably in foreign countries. Examples of firm-specific advantages include superior technology, scale economies and management. It is possible to link the idea of firm-specific advantages to the concept of knowledge capital. Knowledge capital has been important for recent development of FDI theories and has been included in new trade models analysing FDI, such as Carr et al. (2001) and Markusen and Maskus (2002). Knowledge capital is a broad concept consisting of intangible assets such as brand name, human capital, patents, trademarks and technology. Markusen (1995, 2002) argue that knowledge-capital is important for MNEs based on the fact that MNEs tend to have large R&D expenditures, a large share of technical workers and produce technically advanced products. It is primarily MNE possession of knowledge-capital that is important for providing firm-specific advantages allowing MNEs to operate profitably in multiple economies.

According to Markusen (1995), knowledge-capital assets share two characteristics allowing an MNE to perform FDI. Firstly, it is easy and inexpensive to transfer knowledge-capital assets to new geographical locations. Secondly, since knowledge has a joint character, it can create a flow of services at several different production facilities without affecting its productivity. Knowledge capital has the nature of a public good. The characteristics of knowledge capital provide the possessing firm with an ability to transfer production to foreign economies. The fact that the MNE can use its knowledge capital simultaneously in multiple locations provides an incentive to perform horisontal FDI implying the same production process is duplicated in several different locations. This could explain why horisontal FDI tends to dominate over vertical FDI, as suggested by Markusen (2002).

It might be instructive to further elaborate on the relationship between the knowledge-capital concept and technology. Freeman (1974) argues that technology is ‘a body of knowledge about techniques’. While this might be a helpful definition, Granstrand (1998) provides a discussion about technology-based firms and their characteristics that is useful for the purposes of this paper. According to Granstrand, the resources of a firm can be classified as tangible or intangible. Tangible resources consist of physical and financial capital. Intangible resources are

either *disembodied* such as patents, licenses, brand names and designs or *embodied* in the form of competences individuals possess such as management skills. Grandstand's concept of intangible firm resources therefore roughly corresponds to the knowledge-capital concept as used by Markusen (1995) and others in recent FDI models. Knowledge is an intangible firm resource and therefore has special characteristics. For example, knowledge is expensive to acquire but is relatively inexpensive to use once acquired. On the relationship between knowledge and technology, Granstrand (1998) further argues technology is a 'special kind of knowledge' that shares the general properties of knowledge but also has special characteristics distinguishing it from other types of knowledge. Summarising his argument, technology is linked to artefacts and science, generally has a high degree of codifiability, is used for practical applications and is possible to protect by patent rights.

What implications does the importance of knowledge-capital and technology for MNE operations have for the growth enhancing potential of FDI inflows? As argued above, advanced technology is an important component of knowledge capital and technology in many cases forms the basis for an MNE's firm-specific advantage. Not only is technology very important as a firm specific advantage for many MNEs, but it provides a link between FDI and economic growth.

The non-rival characteristic of technology implies that MNEs try to protect their technology by using brand names and patents. Since the MNE is dependent on its firm-specific advantage (often in the form of technology) for profitable business operations as argued by Hymer (1960), the MNE has an incentive to try to prevent spillovers of technology to other firms. Spillovers of technology are an externality that can occur through several different channels including imitation, reverse-engineering and supplier linkages. When spillovers do occur, it implies the MNE is unable to internalise all of the returns to its technology resulting in a positive externality since the social return on investment is higher than the private return**.** It is argued in this paper that the positive externalities from technology spillovers provide the best possibility for FDI to enhance the rate of economic growth.[1] The emergence of theories of endogenous growth provides a framework describing how positive externalities can improve long run economic growth. Positive externalities provide non-diminishing returns to capital and therefore enhance growth also in the long run. Endogenous growth theories therefore support the idea that FDI could enhance economic growth. Balasubramanyam et al. (1996, p. 95) argue that the 'new

[1]Positive externalities could also arise as a result of increased competition or as a result of MNEs exporting to third countries. Such export links could help domestic firms to start exporting to the same markets.

growth theory … provides powerful support for the thesis that FDI could be a potent factor in promoting growth'.

2.2 Physical capital and labour

We argued above that technology spillovers provide externalities which should have a positive effect on economic growth in the host country. Besides of knowledge-capital, FDI can also generate an inflow of physical and human capital to the host country. As the size of the host country physical capital stock increases the productive capacity of the host country also increases. Unfortunately the growth enhancing effect of an ever growing stock of physical capital is not endless. Even though additional capital can have important effects on economies with a low capital-labour ratio, diminishing returns imply that accumulation of physical capital cannot function as a permanent source of long-run growth. Since Solow type models rule out capital as a source of long-run per capita growth, in such a framework FDI can only affect growth through an inflow of capital in the short run while the economy is in transition toward steady state. However, empirical research on the role of capital accumulation for economic growth has not been conclusive. Easterly and Levine (2001) used a growth accounting framework and reached the conclusion that investment in physical capital is relatively unimportant in explaining long run economic growth since technological progress accounts for most of the cross-country variation in growth. On the other hand, Bond et al. (2004) argue that this conclusion is premature since the modeling framework in Easterly and Levine is too restrictive.

An inflow of FDI is unlikely to generate a large inflow of labour to the host country.[2] Except for management, most of the MNE employees are expected to be recruited from the host country labour force. Furthermore, when investment takes the form of brownfield FDI it is not uncommon that MNEs lay off a substantial share of the incumbent labour force as usually done during privatisations. Therefore, FDI is not expected to affect economic growth through changes in the stock of labour.

Based on the discussion in this section, the conclusion is reached that the primary effect from FDI inflows on host country economic growth should arise as a result of technology

[2]FDI could still have substantial effects on the host country labour market through an increase in the demand for labour, resulting in an increase of the real wage. Aitken et al. (1996), among others, have shown that MNEs tend to increase the average wage in the host country.

spillovers rather than through an increase in the stocks of capital and labour. This view is shared by other studies such as De Mello (1997).

2.3 Greenfield and brownfield FDI

The growth enhancing ability of FDI is affected by the chosen mode of FDI. It is argued in this paper that the effects of FDI inflows on variables such as technology spillovers and physical capital are expected to differ between greenfield and brownfield FDI. Greenfield FDI implies that the MNE constructs new facilities of production, distribution or research in the host country. The result is an increase in the host country stock of physical capital that can be substantial, especially for capital scarce developing economies. In the case of brownfield investment, the MNE acquires already existing facilities in the host country. Brownfield FDI should therefore only result in a limited increase in the stock of physical capital since there is a change in ownership rather than an inflow of new capital. Greenfield and brownfield FDI should affect host country growth differently since greenfield FDI results in a larger inflow of physical capital. While brownfield FDI results in a small inflow of physical capital, Javorcik (2004) argues that brownfield FDI in the form of a merger or joint venture could maximise the potential for technology spillovers. Unfortunately, lack of appropriate data precludes an empirical analysis of this interesting research problem. However, since we believe that the mode of FDI is important for the effects on economic growth, this question is further discussed in Section 3.

