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PRODUCTIVITY AND INVESTMENT CLIMATE  
IN DEVELOPING COUNTRIES:  
HOW DO MENA INDUSTRIES PERFORM?

Tidiane Kinda, Patrick Plane, and  
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**PRODUCTIVITY AND INVESTMENT CLIMATE IN  
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HOW DO MENA INDUSTRIES PERFORM?**

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## Abstract

This paper investigates the relationship between firm-level productivity and investment climate (IC) for a large number of countries (23) and manufacturing industries (8). We first propose three measures of firms' productive performances: Labor Productivity (LP), Total Factor Productivity (TFP), and Technical Efficiency (TE). We reveal that enterprises in MENA perform poorly on average, compared to other countries of the sample. The exception is Morocco, whose various measures of firm-level productivity rank close to the ones of the most productive countries. We show at the same time that firms' competitiveness in MENA is handicapped by high unit labor cost, compared to main competitors like China and India. The empirical analysis also reveals that the investment climate matters for firms' productive performances. This is true (depending on the industry) for the quality of a large set of infrastructures, the experience and level of education of the labor force, the cost and access to financing, as well as to a lower extent, different dimensions of the government-business relation. These findings bear important policy implication by showing which dimension of the investment climate could help manufacturing firms in MENA to become more competitive on the world market.

## ملخص

تبحث هذه الورقة العلاقة بين الإنتاجية ذات المستوى الثابت ومناخ الاستثمار بالنسبة لعدد كبير من الدول (23) والصناعات التمويلية (8). ونبدأ بطرح ثلاثة معايير للأداء الإنتاجي: إنتاجية الأيدي العاملة، إنتاجية العوامل الإجمالية، والكفاءة التقنية، ونكشف أن الأعمال في الشرق الأوسط وشمال أفريقيا أداؤها رديء في المتوسط قياسيا بسائر الدول في العينة. وذلك باستثناء المغرب حيث أن معاييرها المختلفة لقياس الإنتاجية ذات المستوى الثابت تقترب بشدة من معايير الدول الأكثر إنتاجية ونبين في ذات الوقت أن من معوقات تنافسية الشركات في الشرق الأوسط وشمال أفريقيا ارتفاع تكلفة الأيدي العاملة قياسيا بالدول المنافسة الرئيسية كالصين والهند كما يكشف التحليل الخبروي أن المناخ الاستثماري من الأمور المهمة بالنسبة للأداء الإنتاج للشركات. وينطبق هذا (حسب الصناعة) على جودة مجموعة كبيرة من البنى التحتية، وخبرة القوى العاملة ومستوى تعليما وتكلفة التمويل وسهولة الحصول عليه وكذا بدرجة أقل، على أبعاد مختلفة لعلاقة الحكومة بالعمل التجاري. وتحمل هذه النتائج مضامين مهمة بالنسبة للسياسة بأن تدلنا على البعد الذي يتضمن المناخ الاستثماري ويمكن أن يساعد شركات الصناعات التحويلية في الشرق الأوسط وشمال أفريقيا لزيادة قدرتها التنافسية في السوق العالمي.

## 1. Introduction

The revival of interest in economic growth has renewed the question of the differences in productivity among countries and regions. Productivity, in the form of technical progress and production efficiency, is actually seen as the major source of economic growth and convergence of economies. This question justified why much research has focused on the manufacturing industry as the place of innovation and the engine of growth. Productivity in the manufacturing industry is also central to international competitiveness, as developing countries face the increasing pressure of globalization. High productivity gains have been seen as a powerful means of improving export capacity and diversifying the economy. The persistence of productivity differences across countries, regions and firms, however, don't find any justification in the present situation of globalization characterized by capital mobility and diffusion of technology. These differences have to be explained by factors which are specific to each country and region. It is in this context that a new branch of the literature has explored the question of the differences in the investment climate, as a major factor contributing to the differences in productivity<sup>1</sup>. It is this direction that we have also chosen, to explain MENA deficient economic performances.

Understanding the factors that affect industrial performances bears important policy implication in the case of MENA countries, which do not benefit from diversified economies or a substantial manufacturing export capacity. Although MENA countries are, on average, defined as middle income countries, economic performance in the region has most of the time been disappointing. This has been the case of growth and investment for more than three decades<sup>2</sup>. Attractiveness for FDI has also been weak, as well as competitiveness and exports of manufacturing<sup>3</sup>. In fact, MENA competitiveness has constantly been affected by poor exchange rate policies and insufficient economic reforms. But other factors, such as the investment climate, can surely explain the low productivity and the high production costs at the firm level. Various studies have pinpointed MENA's investment climate deficiencies<sup>4</sup>. These deficiencies have been partially responsible for the slow economic activity in the region<sup>5</sup>.

The World Bank Investment Climate (ICA) surveys collect data on inputs and outputs, as well as on various aspects of the investment climate at the firm level. ICA surveys produce both subjective evaluations of obstacles, as well as other more objective information on the themes of infrastructure, human capital, technology, governance, and financial constraints. These standardized surveys of large, random samples of firms from different sectors permit comparative measures of firms' productive performance. They also provide information to estimate the contribution of investment climate to these performances. The ICA surveys can thus be seen as an instrument for identifying key obstacles to firms' productivity and competitiveness. They can be used to support policy reforms for an increased economic growth. The objective of this paper is to help progress in that direction.

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1 See at the macroeconomic level Bosworth and Collins (2003); Djankov et al. (2002); Hall and Jones (1999); Haltiwanger (2002); He et al. (2003); Loaya, Ociedo and Serven (2004); OECD (2001); Rodrik, Subramanian (2004); McMillan (1998 and 2004); World Bank (2003, 2004) Frankel (2002) and Rodrik (1999). See also Bastos and Nasir (2004); Dollar et al. (2005); Eifert et al. (2005); Escribano and Gasch (2005) for results on firms' performances at the microeconomic level.

2 See Nabli. (2007); Nabli and Véganzonès-Varoudakis (2004); Aysan, et al. (2007 and 2008).

3 See Sekkat and Véganzonès-Varoudakis, (2007); Nabli and Véganzonès-Varoudakis (2007).

4 See the World Bank (2004a), as well as the World Bank Investment Climate Assessments (ICA) of Egypt (2005 and 2006), Morocco (2001 and 2005), and Algeria (2002). Doing Business 2005 (World Bank, 2004b) also places MENA low on business climate indicators compare to other regions.

5 See see El Badawi (2002); the World Bank (2004a); Aysan et al. (2007).

Drawing on the World Bank's firm-surveys, this paper analyses the relationship between investment climate and firm-level productivity for 23 countries (5 of which are MENA countries, see the complete list in Annex 1) and 8 manufacturing industries<sup>6</sup>. We first propose different measures of firms' productive performances by industry, such as Labor Productivity (LP), Total Factor Productivity (TFP), and Technical Efficiency (TE) using a production frontier approach. These indicators are compared with each other, as well as across countries in order to position MENA manufacturing firms among a wide range of firms from other regions. We reveal that enterprises in MENA perform poorly on average compared to other countries of the sample. The exception is Morocco, for which measures of firms' productive performance always rank close to the most productive firms in the sample. In this paper we will generate a few composite indicators of investment climate using Principal Component Analysis (PCA), which summarize the key dimensions of the investment climate. This will help tackle the problem of multicollinearity when explaining firm productive performances with a wide range of correlated investment climate (IC) variables. We define four axes of the investment climate: the Quality of Infrastructure (Infra), the Business-Government Relations (Gov), the Human Capacity (H), and Financing Constraints (Fin). We use, as well, city-sector averages to reduce the potential endogeneity problem underlying the IC variables. The analysis finally shows that investment climate matters for firms' productive performances. This has been done by estimating an efficiency function explaining firm-level productivity for each of our 8 manufacturing industries.

