Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen Kassel · Marburg · Siegen

ISSN 1867-3678

No. 37-2015

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Sectoral FDI, Absorptive Capacity and Economic Growth — Empirical Evidence from Egyptian Governorates

Shima'a Hanafy♣ and Marcus Marktanner♣♣

This version: 5 April 2018

Abstract

Using a novel panel dataset of Egyptian governorates for the period 1992–2007, we investigate the effects of aggregate and sectoral foreign direct investment (FDI) on Egypt's economic growth. We distinguish between FDI in the manufacturing, agriculture and service sector. The similarity of governorates in terms of institutional characteristics like culture, language, and legal framework and the consistency of the data collection process enables an effective estimation of the effect of FDI on Egypt's economic growth. Employing General Methods of Moments (GMM) panel estimations, we find that neither aggregate nor sectoral FDI has an unconditional effect on economic growth. We also reject human capital as a channel of absorptive capacity, but reveal an interesting effect of FDI in the service sector on economic growth in interaction with domestic private investment (DPI). Service FDI promotes economic growth only if the host governorate has a minimum threshold of DPI to absorb foreign knowledge and technology.

Keywords: Foreign direct investment; sectoral FDI; absorptive capacity; economic growth; Egypt.

JEL: F21, F23, F43, O47, O53

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We thank Bernd Hayo, Moamen Gouda, Michael Kirk, two anonymous reviewers, participants of the brown-bag research seminar at Philipps-University Marburg, participants of the 2017 International Conference of the Korea Association of Middle East Society and participants of the 9th International Conference of the Korean Association of International Studies, for helpful comments and suggestions. We would also like to thank all the people that helped facilitate, directly or indirectly, the data collection in Egypt.

1. Introduction

Economic theory suggests that foreign direct investment (FDI) has long-term growth effects (Barro and Sala-i-Martin, 1995). In addition to capital formation, the presence of foreign firms presumably generates knowledge and technology spillovers that enhance aggregate productivity and growth (De Mello, 1997; Castellani and Zanfei, 2006). Yet, growth impacts of FDI remain inconclusive, being more evident in growth theory than in the many empirical studies (Iamsiraroj and Ulubasoglu, 2015). Although findings on direct effects of FDI on economic growth are mixed, the importance of the absorptive capacity of recipient countries is regularly highlighted (e.g., Borensztein et al., 1998; de Mello, 1999; Alfaro et al., 2004; Makki and Somwaru, 2004; Gönel and Aksoy, 2016).

The idea that different sectors vary in their potential to absorb foreign technology and create linkages with the rest of the economy was early discussed in the seminal work by Hirschman (1958). However, as stated by Gönel and Aksoy (2016), the literature still largely neglects the sectoral dimension of FDI when studying the effect of FDI on economic growth. Moreover, studies that investigate possible channels of absorptive capacity, while distinguishing between the FDI recipient sectors, are scarce, especially in the case of developing countries. The cross-sectional analysis by Alfaro (2003) investigates only human capital as a channel of absorptive capacity. Restricted to OECD countries only, Gönel and Aksoy (2016) additionally investigate financial and technological development as channels of absorptive capacity of sectoral FDI with a strong focus on Information and Communication Technology (ICT).

Our main contribution is that we not only investigate the effects of sectoral FDI on economic growth, but also give special attention to channels of absorptive capacity. Our analysis is based on a new panel dataset of the 26 Egyptian governorates for the period 1992–2007. Our dataset has several advantages. First, in line with several studies particularly calling for host country-specific studies (e.g., Chakraborty and Nunnenkamp, 2008; Chowdhury and Mavrotas, 2006), our dataset enables focusing on cross-sectoral heterogeneity of the FDI-led growth effect while, additionally, reducing noise from cross-country heterogeneity. Governorates within the same country are homogenous in terms of institutional characteristics like culture, language and legal framework. The consistency of the data collection process across governorates is another benefit.

Second, as spillovers typically occur more locally than nationally and only disperse slowly over time into neighbouring regions (Jaffe et al., 1993; Ford et al., 2008), our dataset at the governorate level allows for a better exploration of FDI effects compared to datasets at the national level.[1]

Third, the dataset allows us to capture the sectoral dimension of FDI when we analyse its effect on economic growth. We distinguish between manufacturing, agricultural and services FDI. Our dataset further enables a breakdown of domestic private investment (DPI) based on the same three sectors.

Fourth, we investigate the hypothesis that FDI and DPI complement each other in promoting economic growth as a possible channel of absorptive capacity (Makki and Somwaru, 2004). The idea is that a certain amount of domestic investment might be necessary to absorb FDI spillover effects. Although Makki and Somwaru (2004) test this hypothesis in a cross-country analysis using aggregate data of FDI and domestic investments across all sectors, we are not aware of any study on the effect of FDI on economic growth that investigates this channel of absorptive capacity while distinguishing between FDI and DPI recipient sectors. Analysing this channel is closest to the analysis by Fillat and Woerz (2011), who investigate differences of absorptive capacity between various industries through interactions of FDI and domestic investment at the industry level. However, the study is restricted to FDI in the manufacturing sector only and to advanced countries. With the increasing share of FDI in services, especially in developing countries, investigating the effect of service FDI is of particularly great relevance.

Fifth, we are able to construct a stock measure of FDI that permits better estimation of the long-term growth effect of FDI, compared to using FDI flows. Using FDI stock is more consistent with growth theory and FDI-related theories (Nunnenkamp and Spatz, 2004; Ford et al., 2008). This is because growth-enhancing spillovers are not only restricted to recent FDI inflows but should also result from FDI received in previous periods. Moreover, some authors argue that using FDI stock can reduce endogeneity problems (Nunnenkamp and Spatz, 2004; Cipollina et al., 2012).

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[1] A similar argument is made by Ford et al. (2008), who analyse the impact of FDI on economic growth at the US states' level. Similarly, Zhang (2001) and Yao and Wei (2007) investigate FDI effect on economic growth in China using a panel of Chinese provinces.

Sixth, the country of analysis, Egypt, has recently experienced an uprising, not only due to political but also economic reasons (Malik and Awadallah, 2013) and is currently undergoing several economic reforms. Attracting FDI is one of the highest priorities of the current Egyptian government, as indicated by the government-launched 'Egypt Economic Development Conference' in Sharm El Sheikh in March 2015, which presented key investment opportunities to international investors to increase economic growth in the country.[2] Our dataset allows us to investigate whether, and in which sectors and under which conditions, FDI is a potential source of economic growth in Egypt. We are not aware of any econometric study that investigates the determinants of economic growth on the level of Egyptian governorates. Our results, therefore, should be relevant for policymakers in Egypt.

Using General Methods of Moments (GMM) panel estimations, our results show that both aggregate as well as sectoral FDI do not have an unconditional effect on economic growth. We also reject the hypothesis that the effect of FDI on economic growth depends on a sufficient level of human capital (as a channel of absorptive capacity). However, our findings reveal differences between sectoral FDI in indirectly affecting economic growth based on existing DPI activity. We find a complementary effect of FDI and DPI in the service sector, where they reinforce each other in promoting economic growth. The positive interactive term of FDI and DPI in the service sector shows the importance of DPI for the absorptive capacity of new technology and know-how. Our results echo findings from micro-panel research on the significance of horizontal linkages and spillovers of FDI in the service sector, as opposed to other sectors (Marcin, 2008; Gorodnichenko et al., 2014). However, our results show that for a positive growth effect of FDI in services to occur, a minimum threshold of DPI needs to be locally present to absorb the superior know-how of foreign-owned service providers. We calculate this threshold. Our further findings show some complementarity of service FDI with DPI in the non-service sectors in promoting economic growth, suggesting cross-sectoral spillovers from service FDI to other sectors.

The paper is structured as follows. Section 2 reviews the related literature and introduces our hypotheses. Section 3 introduces the data and methodology. Section 4 presents our estimation results and robustness checks. In Section 5 we present our conclusions.

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[2] http://www.middleeasteye.net/news/high-hopes-egypts-economy-conference-bombs-rock-cairo-1705596510 (Accessed 2 November 2015).