3. Modelling FDI and host country economic growth

In this section the discussion of Section 2 is extended and formalised. The objective is to model how FDI inflows affect the size of the stock of physical capital and how FDI can generate spillovers improving the conditions for economic growth.

3.1 FDI as a source of inflow of physical capital

The host country capital stock consists of foreign-owned (MNE) as well as domestic-owned physical capital. Therefore, the host country stock of physical capital can be described by the following expression:

$$K_{HC} = K_{DOM} + K_{MNE} \quad (1)$$

where K_{DOM} is domestic-owned physical capital and K_{MNE} is foreign-owned physical capital

How is the stock of physical capital affected when an MNE invests in the host country? FDI inflows in the form of greenfield investment would increase the existing host country stock of capital through an increase in K_{MNE}. From this perspective, FDI has a similar effect as domestic investment since both increase the country's stock of physical capital. However, it is the relationship between foreign and domestic investments that determines the ultimate effect on the capital stock. The central question is whether domestic and foreign investments are complements or substitutes. Theoretically, both alternatives are plausible. For example, if an MNE finance its investment through borrowing in the host country financial market it can result in an increase in the interest rate causing domestic investment to be crowded out. This is an example of how FDI can have a negative effect on economic growth. On the other hand, MNE operations can stimulate host country production in additional industries through creating a demand for intermediate goods. If host country firms can supply these intermediate goods the result can be an increase in domestic investment. The relationship between foreign and domestic investment has to be determined empirically. Borensztein et al. (1998) and De Mello (1999) found a complementary relationship between domestic and foreign investment suggesting that greenfield FDI has a potential for affecting economic growth through an additional increase in the host country stock of physical capital. De Mello (1997) argues that a complementary relationship between FDI and domestic investment dominates in developing economies. The empirical part of this paper performs a bivariate regression having domestic investment as the dependent variable and FDI as the explanatory variable to analyse this relationship.

Unlike greenfield FDI, brownfield FDI results in a change in ownership of already existing capital in the host country rather than an inflow of additional capital. Brownfield FDI would cause a shift between domestic-owned and foreign-owned capital, decreasing K_{DOM} would

decrease while K_{MNE} would increase, resulting in a small total change for the aggregate host country stock of physical capital. Therefore, inflows of brownfield FDI are unlikely to affect the size of the capital stock.

3.2 FDI as a source of technology spillovers

What about knowledge capital and technology spillovers? It was argued above that knowledge capital is a characteristic of MNEs and that technology is a component of knowledge capital. The MNE is assumed to possess a technology superior to the technology available to host country firms. However, elements of the MNE technology can voluntarily or involuntarily spill over, allowing host country firms to adopt it. There are several possible channels for spillovers of technology between firms. For example, reverse engineering provides information about the technology used in production. Spillovers could also occur as a result of a firm hiring an employee from a competing firm who has knowledge about the technology that is used. The knowledge is embodied in the employee allowing the hiring firm to use that knowledge.

How can the process of technology spillovers be described in more detail on the micro level? Our starting point is Javorcik's (2004) discussion about spillovers through forward and backward linkages. In the case of a backward link, the MNE buys intermediate goods from a domestic supplier. In this situation it can actually be in the interest of the MNE to try to maximise spillovers to the supplier. For example, in order to improve product quality the MNE can provide technical advice resulting in a voluntary spillover of technology increasing the supplier's productivity.

A forward link implies that an MNE sells intermediate inputs to domestic firms in the host country. Javorcik (2004) argues that the domestic firms could become more productive as they get access to improved MNE input goods. For this scenario there is no reason to believe the MNE should have a strong incentive to actively try to avoid technology spillovers to the domestic firm.

As argued by Javorcik (2004), backward and forward linkages provide two scenarios where spillovers could occur voluntarily between the MNE and the supplying or supplied firm respectively. However, we also want to allow for situations where *involuntary* spillovers may arise. Involuntary spillovers would appear when the MNE is operating in the same sector as competing host country firms. In this scenario the MNE has an incentive to prevent spillovers.

First, we want to model the technology advantage the MNE has compared to the host country firms. Based on the earlier discussion about the importance of knowledge capital for MNEs, it is assumed that the MNE possesses a more advanced technology than the host country firms:

$$A_{MNE} > A_{DOM} \tag{2}$$

where A_{MNE} represents the level of technology the MNE possesses and A_{DOM} represents the level of technology a domestic firm possesses

At time t of investment the MNE consequently has a technology advantage over the host country firms and the size of the advantage is simply:

$$A_{MNE_t} - A_{DOM_t} > 0 \tag{3}$$

Spillovers of technology to competing firms would erode the MNEs technology advantage. When modelling the technology externalities of FDI, it is useful to make a distinction between *leakages* of technology and *spillovers* of technology. This distinction allows for scenarios where a leakage of technology does not automatically result in a positive technology externality.

We use $0 \leq \beta \leq 1$ for describing the amount of the MNE technology advantage 'leaking' and that host country firms potentially can adopt for use in their own production. A leakage of technology is defined as information about the MNE technology having been revealed as a result of MNE activities in the host country. For a situation where the MNE is successful in preventing leakages of technology to host country firms, β is close to zero. On the other hand, when technology leakages are large, β is close to 1. When does a leakage of technology result in a spillover of technology? Successful adoption of MNE technology by a host country firm implies a spillover of technology has taken place.

While technology spillovers can be both intra- and inter-industry in character, it is not necessary to complicate the model by trying to distinguish between these effects. In other words, the model does not distinguish between spillovers to domestic firms operating in the same or a different industry than the MNE. Furthermore, whereas it is reasonable that

geographical location in the host country should have an effect on technology spillovers we do not take this into account in the model.

What determines the size of the leakage of technology? An important factor is the channels for technology diffusion discussed earlier. For the case described by Javorcik (2004) of voluntary leakages through backward linkages, β will be close to 1 since the MNE tries to maximise the chances that the supplier can adopt the technology. What can an MNE do to prevent involuntary leakages? For example, it can try to use patents to minimise technology leakages. If the technology is of a kind easy to protect by using patents, β should be close to 0.

According to Keller (2004), earlier empirical studies of the existence of technology spillovers on the micro-level have reached mixed results. A possible explanation can be that there are many factors affecting the amount of spillovers taking place. Location and industry effects have already been mentioned. It is assumed in this paper that even a voluntary leakage of technology does not automatically result in a *spillover* of technology since it is necessary to take into account the ability of host country firms to actually adopt the technology leakage. Teece (1977) showed how the cost for transferring technology is substantial even in situations where both parties desire this. We use $0 \leq \gamma \leq 1$ to describe the amount of the leakage a host country firm can adopt. This variable is defined as the host country firm's 'absorptive capacity' along the same line of reasoning as in for example Glass and Saggi (1998). When the absorptive capacity is high, γ is close to 1 while it is close to 0 when the firm's absorptive capacity is low.