The paper is organized as follows. The second section introduces different concepts of firm-level productivity and discusses the advantages and limits of the different measures. Section three presents briefly the ICA surveys data and summarizes their main limitations. The fourth section presents and compares, across countries, our different estimations of firms' productive performances by industry. The fifth section introduces and categorizes the investment climate indicators used in the empirical analysis, and calculates our four broad IC indicators. In the sixth section, we estimate the extent of which the IC constraints firms' productive performances. The last section concludes.

## **2. Measures of Firm-Level Productivity: Methodological Aspects**

The first challenge is to measure firms' productive performance in a relevant way. We propose different approaches and measures. We first consider a non parametric model of productivity, which consists of calculating productive performances without estimating a production function. A non-parametric measure of productivity constitutes a simple and already meaningful way of assessing LP and TFP for example. Another way is to calculate firms' productive performance from a parametric production frontier. This more sophisticated methodology allows us to identify the most efficient firms of the sample and to compare MENA firms' performances to them.

### ***2.1 Non-Parametric Measures of Productivity and Unit Labor Cost***

Productivity can be easily calculated as the ratio of an output to a specific factor of production, labor being the main input. We can also consider all the relevant factors of the production technology. We then refer to the TFP. In this paper — due to the limited time dimension for the production factors, two or three years at best, and no time dimension for the ICA determinants — we only refer to productivity levels. Our analysis focuses on comparisons of firm-level productivity among enterprises, industries and countries<sup>7</sup>.

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6 Agro Processing, Leather, Textile, Garment, Wood & Furniture, Chemical & Pharmaceutical Products, Metal & Machinery Products, and Non-Metal & Plastic Materials.

7 Measuring productivity, although more restrictive than measuring growth rates (it requires for example specific functional forms of the production function), is less demanding in terms of data quality requirement. It

In the empirical analysis, we first discuss LP. This indicator gives an idea of the firm's productive performance. It has the advantage of not being affected by the error in measuring capital stock. However, the technology is only partially described and then the productivity suffers from an omitted variable. LP can be complemented by calculations of unit labor cost defined as the ratio of firm's average wage to firm's labor productivity. This indicator allows comparisons of the organizational competitiveness across countries. In addition, firm productive performance can also be biased by the choice of the exchange rate when converting production into US\$. This is not the case when TFP is estimated. The same rate applies to the output ( $Y$ ) at the numerator but also to the intermediate consumption ( $ICO$ ) and the capital stock ( $K$ ) at the denominator, under the form of a weighted average of these inputs. Under the hypothesis of constant returns to scale, (i.e., perfect competition for goods but also for factors that are remunerated at their marginal productivity), weights of Intermediate Consumptions ( $ICO$ ) and of Labor (Wages,  $W$ ) are calculated as the ratio of the cost of these factors to the Total Cost of Production including profit ( $Y$ ). The contribution of Capital ( $K$ ) is then calculated as the complement to one. The advantage of this approach, based on the Solow residuals, is that it does not require the inputs to be exogenous or the inputs' elasticity to be constant. The disadvantage is that two hypotheses have to hold: constant returns to scale and competitive input markets. Another limitation can be seen in the fact that productivity is calculated as the residual of the production function, it is considered a random variable, which makes it difficult to justify that some exogenous factors can explain productive differences.

$$TFP_i = \frac{Y_i}{L_i^{\omega_{1i}} ICO_i^{\omega_{2i}} K_i^{(1-\omega_{1i}-\omega_{2i})}} \quad (1)$$

$$\omega_{1i} = \frac{W_i}{Y_i}, \quad \omega_{2i} = \frac{ICO_i}{Y_i} \quad (2)$$

## 2.2 Parametric Production Functions and Production Frontiers

In the parametric approach, TFP is calculated as the residual of an estimated production function, thus relaxing the hypotheses of constant returns to scale (but not automatically of productivity as a random variable). Various hypotheses can be adopted with regards to the technology of production. The Cobb Douglas and the Translogarithmic production functions are the most commonly used. Although both present good mathematic properties, the elasticities of the production to the inputs are easy to read and to interpret with the Cobb Douglass technology. In the case of a parametric production function, production is derived from the optimization problem of firms, which maximize current and expected profits by equating production prices to their marginal costs. This hypothesis does not permit any waste of resources or organizational weaknesses. The production frontier approach, however, allows for non optimal behaviors of the firms. Enterprises can be positioned using the most efficient firms that define an empirical production frontier as a benchmark. Firm-level TE can then be defined as the firms' productivity gap (or efficiency gap) to the "best practice", the empirical practice of firms which are located on the production frontier.

In the stochastic model, the likelihood estimation method is typically applied to estimate a composite error term which is split into two uncorrelated elements. The first term ( $v$ ), which is a random variable, represents the external shocks to the firm. These shocks, independent and identically distributed, follow a normal distribution, with zero average and  $\sigma^2$  standard deviation. The second term represents the TE ( $-u$ ). In our case we will suppose that  $u$  follows

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allows, in particular, unbalanced panels with short term dimension, measurement errors, or constant value of IC variables (see Escribano and Guasch, 2005).

a truncated normal distribution<sup>8</sup>. In this specification, firms' productive performances are not assimilated to a random variable and can then be explained by exogenous factors. The interest of this approach can also be seen in the fact that TEs have a relative form — firm productivity being compared to or benchmarked by the most efficient ones across countries and regions.

$$y_i = f(x_i, \beta) - u_i + v_i \quad (3)$$

With

- $y$ : Production
- $x$ : Production factors
- $\beta$ : Parameters of the equation
- $v$ : External shocks
- $u$ : Technical Efficiency ( $TE$ )
- $i$ : Firm index

### 2.3 Explaining Technical Efficiency

A complementary approach, when having calculated Technical Efficiency ( $TE$ ), is to explain the reasons for firms' diverse performances. Firms' inefficiency can be explained by "exogenous" factors which affect either the technology of production, or the firm's ability to transform inputs into outputs. In the literature, these factors have been estimated in two different ways. A simple method consists in estimating the stochastic production frontier, and in regressing the residuals of the estimation (the Technical Efficiency,  $TE$ ) on a vector of explanatory factors ( $z$ ). This method is called the "Two Steps" procedure. Different estimation procedures can be used. The simplest way is to run an OLS regression. Another possibility is to apply a Tobit model, in order to address the question of the distribution of the efficiency. The "Two Steps" procedure presents, however, several limitations. There is an identifying problem in separating the Technical Efficiency ( $TE$ ), from the production frontier. When any of the production frontier inputs ( $x$ ) is influenced by common causes affecting efficiency, there is a simultaneity problem (see Marschak and Andrews, 1944; Griliches and Mairesse, 1995). In general, one should expect that the Technical Efficiency term ( $TE$ ) is correlated with the production frontier inputs ( $x$ ). In this case, due to the omission of important explanatory variables, the likelihood estimation of the stochastic production frontier is biased.