2. Literature Review and Hypotheses

Economic theory provides many reasons why FDI enhances economic growth of the receiving country. In neo-classical growth literature, FDI increases capital stock in the same way as domestic investment. Due to diminishing returns to capital, FDI and domestic investment alike have no permanent long-term impact on economic growth (Herzer et al., 2008). In contrast, according to endogenous growth models, FDI is considered more productive. In addition to the capital inflows, the presence of foreign firms is expected to generate knowledge and technology spillovers that enhance aggregate productivity and growth (Barro and Sala-i-Martin, 1995; De Mello, 1997, 1999; Castellani and Zanfei, 2006). These spillovers would offset the effects of diminishing returns to capital of Solow-type models and thus keep the economy on a long-term growth path (Herzer et al., 2008).[3]

Blomström and Kokko (1998) present a detailed overview of possible channels of productivity spillovers originating from foreign firms. The productivity and efficiency of local firms, for example, might improve because of forward or backward linkages with foreign firms,[4] imitation of foreign firms, and increasing competition by foreign firms, which might increase the efficiency of local firms. A further channel of productivity spillover results from local firms' recruitment of workers who were originally trained in the knowledge, skills, and technology of foreign firms. Furthermore, foreign firms' experience and knowledge about international markets may spill over to local firms. However, the impact of these potential channels likely depends on the strength and nature of economic linkages between foreign and local firms (Cipollina et al., 2012).

Several studies argue that the positive knowledge spillovers, as predicted by endogenous growth models, might not occur in developing countries (e.g., Aitken and Harrison, 1999; Görg and Greenaway, 2004; Herzer et. al., 2008). Multinational corporations, for example, might be

[3] See Baldwin et al. (2005) for an endogenous growth model where multinational corporations (MNCs) directly affect the endogenous growth rate via technology spillovers. Productivity spillovers take place when the entry or presence of foreign firms generate productivity or efficiency benefits for domestic firms, whereas the foreign firm is not able to fully internalize these benefits (Blomström and Kokko, 1998). It is usually assumed that a foreign firm that enters a certain domestic market has some superior knowhow that allows it to compete in a foreign country and/or compensate for the better knowledge of domestic markets by domestic firms (Graham and Krugman, 1991; Blomström and Kokko, 1998; Borensztein et al., 1998; Ford et. al., 2008).

[4] See, for example, Rodriguez-Clare (1996) for a theoretical model of FDI spillovers via backward linkages through the intensive use of intermediate products by foreign firms. For further examples of spillover channels through backward and forward linkages, see Javorick (2004).

able to protect their firm-specific knowledge or the technological gap between domestic and foreign firms might be too large (Görg and Greenaway, 2004). Furthermore, multinationals might be procuring their intermediate inputs from foreign and not from local suppliers (Aitken and Harrison, 1999).[5]

Despite the large number of empirical studies on the effect of FDI on economic growth, empirical findings are still inconclusive. Using cross-country growth regressions, some studies find a positive direct impact of FDI on economic growth (Li and Lui, 2005; Lensink and Morrissey, 2006), whereas other studies find no significant direct effect of FDI on economic growth (Borensztein et al., 1998; Alfaro, 2003; Alfaro et al., 2004; Carkovic and Levine, 2005; Herzer et al., 2008). Herzer (2012) finds that FDI, on average, has a negative effect on economic growth—with large differences in the effect across countries. Investigating the FDI effect on economic growth in Arab countries, Neaime and Marktanner (2009) and El-wassal (2012) find that FDI has no, or only very limited, direct growth-enhancing effect. Based on a panel of 50 African countries, Gui-Diby (2014) finds that the impact of FDI on economic growth is negative between 1980 and 1994 and positive from 1995 to 2009.

In contrast to a possible direct effect of FDI, the importance of the absorptive capacity of recipient countries, that is, the extent to which they are able to adopt and implement the new available technologies, has been a central finding in many empirical studies on the growth effect of FDI (see, e.g., Borensztein et al., 1998; de Mello, 1999; Makki and Somwaru, 2004; Durham, 2004; Fillat and Woerz, 2011; and Gönel and Aksoy, 2016).[6] Using human capital as an indicator for absoptive capacity, Borensztein et al. (1998) show in a cross-country analysis that FDI only enhances economic growth in developing countries when a minimum threshold of human capital exists in the host economy. Although some studies found support for a conditional effect of FDI depending on human capital (e.g., Xu, 2000; Li and Lui, 2005), several other studies rejected this conditional effect (e.g., Alfaro et al., 2004, 2009; Carkovic and Levine, 2005; Lensink and Morrissey, 2006; Herzer et al., 2008; Herzer 2012). Furthermore, this hypothesis is rejected by El-wassal (2012) in the context of Arab countries and Gui-Diby

[5] Moreover, spillovers from foreign firms' presence do not have to be positive. At least in the short run, the market entrance of new foreign companies may decrease the productivity of domestic companies in the same industry through market stealing (or competition) effect (Aitken and Harrison, 1999; Marcin, 2008).

[6] In a theoretical three-period model, Markusen and Rutherford (2005) show that the speed and degree of positive spillovers from FDI positively depend on the absorptive capacity of the host country.

(2014) for African countries. A second possible source of absorptive capacity lies in the nature of interaction between foreign and local firms (De Mello, 1999; Makki and Somwaru, 2004). The effect of FDI might depend on the amount of domestic investment in the host region, whereas a certain amount of domestic investment might be necessary to absorb the spillover effects of FDI (Fillat and Woerz, 2011).

The literature tackles further local conditions for the FDI absorptive capacity of recipient countries such as trade openness (Balasubramanayam et al., 1996, 1999), development of financial market development (Alfaro et al., 2004, 2010), economic freedom (Azman-Saini et al., 2010), and recipient countries' institutional framework. However, since our analysis is at the governorate level within the same country, the trade regime, financial markets and institutions are largely homogenous.

Furthermore, FDI absorptive capacities likely differ according to the receiving sector (Alfaro, 2015). This is because sectors and industries are likely to be heterogeneous in their potential to create linkages and spillovers of knowledge and technology from foreign to domestic firms, an idea that has been supported by some micro-panel studies like Marcin (2008), Lesher and Miroudot (2008) and Gorodnichenko et al. (2014). Accordingly, growth effects of FDI might vary according to the sector that receives FDI (Alfaro, 2003; Chakraborty and Nunnenkamp, 2008; Wang, 2009; Gönel and Aksoy, 2016).

According to Alfaro (2003), FDI-related transfers of technology and know-how and the introduction of new processes are expected to primarily occur in the manufacturing sector as it has the most linkage-intensive activities. According to Doytch and Uctum (2011), manufacturing FDI predominantly transfers 'hard technology' such as equipment and industrial processes.

Yet, according to UNCTAD (2004), the older perception that FDI in the service sector does not transfer new technology has changed, 'if "technology" is defined broadly to include organizational, managerial, information processing and other skills and knowledge', all of which can be referred to as 'soft technology' (Kugler, 2006; Doytch and Uctum, 2011; Fernandes and Paunov, 2012). Service FDI is likely to increase the quality of services due to competition and to the superior technological, organizational and managerial know-how of foreign-owned service providers that may also spill over from foreign to domestic firms

(Fernandes and Paunov, 2012). Gorodnichenko et al. (2014) argue that, as opposed to the manufacturing sector, methods of 'production' are relatively visible in the service sector and easier to adapt and imitate by local firms. Moreover, Aykut and Sayek (2007) argue that service FDI has a high potential for forward linkages due to the non-tradable nature of many services, which require close proximity between producers and consumers. Furthermore, FDI in banking and finance can enhance the efficiency and stability of the banking system, for example, through increased competition and increased access to global financial markets.[7]

Additionally, FDI-induced improvements of services quality in the recipient country would positively affect the productivity of other sectors in the economy: for example, service FDI can enhance the efficiency of business or producer services that are used throughout the economy (Aykut and Sayek, 2007; Chakraborty and Nunnenkamp, 2008).[8] Manufacturing firms, for instance, may benefit from their interaction with foreign services suppliers through spillovers of management, organizational, marketing, or technological knowledge (Markusen, 1989; Rivera-Batiz and Rivera-Batiz, 1992; Fernandes and Paunov, 2012). This know-how could spill over to domestic firms through demonstration effects, personal contacts and worker turnover, where service suppliers are likely to be less concerned about leakages of knowledge to a different sector (Kugler, 2006; Fernandes and Paunov, 2012).

The expected effect of agricultural FDI on economic growth is, a priori, ambiguous. The literature on agricultural FDI mentions the typical potential theoretical benefits of FDI activities (UNCTAD, 2009; Songwe and Deininger, 2009; Hallam, 2011). However, research also emphasizes that a domestic agriculture sector with absorptive capacity is a prerequisite for such benefits to occur. According to Hallam (2011), the necessary conditions for positive spillover benefits may frequently be absent, especially when agricultural FDI projects have an enclave character. Similarly, UNCTAD (2001) and Alfaro (2003) argue that the scope for linkages and spillovers between foreign and domestic firms is rather limited in the agriculture sector, thereby restricting the effect of agricultural FDI in promoting economic growth.

