Does Investment in Knowledge and Technology Spur "Optimal" FDI in the MENA Region? Evidence from Logit and Cross-Country Regressions

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Abstract

UNCTAD data reveal that most Middle-East and North African (MENA) countries have failed to attract Foreign Direct Investment (FDI) to levels that are commensurate with their *potential.* Generally, FDI flows to the MENA region have been consistently abysmal. While there is anecdotal evidence that knowledge, technology, and human capital are becoming more salient than factor accumulation in international competitiveness and capital flows, most studies on FDI flows to the MENA region have not systematically explored the interconnection between knowledge and FDI. In this study, I apply logit and cross-country regressions using data from 61 MENA and non-MENA countries, to investigate whether or not inadequate investment in knowledge, technology, and human capital by MENA countries explains their sub-optimal FDI profile. Results from both models suggest that investment in knowledge and technology is not significant for a MENA country's ability to attract an optimal level of FDI. Openness of the economy, political risks, and economic growth are more important for FDI flows. This implies that despite their poor science and technology infrastructure, MENA countries could still attract FDI by promoting openness, implementing pro-growth economic policies and protecting political rights/civil liberties.

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1. Introduction

Countries in the MENA region have the potential to attract a substantial inflow of Foreign Direct Investment (FDI), but they have failed to do so. Apart from being the bastion of the world's largest oil reserves, the MENA region features abundant natural resources, a fairly skilled workforce, and proximity to European markets. Yet, in ranking after ranking, MENA countries have been consistently listed as among those that have not attracted FDI to levels that are commensurate with their capabilities. In UNCTAD's 2000-2002 classification of countries by their levels of FDI vis-à-vis potentials (see Table 1), only four MENA countries were classified as either "Front-Runners" or "Above-Potential." The rest were classified as "Below-Potential" or "Under-Performers."[2]

This ranking is consistent with data on FDI flows to the MENA region, which show that MENA countries receive less FDI than most countries in the developing world.

Prior to 2003, as Table 2 shows, FDI to GDP ratio for MENA averaged one percent per annum. It was the least among the regions reported in the table, except South Asia. In addition, six of the bottom 10 countries in UNCTAD's Inward FDI Performance Index in 2003 are MENA countries.[3] Since 2003, however, FDI flows to the MENA region have gradually caught up with those of sub-Saharan Africa (SSA), but are still below the levels for East Asia/Pacific and Latin America/Caribbean. In 2006, the MENA region received a big leap in FDI flows (four percent of GDP), surpassing flows to all other regions. Whether this sudden rise in FDI flows to the MENA region will be sustained in the medium to longer term remains to be seen.[4]

Aggregate flows of FDI to the MENA region can be misleading. They often conceal wide variations in FDI flows to the region. As Table 3 shows, the largest recipients of FDI in the past five years or so include Bahrain, Djibouti, Egypt, Israel, Jordan, Lebanon, and Tunisia. Surprisingly, some of the least recipients include oil-rich countries such as Algeria, Iran, Kuwait, and Saudi Arabia (Eid and Paua 2002, p. 110). FDI flows to the MENA region also vary by sectors. Most of the foreign investors venture into petroleum-related (particularly hydrocarbons) and other primary activities. Non-petroleum FDI (especially to countries such as Bahrain, Egypt,

2. As Table 1 shows, nearly 40 percent of the countries listed as "Below-Potential" are MENA countries.
3. The Inward FDI Performance Index ranks countries by the FDI they receive relative to their economic size, computed as the ratio of a country's share in global FDI inflows to its share in global GDP. For details about this index, see UNCTAD (2003).
4. FDI flows to the MENA region has been abysmal despite the adoption by some MENA countries, of the European Union policies and regulations designed, among other things, to promote FDI. Many MENA countries have also implemented structural adjustment programs that have led to the privatisation of inefficient public enterprises, fiscal reforms, and reform of the banking system. These countries have also introduced FDI policies designed to create an enabling environment for FDI [see, for instance, Eid and Paua (2001), Rivlin (2001) and Noland and Pack (2007)].

Morocco, Tunisia, and Lebanon) are in tourism, banking, telecommunications, manufacturing, and construction (Eid and Paua 2002, p. 111).

The meager flow of FDI to MENA countries reflects a historical trend.[5] Of developing countries' 65.7 percent share of the global stock of FDI in 1938, MENA's share was 2.6 percent, compared to Africa's 7.4 percent. In 1960, the share of FDI to developing countries was 32.3 percent. MENA received 2.8 percent and Africa 5.5 percent (Dunning 1981, p. 224-235).