In fact, a relatively new branch of the literature proposes to estimate the production frontier and the factors explaining inefficiency at the same time. This is the "One Step" procedure. In this case, the parameters of the equation (here  $\beta$  and  $\delta$ ) are simultaneously estimated by the likelihood estimation method. The stochastic version of the model can be written:

$$y_i = f(x_i, z_i, \beta, \delta) - u_i + v_i \quad (4)$$

With

- $y$ : Production
- $x$ : Production factors
- $z$ : Factors explaining Technical Efficiency
- $v$ : External shocks
- $u$ : Technical Efficiency
- $\beta / \delta$ : Parameters of the equation
- $i$ : Firm index

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<sup>8</sup> Although there is a wide range of choices for the statistical distribution of the efficiency term ( $u$ ), the ranking of firms according to the efficiency term is generally not sensible to the choice of the specific distribution (Coelli, Prasada Rao and Battese, 1998).

### 3. The ICA Firms Surveys: Data Limitations

The ICA surveys collect data on inputs and outputs, as well as on a large variety of quantitative and qualitative (perception-based) indicators of the investment climate. In building the database, we have tried to incorporate as much information as possible. We have integrated 23 countries in our sample, surveyed at the time when our empirical work started (see list of countries in Annex 1)<sup>9</sup>. These countries participate in the five main regions of the developing world: Sub-Saharan Africa (AFR), East Asia (EAS), South Asia (SAS), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA). In this sample, MENA is represented by 5 countries: Algeria (2002), Saudi Arabia (2005), Lebanon (2006), Morocco (2000, 2004) and Egypt (2004, 2006)<sup>10</sup>. Syria (2003) and Oman (2003) had to be removed from the sample because of a very low rate of answer to the questionnaire. By broadening the initial sample to a large number of countries from different regions, we are able to compare MENA performances to other emerging countries which stand as major competitors on the world market — China (2002) and India (2000, 2002), in particular.

To estimate firm-level productivity, a population of almost 20,000 firms, coming from 13 manufacturing industries was initially considered. This sample had to be reduced due to various limitations, particularly the lack of production technology variables and the necessity of a cleaning up when figures proved to be poorly transmitted or recorded. Some industries had to be merged, due to insufficient observations. Finally, 12,414 enterprises (3,073 for the MENA region) regrouped in eight industries were retained when estimating production frontiers (see Annex 2)<sup>11</sup>. As for inputs and output, IC variables are subject to measurement errors. In the surveys, some firms did not report the full range of IC measures. Other firms reported numbers that were not credible. This is also due to the fact that most IC factors are qualitative variables of perception, thus allowing answers to vary depending on the firms, the regions or the countries. Our choice has been to keep as many firms as possible, providing sufficient information on a wide range of IC variables. Once outliers and incomplete observations are removed, 5,002 observations were left, among which 1,483 were for the MENA region, which represent 34% of MENA initial population and 30% of the total number of enterprises with IC variables (see Annex 2)<sup>12</sup>. The IC variables considered here are the same ones that we use to explain firms' TE (see sections 5 and 6).

Another question relates to the endogeneity of the IC variables, due to the qualitative nature of IC factors. This is particularly true for perception variables (such as obstacles to operation)

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9 Some countries benefit from two surveys. This is the case for Egypt (2004, 2006), India (2000, 2002) and Morocco (2000, 2004).

10 The year of the survey is in brackets. Lebanon and Saudi Arabia are, however, less represented than other countries of the region. In the case of Lebanon, the low number of observations makes results difficult to interpret. For Saudi Arabia, firms' surveys cover only 3 of the 8 industries studied (Agro-Processing, Wood & Furniture, Metal & Machinery).

11 For MENA, the loss of information fluctuates from 22% in Garment to 41% in Wood & Furniture (around 30% in Metal & Machinery Products, Non Metal & Plastic Materials and Textile, and 35% in Leather, Agro-Processing and Chemical & Pharmaceutical Products). This loss of 20% to 25% for the whole sample of countries, is lower than that for MENA. This means that answers in MENA were, on average, less satisfactory than in the other countries of the sample. MENA's contribution to the whole sample, when estimating the production frontiers, varies from 11% in Wood & Furniture to 37% in Non Metal & Plastic Materials (25% on average for the whole manufacturing industry, see Annex 2), which is a bit less than, but consistent with, the contribution of MENA to the initial sample.

12 This percentage is 45 for the whole sample, which shows that MENA firms did not answer as accurately as the rest of the sample. This is the case in all industries, but more particularly in Agro-Processing, Chemicals & Pharmaceutical Products and Wood & Furniture, in which almost 20% less enterprises have given correct IC information.



for which firms are asked to position their answer on a given scale<sup>13</sup>. The perception of the scale may be different across firms, industries, regions and countries. Besides, when answering the questions on their investment climate, firms may be influenced by the perception they have of their own productivity and may attribute their inefficiencies to external factors. High-performing firms may be proactive in reducing their investment climate constraints, for example by working with the authorities to limit inspections or secure a more reliable power supply. In the empirical part, we assume this endogeneity and use appropriate estimation techniques to evaluate the impact of the investment climate on the firms' productive performances. In particular, we measure IC variables as city-sector averages of firm-level observations<sup>14</sup>. This also helps to mitigate the effects of missing observations for some firms. Actually, if we take each investment climate indicator at the firm level, we end up with a smaller sample of observations in which all indicators are available<sup>15</sup>.

Exchange rate constitutes another source of uncertainty which may lead to over or under evaluation of firms' productive performances. This rate is used to convert production and production factors into US\$. Several exchange rates can be chosen to calculate and compare firm-level productivity across countries. In this study, we considered the current market rate in US\$ which is the rate that firms use for their economic calculations<sup>16</sup>.

#### **4. Firm-Level Productivity: MENA Performance Gap**

In this section, we present our three measures of firm-level productivity: LP, TFP and TE. The data was pooled across the 23 countries of our sample. Firm-level productive performances are calculated for each of the eight industries. Differences and similarities across countries have been analyzed. A pattern of generally low productive performances is observed in the MENA region, with some countries showing better results.

##### ***4.1 Firm-level Productivity of Labor and the Unit Labor Cost***

Firm-level LP is estimated as the ratio of firms' value added to the number of permanent workers. Value added is calculated as the difference between total sales and total purchase of

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13 Firms are asked to quantify their constraints on a scale going from none to very severe.

14 We ensure getting a sufficient number of observations by city and sector.

15 A relative issue concerns the endogeneity of implantation. High-performing firms having the option to choose a location with better infrastructure and production conditions. In the empirical analysis, we test this hypothesis by excluding foreign and large domestically owned firms employing more than 150 workers from the sample. Our results are unchanged and show that small domestic firms also suffer from investment climate deficiencies. Results of regressions are not reported for brevity.

16 The choice of an adequate exchange rate depends, among other things, on the exchange rate regime of the country. In the presence of a floating exchange rate regime, the volatility of the current exchange rate may affect the perception of the productive performances. This is particularly true for the LP. For TFP, this problem is somewhat attenuated by the fact that the same exchange rate is used to convert intermediate consumptions and capital in the denominator, and production in the numerator. Moreover, using the current exchange rate introduces a bias for example when fixed exchange rate policy leads to an overvaluation of the currency or when the floating rate suffers from overshooting.