[7] UNCTAD (2007) sheds light on potential linkages and knowledge spillover channels of tourism FDI with the local economy.

[8] Producer services are, for example, banking, finance, consulting, insurance, real estate, engineering, accounting or legal services as defined by UNCTAD (2004). In addition to that ICT services have become one of the most important business services. See Markusen et. al. (2005) for a theoretical model where producer services are modeled as intermediate inputs.

Most empirical studies on FDI-induced growth effects do not consider the varying impact of FDI across sectors, partly due to data limitations, especially in developing countries. The limited body of empirical literature on cross-country effects of sectoral FDI on economic growth supports the notion that the effects vary across different sectors. There is also research supporting the idea that manufacturing FDI has positive growth effects. Alfaro (2003), using a cross-sectional analysis of 47 countries, shows that whereas the effect of aggregate FDI flows on economic growth is ambiguous, the effect of FDI on economic growth differs across sectors. FDI flows in the primary sector have a negative effect, manufacturing FDI has a positive effect and findings from the service sector show that FDI flows have insignificant effects on growth. Using a panel dataset for 12 Asian economies for 1987-1997 period, Wang (2009) finds a significant growth-enhancing effect of manufacturing FDI and an insignificant effect of non-manufacturing FDI. Based on cross-country data between 1990 and 2003, Aykut and Sayek (2007) find a positive effect of FDI on economic growth when the sectoral composition of FDI is skewed towards the manufacturing sector, and a negative effect when the sectoral composition is skewed towards the service or primary sectors.

Empirical studies on the effect of agricultural FDI on economic growth are scarce. Recent studies emphasize problems of availability and reliability of agricultural FDI data in developing countries, (e.g., Deininger et al., 2011; Hallam, 2011; Liu, 2014) and in the case of Arab countries (Tanyeri-Abur and Elamin, 2011). None of the studies that compare the effects of sectoral FDI investigate the effect of FDI in agriculture separately. Agricultural FDI is only included as a part of FDI in the primary sector in some of these studies, such as in Alfaro (2003) and Aykut and Sayek (2007), suggesting a negative effect of FDI in the primary sector on economic growth. Research on the impacts of agricultural FDI in developing countries mainly relies on country case studies and shows mixed results on technology transfer (Gerlach and Liu, 2010; Hallam, 2011; FAO, 2013; Liu, 2014). According to UNCTAD (2009), technology transfers by agricultural multinationals in developing countries are limited. However, a FAO (2009) study on Egypt reports productivity enhancing technology spillovers and an increase in value added by agricultural FDI. In contrast, Massoud (2008) finds a negative effect of agriculture FDI inflows on value-added growth and output growth in the same agricultural sub-sectors in Egypt.

Whereas studies by Alfaro (2003) and Wang (2009) show an insignificant effect of service FDI on economic growth, Nunnenkamp and Spatz (2004) suggest that the link between FDI stock and economic growth in developing countries is stronger in the service sector than in the manufacturing sector. Using firm-level data from OECD countries, Lesher and Miroudot (2008) find that spillovers from FDI vary considerably across sectors and that service industries enjoy the strongest productivity-enhancing effects of FDI. Strong positive spillover effects, for example, were generated by activities of hotels and restaurants, construction, transportation, wholesale and retail trade services, post and telecommunication and other business activities. Micro-studies show that the service sector is different from other sectoral FDI in terms of its horizontal spillovers (i.e., spillovers within the same sector) and forward linkages (i.e., foreign presence among suppliers). Although there is a consensus in the micro-literature that horizontal spillover effects of FDI are non-existent or negative in developing countries (Irsova and Havranek, 2013), recent studies find evidence for positive horizontal spillover effects of FDI in the service sector (Marcin, 2008; Gorodnichenko et al., 2014). A possible explanation is that whereas foreign firms usually have an incentive to minimize the leakage of know-how and technology to local competitors (Javorcik, 2004; Kugler, 2006; Blalock and Gertler, 2008), methods of 'production' are relatively visible in the service sector and easier to adapt and imitate by local firms (Gorodnichenko et al., 2014). Moreover, using data from 17 transition countries, Gorodnichenko et al. (2014) show that forward linkages are strong in the service sector, in contrast to the common result of limited forward linkages by foreign firms as shown in a meta-analysis by Havranek and Irsova (2011). Accordingly, domestic firms strongly benefit from buying service inputs from foreign firms. Investigating backward spillovers, on the other hand (i.e., with foreign firms among customers), Marcin (2008) and Gorodnichenko et al. (2014) find them to be most obvious in the manufacturing sector, whereas Lesher and Miroudot (2008) find strong backward linkages of services FDI.

Some studies find further evidence for cross-sectoral linkages and spillovers of sectoral FDI, especially in the case of service FDI. Fernandes and Paunov (2012), for example, show that FDI in producer services increased total factor productivity and innovation activities in manufacturing firms in Chile, and offered opportunities for lagging firms to catch up with leading competitors. Results by Chakraborty and Nunnenkamp (2008) suggest that FDI in the service sector in India promoted output growth in the manufacturing sector through cross-sectoral spillovers. Cross-country results by Doytch and Uctum (2011) show that financial service FDI enhances growth in South-East Asia and the Pacific, high income countries and service-based economies, by stimulating activity in both manufacturing and service sectors, whereas non-financial service FDI seems to drain resources. In general, Eschenbach and Hoekman (2006) and Mattoo et al. (2006) show that countries with liberalized service sectors, which is highly correlated with inward services FDI, significantly grow faster.

Macro studies that particularly investigate channels of the absorptive capacity of FDI across different sectors are limited. Alfaro (2003), for example, rejects the hypothesis that the growth effect of FDI in any of the three sectors depends on human capital. Gönel and Aksoy (2016) investigate the role of FDI absorptive capacity through human capital, financial and technological development in OECD countries and find that those absorptive capacity channels are only significant for FDI in Information and Communication Technology (ICT) based sectors. Fillat and Woerz (2011) investigate FDI absorptive capacity differences between different industries through interactions of FDI stock and domestic investment at the industry level, arguing that a certain amount of domestic investment is necessary to absorb FDI spillover effects. The authors find that complementary effects of FDI and domestic investments vary across different industries. Despite the rich dataset at the industry level, the study by Fillat and Woerz (2011) is restricted to FDI stock in the manufacturing sector only and does not include any developing countries.[9]

Hypotheses

Using total FDI at the governorate level in Egypt, we test the following hypotheses.

1. FDI has a direct positive impact on economic growth in the host region.
2. There are two channels of absorptive capacities of recipient governorates.
    - I) Following Borensztein et al., (1998), FDI depends on the level of human capital in the host region as a channel of absorptive capacity.
    - II) Following Makki and Somwaru (2004), FDI and domestic private investment reinforce and complement each other in their effect on economic growth.

Furthermore, like Gönel and Aksoy (2016), we argue that the absorptive capacity of the host country might differ according to the FDI recipient sector. Using sectoral FDI at the

[9] Fillat and Woerz (2011) further show differences across industries when using human capital as a further channel of absorptive capacity.

governorate level in the manufacturing, agriculture and service sector, we further test the following two hypotheses:

3. Sectoral FDI in manufacturing, services and agriculture has a direct effect on economic growth.
4. Different sectors have different absorptive capacity channels of sectoral FDI. Specifically,
   I) The effect of sectoral FDI on economic growth depends on human capital.
   II) Sectoral FDI and domestic private investment complement each other. We also allow for cross-sectoral complementarities.

3. Data and Methodology

3.1. FDI in Egypt

As in many other countries, attracting FDI is an important target for Egyptian policymakers. FDI policies and data in Egypt are described thoroughly in Hanafy (2015a). Our FDI data at the governorate level is based on registered investments by foreign firms at the General Authority for Investment and Free Zones (GAFI).[10] The data from GAFI only includes greenfield FDI and company expansions [11] and does not include investments in the petroleum sector. Consequently, our dataset captures only 'non-petroleum greenfield FDI' in Egypt. For the sake of simplicity, we mostly use 'FDI' in this paper as shorthand for 'non-petroleum greenfield FDI'.