What can be assumed about the level of a firm's absorptive capacity? The absorptive capacity is determined by the characteristics of the firm and of the economy where the firm operates. A large amount of knowledge capital increases a firm's absorptive capacity. The quality of the host country infrastructure should also affect the capacity. Earlier studies such as Glass and Saggi (1998) suggest that an economy's stock of human capital can be used as a proxy for the absorptive capacity on the national level.

The magnitude of the actual spillover is determined by the size of the MNE technology advantage, the size of the technology leakage and by the host country firm's absorptive capacity. The 'threshold' concept implies that no spillovers occur if the absorptive capacity of the host country firm is too low. The idea of a threshold level of absorptive capacity has been used in earlier empirical studies such as Borensztein et al. (1998). Equation (4) describes how the level of technology of a host country firm is affected by a technology leakage based on the earlier discussion:

$$A_{DOMt+1} = \beta\gamma_{DOMt}(A_{MNEt} - A_{DOMt}) \quad (4)$$

where A_{DOM} represents the level of technology a domestic firm possesses, A_{MNE} represents the level of technology the MNE possesses, β is the size of the technology leakage and γ represents the domestic firm's absorptive capacity

Equation (4) suggests that the size of the technology spillover is positively related to the size of the technology leakage, the host country firm's absorptive capacity and the size of the MNE's technology advantage. However, we want to take into account the threshold argument suggesting no spillovers take place if the absorptive capacity of the domestic firm is below a minimum threshold level. Therefore, Equation (4) is made conditional on the following expression:

$$\gamma \geq \gamma_{THRESHOLD} \quad (5)$$

where $\gamma_{THRESHOLD}$ is the minimum level of absorptive capacity allowing the host country firm to adopt MNE technology

As long as the host country firm has achieved the threshold level of absorptive capacity, a spillover is maximised when the MNE's technology advantage toward the domestic firm is large.

The preceding discussion has provided a base for constructing an aggregate country level production function describing how FDI inflows can affect host country economic growth.

$$Y_{HC} = F(A_{HC}(K_{HC}, L_{HC}), K_{MNE}, KK_{MNE}) \quad (6)$$

where K_{HC} is the domestic-owned stock of physical capital, K_{MNE} is the foreign-owned stock of physical capital, KK_{MNE} represents MNE knowledge capital, L_{HC} represents the stock of labour while A_{HC} represents the technological level of the host country

Equation (6) can be used to summarise the earlier discussion of how FDI can affect host country production. Firstly, FDI inflows can cause an increase in the stock of physical capital in the host country. It was argued that greenfield FDI generates an increase in K_{MNE} resulting in an increase in the total stock of physical capital as long as foreign and domestic investments are not substitutes. However, diminishing returns to capital reduce the effect on growth that results from an FDI-induced increase in the stock of physical capital. As regards the size of the stock of labour in the host country, the paper argues that FDI has a very small effect.

More interestingly, it has been argued that FDI can generate positive technology externalities for the host country. We want to represent these externalities by modeling a link between FDI and the host country level of technology, A_{HC}. The MNE's knowledge capital (KK_{MNE}) enters as an additional input in the production function (Equation (6)) in a similar fashion as in Balasubramanyam et al. (1996) and De Mello (1999). FDI also has the potential to generate externalities through technology spillovers and spillovers allowing KK_{MNE} to affect A_{HC}. MNEs that bring a large amount of knowledge capital to the host country are assumed to possess advanced technology generating spillovers according to Equation (4). As long as Equations (2) and (5) hold, there will be technology spillovers from the MNE to the host country firm, the size of which is determined by Equation (4). These spillovers also improve the aggregate host country level of technology, A_{HC}, and result in a more efficient use of the host country's stock of physical capital and labour as shown in Equation (6). KK_{MNE} therefore has the potential to affect A_{HC} in Equation (6) because spillovers from MNEs to domestic firms should increase the host country level of technology (A_{HC}).

3.3 Model implications

What implications can be drawn from the model in Section 3.2? The model and discussion provides insights into the growth enhancing potential of FDI inflows into developed and developing host countries, respectively.[3] Table 2 presents host country conditions which are important for the potential of FDI to affect economic growth and covered by the model. The first two conditions, level of technology and absorptive capacity in the host country, affect the

[3]Chapter 2 of this dissertation describes the importance of FDI for the transition economies in Eastern Europe. It would have been interesting to study the effect of FDI on economic growth in transition economies but we choose not to pursue this line of research due to data problems and problems of controlling for growth effects from the transition process.

growth enhancing potential of FDI resulting from technology spillovers. The remaining host country condition, per capita stock of real capital, affects the growth enhancing potential of FDI based on inflow of physical capital.

Table 2 Host country conditions for realising the growth enhancing potential of FDI inflows

Type of economy / Condition	Developed	Developing
Host country level of technology (A_{HC})	High	Low
Absorptive capacity of host country firms (γ)	High	Low
Per capita stock of real capital (k_{HC})	Large	Small

Source: Own construction

It is reasonable to assume that the level of technology is higher in developed than in developing economies. This assumption implies the technology advantage an MNE has towards the host country firms (described by Equation (3)) in developing economies is large. Consequently, technology spillovers from FDI should be much more important for improving the level of technology in developing economies.

The absorptive capacity should be higher in developed economies than in developing economies. However, Equation (4) implies that for the case of FDI inflows to developed economies even if the absorptive capacity (γ) is high, the ultimate effect on A_{DOM} should be limited since the MNEs technology advantage, $A_{MNE} - A_{DOM}$, is expected to be small. The low absorptive capacity in developing economies reduces the potential improvement of the level of technology that could be achieved by FDI inflows thereby also reducing the growth enhancing potential of FDI.

The size of the host country stock of physical capital is important since it has implications for the returns to scale on investment. Developed economies have large per capita stocks of physical capital suggesting diminishing returns to investment. For the developing economies we have the opposite case: small stocks of physical capital imply increasing returns to scale on investment. However, the returns to scale are also affected by the market structure in the host country. Increasing returns to scale should be expected in a situation of monopolistic

competition and a limited number of firms. So what does capital stock and market structure imply for a comparison of developed and developing economies?

What is known about the market structure in developing economies? Studies that have analysed this research problem include Westbrook and Tybout (1993) and Tybout (2000). Many industries in developing economies are characterised by a large number of small firms. The empirical evidence suggests that returns to scale in developing economies are mostly consistent with constant returns to scale.

The developed economies have larger per capita stocks of real capital than developing economies. Consequently, these economies should be closer to experience diminishing returns to capital than developing economies when there is an inflow of physical capital.

Table 3 summarises the discussion and presents an overview of the differences in the ability of developed and developing economies to realise the growth enhancing potential of FDI inflows.