The current exchange rate has the advantage of representing the rate that firms deal with when making their own economic calculations. This is the rate that the producer faces when he competes on external as well as domestic markets. Both, a constant exchange rate or the use of a Purchasing Power Parity (PPP) exchange rate with the US\$, are surely more problematic for our analysis. PPP conversion rate is useful when comparing the purchasing power of income per capita. We know that the purchasing power in developing countries tends to be higher than when GDP per capita is converted using nominal exchange rate. But when dealing with production, the current rate is more representative of the enterprises' economic reality. The choice of exchange rate does not seem to change radically the perception of the firms' productive performances. The coefficient of correlation of our three measures of firm-level productivity using alternatively current and constant exchange rates is relatively high.

raw material excluding fuel<sup>17</sup>. It is assumed that firms are price takers and purchase raw material at world price. This assumption is reasonable for competitive industries. Thus, the dollar value of raw material and the dollar value of output can be compared across countries.

Equation is as follows:

$$LP_{i,j} = Y_{i,j} / L_{i,j} \quad (5)$$

With

- $Y_{i,j}$ : Value Added.
- $L_{i,j}$ : Number of Permanent Workers
- $i/j$ : Enterprise and country index respectively.

Table 1 displays the average LP while Table 2 reflects the relative unit labor cost. For each country, average productivity (LP and unit labor cost) is expressed in percentage of the level of the country with the most performing firms (or the country with the lowest unit labor cost). The analysis reveals a relatively stable ranking of countries. South African and Brazilian firms have the best performance — on average and in most industries. This result is consistent with the relatively high incomes in both countries (\$2,710 and \$2,780 per capita respectively, see World Bank, 2005). Moroccan firms also participate in the best performances of the sample, especially in Metal & Machinery Products, Chemical & Pharmaceutical Products, Leather, and Agro-Processing.

As far as other MENA countries are concerned, the ranking also remains rather stable. Egyptian and Lebanese's firms are systematically among the least performing in all industries (although Morocco and Egypt have the same GDP per capita, around \$1,300 in 2003). In Algeria, firm-level LP ranks in an intermediate position, close to India in Agro-Processing and Chemical & Pharmaceutical Products, but below in Textile and Metal & Machinery Products (firms' performances are always lower than in China). Moroccan firms remain the highest performing in MENA, with LP levels far above the two Asian giants (China and India), and close to the most productive firms/countries of the sample<sup>18</sup>.

This relative efficiency of some MENA countries, however, is not sufficient to understand the capacity of these countries to promote industrial and export activities. Remuneration of labor is an important factor which should be in line with productivity. By combining information LP and the cost of the labor input, the relative unit labor cost gives an idea of the competitiveness. Table 2 presents some information on the subject. It is worth noting that the unit labor cost in MENA is one of the highest among our sample of countries. This is particularly true for Algeria and Egypt — countries where firm-level LP is extremely low — but also in Morocco and to some extent in Lebanon. In MENA, the unit labor cost tends to be higher than the majority of Asian economies (India, China, Sri Lanka, Bangladesh and Thailand). In China and India, salaries (around \$100 per month for unskilled workers) are far lower than in Morocco. In the labor intensive sectors of Textile and Garments, cost of labor is two to two and a half time higher in Egypt and Morocco than in India. This situation is important to address if MENA wants to compete in the world market. If not, MENA will continue to suffer from the faster technological innovation in Asia where wages remain low.

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17 In the surveys, data on total purchases of raw materials (excluding fuel) are more available compared to that on direct raw material costs.

18 Firms in Saudi Arabia seem to perform very well in the sectors covered by the survey (Agro-Processing, Metal & Machinery Products, and Wood & Furniture).

#### 4.2 Firm-Level Total Factor Productivity

In this section, firm-level TFP is calculated from a non-parametric relation. Production factors include Labor ( $L$ ) and Capital ( $K$ ). Same hypotheses and definitions as before apply to input and output variables.

$$TFP_{i,j} = \text{Log}(Y_{i,j}) - \alpha \text{Log}(K_{i,j}) - \beta \text{Log}(L_{i,j}) \quad (6)$$

With

- $Y_{i,j}$ : Value Added
- $L_{i,j}$ : Number of Permanent Workers
- $K_{i,j}$ : Gross Value of Property, Plant and Equipment
- $\beta$ : Ratio of Total Wages ( $W$ ) to Total Production Cost ( $Y$ ).
- $\alpha = 1 - \beta$
- $i/j$ : Enterprise and country index, respectively

Table 3 presents the firm-level relative TFP by industry under the reasonable assumption that a sector-based technology leads to a more homogeneous production function. As for LP, results are presented in percent of average TFP of the highest performing country. Conclusions are quite similar to LP. A first conclusion concerns the ranking of the highest performing countries. Again, South Africa and Brazil present the highest performing firms in most industries, and again they are followed by Morocco, the firms' performances of which are quite good in most industries. When compared to Brazil, Moroccan firms show a TFP gap of 10 to 30% depending on the industry — which is less than the revenue gap between the two countries (47 %, or 38.5% in PPP). As far as MENA is concerned, ranking is also quite similar to LP. As before, Egypt and Lebanon rank at the bottom of the sample and Algeria stays in an intermediate position. TFP calculations thus confirm the productivity gap assessed through LP<sup>19</sup>.

#### 4.3 Firm-Level Technical Efficiency

Firm-level TE is based on the likelihood estimation procedure. As seen in section 2.2, this method allows splitting the error term into two independent factors: the error term ( $v$ ), which follows a normal distribution, and the technical efficiency ( $u$ ), which obeys a truncated normal distribution. The technology of production explains the Value Added ( $Y$ ) by the Capital ( $K$ ) and the Labor ( $L$ ). As before, the same hypotheses and definitions apply to input and output variables.

$$\text{Log}(Y_{i,j}) = \alpha \text{Log}(K_{i,j}) + \beta \text{Log}(L_{i,j}) + dum_i - u_{i,j} + v_{i,j} \quad (7)$$

With:

- $Y_{i,j}$ : Value Added
- $L_{i,j}$ : Number of Permanent Workers
- $K_{i,j}$ : Gross Value of Property, Plant and Equipment
- $dum_j$ : Country-dummy variables
- $\alpha, \beta$ : parameters of the equation
- $v_{i,j}$ : Error term
- $u_{i,j}$ : Technical Efficiency ( $TE$ ).
- $i/j$ : Enterprise and country index respectively.

A production frontier is estimated for each industry. This leads to more homogeneous production frontiers and makes it easier to attribute the residual to differences in efficiency. Differences in coefficients of capital and labor justify this choice against an alternative

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<sup>19</sup> Interpretation of results is, however, more difficult for some countries. This is the case for Lebanon, for which the number of observations is too small (5 for Textile and 16 for Agro-Processing) to reach a reliable conclusion. The combination of the two surveys for Morocco and Egypt gives more than one hundred observations per industry. Morocco, for example, benefits from 500 enterprises in Garments. In Saudi Arabia, firms have good productive performances, although most of the industries suffer from a relatively small number of observations. In Wood & Furniture, firm-level TFP is one of the highest in the sample. This result confirms the conclusion reached through LP.

assumption of estimating the same production frontier with specific sector-based dummies (see Table 4).