Hanafy (2015a) describes in detail the development and characteristics of FDI in Egypt since the beginning of the open-door policy in the 1970s, based on the GAFI dataset. Here, we briefly mention relevant facts for the 1992-2007 time period of our model analysis. The contribution of FDI inflows to GDP increased starting in mid-2000s (Figure A.1 in the Appendix). In 2007, non-petroleum greenfield FDI inflows constituted 5% of the country's GDP.[12] The same period saw an acceleration of the GDP per capita growth rate in Egypt, which reached 5% in 2007. Non-petroleum greenfield FDI, on average, contributed 24% of total non-

[10] FDI data by the Central Bank of Egypt (CBE) are not reported at the governorate level.
[11] In fact, separating the effect of greenfield FDI from mergers and acquisitions (M&A) while investigating their effect on economic growth is consistent with literature recommendations and findings by Wang and Wong (2009) and Harms and Méon (2014). However, data on M&A in Egypt are not available at the governorate level to test hypotheses on differences in growth effects by FDI mode.
[12] The stock of non-petroleum greenfield FDI accounted for 23% of GDP in 2007.

petroleum private investment in 1992–2007. This contribution more than doubled from 15% in 1992–1999 to 33% in 2000–2007, reflecting the increasing contribution of FDI.

The largest recipient sector of non-petroleum greenfield FDI inflows to Egypt is the service sector, receiving an annual average of 56% of FDI inflows in 1992–2007, while 41% of FDI targeted the manufacturing sector and only 3% went to the agricultural sector. With accelerating FDI inflows to Egypt, the service sector experienced an increasing share of FDI inflows compared to the 1980s when the service sector ranked second to the manufacturing sector (49%) in receiving FDI (47%). On average, during 1992–2007, the breakdown of services FDI flows is as follows: finance (34%), tourism (27%), construction (12%), ICT (7%), 'other services' (20%).[13] The average sectoral composition of DPI is quite similar to FDI inflows (36% manufacturing, 60% services, 4% agriculture). FDI has a non-negligible contribution to private investment in all three sectors. During the same time period, FDI, on average, accounted for 25% of private investments in manufacturing, 23% of private investments in services, and 18% of private investments in agriculture.

The geographic distribution of FDI in Egypt is highly uneven (Hanafy, 2015a, 2015b). Egypt has 27 governorates, but 60% of FDI flows in Egypt were almost equally directed to the governorates of Cairo and Giza in 1992–2007. Moreover, roughly 90% of FDI flows targeted only 10 governorates. Regarding the geographical distribution of sectoral FDI, FDI in services shows the strongest concentration, whereas manufacturing FDI is the most geographically dispersed.[14]

3.2. Model Specification and Data

In line with the growth literature and similar to Ford et al. (2008), Azman-Saini et al. (2010) and Gui-Diby (2014), we estimate

$$y_{i,t} = \alpha_i \, y_{i,t-1} + \beta_1 * FDI_{i,t} + \beta_2 * X_{i,t} + \eta_i + \mu_t + \varepsilon_{i,t} \qquad (1)$$

[13] According to GAFI, the category 'other services' includes consultancy, trade services, petroleum services, education and human resources, health as well as general services. We do not have data from GAFI on the breakdown of manufacturing FDI and agricultural FDI. However, according to the American Chamber of Commerce in Egypt (2008), manufacturing FDI stock in 2007 consists of FDI in chemicals (27%), building materials (21%), food and beverages (16%), pharmaceuticals (11%), engineering (9%) and others (15%). In our dataset, FDI in agriculture includes land reclamation and cultivation, livestock, poultry farming, fish and slaughter houses. According to FAO (2011), the majority of agricultural FDI is directed to land reclamation and cultivation projects.
[14] For more details on the distribution of aggregate and sectoral FDI at the governorate level, see Hanafy (2015a).

where i and t represent the governorate and time index, respectively. Our dependent variable y is the logarithmic value of real GDP per capita for a given governorate i. $y_{i,t-1}$ captures the lagged dependent variable. Our main explanatory variable of interest is foreign direct investment, once foreign direct investment in aggregate terms and once foreign direct investment by agricultural, manufacturing, and service sectors. X is the matrix of control variables, while η denotes the governorate-specific effect, which accounts for unobserved heterogeneity due to time-invariant governorate characteristics such as their geographical location.[15] μ captures unobservable time-specific effects. ε is the error term.

We use FDI stock as a measure for FDI, following Nunnenkamp and Spatz (2004), Ford et al. (2008), Cipollina et al. (2012) and Fillat and Woerz (2011). Using FDI as a stock measure is more consistent with growth and FDI theories. This is because growth-enhancing spillovers are not only restricted to recent FDI inflows but should also result from FDI received in previous periods. Thus, using a flow measure of FDI does not capture the total long-term growth impact of FDI.[16] We use FDI flows for robustness checks.

The set of control variables at the governorate level included in the matrix X are domestic private investment (DPI), public investment (PubInv), and human capital proxied by the percentage of the labor force with secondary education (SecEdu). Our education variable has the advantage of measuring the actual level of educational attainment of the labor force. We investigate two potential channels of absorptive capacity using further estimation models that include two different interactive terms: (1) an interactive term of FDI with the human capital variable[17] and (2) an interactive term of FDI with the DPI variable (FDIxDPI).[18]

[15] The governorate dummy also captures the urbanisation rate as well as port and airport availability at the governorate level, since available data show that these variables have hardly changed over time during our sample period (Hanafy, 2015b).

[16] In fact, some studies justify the use of FDI flows by the lack of data on FDI stock (e.g., Borensztein et al., 1998).

[17] Since the coefficient of a simple interaction of FDI and human capital would measure the effect when human capital equals zero, which is unlikely, we follow the valuable suggestion of one anonymous referee and mean-center the human capital variable in the interactive term. This provides an easier interpretation of results based on the marginal effect of FDI for different values of human capital.

[18] The addition of an interactive term may lead to multicollinearity as the interactive term tends to be strongly correlated with the original variables that were used to construct it. In our case, the two investment variables lnFDIst and lnDPI are strongly correlated with a correlation coefficient of 0.78. Similarly, FDI stock and DPI are strongly correlated at the sectoral level. In order to alleviate this problem, we follow the approach by Burill (2007) and Azman-Saini et al. (2010) in orthogonalizing the interactive term using the following two-step procedure. First, we regressed the interactive term (FDIxDPI) on the FDI and DPI variables. Second, we used the residuals from the regression of the first step to represent the interaction term. We call the new interactive term

Our model includes 26 Egyptian governorates.[19] Our model time-frame is between 1992 and 2007 and is restricted by available data on GDP at the governorate level before 1992 and after 2007. We average our data over three-year-subperiods.[20] This is consistent with the underlying growth theories, which do not attempt to explain short-run business fluctuations but rather long-run growth effects (Barro, 2013). Our panel is unbalanced due to lack of data on the five population-scarce frontier governorates in the 1990s. Table 1 introduces all the variables used in the empirical models and provides descriptive statistics.[21] The appendix provides a description of our data and sources.

< Table 1 here >

3.3 Methodology

Following Azman-Saini et al. (2010) and Gui-Diby (2014), we apply the generalized method-of-moments (GMM) panel estimator, which was first proposed by Holtz-Eakin et al. (1988) and subsequently extended by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).[22] There are at least two reasons for choosing this estimator (Azman-Saini et al., 2010). First, it controls for country specific effects, which cannot be controlled for by using country-specific dummies due to the dynamic structure of the regression equation. Second, the GMM estimator controls for a simultaneity bias caused by the possibility that some of the explanatory variables may be endogenous. For example, FDI is likely to be endogenous as higher GDP per capita may attract more FDI (Carkovic and Levine, 2005: Li and Liu, 2005). Higher output may also attract domestic private and public investments to the same region. Accordingly, from a theoretical point of view, we assume that all investment variables are endogenous. Differently, we do not consider the human capital variable, which is the percentage of labor force with secondary education to be endogenous, since the decision on

(FDIxDPInew). We would like to thank two anonymous reviewers for helpful comments regarding the creation of the interactive terms.

[19] Egypt currently consists of 27 governorates. However, we merged the governorates Qena and Luxor for the sake of data consistency, as most data sources do not report separate data for Luxor for our sample period. Luxor was only split from the governorate Qena to become a single governorate in 2010.

[20] We opt for three-year periods due to the limited time span of our sample, similar to Aykut and Sayek (2007). Extending the time periods would not allow us to run a dynamic GMM model with the necessary statistical tests. The sub-periods for our dependent variable are constructed for the intervals 1992–1994, 1995–1997, 1998–2000, 2001–2003 and 2004–2007. Only the final time period consist of four years.

[21] Prior to running our regressions, we studied the correlation matrix of all variables, which we do not include in this paper due to space constraints.

[22] We would like to thank one anonymous reviewer who suggested the use of a GMM estimator.

educational attainment by the labor force participants is an 'old' decision that had been made long before economic growth ocured. We ran Hausman specification tests which support our endogeneity/exogeneity assumptions.