Although FDI flows to MENA countries have been rising in the past few years, they still remain relatively low in view of the region's potential. As Noland and Pack (2007, p. 262) point out, "inward flows are not only low as might be expected on the basis of the fundamentals, but also below the norm" (Noland and Pack 2007, p. 262). The question, therefore, is: What is wrong with MENA countries? Why have they not lived up to expectations with regard to FDI?

Although various studies have explored why MENA countries have not attracted an optimal level of FDI, none has undertaken a systematic empirical analysis of the role played by investment in knowledge and technology. This is despite the fact that there is circumstantial evidence that foreign investors are becoming *less* sensitive to political and macroeconomic instability. They are increasingly *more* concerned about the availability of a skilled workforce as well as a robust science and technology "infrastructure" in the host country. The massive inflow of FDI to China and India during the past decade is often used as anecdotal evidence of the salience of knowledge and technology for FDI flows. China and India have invested in high technology. The Republic of Ireland has also attracted large inflows of FDI during the past decade largely because of the existence of a cluster of firms such as Intel and Microsoft in that country.[6]

This paper uses logit and cross-country regressions, with a sample of 61 MENA and non-MENA countries, to investigate whether the ability of MENA countries to attract FDI in levels commensurate with their potential depends on their levels of technological development. Based on the empirical results, the paper proposes policy measures that MENA countries need to undertake in order to move from "Below-Potential" to "Above-Potential" and "Front-Runner." The paper is divided into six sections. Following the introduction in Section I, Section II discusses some of the rationale and motivations for FDI. Section III presents the empirical model, while Section IV discusses the results from logit and cross-sectional OLS regressions. Section V considers the policy implications of the results. Section VI focuses on the conclusions and recommendations for further research.

5. This historical trend suggests that endemic institutional constraints may also be responsible for the abysmal flow of FDI to the MENA region.
6. Bangalore in India has become a hub for foreign investors because of the existence of a coterie of software engineers and other professionals in the area. For more information on the role of the availability of skills in the agglomeration of foreign firms in Bangalore, see Friedman (2006).

2. Rationale and Motivation for Foreign Direct Investment

The classic literature on FDI recognises market size, proximity to low-cost factors of production, and host-country policies as motivating factors for FDI [see, for instance, Lall and Streeten (1977) and Dunning (1981)].When investigating why FDI to the MENA region has been abysmal, most researchers tend to focus on macroeconomic and sometimes institutional variables such as economic growth, openness, bilateral investment treaties, real interest rates, rate of return on investment, infrastructures, natural resources, corruption, and political stability [see Richards and Waterbury (1996), Chemingui (2000), Kamaly (2002), Eid and Paua (2002), Rivlin (2001), and Mina (2009)].

The empirical papers typically use fixed effects panel regressions, and a small sample of MENA countries. These studies often conclude that macroeconomic stability, openness, and political stability are important for FDI flows to the MENA region. Kamaly (2002), for instance, used a dynamic panel model covering the period 1990-1999 to identify the determinants of FDI flows to the MENA region, and concluded that the lagged value of FDI/GDP and economic growth were the only significant factors amongst a multitude of macroeconomic indicators. In a study that used fixed effects panel regressions, Onyeiwu (2004) found that openness and corruption/bureaucratic red tape were the only significant variables for FDI flows to the MENA region. Using an Instrumental Variable (IV) model, Mina (2009) concludes that Bilateral Investment Treaties (BITs) contracted by MENA countries with OECD and upper middle-income countries have a negative impact on FDI flows to the region. In contrast, BITs with non-OECD countries have positive effects on FDI flows.

However, rarely do empirical studies on FDI flows to MENA countries explicitly model science and technology indicators.[7] This is despite the increasing importance of technological innovation in the new global economy, and the anecdotal evidence that it may even have become a key determinant for attracting FDI. Mytelka (1987, p. 43), for instance, notes that if R&D, design, engineering, advertising, and marketing are regarded as part of "knowledge," then "present trend suggests that knowledge inputs may be displacing capital, land, and labour as the primary defining feature of the production process." According to Paus (2005, p. 193):

> The absolute number of skilled and educated workers in a developing country is one factor that, *ceteris paribus*, influences the amount of high-tech FDI a developing country can attract. One of the reasons Ireland was able to attract large inflows of high-tech FDI was the

7. Economists often regard technology as exogenous to the economic system. Though endogenous growth theories have shown that technological change does affect economic growth and investment (Romer 1986), economists still do not model the role of innovation and technological change in FDI flows.

> relatively large number of engineers and other highly trained people it could provide.

In his interviews with R&D managers of foreign corporations operating in China, Chen (2008, p. 628) notes that "the primary motives underlying the establishment of advanced R&D centres in China concerned not the cost, but the availability of the required skilled labour." Corroborating this point, the director of IBM China Research Labs pointed out that:

> ……the migration is not just about outsourcing for low labour rates. If it were just about low labour rates, we'd probably have R&D centres in places like Romania and the Philippines. China's advantage is not in low production costs. Production costs are even lower in India. China's advantage lies in the availability of the best talent (Chen 2008, p. 628).