Table 4 presents the estimation results. In most industries, the sum of the coefficients relative to labor and capital inputs is close to one. It is a bit higher for some sectors than can be suspected to face investment indivisibilities. In comparison with other sectors, Textile is probably the most exposed to competition, and the production technology does not reject this hypothesis. For all industries, the coefficients are statistically significant at the 99% level of confidence.

Table 4 also specifies the percentage of the residual explained by TE. In all industries, the efficiency term accounts for a significant part of total residuals and is statistically significant at 99%. This result justifies the production frontier model, against the production function approach. In this model, TE explains 24% of the error term in Garment and almost 70% of the error term in Non Metallic & Plastic Materials. TEs are distributed in an interval of 0 to 1 (1 is the value of the sector's most efficient firms). In Table 5, TEs are presented in percent of the average TE of the highest performing country. On average, our TE results are close to the ones obtained for the non-parametric TFP under the hypothesis of constant returns to scale. The ranking of countries, in particular, remains unchanged. Only in Garment and Leather, are Moroccan firms surpassed by Thailand and Ecuador respectively. Ranking of MENA countries remains unchanged as well.

Annex 3 displays, by industry, the Spearman coefficients of correlation of our three measures of firm-level productivity. All coefficients are highly significant and show a high degree of correlation between the different measures. This is the case in all industries, but more specifically in Wood & Furniture, Non Metallic & Plastic Materials, and Metal & Machinery Products (after Agro-Processing, Chemicals & Pharmaceutical Products, Leather, and Textile). Beyond the proximity of the results for whatever method we use, to what extent can we impute the variance of the TEs to some factors of the investment climate?

## **5. Assessing the Investment Climate of the Manufacturing Industries**

The ICA surveys provide information on a large number of IC variables, in addition to general information on firms' status, productivity, sales and supplies. These IC variables are classified into 6 broad categories: **(a)** Infrastructures and Services, **(b)** Finance, **(c)** Business-Government Relations, **(d)** Conflict Resolution/Legal Environment, **(e)** Crime, **(f)** Capacity, Innovation, Learning, **(g)** Labor Relations.

In the surveys, there are multiple indicators that cover a similar theme. Within the same theme, the correlation between indicators is quite high. One solution applied in some studies has been to restrict the analysis to a limited number of indicators and accept the potential omitted variable bias. This also poses the question whether the IC variables used provide a representative description of the investment climate and whether the strength of the results is due to the particular selection of variables. Another solution to overcome these problems consists of generating a few composite indicators. Because we intend to determine which IC variables are more detrimental to firm performances, we tried to take into consideration the largest possible set of IC variables which are not typically used in the literature. Since these variables are likely correlated, we applied the PCA<sup>20</sup> to produce a limited number of composite indicators<sup>20</sup>.

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20 See Manly (1994); Mardia, Ken and Bibby, (1997); Nagaraj et al. (2000); Mitra et al. (2002); Nabli and Véganzones-Varoudakis (2007); Aysan et al. (2007) and. (2008).

Based on the ICA surveys, we defined the investment climate by four broad categories: Quality of Infrastructure (*Infra*), Business-Government Relations (*Gov*), Human Capacity (*Human*), and Financing Constraints (*Finance*). As seen in Section 3, our choice of indicators has been restricted by several data limitations. This is also why we have not been able to cover all aspects initially developed in the surveys. Indicators have been selected on the basis of being available for as many countries as possible, as well as on capturing the different key dimensions of the investment climate. Besides, we have tried to complement, as much as possible, the qualitative (perception-based) IC indicators by quantitative information, in order to get a better picture of the investment climate in each industry.

The quality of infrastructure indicator (*Infra*) has been defined by six variables: Obstacles for enterprise operation<sup>21</sup> caused by deficiencies in (*a*) telecommunications, (*b*) electricity, and (*c*) transport; (*d*) the presence of a firm generator, (*e*) the percentage of electricity coming from that source; and the possibility for enterprise to access to (*f*) E-mail or (*g*) Internet. Infrastructure deficiencies constitute an important constraint to private sector development in developing countries (see World Bank, 1994). In the literature, deficiency in infrastructure is seen as a burden for enterprise operations and investments. Infrastructure is considered as a complementary factor to other production inputs as well. In particular, infrastructure stimulates private productivity by raising profitability of investment<sup>22</sup>. Furthermore, infrastructure also increases firms' productive performances by generating externalities across firms, industries and regions<sup>23</sup>.

The Business-Government Relations indicator (*Gov*) includes three to six variables (depending on the industries): Obstacle for the operation of the enterprise caused by (*a*) tax rate, (*b*) tax administration, (*c*) customs and trade regulations, (*d*) labor regulation, (*e*) business licensing and operating permits, and (*f*) corruption. We suppose that this indicator illustrates the capacity of the government to provide an investment-friendly environment and reliable conditions to the private sector. Corruption is seen as having an adverse effect on firms' productive performances. This fact is well documented and often described as one of the major constraints facing enterprises in the developing world (see the World Bank, 2005). Corruption increases costs, as well as uncertainties about the timing and effects of the application of government regulations (see Tanzi and Davooli, 1997). Taxation and regulations have also a first order implication on firms' costs and productivity. Although government regulations and taxation are reasonable and warranted in order to protect the general public and to generate revenues to finance the delivery of public services and infrastructures, over-regulation and over-taxation deter productive performances by raising business start-up and firms' operating costs.

The Human Capacity indicator (*Human*) is represented by three to four variables: Obstacle for the operation of the enterprise caused by deficiencies in (*a*) skill and education of available workers; (*b*) education levels<sup>24</sup> and (*c*) years of experience of the top manager; (*d*) training of the firm's employees. Human capital constitutes an essential factor of firms' productive performance, stimulating capital formation by raising firms' profitability. Human capital is also at the origin of positive externalities<sup>25</sup>. Because skilled workers are better in dealing with changes, a skilled work force is essential for firms to manage new technologies that require a more efficient organizational know-how (see Acemoglu and Shimer, 1999).

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21 Obstacles' value goes from none (0) to very severe (4).

22 See Aschauer (1989), Argimon et al., (1997), Barro (1990), Blejer and Kahn (1984), Murphy, Shleifer, and Vishny (1989).

23 For spatial externalities, see Holtz-Eakin and Schwartz (1995).

24 Education level goes from primary to post graduate.

25 See Lucas (1988), Psacharopoulos (1988), and Mankiw, Romer and Weil (1992).

New technologies generally require significant organizational changes, which are better handled by a skilled workforce (see Bresnahan, Brynjolfsson and Hitt, 2002). Human capital also gives the enterprise the opportunity to expand or enter new markets.

The Financing Constraints indicator (*Finance*) consists of three variables: Obstacle for the operation of the enterprise caused by: (a) cost, (b) access to financing, and (c) access to an overdraft facility or a line of credit. Access to (and cost of) financing represent major determinant(s) of firms' productive performance. Access to financing allows firms to finance more investment projects, which leads to an increased productivity through higher capital intensity and technical progress embodied in the new equipment. Besides, financial development has a positive effect on productivity as a result of better selection of investment projects and higher technological specialization through diversification of risk. A developed financial system creates more profitable investment opportunities by mobilizing and allocating resources to the most profitable projects (see Levine, 1997).