We use a system GMM estimation (Blundell and Bond, 1998) as this method has been found adequate for panel data with small T (Baltagi, 2009). In our case T=5 and N=26. Moreover, we use the asymptotically more efficient two-step estimator. The robust standard errors of the two-step estimation are computed using the finite-sample corrections by Windmeijer (2005). Following recommendations of Roodman (2009b), we reduce the dimensionality of the instrumental variable matrix.[23] We test the hypothesis of no second-order serial correlation and run the Sargan/Hansen overidentification test[24] to check for the validity of instruments. Failure to reject the null of both tests provides support for the estimated model.

4. Empirical Results

Table 2 provides the system-GMM panel estimation results using aggregate FDI and testing for channels of absorptive capacity of aggregate FDI. In all estimated models in Column (I) through (V), we do not reject the hypothesis of no second-order serial correlation nor the Sargan/Hansen overidentification test.[25]

< Table 2 here >

In Table 2, we first investigate in model (I) whether FDI stock has a direct effect on economic growth when controlling for domestic private investment (DPI), public investment as well as human capital stock. The coefficient of FDI stock is insignificant, suggesting that FDI stock has no direct impact on economic growth.[26] Our result is in line with several previous cross-country studies that do not find support for a significant direct effect of aggregate FDI on economic growth in developing countries (e.g., Borensztein et al., 1998; Alfaro, 2003; Alfaro

[23] We use four lags only as instruments to limit the number of instruments. However, our main findings are also robust to using three lags. We report the number of instruments under each estimation model of our results. We run the regressions using the statistical package gretl, which reports results similar to stata's xtabond2 routine by Roodman (2009a) (see the gretl user guide).
[24] Gretl reports the Sargan test which is similar to the Hansen test in stata's xtabond2 according to the software manual and the lead software developer Allin Cottrel. We thank Allin Cottrell for the prompt reply to our inquiry.
[25] This applies for all our reported models in this paper.
[26] Note that this result remains unchanged when we run the regression without DPI or without the human capital variable.

et al., 2004, 2010; Carkovic and Levine, 2005; Herzer et al., 2008) and in the specific case of Arab countries (Neaime and Marktanner, 2009; El-wassal, 2012).

We further test possible channels of absorptive capacity of hosting regions. In model (II), we test whether the effect of FDI stock on economic growth depends on human capital as a channel of absorptive capacity, by including an interactive term of FDI stock with human capital. The interactive term is not significantly different from zero. Although human capital has a direct positive impact on economic growth, the regional level of human capital does not reinforce positive impacts of FDI. Consequently, we reject the hypothesis of an indirect effect of FDI on economic growth conditional on the local level of human capital. This result differs from that of Borensztein et al. (1998) and Li and Liu (2005), but is similar to findings for developing countries by Carkovic and Levine (2005) and Herzer et al. (2008), for Arab countries by El-wassal (2012) and for African countries by Gui-Diby (2014). Possible reasons why the local level of human capital in Egypt does not complement the effect of FDI could be that the quantitative measure of human capital does not fully reflect the educational quality and the skills needed by foreign firms. Furthermore, labour force is strongly mobile across Egyptian governorates especially for well-paid jobs in foreign investment projects.[27]

In model (III), we investigate a possible complementary effect of FDI and DPI in fostering economic growth. A positive coefficient for the interaction term would suggest that FDI and domestic investment reinforce each other in advancing economic growth (Makki and Somwaru, 2004). However, our findings show that the interactive term is insignificant. In short, the results of Table 2 fail to suggest a direct or indirect effect of FDI on economic growth when aggregate FDI data (across all sectors) is used.

Interestingly, the DPI variable is regularly significant with an unexpected negative sign, which may reflect the absence of unconditional spillover effects to overcome the diminishing returns of factor capital. We will further discuss this result when an interactive term of sectoral FDI and DPI is introduced in Table 5. Likewise, public investment regularly carries a negative sign, but is statistically insignificant.

< Table 3 here >

[27] For example, Hanafy (2015b) finds that labour force education is not a significant determinant of FDI location in Egypt.

Table 3 provides the system-GMM panel estimation results using FDI stock disaggregated by recipient sector. We distinguish between FDI stock in the manufacturing, agriculture and service sectors. In column (I) we include the variables for all three FDI sectors in addition to the usual control variables. The manufacturing FDI coefficient is positive but insignificant, rejecting a positive direct effect of manufacturing FDI on economic growth in Egypt. Our result is different from cross-country findings by Alfaro (2003), Aykut and Sayek (2007), and Wang (2009). Using data at the national level, Massoud (2008) finds no significant direct effect of FDI inflows in manufacturing sub-sectors on the respective sub-sector's value added growth and output growth. Our findings go beyond that, implying a missing direct positive effect of manufacturing FDI on aggregate economic growth.

Our results show that governorates which received more agricultural FDI experienced lower economic growth. Specifically, a 1% increase in agricultural FDI (% GDP) goes in hand with 0.2% lower economic growth. The effect is significant at the 10% level. The negative effect of agricultural FDI on economic growth might be partly driven by the negative effect of agricultural FDI flows on the sector's value added and output growth, as shown by Massoud (2008). Our findings support the reasoning in Section two that the scope for linkages and technology transfer is typically limited in the agricultural sector (UNCTAD, 2001, 2009) and echoes cross-country findings on negative growth effects of FDI in the primary sector (Alfaro, 2003; Aykut and Sayek, 2007).

Moreover, our findings show no significant direct effect of services FDI on economic growth, in line with cross-country findings by Alfaro (2003) and Aykut and Sayek (2007). We verify that our results on missing positive direct effects of sectoral FDI on economic growth are not driven by potential collinearity (since model (I) includes several strongly correlated investment variables) by checking the robustness of our results in columns (II) through (VI). Our results from column (I) are robust to dropping DPI in column (II), dropping both DPI and public investment in column (III) and in including the sectoral FDI stock variables one by one in columns (IV) through (VI). Manufacturing and service FDI remain insignificant in columns (IV) and (VI), respectively. The effect of agricultural FDI becomes insignificant when the other FDI sectors are not included in column (V).

In columns (VII) to (IX), we test whether the effect of sectoral FDI on economic growth depends on human capital as a channel of absorptive capacity. We test this hypothesis for each of the three sectors individually (one by one) to avoid collinearity issues. Our results show that all three interactive terms are insignificant, further rejecting the hypothesis that the growth-effect of FDI in any of the three sectors is conditional on local human capital. This result is in line with cross-country findings by Alfaro (2003).

< Table 4 here >

Table 4 distinguishes between the three recipient sectors of FDI stock and of DPI, and tests whether the FDI absorptive capacity of local economies depends on the existence of sufficient DPI in the recipient sector. Regarding the manufacturing sector, the positive coefficient of FDI remains insignificant, whereas manufacturing DPI shows a negative effect on economic growth, significant at the 10% level (column I). In column (II), we add an interactive term of FDI and DPI in manufacturing, which, however, is not significant. Our results do not support the hypothesis that FDI and DPI in the manufacturing sector complement each other in promoting economic growth. The negative manufacturing DPI coefficient is no longer significant in column (II).[28]

As for the agriculture sector, the results again suggest a significant negative effect of agriculture FDI, similar to the finding in Table 3, whereas the effect of agriculture DPI is insignificant (column III). The interactive term of agriculture FDI and DPI in column (IV) is not significant, which is similar to the manufacturing sector, rejecting the idea that FDI and DPI in the agriculture sector reinforce each other in promoting economic growth.

Our results are different regarding the service sector. Although the coefficients for FDI and DPI in the service sector are individually insignificant in columns (V) and (VI), the interactive term of both variables is positive and significant at the 5% level, as shown in column (VI). Accordingly, there is a complementary effect of FDI and DPI in the service sector, where both reinforce each other in promoting economic growth in the recipient governorate.

But how to interpret the coefficient of 0.087? The negative coefficient for services FDI and the significantly positive coefficient of the interactive term of service FDI and service DPI (both variables are also jointly significant (F(2,84) = 2.85*)) suggest that a minimum amount of DPI in the service sector is necessary for service FDI to significantly promote economic growth.

[28] The manufacturing FDI and DPI variables and their interaction term are also not jointly significant F(3,84) =0.37.