Table 3 Host country ability to enhance economic growth through FDI inflows

Effect on growth of:	Developed economies	Developing economies
Technology spillovers from FDI	+ High absorptive capacity implies a high potential to adopt technology leakages and realise spillovers - An already high host country level of technology reduces the potential for further improvements from spillovers	+ Low host country level of technology indicates a high potential for improvement even if spillovers are small - Low absorptive capacity implies that only a limited share of an MNE technology leakage can be turned into spillover through adoption
Physical capital inflow from FDI	+ Market structure implies existence of increasing returns to investment in physical capital - Large per capita stocks of physical capital suggests decreasing returns to investment	+ Small per capita stocks of physical capital implies increasing returns to investment - Market structure studies indicate that constant returns to scale dominate in developing economies

What conclusions can be drawn based on the summary in Table 3? There seems to be no clear indication whether developed or developing economies should experience the strongest growth effects from FDI inflows. Applying the discussion in Section 3.2 to a comparison between developed and developing economies suggests there are forces providing advantages and disadvantages to both types of economies leaving the question of what type of economy has the best potential to realise economic growth to be determined empirically.

This section has described the potential of FDI to enhance economic growth. While the section has stressed the importance of technology spillovers for realising the growth enhancing potential of FDI, analysing these effects on the macro level is difficult. Section 4 aims to determine empirically whether FDI indeed affect host country economic growth.

4. Data and empirical analysis

Section 4.1 presents some descriptive data of FDI inflows and economic growth. Section 4.2 describes the empirical approach and the data. Sections 4.3 and 4.4 provide the empirical analysis.

4.1 Some descriptive data

We start the empirical investigation of the relationship between FDI and growth by presenting a scatter plot providing a rough indication of the importance of inward FDI for host country economic growth. Figure 1 plots the average inward stock of FDI per capita to the average annual growth rate of real GDP per capita during the period 1980 to 2002 for the total dataset used in this paper covering 90 developed and developing economies.

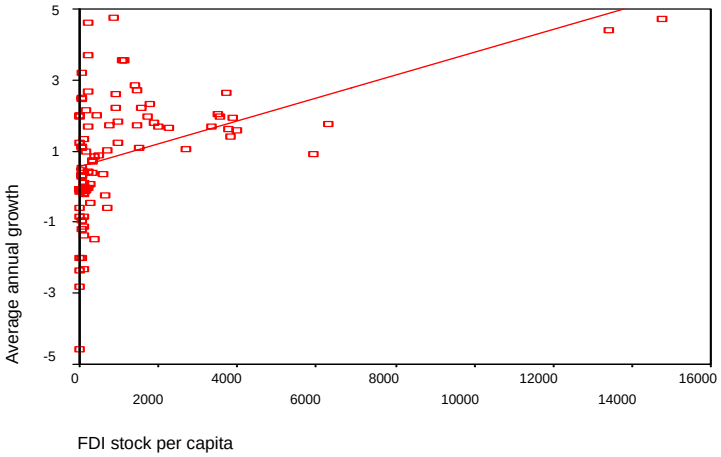

Figure 1 Average inward FDI stock per capita and average annual per capita GDP growth 1980 to 2002

The plot indicates a positive relationship between the average annual growth rate and the average inward stock of FDI. The two observations in the right upper corner are Singapore and Ireland.

Which of the developing economies have been successful or not in achieving economic growth in the last two decades? Table 4 lists the ten best performing and the ten worst performing developing economies during the period 1980 to 2002.

Table 4 High and low growth developing economies

High growth economies	Average annual growth 1980 to 2002	Low growth economies	Average annual growth 1980 to 2002
China	8.2	Congo, Dem. Rep.	-4.6
Korea	5.7	Liberia	-2.8
Botswana	4.8	Sierra Leone	-2.8
Thailand	4.6	Saudi Arabia	-2.5
St Kitts and Nevis	4.6	Haiti	-2.4
Singapore	4.4	Ivory Coast	-2.3
Antigua and Barbuda	4.1	United Arab Emirates	-2.1
Cyprus	4.0	Niger	-2.0
Hong Kong	4.0	Madagascar	-2.0

Malta	3.8	Venezuela	-1.5

Source: Based on data from World Development Indicators

Table 4 reveals the existence of considerable cross-country variation. It is not uncommon that developing economies experience negative economic growth over an extended period of time. Table 4 also illustrates two of the well-known stylised facts from economic growth research. Firstly, the East Asian economies have experienced high growth in the last two decades. Among the ten fastest growing economies, five are located in East Asia. China is the star performer, having achieved an average growth rate above 8 per cent during the period. Secondly, the sub-Saharan African economies have largely failed in achieving economic growth. Six of the ten worst peforming economies are located in sub-Saharan Africa.

Table 5 provides a rough indication of the importance of inward FDI for the same economies included in Table 5.

Table 5 Inward FDI stocks in high and low growth developing economies

High growth economies	Inward FDI stock per capita in 2002, USD	Low growth economies	Inward FDI stock per capita in 2002, USD
China	..	Congo, Dem. Rep.	16
Korea	918	Liberia	835
Botswana	499	Sierra Leone	5
Thailand	570	Saudi Arabia	1 159
St Kitts and Nevis	14 222	Haiti	27
Singapore	32 634	Ivory Coast	224
Antigua and Barbuda	9 465	United Arab Emirates	957
Cyprus	6 348	Niger	37
Hong Kong	53 968	Madagascar	26
Malta	..	Venezuela	1 264

Source: Based on data from UNCTAD (2004) and population data from World Development Indicators

Note:

".." indicates that data is missing

The high growth economies tend to have substantial inward stocks of FDI. The two city-state economies, Hong Kong and Singapore, have extremely large inward FDI stocks. On the other hand, several of the low growth economies, such as Sierra Leone and Haiti, have been unsuccessful in attracting inflows of FDI.

What about economic growth and FDI in developed economies? A similar review of the data for the developed economies suggests that there is considerably less variation in average annual growth. Ireland had the highest growth of 4.7 per cent, while Switzerland only achieved an average growth rate of 0.9 per cent during the period. The variation in inward FDI stocks is also smaller than for the developing economies. Ireland is an outlier since its inward FDI stock in 2002 was almost five times larger than the average stock for the developed economies sample.

4.2 Empirical approach, data and regression variables

What approaches have been used in earlier studies of economic growth? Table 1 reveals that earlier research analysing the effects of FDI on economic growth is dominated by cross-section and panel data studies. Time series analysis was used in two of the studies described in Table 1. Temple (1999) argues that researchers should avoid presenting the results of a single model since this might be misleading. The fragility of many of the independent variables used in growth studies implies a wider range of results should be presented. This paper follows Temple's argument and uses both cross-section, panel data and time series regressions.

An alternative approach to cross-section and panel data analysis is to perform separate time series regressions for each individual host country. This paper performed exploratory time series analysis, using the annual change in FDI as the independent variable and the annual change in real GDP per capita as the dependent variable. Despite trying various lags, FDI only occasionally had a significant effect on GDP (the results are not reported). Temple (1999) is sceptical to this approach to growth studies due to data quality problems and the short time series available for developing economies. The lack of significant results seems to support Temple's argument, and the time series approach is not pursued further. Instead, cross-section and panel data analysis is performed.