The analysis usually treats the investment climate indicators as exogenous determinants of firms' performance. As seen in Section 3, however, this is not always the case. In order to address this issue, we have measured investment climate variables as city-sector averages of firm-level observations. This helps to increase the number of observations by integrating firms for which information is insufficient into the sample.

All four aggregated indicators are generated at the industry level, thus defining the specific investment climate of each industry in each country. This produces 32 aggregated indicators (four indicators for each of the eight industries) by applying PCA<sup>26</sup>. For "Infrastructure" and "Business-Government Relations", we have measured the initial variables as city-sector averages. For Human Capacity and Financing Constraints, however, the initial indicators having been interpreted as specific to each firm, information has been kept at the firm level (except for the variable "Skill and Education of Available Workers").

## 6. Investment Climate and Firm-Level Productivity: Is There a Link?

In a global economy, where technology diffuses rapidly and capital is mobile, the persistence of disparities in levels of productivity can be explained by differences in the investment climate. Which determinants of productivity cause producers in one country to be more efficient than those in competing countries? Where should reform efforts be targeted to have the greatest impact on productivity? We link the investment climate to firm productive performance and identify the dimensions that account for cross-country differences in productivity. In this section, we estimate two variants of the same model. We show that our results are unambiguous and robust to the different specifications. All coefficients have been estimated by using the *one step procedure*, as discussed before. In other words, we simultaneously identify the production frontiers and the factors contributing to firms' TE<sup>27</sup>.

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26 The principal components of the initial variables were extracted for each aggregated indicator. The four composite indicators were then constructed as the weighted sum of two or three principal components, depending of the explanatory power of each component. We chose the most significant principal components whose eigenvalues were higher than one. In this case, we explain around 70 percent of the variance of the underlying individual indicators. The weight attributed to each principal component corresponds to its relative contribution to the variance of the initial indicators (calculated from the cumulative R<sup>2</sup>). The contribution of each individual indicator to the composite indicator can then be computed as a linear combination of the weights associated with the two or three principal components and of the loadings of the individual indicators on each principal component. For more details on the aggregation method using Principal Component Analysis (PCA) see Nagaraj, Varoudakis, Véganzonès (2000), and Mitra, Varoudakis, Véganzonès (2002).

27 See Marschak and Andrews (1944) and Griliches and Mairesse (1995).

### 6.1 Common Model with Individual Indicators of Investment Climate

Our empirical model considers the same representation for all industries. This model is estimated at the branch level, thus allowing the coefficients to vary across branches. We explain TEs by regressing the logarithm of the production factors (capital and labor), as well as various plant characteristics and investment climate variables, on the logarithm of the firms' value added. At this first stage of investigation, we use initial IC variables before aggregation. The model is as follows:

$$\begin{aligned} \ln(y_{i,j}) = & c_i + \hat{\alpha}_1 \ln(l_{i,j}) + \hat{\alpha}_2 \ln(k_{i,j}) + \beta \text{Size}_{i,j} + \gamma \text{Foreign}_{i,j} + \delta \text{Export}_{i,j} \\ & + \varepsilon_1 \text{RegElect}_{i,j} + \varepsilon_2 \text{RegWeb}_{i,j} + \lambda_1 \text{Cred}_{i,j} + \lambda_2 \text{AccessF}_{i,j} + \eta_1 \text{EduM}_{i,j} + \eta_2 \text{ExpM}_{i,j} \\ & + \eta_3 \text{Training}_{i,j} + \mu_1 \text{RegLregul}_{i,j} + \mu_2 \text{RegCorrup}_{i,j} + c + v_{i,j}. \end{aligned} \quad (8)$$

With:

$y_{i,j}$	Value Added <sup>28</sup>
$l_{i,j}$	Number of Permanent Workers
$k_{i,j}$	Gross Value of Property, Plant and Equipment
$\text{Size}_{i,j}$	Size of the firm
$\text{Foreign}_{i,j}$	Foreign capital ( <i>% of firm's capital</i> )
$\text{Export}_{i,j}$	Export ( <i>% of firm's sales</i> )
$\text{RegElect}_{i,j}$	Electricity delivery ( <i>obstacle for the enterprise, regional average</i> )
$\text{RegWeb}_{i,j}$	Utilization of Internet ( <i>regional average</i> )
$\text{Cred}_{i,j}$	Overdraft facility or credit line
$\text{AccessF}_{i,j}$	Access to financing ( <i>obstacle for the enterprise, regional average</i> )
$\text{EduM}_{i,j}$	Level of education of the top manager ( <i>number of years</i> )
$\text{ExpM}_{i,j}$	Experience of the top manager ( <i>number of years</i> )
$\text{Training}_{i,j}$	Training of workers
$\text{RegLregul}_{i,j}$	Labor regulation ( <i>obstacle for the enterprise, regional average</i> )
$\text{RegCorrup}_{i,j}$	Corruption ( <i>obstacle for the enterprise, regional average</i> )
$c_i$	Country-Dummy variables
$c$	Intercept
$v_{i,j}$	Error terms
$i/j$	Enterprise and country index respectively

The choice of IC variables is based on being available for as many firms/ industries/ countries as possible, as well as on capturing the different key dimensions of the investment climate. Our variables explain the various aspects of the investment climate and cover our four definitions of investment climate. To address the problem linked to the endogeneity of the IC variables when estimating the TE frontier models, we consider the city/region averages (*Reg* preceding the variable). This is the case for electricity delivery (*RegElect*); access to internet (*RegWeb*); labor regulation (*RegLreg*), and corruption (*RegCorrup*). The number of

28 We will recall that the value added is calculated as the total sales – “Total Purchase of Raw Material” (excluding fuel).

explanatory variables, however, has been limited by the multicollinearity between several IC variables when estimating the TE frontier models.

Other individual variables consist of: the percentage of sales exported by the firms (*Export*), the percentage of foreign ownership in firms' capital (*Foreign<sub>i,j</sub>*), and the firm size (*Size<sub>ij</sub>*). The level of exports is included in the regressions because exporting is a learning process which enables companies to improve productivity by learning from customers and by facing international competition. Likewise, foreign ownership may increase productivity if foreign investors bring new technologies and management techniques. As for the size, we intend to test the hypotheses of scales economies and increasing returns to scale in big enterprises<sup>29</sup>. It is worth noting that expected sign for these variables is negative, due to the fact that the one step procedure explains firm-level inefficiency. The same precautions must be taken when interpreting the sign of the coefficients of the other variables. Country-dummy variables have also been introduced when estimating the production frontiers.

These dummies pick up the effect of country specific factors, such as endowment in natural resources, national-level institutions, macro or political instability, trade policy, etc... Country-dummy variables are intentionally not included in the second part of the equation when explaining TEs, since they could reduce the impact of some IC variables.

Equation (8) is estimated on unbalanced panels, going from 380 observations (in *Leather*) to 1,601 observations (in *Garment*) depending on the industry. A Cobb-Dougllass production function is chosen to estimate the production frontiers. We also maintain our previous assumption with regards to the specification of technology and the TEs. Although the sample size is modified when incorporating the regressors explaining the firm distance to the frontier, the coefficients of the technology are marginally (but downward) affected. These modifications display the potential impact of the interactions and the limitation that we would face when estimating the TE determinants through the two stage method, as previously discussed<sup>30</sup>. Sector-based estimates are presented in Table 6.