We calculate the threshold for a positive effect to occur by taking the derivative of the growth equation with respect to lnFDIservst (which is the logarithmic value of FDI stock in the service sector as a % of GDP), set it equal to zero, and solve for the threshold level of service DPI.[29] The result of 4.02 (in % of GDP) is the threshold of DPI in services that is needed to experience economic growth. In other words, this is the minimum amount of DPI in services that is needed in a governorate that receives service FDI in order to have sufficient absorptive capacity in a way that promotes economic growth. Data on DPI in the service sector in Egypt show that only 9 of 26 governorates meet this threshold, that is, have sufficient DPI in services in a way that makes it possible to experience positive economic growth from FDI in services. This threshold of DPI in services is reached in all time periods of our analysis in 3 of the 9 governorates, (Giza, Red Sea and South Sinai), and is only reached in some of the time periods in 6 of the 9 governorates (Alexandria, Cairo, Ismalia, Matruh, North Sinai and Suez).

Our results seem to echo those from micro panel research on the significance of horizontal linkages and spillovers of FDI in the service sector as opposed to the other sectors (Marcin, 2008; Gorodnichenko et al., 2014). However, our results suggest that in order to achieve a positive effect FDI in services on economic growth, a sufficient amount of local service firms needs to be present to absorb the superior know-how of foreign service providers.

< Table 5 here>

We further investigate whether the complementarity between FDI and DPI is restricted to their occurrence in the same sector. Accordingly, in Table 5 we allow for an interactive term of FDI in each sector with aggregate DPI (instead of DPI in the same sector only, as in Table 4). Specifically, we extend each of the models in columns (IV), (V) and (VI) of Table 3 by one interactive term of FDI in the respective sector and aggregate DPI. The results for the manufacturing, agriculture and service sectors are reported in Columns (I), (II) and (III) of Table 5, respectively. Again, only the interactive term of service FDI stock with DPI shows a positive and significant effect (at the 10% level). Moreover, the variable for services FDI and the interactive term of service FDI with aggregate DPI are jointly significant at the 5% level

[29] That is: $\partial y/\partial \ln(FDIservst) = -0.129+0.087*\ln(DPIserv) = 0$; $\ln(DPIserv) = 0.129/0.087$; $DPIserv = \exp(0.129/0.087) = 4.02$. See Ford et al. (2008) for a similar approach of a different FDI interactive tem.

(F(2,84)=3.44**). Consequently, our findings indicate that service FDI significantly promotes economic growth when a sufficient amount of DPI is present.

This could be driven by our previous result in Table 4 only (the existence of sufficient service DPI), or possibly caused by cross-sectoral complementarity of service FDI with DPI in non-service sectors. However, the newly calculated threshold of DPI of 2.4%[30] is lower than the threshold of service DPI from Table 4 (4.0%) despite the fact that service DPI is only a subgroup of aggregate DPI. This result shows the additional complementarity of service FDI with local DPI in the non-service sectors in promoting economic growth. This cross-sectoral complementarity could be based on cross-sectoral spillovers from service FDI to other sectors, echoing results by Chakraborty and Nunnenkamp (2008) and Fernandes and Paunov (2012) from India and Chile, respectively. Domestic firms seem to benefit from local services provided by foreign firms and from the likely improvement of business and producer services. Management, organizational and technological knowledge spillovers are not only restricted to domestic firms in the service sector since service suppliers are likely to be less concerned about leakages of knowledge to a different sector, as put forward by Fernandes and Paunov (2012). However, for these effects to promote economic growth, a sufficient level of domestic investment needs to be present to absorb the superior know-how.

This new result from Table 5 implies that more governorates experience positive growth effects from service FDI when our model further allows for cross-sectoral complementarity with DPI in comparison to Model (VI) from Table 4. Data on DPI in Egyptian governorates show that 18 out of 26 governorates meet this threshold, that is, they have sufficient DPI to experience positive economic growth from FDI in services.[31]

Further illustrating the impact of positive spillovers effects from service FDI, the coefficients of model (III) of Table 5 show that DPI has an indirect positive effect on economic growth, when sufficient FDI stock is present in the service sector. This result is particularly important given the negative and significant coefficient of DPI in most of our previous regression models. DPI has a conditional positive effect on economic growth in Egyptian governorates when a

[30] $\partial y/\partial \ln(FDIservst) = -0.043+0.049*\ln(DPI) = 0$; $\ln(DPI) = 0.043/0.049$; $DPI = \exp(0.043/0.049) = 2.39$

[31] In 10 of the 18 governorates, this DPI threshold is reached in all time periods of our analysis (Alexandria, Cairo, Giza, Matruh, North Sinai, Port Said, Red Sea, Sharkia, South Sinai and Suez). In 4 of 18 governorates the threshold is reached in most time periods (Aswan, Damietta, Ismalia and Menoufia), while 4 out of the 18 governorates meet this DPI threshold only in one, mostly the final, time period (Assuit, Kalyoubia, New Valley and Qena).

minimum threshold of service FDI is present. This result suggests an important role of FDI in the service sector in increasing the efficiency of Egyptian DPI and indirectly promoting economic growth. The threshold of service FDI stock for this positive effect to occur is 3.9% of GDP.[32] Ten out of 26 governorates meet this threshold for all of our time periods (Aswan, Cairo, Giza, Ismalia, Matruh, North Sinai, Port Said, Red Sea, South Sinai and Suez).

Robustness Checks

Our results are robust to several robustness checks. We do not present the table of results due to space limitations, however, all results are available upon request. First, our results are qualitatively robust to using FDI flow instead of FDI stock as an explanatory variable.[33] Second, substituting our human capital variable on secondary education with the share of the labor force that holds a university degree does not change our results on human capital: (1) university education shows a positive and significant direct effect on economic growth in Egyptian governorates. (2) Our results do not support the hypothesis that the effect of FDI depends on the level of human capital in the host region as a channel of absorptive capacity.

5. Concluding remarks

Many developing countries have been adapting more restrictive FDI policies towards services FDI indicating that service FDI are less desirable than manufacturing FDI.[34] One of the main reasons is that – other than in the case of manufacturing FDI – service FDI was, for a long time not seen to provide intensive linkages and positive spillovers to local firms (UNCTAD, 2004).

Employing GMM panel estimations based on a novel dataset of Egyptian governorates, we fail to find any significant effect of manufacturing FDI on economic growth. Yet, we find a positive effect of FDI in the service sector on economic growth when sufficient DPI is present (threshold of DPI in services equals 4% of GDP). Our results imply that service FDI and DPI complement and reinforce each other in fostering economic growth. Our further findings suggest that the interaction of service FDI with local private investments in the service sector

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[32] $\partial y/\partial \ln(DPI) = -0.070+0.049*\ln(servFDIst)=0$; $\ln(servFDIst)=0.070/0.049$; $servFDIst=\exp(0.070/0.049)=3.88$.

[33] The interactive term of FDI flows in services with aggregate DPI is positive and significant at the 5% level. The interactive term of FDI flows and DPI in services is positive but is insignificant at conventional significance levels (p-value=0.15). However, combining both results highlights our finding on the cross-sectoral complementarity between FDI in services and DPI in the other sectors.

[34] See Golub (2009) for an International Index of FDI restrictions in the services sector. Accordingly, the Middle East, East Asia and South Asia rank as the most restricted.

as well as in the non-service sectors positively affects economic growth. This seems to be in line with literature findings on the particular relevance of horizontal spillovers and cross-sectoral spillovers of service FDI. Our paper contributes to the limited literature that analyses possible channels of absorptive capacities that affect the impact of sectoral FDI on economic growth. Accordingly, our results support domestic investment as a channel of absorptive capacity.

Our findings suggest that reducing restrictions and barriers on service FDI in Egypt is strongly recommended (Egypt shows an average rank in restricting services FDI according to the International Index of FDI Restrictions by Golub (2009)). Attracting more FDI in the service sector would be beneficial in complementing Egyptian private investments and in achieving higher economic growth.[35] Our results further show that only some governorates manage to achieve positive growth effects from the complementarity of service FDI and DPI due to either limited amounts of service FDI and and/or amounts of DPI. It seems inevitable to have a hand-in-hand increase of both investment origins in investment-scarce governorates to achieve higher economic growth. Analyzing determinants of FDI location in Egypt, Hanafy (2015b) shows that foreign investors to Egypt are attracted to governorates with higher amounts of DPI. Accordingly, improving the investment infrastructure and facilitating efficient DPI (e.g., through financial reforms and better access to credit), especially in investment-scarce regions in Egypt, could increase both DPI and FDI in these disadvantaged governorates and generate complementary positive growth effects.

Future research should investigate whether our results hold for the different services subsectors. Making data on output growth at the sectoral and sub-sectoral level in Egyptian governorates available for researchers would certainly enable a better understanding of intra-sectoral and inter-sectoral growth spillover effects of FDI. Finally, one should be cautious about recommending limiting agricultural FDI based only on our finding that agricultural FDI in Egypt seems to slowdown economic growth. Further research needs to assess the impact of agricultural FDI on other factors, such as food security, employment creation and poverty.