The dataset used in this study includes 90 countries and covers the period 1980 to 2002. The paper follows the argument in Blonigen and Wang (2004) discussed in the literature review and divides the total dataset into one sample of developing economies and one sample of developed

economies to avoid obscuring the potential relationship between FDI and growth. Several of the earlier studies that failed to find a link between FDI and economic growth pooled developed and developing economies. There is also a larger total number of countries in our dataset compared to earlier studies. Appendix A presents the countries that are included in the total dataset and the two sub samples.

GROWTH represents the average annual growth rate of real GDP per capita over the period 1980 to 2002 and is used as the dependent variable in all cross-section specifications. FDI is the primary variable of interest and is represented by the average stock of inward FDI as share in GDP during the period 1980 to 2002. This should provide a proxy for the importance of inward FDI for a host country during the whole time period.

The paper focuses on how FDI inflows affect host country economic growth, but it is necessary to control for additional determinants of economic growth in order to reduce the problem of omitted variable bias. The variable DOMINV is introduced in order to take into account the effects of domestic investment on economic growth. Since data for stocks of physical capital are difficult to construct, gross capital formation as a share of GDP for 1980 to 2002 is used as a proxy for the influence of domestic investment in a similar fashion as Olofsdotter (1998). The FDI component of gross capital formation has been subtracted.

What other explanatory variables should be included in the analysis? Sala-i-Martin et al. (2004) point to the difficulty of choosing among the multitude of potential determinants of economic growth when analysing growth empirically. Sala-i-Martin et al. (2004, p. 813) argue that 'growth theories are not explicit enough about what variables [that] belong in the "true" regression', and this can result in data-mining type of problems. Taking a Bayesian approach, they analyse 67 variables that have been used in empirical growth studies. 18 of these are proved to be significantly correlated with economic growth. The strongest indication is found for primary schooling, the price of investment and the initial level of GDP per capita. Taking these findings into account we include average years of schooling and the GDP level in 1980. For our purposes the schooling variable can function both as a measure of human capital and a rough proxy for the absorptive capacity of the host country. These variables are defined as SCHOOL1980 and GDP1980 respectively.

Sala-i-Martin et al. (2004) also find that regional dummies are related to economic growth. Accordingly, dummies for the African sub-Saharan economies and the East Asian economies are included and are defined as AFRICA and ASIA. Along the lines of earlier research such as Borensztein et al. (1998), an interaction variable is introduced, FDI*SCHOOL, to find the joint

effect of FDI and SCHOOL1980. The interaction variable is the product of FDI and SCHOOL1980 and is included in order to analyse the effect of the absorptive capacity in the host country on the potential of FDI to affect economic growth.

Many developing economies, particularly in Africa, have been severely affected by war. It is reasonable to assume that economic growth in these economies should be affected negatively. Consequently, the variable WAR is introduced. The dummy variable takes a value of 1 for economies which Collier and Hoeffler (2004) described as having suffered from war during the period under study.[4]

In order to control for the importance of host country institutions for economic growth, we introduce the variable EFI1980. This variable is the Economic Freedom Index provided by the Frasier Institute. The index incorporates ten weighted country attributes such as property rights and informal market activity. The index ranges from 0 to 10, and higher values imply better conditions for economic growth. The value for the year 1980 is used to control for the quality of host country institutions.

What signs do we expect the coefficients of the independent variables to take? FDI and DOMINV should have positive effects on economic growth. The expected sign on the coefficient for the level of GDP per capita in 1980 is less straightforward. The initial level of income is used in growth regressions to investigate the existence of convergence in income levels. This research problem has been common in empirical studies of economic growth, for a very influential study, see Mankiw et al. (1992). A negative coefficient on GDP1980 would indicate convergence, i.e., the economies in the sample tend to move towards the same level of per capita income. A positive coefficient would imply that economies with a high per capita income in 1980 grew faster than economies with a low income, causing income levels to diverge. Earlier research has found little evidence of convergence except for samples with similar high income countries. Accordingly, the expected sign of the coefficient for GDP1980 is left an open question. FDI*SCHOOL is expected to have a positive effect on economic growth since a higher absorptive capacity would imply that technology spillovers become more important. As far as the two regional dummies are concerned, the data presented in Table 4 suggests that the AFRICA and ASIA variables should have a negative and positive sign respectively. Since the SCHOOL1980 variable functions as a proxy for human capital it is

[4]These economies are Algeria, Burundi, Colombia, El Salvador, Guatemala, Indonesia, Morocco, Nicaragua, Nigeria, Peru, Philippines, Rwanda, Sierra Leone, Sri Lanka and Turkey.

expected to have a positive effect on economic growth. EFI1980 is expected to have a positive effect on growth since higher index values imply higher quality institutions.

Table 6 provides a summary description of the variables used in the cross-section and the panel data analysis.

Table 6 Regression variables

Variable name	Explanation	Data source and period	Expected sign of coefficient
Dependent variable			
GROWTH	Average annual growth rate of real GDP per capita.	WDI (2004), 1980-2002	na
Independent variables			
AFRICA	Dummy variable. Equal to 1 for all sub-Saharan African economies, zero otherwise.	na	-
ASIA	Dummy variable. Equal to 1 for all economies classified as 'high performing' in World Bank (1993): Hong Kong, Indonesia, Korea, Malaysia, Singapore, and Thailand, zero otherwise.	na	+
DOMINV	Average share in GDP of gross capital formation reduced for the FDI	Derived from WDI (2004), 1980-2002	+

	component, represents domestic investment.		
EFI1980	The Economic Freedom Index in 1980. The index ranges from 0 to 10 where higher values imply more extensive economic freedom.	Frasier Institute (2005)	+
FDI	Average inward stock of FDI as share in GDP (inward flows are used in the panel data analysis).	UNCTAD (2004)	+
FDI*SCHOOL	Interaction variable. Included in order to take into account the absorptive capacity in the host country.	See FDI and SCHOOL	+
GDP1980	Level of GDP per capita in 1980. Included in order to check for convergence or divergence in income levels.	WDI (2004), 1980	?
SCHOOL1980	Average years of schooling	Center for International	+

	in 1980. Proxy for human capital.	Development (2005), 1980	
WAR	Dummy variable. Equal to 1 for countries having experienced war for at least two years during the period 1980 to 2002.	Collier and Hoeffler (2004)	-

4.3 Cross-section analysis

For the baseline specification, DOMINV and FDI are used as explanatory variables. A linear relationship is assumed resulting in the following regression equation for the cross-section analysis:

$$GROWTH_i = \beta_1 + \beta_2 DOMINV_i + \beta_3 FDI_i + \beta_4 X_i + \varepsilon_i \quad (7)$$

where i indexes the included countries and X_i represents a set of additional explanatory variables introduced in later specifications

An OLS regression is performed for the cross-section sample of developing economies. Table A.1 in Appendix A lists the 68 countries included in the sample. Since we do not have a theory that can suggest a 'true' model of economic growth, it is reasonable to try several different specifications. The test statistics for all slope parameters are calculated by using the White heteroscedasticity consistent variance estimator. The results for the developing economies sample are presented in Table 7.