A first set of conclusions are related to the production frontier models. Our regressions confirm the choice to estimate a production frontier by industry. Elasticities of capital and labor are different from one industry to another. Impact of capital is strong in Chemicals & Pharmaceutical Products, Agro-Processing and, to a lower extent, Textile. Contrarily, elasticity of labor is high in Metal & Machinery, Non Metal & Plastic Materials, Wood & Furniture, Leather, and Garment. These industries look more labor intensive, although two of them (Metal & Machinery and Non Metal & Plastic Materials) usually use more capitalistic technologies in developed countries. This result is confirmed by the computed ratio of the two elasticities (capital/ labor). All coefficients are highly significant (at 1% level), which stresses the robustness of our results. Another result shows that we are close to the constant returns to scales, giving legitimacy to the hypothesis underlying the non-parametric TFP measures (see Section 2.1). Our estimations also highlight that some differences in production frontiers can be explained by country specific conditions. This hypothesis is supported by the data, as country-dummies are significant at this stage of estimations.

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29 The new literature on international trade associates firm size with increasing returns to scale, market imperfections and product heterogeneity linked to technological innovation. The literature on corporate governance describes the difficulties in inciting and controlling big enterprises, although they are more able to reduce transaction costs and facilitate economic calculations. Small enterprises are described as less capitalistic and more flexible in a volatile environment, in particular in economies characterized by rigidities which encourage the development of the informal economy.

30 For two sectors: Chemicals & Pharmaceutical Products; and Wood & Furniture, coefficients of capital and labor are slightly smaller than in the previous estimation (see Table 5).



Interestingly, our estimations verify that differences in the IC participate in firms' TEs discrepancies. This is true for all aspects of the IC, except for the government-business relations. Our results confirm that a good quality of infrastructure (proxied by the quality of the electric network and the availability of internet access), a satisfactory access to financing, as well as the availability of expertise at the firm level (such as education level and experience of the manager, and training of the employees) are important factors for enterprises productive performances. This outcome, which is consistent with the theory, makes a real contribution to the empirical literature by validating, for a large sample of industrial firms in developing countries, the role of a substantial set of IC variables on firms' productive performances.

.This findings are, however, quite different from one industry to another. First, as expected, it looks like estimations have suffered from the colinearity of several IC variables. In fact, although each broad category of IC variables (except government-business relation) ends up being significant in almost all industries, it is very rare to find two significant IC variables in the same category<sup>31</sup>. Impact of IC variables can also vary. Access to credit seems more detrimental in Leather, Metal & Machinery Products and Textile and access to the internet looks more critical in Textile and Wood & Furniture. As for human capacity, the education of the top manager could be a high priority in Metal & Machinery Products, Textile and Non Metal & Plastic Materials. Interestingly, Textile and Metal & Machinery Products look more sensitive to IC deficiencies. Beside, firms' performances depend on more dimensions of the IC in these two sectors. This finding may be explained by the fact that these industries are more exposed to international competition and need a supportive investment climate to efficiently compete.

As for government-business relations, neither labor regulations (*RegLreg*), nor corruption (*RegCorrup*) emerge as an obstacle to firms productive performance, although this outcome has to be considered with caution because of the high correlation between explanatory variables. Difficulties have also occurred in validating the impact of other individual variables. Firms' size (*Size*) and foreign ownership of capital (*Foreign*) justify scales economies and externalities linked to participation of foreign capital in just two sectors (Agro-Processing, and Chemical & Pharmaceutical Products). Export orientation (*Export*) appears detrimental for productivity in only one sector — Garment (which is a reasonable result for this sector when taking into account the high export rate in some developing countries). Regressions results are poor in two sectors: Leather and Wood & Furniture<sup>32</sup>. These difficulties explain why we decided to focus our analysis on a few composite indicators of IC. These indicators are tested econometrically in the next section.

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31 For Infrastructure, the quality of the electrical network (*RegElect*) appears to increase firms' performances in Garment and Metal & Machinery Products. It is, however, the access to internet (*RegWeb*) which emerges as a factor of productivity in more industries (Textile, Agro-Processing, Chemical & Pharmaceutical Products and Wood & Furniture). As far as Human Capacity is concerned, level of education of top manager (*EduM*) is significant in almost all sectors (except Leather and Wood & Furniture), meanwhile number of years of expertise of manager (*ExpM*) and training of employees (*Training*) seem to play a role in only one sector each (Textile and Agro-Processing respectively). Same conclusions can be drawn for Financing Constraints, where access to credit line or overdraft facility (*Cred*) appear to generally stimulate productivity gains (except in Chemical & Pharmaceutical Products and Wood & Furniture), though the qualitative variable of access to financing (*AccessF*) is significant in only three sectors (Agro-Processing, Chemical & Pharmaceutical Products, and Wood & Furniture).

32 In these industries, a few factors seem to explain efficiency (only access to credit line (*Cred*) in the case of Leather and, internet access (*RegWeb*) and access to financing (*AccessF*) in the case of Wood & Furniture. Contrarily, Agro-Processing, Chemical & Pharmaceutical Products, Garment, and Textile display a broader set of factors explaining firms' productivity gains.

## 6.2 Common Model with Composite Indicators of Investment Climate

In this specification, the IC individual variables have been replaced by our four composite indicators: Quality of Infrastructure (*Infra*), Business-Government Relations (*Gov*), Human Capacity (*Human*), and Financing Constraints (*Finance*). This model allows introducing more IC variables than before<sup>33</sup>. Like in the first empirical model, we have considered a same representation for all industries. The model is still estimated at the branch level and explains the logarithm of the firms' value added and *TEs* by using the one step procedure. Other control variables are unchanged. The model is as follows:

$$\ln(y_{ij}) = c_i + \alpha_1 \ln(l_{ij}) + \alpha_2 \ln(k_{ij}) + \beta \text{Size}_{ij} + \gamma \text{Foreign}_{ij} + \delta \text{Export}_{ij} \\ + \varepsilon_1 \text{RegInfra}_{ij} + \varepsilon_2 \text{RegGov}_{ij} + \varepsilon_3 \text{Human}_{ij} + \varepsilon_4 \text{Finance}_{ij} + c + v_{ij}. \quad (10)$$

Results of estimation by industry are given in Table 7. Estimation results reinforce our previous findings. Production frontiers are robust to the introduction of different IC variables, with little changes in returns to scales or in the elasticities of production factors across industries. Countries specific conditions are also validated by the data.

One of the most interesting outcomes, nevertheless, concerns the investment climate of which four dimensions are now significant with the expected sign<sup>34</sup>. Beside, our model validates the impact of a much more substantial number of IC variables incorporated in the aggregated indicators. This result has to be stressed because it is the first time (to our knowledge) that the empirical literature brings evidences of the role of such a significant set of IC variables for such a large and diversified sample of industrial firms.