[35] A consideration of special fiscal incentives for FDI in services would need to be further analyzed.

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Tables

Table 1: List of variables and descriptive statistics

Description	Abbreviation	Mean	Median	Min	Max	Std. Dev.
GDP per capita (ln(x))	Lny	8.05	8.01	7.46	8.88	0.34
Foreign Direct Investment (FDI) stock, %GDP (ln(x+1))	lnFDIst	1.97	1.91	0.00	5.14	1.41
Domestic Private Investment (DPI), %GDP (ln(x))	lnDPI	0.71	0.81	-5.61	4.76	1.75
Public Investment, %GDP (ln(x))	lnPubInv	1.29	1.05	-0.05	3.65	0.81
Percent of labor force with secondary education	SecEdu	51.31	49.1	24.99	84.25	14.23
Interaction (IA) term of lnFDIst stock and secondary education (mean centered)*	FDIstxEdumc	4.52	1.11	-27.80	114.21	17.44
Orthogonalized IA term of lnFDIst and lnDPI**	FDIxDPInew	0.00	-0.66	-6.56	10.67	2.66
FDI stock in manufacturing, %GDP (ln(x+1))	lnFDImanust	1.3	1.13	0.00	4.46	1.08
FDI stock in agriculture, %GDP (ln(x+1))	lnFDIagrist	0.31	0.16	0.00	1.92	0.39
FDI stock in services, %GDP (ln(x+1))	lnFDIservst	1.21	0.57	0.00	5.13	1.45
IA term of lnFDImanust and SecEdu (mean centered)*	FDImanustxEdumc	2.47	0.79	-26.77	29.35	9.79
IA term of lnFDIagrist and SecEdu (mean centered)*	FDIagristxEdumc	0.61	0.01	-7.87	12.22	3.00
IA term of lnFDIservst and SecEdu (mean centered)*	FDIservstxEdumc	3.34	0.00	-25.15	113.9	15.11
DPI in manufacturing (% GDP) (ln(x+1))	lnDPImanu	0.86	0.79	0.00	3.17	0.68
DPI in agriculture (% GDP) (ln(x+1))	lnDPIagri	0.15	0.06	0.00	0.97	0.21
DPI in services (% GDP) (ln(x+1))	lnDPIserv	0.8	0.28	0.00	4.76	1.1
Orthogonalized IA term of lnFDImanust and lnDPImanu**	mFDIxmDPInew	0.00	-0.16	-2.12	3.89	0.79
Orthogonalized IA term of lnFDIagrist and lnDPIagri**	aFDIxaDPInew	0.00	0.01	-0.30	0.39	0.08
Orthogonalized IA term of lnFDIservst and lnDPIser**	sFDIxsDPInew	0.00	0.29	-4.62	5.39	1.59
Orthogonalized IA term of lnFDImanust and lnDPI **	mFDIxDPInew	0.00	-0.05	-3.32	5.30	1.43
Orthogonalized IA term of lnFDIagrist and lnDPI **	aFDIxDPInew	0.00	-0.05	-2.34	1.53	0.49
Orthogonalized IA term of lnFDIservst and lnDPI **	sFDIxDPInew	0.00	-0.05	-4.83	9.12	2.18

Notes: When taking the logarithmic value, we added one when the variable had zero observations. * (**) See footnote 17 (18) on the creation of this interactive terms.

Table 2: Dynamic Panel (system GMM) - Focus on aggregate FDI and absorptive capacity

	Model I	Model II	Model III
lny(-1)	0.565** (0.285)	0.512* (0.261)	0.614** (0.256)
lnFDIst	0.068 (0.062)	0.060 (0.063)	0.031 (0.066)
lnDPI	-0.176*** (0.066)	-0.175*** (0.060)	-0.185*** (0.053)
lnPubInv	-0.018 (0.094)	-0.040 (0.081)	-0.050 (0.082)
SecEdu	0.023*** (0.007)	0.027*** (0.009)	0.025*** (0.006)
FDIstxEdumc		-0.003 (0.006)	
FDIxDPInew			0.044 (0.041)
N	94	94	94
Number of instruments	19	20	20
AR(2) test (p-value)	-1.11 (0.26)	-1.17 (0.24)	-0.94 (0.35)
Sargan/Hansen over-identification test (p-value)	7.88 (0.64)	6.96 (0.73)	5.96 (0.82)
Wald test for model joint significance (p-value)	113.94 (0.00)	138.33 (0.00)	222.70 (0.00)

Notes: Standard errors of coefficients are in brackets below the values of the coefficients. Time dummies are included to capture period-specific effects but are not reported to save space. *, **, *** indicate significance at a 10%, 5%, and 1% level, respectively.

Table 3: Dynamic Panel (system GMM) - Focus on FDI Sectors

	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
lny(-1)	0.531** (0.235)	0.611*** (0.229)	0.542* (0.286)	0.465 (0.291)	0.506*** (0.165)	0.73** (0.315)	0.609** (0.290)	0.462*** (0.163)	0.682** (0.300)
lnFDImanust	0.022 (0.033)	0.018 (0.048)	0.027 (0.045)	0.01 (0.051)			0.028 (0.048)		
lnFDIagrist	-0.224* (0.128)	-0.203* (0.114)	-0.207* (0.114)		-0.108 (0.091)			-0.084 (0.085)	
lnFDIservst	-0.028 (0.079)	-0.075 (0.084)	-0.079 (0.087)			-0.126 (0.094)			-0.115 (0.081)
lnDPI	-0.044 (0.073)			-0.125** (0.049)	-0.087** (0.036)	-0.014 (0.095)	-0.137** (0.069)	-0.096*** (0.037)	-0.002 (0.102)
lnPubInv	-0.03 (0.086)	0.003 (0.094)		-0.02 (0.105)	-0.104 (0.074)	-0.060 (0.114)	-0.014 (0.066)	-0.127* (0.069)	-0.082 (0.136)
SecEdu	0.021*** (0.006)	0.020*** (0.008)	0.021*** (0.007)	0.029*** (0.008)	0.026*** (0.006)	0.021*** (0.008)	0.025*** (0.008)	0.030*** (0.007)	0.021* (0.012)
FDImanustxEdumc							-0.005 (0.010)		
FDIagristxEdumc								-0.017 (0.012)	
FDIservstxEdumc									0.001 (0.006)
n	94	94	94	94	94	94	94	94	94
Number of instruments	27	26	25	19	19	19	20	20	20
AR(2) test (p-value)	-1.51 (0.13)	-1.42 (0.15)	-1.52 (0.13)	-0.88 (0.38)	-1.18 (0.24)	-0.73 (0.46)	-1.11 (0.27)	-1.05 (0.29)	-0.58 (0.56)
Sargan/Hansen over-identification test (p-value)	15.43 (0.49)	18.41 (0.30)	17.66 (0.34)	7.50 (0.68)	6.54 (0.77)	15.78 (0.11)	6.25 (0.79)	5.30 (0.87)	12.68 (0.24)
Wald test for model joint significance (p-value)	111.32 (0.00)	102.91 (0.00)	67.25 (0.00)	148.79 (0.00)	375.62 (0.00)	90.61 (0.00)	324.42 (0.00)	390.75 (0.00)	93.13 (0.00)

Table 4: Dynamic Panel (system GMM) - Focus on FDI sectors and their interactions with sectoral DPI

	Model I	Model II	Model III	Model IV	Model V	Model VI
lny(-1)	0.301 (0.334)	0.401* (0.225)	0.341 (0.211)	0.367 (0.224)	0.586** (0.262)	0.533** (0.260)
lnFDImanust	0.038 (0.053)	0.018 (0.057)				
lnDPImanu	-0.221* (0.118)	-0.077 (0.107)				
lnFDIagrist			-0.183*** (0.060)	-0.193** (0.091)		
lnDPIagri			-0.012 (0.212)	0.071 (0.546)		
lnFDIservst					-0.112 (0.103)	-0.129 (0.131)
lnDPIserv					0.016 (0.132)	0.040 (0.093)
lnPubInv	-0.138* (0.076)	-0.098* (0.052)	-0.097 (0.066)	-0.085 (0.089)	-0.093 (0.105)	-0.227* (0.120)
SecEdu	0.030*** (0.011)	0.024*** (0.008)	0.024*** (0.009)	0.022* (0.012)	0.024*** (0.008)	0.032*** (0.010)
mFDIxmDPInew		0.009 (0.051)				
aFDIxaDPInew				-0.041 (0.386)		
sFDIxsDPInew						**0.087**** **(0.044)**
N	94	94	94	94	94	94
Number of instruments	19	20	19	20	19	20
AR(2) test (p-value)	-1.59 (0.11)	-1.53 (0.13)	-1.65 (0.10)	-1.35 (0.18)	-0.58 (0.57)	-0.11 (0.91)
Sargan/Hansen over-identification test (p-value)	10.97 (0.36)	11.50 (0.32)	13.77 (0.18)	13.58 (0.19)	16.49 (0.09)	8.01 (0.63)
Wald test for model joint significance (p-value)	118.00 (0.00)	185.82 (0.00)	153.89 (0.18)	115.19 (0.00)	87.56 (0.00)	194.67 (0.00)