Table 7 Cross-section analysis, developing economies sample

Independent variable	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS
Constant	-3.297 (-4.86)***	-3.206 (-4.77)***	-3.312 (-4.75)***	-2.167 (-2.95)***	-4.705 (-3.79)***	-2.991 (-4.50)***	-1.363 (-0.78)
DOMINV	17.051 (4.60)***	16.361 (4.50)***	17.028 (4.62)***	13.051 (3.92)***	18.992 (4.42)***	17.019 (4.60)***	12.454 (2.38)**
FDI	2.942 (3.79)***	2.634 (3.01)***	3.035 (3.41)***	2.157 (2.82)***	2.271 (2.50)**		1.756 (1.94)*
SCHOOL1980		0.801E-01 (0.81)					0.118 (0.86)
GDP1980			0.502E-01 (0.04)				-0.247E-03 (-1.84)*
AFRICA				-0.733 (-2.16)**			-0.509 (-0.80)
ASIA				1.803 (4.06)***			2.037 (3.29)***
EFI1980					0.242 (1.15)		-0.892E-01 (-0.52)
WAR					-0.270		-0.556

					(-0.67)		(-1.32)
FDI* SCHOOL						0.620 (3.18)***	
R^2	0.42	0.44	0.42	0.52	0.47	0.43	0.54
Adjusted R^2	0.41	0.40	0.39	0.49	0.43	0.41	0.46
N	68	56	67	68	59	56	52

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.

The first baseline specification includes the DOMINV and FDI variables. Both variables are significant at the 1 per cent level and have the expected positive signs indicating domestic and foreign investment contributes to host country economic growth.

Specification (2) adds SCHOOL1980 to take into account human capital in the host country. SCHOOL1980 is insignificant although it has the correct sign. Consequently, there is no indication that the level of human capital in 1980 had a positive effect on economic growth during the period.

The third specification introduces the GDP per capita level in 1980. Since GDP1980 is insignificant, there is no evidence of convergence or divergence in income levels among the developing economies. This result is in line with earlier empirical studies which have mostly failed to find indications of convergence, except for a small group of developed economies.

Specification (4) adds the two regional dummies AFRICA and ASIA. Both variables are significant and have the expected signs, reflecting the exceptionally strong growth performance in East Asia as well as the poor development in sub-Saharan Africa.

The fifth specification introduces the variables EFI1980 and WAR. EFI1980 has the expected positive sign but is insignificant. WAR has the expected negative sign but is also insignificant and consequently there is no indication of WAR having a detrimental effect on host country economic growth. Replacing WAR with an interaction variable between WAR and AFRICA does not result in a significant relationship. It is possible that the identification of which countries have experienced war is too broad and includes several low intensity conflicts unlikely to affect economic growth in the long run.

The sixth specification replaces FDI with the interaction variable FDI*SCHOOL. This variable should be interpreted as representing the joint effect of FDI and the host country absorptive capacity on economic growth. The interaction variable is significant and positive. This observation reflects an idea frequently referred to in the established theory of innovation.

In specification (7), all of the independent variables are included except FDI*SCHOOL. FDI, the primary variable of interest, is significant at the 5 per cent level and has a positive effect on economic growth. DOMINV and ASIA are also found to have a significant positive effect on economic growth. The negative and significant coefficient for GDP1980 suggests convergence in income levels between the developing economies. AFRICA is insignificant in this specification but has the expected negative sign.

We also investigate the relationship between FDI and domestic investment. A bivariate OLS regression is performed using DOMINV as the dependent variable and FDI as the independent

variable. FDI is significant at the 1 per cent level and has a positive coefficient, providing a rough indication of complementarity between domestic and foreign investment in the developing economies.

The analysis of the developing economies sample shows that both the FDI and DOMINV variables are robust in several different specifications having a significant positive effect on host country economic growth. The results indicate that both domestic and foreign investment contribute to host country economic growth in developing economies. Whereas the observation for Singapore is an outlier, removal of this observation does not change the results. Appendix D presents the results when the average of the inward stock of FDI per capita (FDIPC) is used as dependent variable. The results are similar.

The paper proceeds to perform a similar cross-section analysis for the sample of developed economies. Analysing the developed economies separately allows us to see whether FDI affects economic growth in developed economies. Table A.2 in Appendix A lists the 22 economies included in the sample. The same baseline specification as for the developing economies (DOMINV and FDI) is used and complemented with GDP1980 in order to check for convergence in income levels. The SCHOOL1980 variable is also used in order to investigate the effect of human capital on economic growth. EFI1980 controls for the quality of host country institutions. The results are presented in Table 8.[5]

Table 8 Cross-section analysis, developed economies sample

Independent variable	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Constant	-0.305 (-0.60)	0.597 (0.90)	1.637 (1.38)	1.823 (1.60)	1.818 (1.63)
DOMINV	8.421 (3.68)***	5.977 (2.04)*	4.443 (1.45)	3.956 (1.43)	3.841 (1.06)
FDI	3.077 (8.74)***	0.438E-01 (0.05)	-0.401 (-0.41)	-0.940 (-0.09)	-0.144 (-0.10)
GDP1980			-0.710E-04 (-1.10)	-0.392E-04 (-0.53)	-0.421E-04 (-0.46)
SCHOOL				-0.515E-	-0.523E-

[5]Appendix D presents the results when the average inward stock of FDI per capita (FDIPC) is used as the dependent variable. The results are similar.

1980				01 (-1.42)	01 (-1.55)
EFI1980					0.113E-01 (0.10)
R^2	0.67	0.20	0.29	0.32	0.32
Adjusted R^2	0.63	0.11	0.16	0.15	0.10
N	22	21	21	21	21

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.

The first specification is the same baseline specification used for the sample of developing economies. FDI and DOMINV are found to have a positive and significant effect on host country economic growth. However, ocular inspection of the observations reveals that Ireland is an extreme outlier. Ireland has attracted very large inflows of FDI; in 2002 the inward stock was close to five times as large as the average stock in the developed economies sample. Ireland's growth rate is also more than twice as high as the average for the sample. Therefore the first specification is re-run, excluding the observation for Ireland from the sample. Specification (2) reveals that the significant positive effect of FDI on economic growth disappears and DOMINV is also insignificant when Ireland is excluded. Three additional specifications are used but none of these indicate a significant effect on economic growth from FDI. The analysis is not able to find any indications that FDI inflows affect host country economic growth in developed economies.