Athreye and Kapur (2009, p. 213) contend that foreign investment is motivated by the quest for the acquisition of strategic assets like new technologies and brands, as well as to secure access to raw materials and distribution networks. Although firms can acquire technology through arm's length transactions and from domestic sources, the authors note that market imperfections and transaction costs may make acquisition through FDI more effective.

Investigating whether knowledge and technology play an important role in FDI flows to the MENA region is warranted, given the region's poor science and technology (S&T) infrastructure. Table 4 shows that Gross Domestic Expenditure on Research and Development (GERD) in Arab States (most of which are in the MENA region) as a percentage of world GERD is about 0.4 percent. It is the lowest for the regions reported in the table. GERD as a percentage of GDP in Arab States is 0.2 percent, which is also the lowest for all the regions. Only a paltry 1.6 percent of researchers in the world are located in Arab States. The numbers are lower than for every other region except for SSA.

Additionally, the number of patents granted to firms in the MENA region during the period 1989-1996 was a paltry 200, compared with 11,302 for Korea, 1,725 for Singapore, 1,510 for India, and 1,081 for Hong Kong (Statistical Abstract of the World 1996). Trade data also show that MENA countries export predominantly low-tech products, reflecting their lack of investment in technological innovation. The volume of scientific publications by MENA scientists in international journals is also considered to be unimpressive (Radwan and Kassem 2002, p. 415).

As further evidence of the poor S&T infrastructure in the MENA countries, Table 5 shows that most of the researchers in the region are employed in the public sector and higher education, rather than in business enterprises. Of the four MENA countries for which data were available, only Israel had a significant portion (82 percent) of its R&D personnel employed in business enterprises, followed by Turkey with about 30 percent. Incidentally, these countries have also attracted a significant volume of FDI compared to other

MENA countries. All of Algeria's and Tunisia's R&D personnel were employed in the public sector and in higher education. By contrast, China and Ireland, which are two large recipients of FDI, had about 78 percent and 62 percent of their R&D personnel employed in business enterprises respectively.

Studies have shown that firms tend to be located in regions with a cluster of businesses engaged in R&D. That way, they reap the benefits of agglomeration economies in the form of availability of researchers, diffusion of technical and scientific knowledge, and a strong S&T infrastructure.

Beyond these anecdotal and circumstantial evidence, does economic theory lend credence to the notion that knowledge and technology are salient for FDI flows? This question is addressed in the next section.

3. The Empirical Model

In this section, I investigate whether science and technology indicators explain why FDI flows to the MENA region do not reflect their capabilities. As discussed earlier on, UNCTAD classifies countries into four categories, according to their abilities to attract different levels of FDI. Two of these categories, "Front-Runner" and "Below-Potential", are of particular interest in this study because of two reasons: First, the former category represents the highest level in UNCTAD's classification. Second, most MENA countries fall under the latter category. The crucial questions, therefore, are: How might MENA countries become "Front-Runners"? What are the policies required to facilitate the flow of FDI to the region? Because other studies have investigated the impact of macroeconomic and institutional variables on the FDI flows, my goal in this section is to use the logit model to determine whether a MENA country's investment in science and technology increases its probability of becoming a front-runner.

The dependent variable in this model is a binary-choice variable called "Country Category". It assigns the number 1 to "front-runners" and zero to "below-potentials", for the countries listed in Table 1.[8] The model is specified as:

$$\text{Country Category} = ß_0 + ß_1 R\&D + ß_2 BUSR\&D + ß_3 NRES + ß_4 TECHEX + ß_5 \text{GDPCAP} + ß_6 POLR + ß_7 OPEN + ß_8 HCAP$$

Explanatory Variables

There are two sets of explanatory variables in this model: *Science and Technology indicators* and *Control Variables.* The science and technology indicators include the following variables:

8. Non-MENA countries are included in the model because of the lack of data for most MENA countries.

R&D Expenditure (R&D): Most innovative activities take place in public and private R&D laboratories. Although there is controversy about whether R&D labs are the most important sources of technical change, it has become customary for economists to measure the level of innovative activity by expenditures on R&D as a percentage of GDP. I expect the coefficient on this variable to be positive because a higher R&D expenditure would increase the propensity of a country to become a front-runner.

Business R&D (BUSR&D): Expenditure on R&D *per se,* while necessary, is not a sufficient condition for attracting an optimal level of FDI. A preponderance of that expenditure must occur in the private sector for it to be an effective tool for attracting FDI. A large share of business R&D in a country's total R&D expenditure indicates that the private sector is not only vibrant, but also the driving force of the economy. Thus, the larger the proportion of business R&D in total R&D expenditure, the more likely that a country would attract an optimal level of FDI and become a front-runner.