Table 5: Dynamic Panel (system GMM) - Focus on FDI sectors and their interactions with aggregate DPI

	Model I	Model II	Model III
lny(-1)	0.503* (0.266)	0.570** (0.228)	0.612** (0.31)
lnFDImanust	0.012 (0.045)		
lnFDIagrist		-0.161* (0.092)	
lnFDIservst			-0.043 (0.121)
lnDPI	-0.14** (0.056)	-0.096** (0.045)	-0.070 (0.068)
lnPubInv	0.001 (0.074)	-0.042 (0.074)	-0.163 (0.176)
SecEdu	0.027*** (0.008)	0.024*** (0.006)	0.028** (0.012)
mFDIxDPInew	0.014 (0.021)		
aFDIxDPInew		0.042 (0.034)	
sFDIxDPInew			**0.049*** **(0.029)**
N	94	94	94
Number of instruments	20	20	20
AR(2) test (p-value)	-0.87 (0.38)	-1.11 (0.27)	-0.86 (0.39)
Sargan/Hansen over-identification test (p-value)	7.50 (0.68)	6.53 (0.77)	12.66 (0.24)
Wald test for model joint significance (p-value)	232.04 (0.00)	234.90 (0.00)	122.33 (0.00)

Appendix A: Data Sources and Details

Logarithmic (log) value of the real GDP per capita (dependent variable): Log value of GDP per capita (at 1992 prices) over three-year period. Data on nominal GDP per capita were collected from several English and Arabic *Egypt Human Development Reports* by UNCTAD. These reports are not issued annually and thus data are missing for a few years. Where possible, we used governorates' *Human Development Reports*, made available by the National Institute of Planning, to fill in missing data on governorate GDP per capita. To fill in remaining gaps, we conducted a linear interpolation. Real figures have been calculated using the GDP deflator (1992=100) reported by the World Bank. Note that data on the population-scarce frontier governorates are available only since 2000. Thus, our panel is an unbalanced one.

Log of FDI flow (%GDP): FDI inflows (in EGP) are divided by GDP (in EGP) and multiplied by 100 (three-year-average). FDI inflows are based on unpublished raw data of investments by foreign enterprises registered at the General Authority for Investment and Free Zones (GAFI). GAFI only registers 'non-petroleum greenfield FDI' and their expansions. To obtain the **governorate's GDP**, GDP per capita was multiplied by the population at the governorate level. GDP per capita data is compiled from *Egypt Human Development Reports* by UNCTAD and governorates' *Human Development Reports*, as described above. We obtained the population data at the governorate level from two sources: (1) the population since 1995 was collected from available yearbooks by the Central Agency for Public Mobilization and Statistics (CAPMAS) and (2) the population for the period 1990–1992 was obtained from the Annual Labour Force Sample Issues by CAPMAS. To bridge the gap of the two missing years of 1993 and 1994, we conducted a linear interpolation of population data.[36] Both FDI flow and GDP were in current EGP. *This variable is used for robustness check.*

Log of FDI stock (%GDP): FDI stock (in EGP) is divided by GDP (in EGP) and multiplied by 100 (three-year-average). The FDI stock is defined as the amount of cumulative FDI flows from 1972 until the end of the respective year. Egypt's open-door policy started in 1974, but the country had already begun receiving first inflows in 1972. To calculate the FDI stock, we used an annual depreciation rate of 4%, based on the calculations by Hevia and Loayza (2012) for Egypt. See FDI flow above for more details on the construction of this variable.

Log of FDI stock in manufacturing / agriculture / services (%GDP) Calculation and sources similar to FDI stock above.

Log of DPI (%GDP): Domestic private investment (in EGP) are divided by GDP (in EGP) and multiplied by 100 (three-year-average). Calculation similar to FDI flow. Source: GAFI.

Log of public investment (%GDP): Public investment data (in EGP) are divided by GDP (in EGP) and multiplied by 100 (three-year-average). Unpublished regional public investment data, which were made available by the Ministry of Planning, are disaggregated at the governorate level starting in 1997. For the years before 1997, only annual aggregate public investment data were made available according to five-year-plans. To estimate public investments per governorate for 1992–1996, we made the assumption that a governorate's share in total public investment is the same as the average of the following five years (1997–2001).

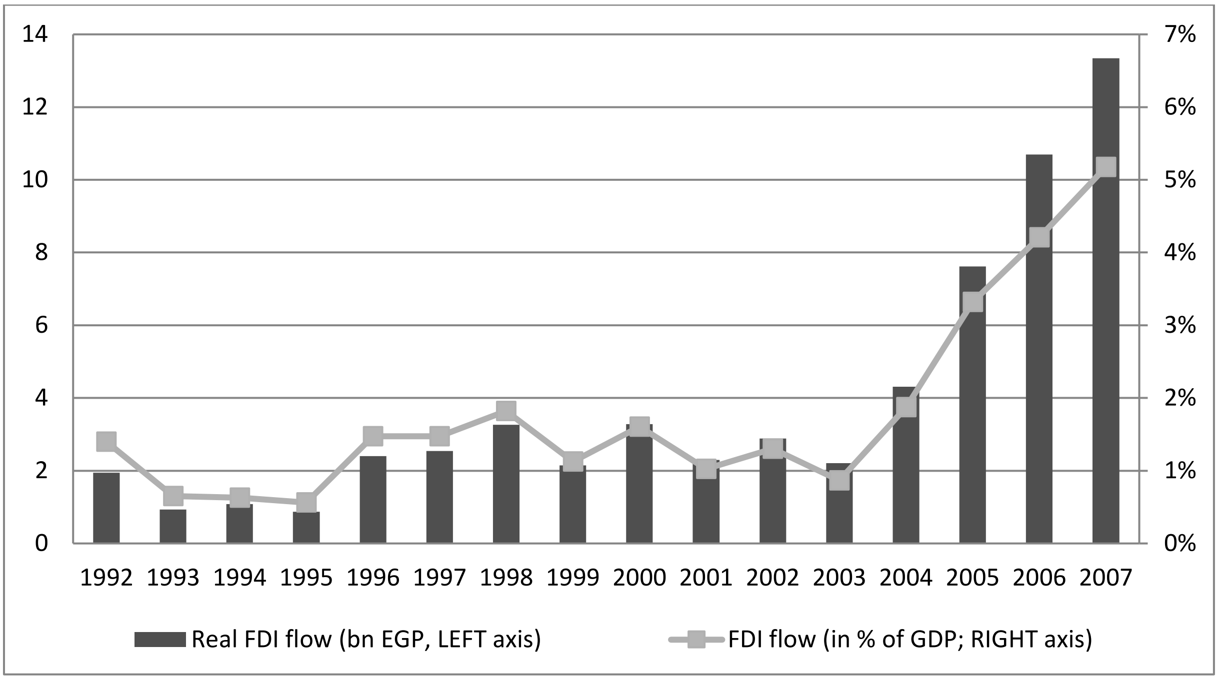
[36] Similarly, Blonigen et al. (2007) use linear interpolation to fill missing data.

Percent of labour force with secondary education: Share of labour force that holds at least an intermediate level of education (equivalent to at least secondary education) in percent. Data on labour force and labour force education are collected from the Annual Labour Force Sample Issues by CAPMAS. As no issue is available for the year 1996, we interpolated the data to fill this gap.

University education (% of labour force): Share of labour force that holds a university degree in percent (see secondary education above). *This variable is used for robustness check.*

Appendix B: Figures

Figure A.1: 'Non-petroleum greenfield' FDI to Egypt in 1992–2007



Notes: On left axis: Real 'non-petroleum greenfield' FDI flow (in billion EGP at constant 1992 prices). On right axis: Flow of 'non-petroleum Greenfield FDI' (in % of GDP). Source: Author's calculations, based on FDI data from GAFI and GDP data from the World Bank.