The cross-section analysis suggests that FDI inflows have a positive effect on economic growth in developing but not in developed economies. However, the small number of observations, particularly for the sample of developed economies, implies that this finding may be unreliable. The results from the cross-section analysis motivate extending the empirical work by using panel data.

4.4 Panel data analysis

Temple (1999) argues that empirical studies of economic growth should use more than one model in order to avoid presenting misleading results. Panel data allows for taking the time series dimension into account and substantially increases the number of observations. This is particularly important for the developed economies sample used in this study.

Fölster and Henrekson (2001) argue that annual data should be avoided in growth studies since the results might be affected by short-run business cycle effects. Accordingly, averages over five-year periods are used instead of annual observations resulting in four five-year periods covering the 1980 to 1999 time span. Similar explanatory variables as in the cross-section analysis are included, the difference being that five-year averages are used. In the panel data analysis, FDI is measured as the inflows of FDI as a share in GDP averaged over a five-year period. The same developing and developed economies sub-samples are used.

The regression equation used in the panel data analysis takes the form:

$$GROWTH_{it} = \beta_1 + \beta_2 DOMINV_{it} + \beta_3 FDI_{it} + \beta_4 Z_{it} + \varepsilon_{it} \quad (8)$$

where i indexes the included countries, t denotes five-year period averages and Z_{it} represents the set of additional explanatory variables

The panel data results for the developing economies sample are presented in Table 9. The LM-test suggests OLS should be used for the developing economies sample. However, using a fixed or random effects model instead of OLS does not substantially change the results.

Table 9 Panel data regression results, developing economies sample

Independent variable	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS
Constant	-3.129 (-5.37)***	-3.206 (-4.81)***	-3.236 (-5.50)***	-2.260 (-3.46)***	-4.165 (-3.99)***	-3.016 (-4.83)***	-1.971 (-1.44)
DOMINV	16.192 (6.00)***	16.214 (5.58)***	16.285 (5.90)***	13.249 (4.64)***	18.106 (5.77)***	17.051 (5.80)***	15.453 (3.83)***
FDI	29.137 (4.14)***	25.765 (3.54)***	28.701 (3.90)***	25.298 (4.11)***	39.376 (7.76)***		34.877 (5.36)***
SCHOOL 1980		0.846E-01 (0.73)					0.178 (1.27)
GDP1980			0.554E-04 (0.39)				-0.352E-03 (-1.85)*
AFRICA				-0.752 (-2.08)**			-0.502 (-0.91)
ASIA				1.649 (2.64)***			1.298 (1.71)*
EFI1980					0.130 (0.68)		-0.119 (-0.58)
WAR					-0.908 (-1.58)		-1.203 (-1.88)*

FDI* SCHOOL						5.984 (4.85)***	
R^2	0.23	0.24	0.24	0.26	0.29	0.25	0.30
Adjusted R^2	0.23	0.23	0.23	0.25	0.27	0.24	0.28
N	272	224	268	272	236	220	208

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.

In general, the results of the panel data analysis are similar to the cross-section analysis. DOMINV and FDI are significant at the 1 per cent level of significance. The results again indicate that both domestic and foreign investment have a positive effect on economic growth in the developing economies.

Five-year periods allow for greater precision in using the WAR variable. In the full specification, WAR is significant at the 10 per cent level.

The results for the developed economies sample are presented in Table 10. The same specifications as for the cross-section analysis are used. The Hausman specification test indicates a random effects model (REM) should be used for all specifications.[6]

Table 10 Determinants of economic growth, developed economies sample panel data

Independent variable	(1) REM	(2) REM	(3) REM	(4) REM	(5) REM
Constant	0.245 (0.30)	0.271 (0.35)	0.959 (0.74)	1.136 (0.88)	1.260 0.96)
DOMINV	5.967 (2.26)**	6.622 (2.49)**	5.846 (1.72)*	5.698 (1.69)*	6.219 (1.75)*
FDI	33.196 (4.26)***	12.797 (1.49)	10.496 (0.97)	14.067 (1.26)	15.386 (1.34)
GDP1980			-0.526E-04 (-0.86)	0.652E-05 (0.09)	0.242E-04 (0.29)
SCHOOL 1980				-0.903E-01 (-1.29)	-0.845E-01 (-1.18)
EFI1980					-0.755E-01 (-0.50)
Hausman specification test (Critical	0.47 (5.99)	1.39 (5.99)	0.68 (7.81)	0.65 (9.48)	0.61 (11.07)

[6]The null hypothesis for the Hausman test is that we have a random effect. The test statistic is chi-square distributed (χ_k^2) where *k* is the number of explanatory variables.

value at the 5 per cent level)					
R^2	0.15	0.07	0.07	0.10	0.10
N	88	84	84	84	84

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.

For the developed economies the results are similar to the cross-section analysis expect that domestic investments now have a significant and positive effect on economic growth in all five specifications. FDI only has a significant effect on economic growth when the four observations for Ireland are included. The results suggest that Ireland behaves as a developing economy. Barry and Bradley (1997) argue that Ireland has functioned as a host country for large inflows of export-platform FDI from the U.S. These investments have been performed in Ireland in order to export the produced goods to the rest of the EU, supporting the idea of export-platform FDI provided in Ekholm et al. (2004). It is likely that the large export volumes resulting from these FDI inflows have stimulated the Irish economy. According to the idea of export-led growth, exports stimulate the economy as a whole through productivity enhancing externalities such as technological spillovers, see Pack (1994) for an overview of how externalities affect economic growth. Marin (1992) found indications of productivity improvements from exports for four OECD economies.

The empirical analysis performed in this paper indicates that FDI enhances economic growth in developing economies but not in developed economies. How can this be explained? The discussion in Section 3.3 did not find any clear indication of whether FDI should be more important for economic growth in developing or developed economies. However, it is possible that the small per capita stocks of physical capital in developing economies imply increasing returns to investment allowing FDI to affect growth positively.

5. Conclusions

This paper has argued that FDI should enhance host country economic growth through technology spillovers and inflows of physical capital. The paper discusses and models the effects of FDI inflows on host country economic growth through these two channels.

The empirical part of the paper attempts to verify whether FDI inflows affect economic growth. Performing cross-section and panel data analysis on a dataset of 90 economies, the paper contributes to the mixed results of earlier empirical studies on the macro level by the finding that FDI inflows have a positive effect on host country economic growth for developing but not for developed economies. This may reflect that in a mature market economy there is no difference between domestic and transborder investment. In the panel data analysis, domestic investments also have a positive effect on economic growth both in developed and developing economies.

This paper has assumed that the direction of causality goes from inflows of FDI to host country economic growth. However, economic growth could itself cause an increase in FDI inflows. Economic growth increases the size of the host country market and strengthens the incentives for market seeking FDI. This could result in a situation where FDI and economic growth are mutually supporting. However, for the case of most of the developing economies, even sustained economic growth is unlikely to result in market-seeking FDI due to the low income levels. Therefore, causality is primarily expected to run from FDI inflows to economic growth for these economies.