Number of Researchers (NRES): In addition to being a S&T indicator, this variable also serves as a proxy for human capital. Countries such as South Korea, China, and India, which have large stocks of human capital, also have a very high number of scientists, engineers, and researchers. In the new economy, skills, knowledge, and human capital have become very important competitive factors. As indicated in section II of this paper, some studies suggest that corporations tend to establish businesses in countries with abundant supplies of scientists, engineers, computer programmers, and so on. In a recent *Wall Street Journal* article, Lohr (2005, p. C1) noted that multinational corporations now regard "the quality of scientists and engineers and their proximity to research centers as crucial." India and China have become popular destinations for foreign investors partly because of the availability of a skilled workforce at affordable wage rates. Because the number of researchers in a country may be affected by the country's population, I measure this variable by the number of researchers per million of the population. The coefficient on this variable is also expected to be positive, as an increase in the number of researchers will enhance the ability of a country to attract more foreign investors.

High-Technology Exports (TECHEX): Countries that have invested significantly in science and technology typically export high-tech products. Conversely, countries that have not invested enough in science and technology generally rely on primary products, natural resources, and light/assembly-type manufactured products. This variable is measured as a proportion of manufactured exports. It is expected to be positively correlated with a higher propensity to attract FDI.

The choice of the above S&T indicators was motivated by the availability of data for the sample countries. Other potential variables include the number of patents granted to each of the sample countries, the number of publications by researchers in scientific journals, the rankings of universities, and the

number of research institutes. However, data on these variables are not readily available for many countries, especially those in the MENA region.

The following *control* variables that influence FDI flows are included in the model:[9]

GDP Growth Rate (GDPG)

Nearly every study on FDI has found a positive relationship between economic growth and FDI (Zhang 2001; Chakrabarti 2001; Ramirez 2000). One reason for the positive relationship is that growth increases living standards and thus creates a large market for foreign investors. Apart from having large domestic markets, high-growth economies typically implement stable and credible macroeconomic policies that attract foreign investors. I expect *GDPG* to be positively correlated with a higher propensity to attract FDI.

Political Risk (POLR): Analysts have established a link between political risks and FDI. Other things constant, democratic and politically stable economies attract more FDI than despotic and unstable countries (Schneider and Frey 1985). Democratic regimes are also more likely to respect civil liberties, the rule of law and property rights. These features are more conducive to the flow of FDI. Ngowi (2001) argues that many developing countries have attracted little FDI because they are regarded as "high risk and are characterised by a lack of political and institutional stability and predictability." I measure political risk by Freedom House's *Indexes of Political Rights and Civil Liberties*. For each country in my sample, I calculated the average of these two indexes. Because the indexes measure political rights and civil liberties on a scale of 1 to 7 (with 1 representing the highest levels and 7 the lowest), *POLR* is expected to be negatively correlated with a higher propensity to attract FDI.

Openness of the Economy (OPEN): Additionally, the ease with which investors can move capital in and out of a country (the openness of the economy) is also an important determinant of FDI flows (Chakrabarti 2001, p. 91-92). That is, countries with capital controls and restrictive trade policies discourage inflows of FDI, compared with countries that have fostered liberal policies. Most of the studies on FDI in developing countries have identified a positive relationship between openness and FDI (Morisset 2000; Kandiero and Chitiga 2006). I measure openness using imports plus exports as a percentage of GDP, and expect its coefficient to be positive *a priori.*

Human Capital (HCAP): Studies have found that human capital is a "determinant of economic development, driving the economy to the heights of per capita income achievable by a high level of formally educated human resources." (Amsden 1989, p. 219). Human capital enhances productivity by

9. There is a long list of potential control variables, including natural resources, infrastructures, fiscal indicators, and rate of return on investment. Some of these variables were not included in the model because of the non-availability of data for some of the MENA countries in my sample. Since there is no microeconomic theory of FDI, analysts have tended to include in their models only variables of their choice.

inculcating good attitudes and work habits in the workforce, as well as through the acquisition of specialised knowledge (Curries, 1986, p. 543). Because human capital affects productivity and growth, it also influences the flow of FDI. In this paper, human capital is measured in terms of government expenditure on education as a percentage of GDP.[10]

There are several other control variables that are not included in this paper because other studies have investigated their significance for FDI flows [see, for instance, Asiedu (2002), Kandiero and Chitiga (2006)]. The primary goal of the present paper is to explore whether S&T variables are significant for FDI flows to the MENA region.

Data Sources and Descriptive Statistics: Data on the control variables, including High-Technology Exports, were collected from World Development Indicators published by the World Bank. Data on civil liberties were from the Freedom House Index of Political Freedom, while data on FDI to GDP ratio were from UNCTAD's FDI database. All of the data used in the model are for 2002, except otherwise stated. The descriptive statistics for the explanatory variables are summarised in Table 6, while Table 7 shows the correlation matrix of the explanatory variables.

4. Results and Discussions

The logit model was estimated for the 61 countries (including 11 MENA countries) listed under "Front-Runners" and "Below-Potential" in Table 1.[11] Given the high correlation (0.8) between R&D and BUSR&D as shown in Table 7, the latter was dropped from the model. The dependent (or dummy) variable was regressed on both the science and technology indicators and the control variables. The results are summarised in Table 8. It can be seen from the table that none of the science and technology indicators is significant, suggesting that the propensity for a country to attract an optimal level of FDI is unrelated to the country's investment in science, technology and human capital. This implies that foreign investors consider mainly non-technological factors when making investment decisions.

The control variables – Openness and Political Risk – are the only significant variables in the regression results (Table 8).[12] The positive sign on the coefficient of OPEN implies that the probability of attracting an optimal level of FDI increases with the openness of an economy. Likewise, the negative sign on the coefficient of POLR suggests that the more stable and democratic a country is, the higher its probability of attracting an FDI level

10. This variable can also be interpreted as measuring government commitment to education. The data source for this variable for the sample countries in this study is the *Human Development Report 2007/2008* published by the United Nations. The data used is the average public expenditure on education as a percentage of GDP for the 2002-2005 period.
11. Some of the countries were excluded because of the non-availability of data. The inclusion of just 11 MENA countries was due to the gross lack of data for most countries in the region.
12. These variables are significant at the 5 percent level.

that is commensurate with its potentialities. Surprisingly, economic growth turns out to be insignificant for the propensity of a country to become a front runner in attracting FDI.

To test the robustness of the notion that science and technology indicators have no significant effects on the propensity to attract an optimal level of FDI, I re-estimated the model as a cross-country OLS regression, with FDI (as a percentage of GDP) as my dependent variable. All the explanatory variables remain the same, but year 2003 FDI/GDP data are used because the explanatory variables typically affect FDI flows after a time lag. The results are summarised in Table 9. They confirm that science and technology indicators are not important for FDI flows into countries. As with the logit model, openness and political risks are also significant variables in the OLS model. Contrary to the logit model, however, economic growth is a significant determinant of FDI flows in the OLS model.

The OLS regression results show that political risks have the largest impact on FDI flows. A one-point decrease in political risks increases the flow of FDI by almost one percent, whereas a one percent increase in economic growth raises FDI flows by 0.48 percent. Openness has the least impact on FDI flows. A one percent increase in imports plus exports as a percentage of GDP increases FDI flows by just 0.04 percent.

What are the implications of some of the regression results for FDI flows to MENA countries? How might insights from the key results be used to enhance the capacity of MENA countries to attract FDI? These issues are addressed in the next section.

5. Policy Implications for Mena Countries

Although non-MENA countries were included in the regression models discussed in the previous section, results from the regressions have the following implications for economic policy in the MENA region:

Openness and FDI Flows: What drives FDI flows globally is not how much countries spend on R&D and other technology indicators. More important is how open an economy is to trade, investment, and capital flows. This contention is supported by Jordan's classification as a "front-runner" in Table 1, with both a high FDI potential and High FDI performance. One reason for Jordan's classification under this category is because of its openness compared to other MENA countries.

Following its implementation of economic reforms in the 1990s, Jordan's central bank removed all foreign exchange controls in its attempt to attract foreign investment and to also encourage Jordanians to repatriate foreign exchange held in foreign banks (Elguindi 1998, p. 4). By contrast, many MENA countries are still closed, as manifested by high trade barriers in these countries. Table 10 summarises the various trade protection indicators of developing countries. It shows that trade protection in MENA is on

the average the highest in the developing world. MENA's trade barriers have not only been the highest, but also the slowest to come down (Srinivasan 2002, p. 1).

Another manifestation of the protective nature of MENA economies is the fact that trade flows to the region have declined dramatically for the past 20 years. For instance, trade flows to the Middle East represented about 21 percent of the flows to developing countries in 1980, but fell to 13 percent in 1990 and a meager nine percent in 1997 (IMF 1999). MENA's declining openness contrasts with the increasing openness of Asia, whose share of trade flows increased from 28 percent in 1980 to 52 percent in 1997.