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Appendix A Country samples

Table A.1 Developing economies sample

Algeria	Guinea-Bissau	Panama
Argentina	Guyana	Paraguay
Bangladesh	Haiti	Peru
Benin	Honduras	Philippines
Bolivia	Indonesia	Rwanda
Botswana	Ivory Coast	Senegal
Brazil	Jamaica	Seychelles
Burkina Faso	Jordan	Sierra Leone
Burundi	Kenya	Singapore
Cameroon	Lesotho	Sri Lanka
Central African Republic	Madagascar	St. Vincent and the Grenadines
Chile	Malawi	Swaziland
Colombia	Malaysia	Syrian Arab Republic
Congo, Democratic Republic	Mali	Thailand
Congo, Republic	Mauritania	Togo
Costa Rica	Mexico	Trinidad and Tobago
Ecuador	Morocco	Tunisia
Egypt	Nepal	Turkey
El Salvador	Nicaragua	Uruguay
Gabon	Niger	Venezuela
Gambia	Nigeria	Zambia
Ghana	Oman	Zimbabwe
Guatemala	Pakistan	

Table A.2 Developed economies sample

Australia	Italy
Austria	Japan

Canada	Netherlands
Denmark	New Zealand
Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom
Israel	United States

Note: Belgium and Luxembourg have to be excluded from the developed economies sample due to inconsistencies in the data for inward FDI.

Appendix B Correlation matrices

Table B.1 Correlation matrix for developing economies sample

Variable	AFRICA	ASIA	DOMINV	EFI1980	FDI	FDI* SCHOOL	GDP1980	SCHOOL	WAR
AFRICA	1								
ASIA	-0.209	1							
DOMINV	-0.282*	0.350**	1						
EFI1980	-0.176	0.408**	0.184	1					
FDI	-0.154	0.304*	0.215	0.274*	1				
FDI* SCHOOL	-0.299**	0.276*	0.175	0.260	0.839**	1			
GDP1980	-0.565**	0.121	0.155	0.221	0.266*	0.429**	1		
SCHOOL1980	-0.557**	0.101	0.165	0.130	0.252	0.602**	0.647**	1	
WAR	-0.074	-0.116	-0.141	-0.241	-0.216	-0.229	0.005	-0.031	1

** indicates that correlation is significant at the 1 per cent level

* indicates that correlation is significant at the 5 per cent level

Table B.2 Correlation matrix for developed economies sample

Variable	DOMINV	EFI1980	FDI	GDP198	SCHOOL

DOMINV	1				
EFI1980	-0.004	1			
FDI	-0.396	0.074	1		
GDP1980	-0.110	0.462*	-0.413	1	
SCHOOL1980	-0.345	0.421	0.013	0.561**	1

** indicates that correlation is significant at the 1 per cent level

* indicates that correlation is significant at the 5 per cent level

Appendix C Summary statistics

Table C.1 Summary statistics, developing economies sample

Variable	Variable cases	Mean	Standard deviation	Minimum	Maximum
AFRICA	68	0.41	0.50	0.00	1.00
ASIA	68	0.59E-01	0.24	0.00	1.00
DOMINV	68	0.20	0.56E-01	0.90E-01	0.38
EFI1980	59	5.01	0.91	2.90	7.40
FDI	68	0.19	0.17	0.74E-02	0.87
FDI*SCHOOL	56	0.71	0.81	0.45E-02	3.49
GDP1980	67	1 744.18	1 298.66	330.00	6 260.00
GROWTH	68	0.61	1.80	-4.57	4.77
SCHOOL1980	56	3.14	1.70	0.37	6.62
WAR	68	0.18	0.38	0.00	1.00

Table C.2 Summary statistics, developed economies sample

Variable	Variable cases	Mean	Standard deviation	Minimum	Maximum
DOMINV	22	0.20	0.32E-01	0.15	0.29
EFI1980	22	6.18	0.91	3.60	7.70
FDI	22	0.18	0.21	0.57E-02	1.08
GDP1980	22	9 167.27	2 048.14	5 320.00	13 490.00
GROWTH	22	1.97	0.74	0.91	4.73
SCHOOL1980	22	8.23	2.03	3.27	11.91

Appendix D

Tables D.1 and D.2 present the results of the cross-section analysis when the average inward stock of FDI per capita rather than the average inward stock of FDI as share in GDP is used as the dependent variable.

Table D.1 Cross-section regression results, developing economies sample

Independent variable	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS
Constant	-2.960 (-4.10)***	-2.937 (-4.24)***	-2.880 (-3.78)***	-1.961 (-2.60)**	-4.268 (-3.10)***	-2.776 (-3.99)***	-1.113 (-0.62)
DOMINV	17.491 (4.53)***	16.708 (4.44)***	17.601 (4.58)***	13.784 (3.77)***	19.721 (4.46)***	17.374 (4.57)***	13.575 (2.40)**
FDIPC	0.272E-03 (4.00)***	0.231E-03 (4.84)***	0.293E-03 (3.46)***	0.132E-03 (2.04)**	0.185E-03 (3.11)***		0.221E-03 (3.43)***
SCHOOL1980		0.101 (1.01)					0.202 (1.44)
GDP1980			-0.651E-04 (-0.51)				-0.382E-03 (-2.44)**
AFRICA				-0.736 (-2.08)**			-0.496 (-0.73)
ASIA				1.783			1.670

				(4.01)***			(2.88)***
EFI1980					0.193 (0.84)		-0.135 (-0.78)
WAR					-0.380 (-0.95)		-0.633 (-1.53)
FDI*SCHOOL						0.665E-04 (4.45)***	
R^2	0.41	0.43	0.41	0.49	0.46	0.42	0.55
Adjusted R^2	0.39	0.39	0.38	0.46	0.42	0.40	0.47
N	68	56	67	68	59	56	52

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.

Table D.2 Cross-section regression results, developed economies sample

Independent variable	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Constant	-0.577 (-0.74)	0.893 (1.04)	1.458 (1.34)	1.757 (1.74)	1.754 (1.88)*
DOMINV	9.381 (2.81)**	5.015 (1.43)	4.887 (1.52)	4.211 (1.45)	4.189 (1.13)

FDIPC	0.196E-03 (2.95)***	-0.347E-04 (-0.43)	-0.844E-06 (-0.01)	0.811E-05 (0.13)	0.765E-05 (0.10)
GDP1980			-0.673E-04 (-1.30)	-0.397E-04 (-0.73)	-0.400E-04 (-0.64)
SCHOOL1980				-0.533E-01 (-1.58)	-0.54E-01 (-1.68)
EFI1980					0.228E-02 (0.02)
R^2	0.50	0.21	0.28	0.32	0.32
Adjusted R^2	0.44	0.12	0.16	0.16	0.10
N	22	21	21	21	21

Note: t-statistics within parenthesis. The symbols *, ** and *** denote statistical significance at the 10, 5 and 1 per cent level, respectively.