MENA countries can ameliorate their poor science and technology infrastructure by promoting a policy of openness. As Grossman and Helpman (1991) [quoted in Lai *et al.* (2006, p. 301)] point out, "the higher a country's degree of openness, the more chances it will have of imitating and learning from outside." In other words, foreign investors could import technologies, skills, and expertise from elsewhere, as long as the economy is open. We live in an information society where technical knowledge can be transferred relatively easily from one country to another. For instance, results of R&D conducted in Europe can be disseminated to the subsidiaries of multinational corporations in the MENA region.

Political Risks: The logit regression results show that the propensity of a country to attract FDI to a level that is commensurate with its potential decreases with political risks. Likewise, the cross-country regression results imply that differences in FDI flows across countries can be explained by differences in political risks. This perhaps explains why oil-rich but politically unstable countries such as Algeria, Iran, and Saudi Arabia attract some of the least flows of FDI to the MENA region.

MENA countries are perceived as some of the most unstable and risky countries in the world. The risks and uncertainties in the region stem from two major sources. First, the existence of sectarian regimes in most countries in the region have circumscribed the ability of individuals to exercise their civil rights and liberties. Second, most of the regimes in the region are oligarchic, authoritarian, and undemocratic. In other words, political rights, political freedoms, freedom of expression, etc, are constrained. This is particularly true of countries such as Saudi Arabia, Kuwait, and Iran, where the media and Western influence are severely controlled. Consequently, a precondition for boosting FDI flows to the MENA region is for countries in the region to grant political rights and civil liberties to their citizenry, as well as democratising the political process.

Economic Growth: Results from the OLS model shows that growth is important for FDI flows. This implies that MENA countries should implement pro-growth policies, such as a stable macroeconomic environment, sound fiscal and monetary policies, protection of property rights, transparency, and good governance. Of particular importance is the need for MENA countries to implement structural reform by jettisoning pervasive state

control of the economy, privatising inefficient state enterprises, reducing budget deficits, and strengthening financial institutions.

Analysts have noted that MENA countries have undertaken limited policy reform (Page, 2003). According to Noland and Pack (2007, p. 162), "in recent studies of the Middle East, many variables measuring policy reform and institutions have been examined and the region is found to lag behind in many of them, such as tariff liberalisation, real exchange rates, receipts from sales of state-owned enterprises, and the business environment." In highlighting the salience of policy reform for economic growth in developing countries, the World Bank (1994, p. 131) noted that median annual per capita GDP growth was almost two percent points higher after the implementation of structural adjustment policies, and was 2.6 percent points lower for countries with a deterioration in macroeconomic policies. Thus, MENA countries need to accelerate their economic growth in order to attract more FDI.

Science and Technology Indicators: Does the insignificance of S&T indicators in both the logit and OLS regressions imply that investment in science and technology is a waste of money? As indicated earlier, the insignificance of these variables may be due to the imperfection of the variables used in this paper to proxy science and technology. The fact that data on FDI flows are not typically disaggregated into different categories of FDI (knowledge-based, resource-oriented, financial, manufacturing, etc) may also affect regression results. In other words, lumping all FDI together without regard to the structure of their operations may complicate attempts at isolating the effects of S&T variables on FDI flows.

If interpreted broadly, however, the results from this study may not be inconsistent with the notion that science and technology are important for FDI flows. It could be that foreign investors are attracted to open economies because these countries have liberal policies, not only toward trade and capital flows, but also toward factor movements. Thus, foreign investors can easily attract scientists, engineers, and experts from other countries in open economies. In other words, open economies can overcome their disadvantage in science, technology, and human capital by making it easier for domestic and foreign firms to attract skills and expertise from other countries.

6. Conclusions and Further Research

This paper investigates if the classification of most MENA countries as "Below-Potential" with regard to their ability to attract optimal levels of FDI is related to their inadequate investment in science and technology. Results from both logit and cross-country regressions find no evidence to support the notion that investment in science and technology plays an important role in the ability of MENA countries to attract optimal levels of FDI. The results show that openness, political stability, and economic growth are more impor-

tant in explaining why some countries are "front-runners" and others "below-potential." Given the imperfection of the variables used to proxy science and technology as well as the correlation between some of the explanatory variables, these results are necessarily provisional. They have very important policy implications for MENA countries.

Most MENA countries are not as open as they ought to be. In general, the region is known to be politically unstable and therefore too risky for business. With regard to their lack of openness, there is evidence that MENA economies are some of the most protected in the world. To attain "front-runner" status, MENA countries need to be more open, promote economic growth, protect political rights, and foster civil liberties.

Further research using other measures of science and technology, a larger sample of MENA countries, and a different model specification (such as a system of simultaneous equations) is needed for more definitive conclusions.

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Annex

Table 1. ***Matrix of Inward FDI Performance and Potential, 2000-2002***

	HIGH FDI PERFORMANCE	LOW FDI PERFORMANCE
HIGH FDI POTENTIAL	*Front-runners* Bahamas, Belgium and Luxembourg, Botswana, Brazil, Brunei, Bulgaria, Canada, Chile, China, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Estonia, Finland, France, Germany, Guyana, Hong Kong, Hungary, Ireland, Israel, Jordan, Latvia, Lithuania, Malaysia, Malta, Mexico, Mongolia, Netherlands, New Zealand, Panama, Poland, Portugal, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Kingdom, and Vietnam.	*Below-Potential* Australia, Austria, Bahrain, Egypt, Greece, Iceland, Iran, Italy, Japan, Kuwait, Lebanon, Libya, Norway, Oman, Philippines, Qatar, Korea, Russia, Saudi Arabia, South Africa, Taiwan, Thailand, UAE, and United States.
LOW FDI POTENTIAL	*Above-Potential* Albania, Angola, Armenia, Azerbaijan, Bolivia, Colombia, Ecuador, Gambia, Georgia, Honduras, Jamaica, Kazakhstan, Mali, Morocco, Mozambique, Namibia, Nicaragua, Republic of Congo, Republic of Moldova, Sudan, TFYR Macedonia, Togo, Tunisia, Uganda and Tanzania.	*Under-Performers* Algeria, Argentina, Bangladesh, Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guinea, Haiti, India, Indonesia, Kenya, Kyrgyzstan, Madagascar, Malawi, Myanmar, Nepal, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Peru, Romania, Rwanda, Senegal, Sierra Leone, Sri Lanka, Suriname, Syria, Tajikstan, Turkey, Ukraine, Uruguay, Uzbekistan, Venezuela, Yemen, Zambia, and Zimbabwe.

Source: UNCTAD FDI Database.

Table 2. ***Regional Distribution of FDI Net Inflows (% of GDP)***

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
MENA	0	1	1	1	1	1	1	2	1	2	4
SSA	1	2	2	3	2	4	3	3	2	2	2
S. Asia	1	1	1	1	1	1	1	1	1	1	2
E. Asia	4	4	4	3	3	3	3	3	3	3	3
Latin Amer./ Caribbean	2	3	4	5	4	4	3	2	3	3	2

Source: World Development Indicators database, 2009.

Table 3. ***Inter-Country Variations in FDI Net Inflows (% of GDP) to the MENA Region, 1996-2006***

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Algeria	1	1	1	1	1	2	2	1	1	1	2
Bahrain	34	5	3	7	5	1	3	5	8	7	-
Djibouti	1	0	1	1	1	1	1	2	6	3	14
Egypt	1	1	1	1	1	1	1	0	2	6	9
Iran	0	0	0	0	0	0	0	0	0	0	0
Israel	1	2	2	3	4	3	2	3	2	4	10
Jordan	0	5	4	2	10	2	1	4	7	14	23
Kuwait	1	0	0	0	0	-0	0	-0	0	0	0
Morocco	0	0	0	0	1	0	0	5	1	3	4
Oman	0	0	1	0	0	0	1	2	1	3	3
Saudi Arabia	-1	2	3	-0	-1	0	-0	-0	-0	0	0
Syria	1	1	1	1	1	1	1	1	1	2	2
Tunisia	1	2	3	2	4	2	4	2	2	2	11
Rep. of Yemen	-1	-2	-3	-4	0	2	1	-1	1	-2	6

Source: World Development Indicators database, 2009.

Table 4. ***Regional Science and Technology Indicators***

Regions/ Countries	GERD as % World GERD*	GERD as % of GDP	GERD per Inhabitant (PPP $)	Researchers as a % of World Total	Researchers Per Million Inhabitants	GERD Per Researcher (thousands of PPP$)
Developing Countries	15.6	0.6	20	28.4	347	57.9
Developed Countries	84.4	2.2	377	71.6	3,033	124.2
Asia	27.9	1.3	46	34.5	537	85.1
Latin America & the Caribbean	3.1	0.5	34	6.7	715	48.2
SSA (excluding Arab States)	0.5	0.3	6	1.0	113	49.1
Arab States (in Africa)	0.2	0.2	7	1.5	489	14.9
Arab States (in Asia)	0.1	0.2	11	0.1	52	211.4
Arab States (All)	0.4	0.2	8	1.6	356	23.6
China	3.9	0.6	17	10.6	454	38.3
India	2.0	0.7	11	2.8	151	75.8

* GERD stands for Gross Domestic Expenditure on Research & Development
Source: Computed from UNESCO statistics published in *The State of Science and Technology in the World,* Paris, UNESCO Institute of Statistics, 2001, p. 7.

Table 5. *Total R&D Personnel by Sector of Employment, 2005*

Country	Business Enterprises	Govern-ment	Higher Education	Private Non-Profit Institutions	Total	R&D personnel in Business Ent. as % Total
Algeria	-	1,225	6,106	-	7,331	0
Egypt	N/A	N/A	N/A		N/A	5.8 (1986)*
Jordan	N/A	N/A	N/A		N/A	6.7 (1985)*
Kuwait	N/A	N/A	N/A		N/A	11.7 (1984)*
Libya	N/A	N/A	N/A		N/A	18.2 (1980)*
Sudan	N/A	N/A	N/A		N/A	35.0 (1978)*
Tunisia	-	3,428	12,861	-	16,289	0
Turkey	14,993	8,825	25,436	-	49,254	30.4
Israel	40,970	-	9,011	-	49,981	82.0
China	883,130	254,506	227, 163		1,137,636	77.6
India (2001)	53,408	242,935	22,100	-	318,443	16.8
Ireland	10,338	1,132	5,220	-	16,690	61.9
Mexico	48,044	14,837	25,218	1,299	89,398	53.7
Brazil (2004)	37,542	10,479	108,182	1,392	157,595	23.8
Argentina	7,155	21,688	15,507	1,011	45,361	15.8

Source: UNESCO Statistical Database, 2008 (www.unesco.org).
* UNESCO (1992 p. 143)

Table 6. *Descriptive Statistics of the Explanatory Variables*

	NRES	R&D	HCAP	OPEN	TECHEX	RISK	GDPG
Mean	1989.93	1.28	4.94	77.92	15.62	2.57	3.29
Maximum	7431	5.10	8.5	272.71	74.14	7.00	9.00
Minimum	73.00	0.10	1.3	18.16	0.00	1.00	-1.00
Std. Dev.	1690.48	1.09	1.45	49.45	16.34	1.90	2.42

Table 7. *Correlation Matrix*

	NRES	R&D	BUSR&D	OPEN	TECHEX	RISK	GDPCAP
NRES	1.0	0.8	0.6	-0.02	0.2	-0.5	0.7
R&D	0.8	1.0	0.8	-0.1	0.2	-0.4	0.7
BUSR&D	0.6	0.8	1.0	0.02	0.5	-0.5	0.6
OPEN	-0.02	-0.1	0.02	1.0	0.3	0.09	0.02
TECHEX	0.2	0.2	0.5	0.3	1.0	-0.2	0.2
RISK	-0.5	-0.4	-0.5	0.09	-0.2	1.0	-0.5
GDPCAP	0.7	0.7	0.6	0.02	0.2	-0.5	1.0

Table 8. ***Results From the Logit Model Dependent Variable: Country Category***

Variable	Coefficient	Std. Error	z-Statistic	Prob
Constant	-0.24	1.44	-0.17	0.87
NRES	-0.00058	0.00048	-1.23	0.22
R&D	0.75	0.90	0.84	0.40
OPEN	0.028*	0.010	2.69	0.007
TECHEX	-0.032	0.022	-1.51	0.13
RISK	-0.83*	0.26	-3.17	0.002
GDPG	0.19	0.23	0.86	0.39
HCAP	0.21	0.23	0.91	0.36
R-Squared	0.31		Obs.	61

* Significant at 1%

Table 9. ***Dependent Variable: FDI/GDP***

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Constant	2.81	2.91	0.96	0.34
NRES	-7.45E-05	0.0005	-0.15	0.88
R&D	-0.18	0.80	-0.23	0.82
OPEN	0.04*	0.011	3.61	0.0006
TECHEX	-0.04	0.034	-1.16	0.21
RISK	-0.96*	0.32	-2.98	0.004
GDPG	0.48**	0.25	1.97	0.05
HCAP	0.009	0.44	0.02	0.98
R-Squared	0.34		Obs.	61
Adjusted R-Squared	0.25			

* Significant at 1%
** Significant at 5%

Table 10. ***Trade Protection Indicators for MENA and Selected Regions (Most recent year in late 1990s)***

Country/ Region	Simple Average (percent)	Weighted Average (percent)	Standard Deviation (percent)	NTB Coverage (percent)	Aggregate Measures		
					Sharer	Oliva	AN
MENA	22.3	17.1	30.1	15.9	6.1	22.8	20.7
Europe & Central Asia	9.8	6.7	11.0	10.9	3.5	10.4	11.6
East Asia	13.1	8.7	16.8	9.9	3.9	13.2	11.3
Latin America	13.1	11.9	8.5	17.1	3.6	12.9	14.7
Sub-Saharan Africa	17.7	14.2	13.3	4.5	3.8	13.1	18.9
South Asia	19.7	18.8	11.7	8.2	4.2	14.6	27.7

Source: Srinivasan (2002, p. 9).