Findings by industry are quite interesting as well. Human capital (*Human*), Infrastructure (*Infra*), and Financing Constraints (*Finance*) appear to be the most statistically significant IC factors for firm-level productivity. All three broad indicators clearly explain productivity discrepancies in most industries while Business-Government Relations (*Gov*) constitutes a less robust dimension. Our empirical analysis also reveals that some industries: Textile (for *Human*, *Infra* and *Finance*), Metal & Machinery Products (for *Human* and *Gov*) and Wood & Furniture (for *Human* and *Finance*) appear more sensitive and vulnerable than others in the face of a deficient investment climate (the estimated coefficients of the IC variables are higher for these industries). This comment may be extended to Non Metal & Plastic Materials and Garment for, respectively, Human Capacity (*Human*) and Government-Business Relation (*Gov*). These findings confirm in a different way some of the previous model's conclusions. As mentioned before, this result may be due to the fact that most of these industries face international competition. This fragility justifies that particular attention be paid when taking decisions that may affect their investment climate. This also means that the pay off of an improvement of the investment climate would be more substantial in these industries, which could play a leading role for industrial progress and export development.

By using our IC aggregate indicators, however, we can't always explain productivity. This is somewhat the case for Metal & Machinery Products and Agro-Processing. As for Garment, very few aspects of the investment climate seem to help firms in this industry perform

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33 Respectively seven and six instead of two for Infrastructures and Business-Government Relations, four instead of three for Human Capacity, three instead of two for Financing Constraints.

34 As we actually explain firm-level inefficiency, a positive coefficient is expected for three out of our four indicators. This is the case of RegInfra, RegGov and Fin, which are interpreted as obstacles for the operation of the firms. On the other hand, H constitutes of variables which are supposed to improve TE, and a negative coefficient is expected for this variable (see Section 5 for the definition of the axes of the composite indicators).

better<sup>35</sup>. Again no improvement is seen in Leather, which is poorly explained by the model. However, this loss is compensated by the information gain through the large set of IC variables now explaining firm-level productivity performances, as well as by the validation of another variable of interest: the Government-Business Relation (Gov)<sup>36</sup>.

Another addition of the model is validating the role of more plant characteristics in explaining firm-level TE. This is the case of the variable *Size*, which justifies scales economies in four industries instead of only two — Wood & Furniture and Leather in addition to Agro-Processing and Chemicals & Pharmaceutical Products. This interesting result may justify a policy of concentration of small enterprises, which are important in developing countries. Concentration could boost the efficiency and competitiveness of the industrial sector, thus contributing to industrial development and economic growth. Besides, export orientation (*Export*) explains externalities linked to export activities in Leather in addition to Garment (with a stronger coefficient for Garment), which confirms their exposure to international competition. Increasing the export capacity of some industries appears to be another way of stimulating firms' efficiency and could contribute to an industrial take off.

## 7. Conclusions

In this paper, we show that MENA manufacturing enterprises perform poorly on average compared to a broad sample of firms from different countries. This is true for our three measures of firms' productive performances: Labor Productivity (*LP*), Total Factor Productivity (*TFP*) and Technical Efficiency (*TE*). The exception is Morocco, where various measures of productivity rank close to those of the most productive countries. The poor performance is linked to MENA's investment climate deficiencies, which add to firm costs and handicaps MENA's industrial efficiency and competitiveness.

To explain MENA's disparity in industrial performances, we focus on the role of four broad measures of IC, generated by the PCA of a large set of IC variables. We show that differences in quality of infrastructure, in experience and level of education of the labor force, in cost and access to financing, and, to a lower extent, several dimensions of the government-business relation significantly explain the industrial performances discrepancies. Our results are stronger than those usually found in the literature because of the large number of countries and industrial branches, as well as the indicators of investment climate on which our analysis is based. This supports the idea that deficiencies in the investment climate can be at the origin of a loss of domestic and international competitiveness, and export capacities. Therefore, our results show that enhancing investment climate could be a powerful engine for productivity and competitiveness of the manufacturing industry, and maybe the catalyst for an industrial take off.

Moreover, our study identifies some industries where technical efficiency particularly depends on investment climate limitations. This is the case for Textile and Metal & Machinery Products, and also although to a lower extent, for Non Metal & Plastic Material and Garment. An improvement of various dimensions of the investment climate (depending on the sectors) would positively impact those industries, which could eventually play a leading role in developing an efficient manufacturing industry. This result may lead policymakers to appreciate the positive impact that may result from an investment climate improvement especially that MENA is struggling for integration into the world economy. In addition, our results show that in some industries, the size, and to a lesser extent the export capacity, may boost industrial efficiency and thus competitiveness. In fact, with the

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35 Loss of information appears essentially for "Human Capacity" and "Infrastructure" for which one of the initial individual indicators was previously significant.

36 Besides, this model explains better Wood & Furniture.

implementation of a broad economic reform agenda, improving MENA's export capacity could become a priority. Improving manufacturing productivity could thus become a powerful factor for economic growth and convergence of the MENA region into the global economy. Reforms targeting small and medium enterprises, in addition to those investment climate variables and industries which favor productivity and competitiveness may constitute an integral part of a national strategy for growth and employment.

Actually, like other developing countries, MENA is increasingly concerned with improving competitiveness and productivity, as the region faces the intensifying pressures of globalization. The World Bank firm-surveys provide standard instruments for identifying key obstacles to firm-level performances and prioritize policy reforms. These instruments may be used to boost competitiveness and diversify MENA economies, if the region wants to face the increasing competition of countries such as China and India, which have successfully diversified their economy and benefit, in addition, from low labor costs.

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**Table 1: Firm-Level Relative Productivity of Labor (country average, in % of the country with the most productive firms)**

Country*	Textile	Leather	Garment	Agro Processing	Metal & Machinery Products	Chemical & Pharmaceutical Products	Wood & Furniture	Non Metal & Plastic Materials
South Africa (2003)	52		100	100	94	97	87	100
Brazil (2003)	100	100	50	50	66	100	38	
Morocco (2004)	54	80	54	79	100	91		66
Morocco (2000)	56	94	55	85	48	63		57
Saudi Arabia (2005)				77	92		100	
Ecuador (2003)	58	91	80	48	50	54	42	66
El Salvador (2003)	71	59	55	35	28	51		46
China (2002)	52	69	45		31			
Thailand (2004)	62		62	45	40		31	43
Guatemala (2003)	43		64	31	26	36	33	48
India (2002)	35	66	53	21	22	17		
Honduras (2003)	56		50	29	23	39	21	26
India (2000)	39		48		28	24		
Pakistan (2002)	40	35	49	22		17		
Tanzania (2003)				35			20	
Philippines (2003)	32		32	14				
Algeria (2002)	27			21	19	19		31
Bangladesh (2002)	18	53	16	9		11		
Nicaragua 2003	13	38	26	17	13	17	16	21
Sri Lanka (2004)	13		27	9	17			28
Zambia (2002)	16			13	24	18		
Ethiopia (2002)	11	20	20	10			10	
Egypt (2006)	14	15	14	12	16	11	10	13
Egypt (2004)	15	20	14	9	11	11	11	11
Lebanon (2006)	11		17	8			7	

Note: \* Ranking is from countries with the most productive firms to the ones with the least productive firms.

Source: Authors' calculations.

**Table 2: Firm-Level Relative Unit Labor Costs (country average, % of the country with the highest unit cost)**

Country*	Textile	Leather	Garment	Agro Processing	Metal & Machinery Products	Chemical & Pharmaceutical Products	Wood & Furniture	Non Metal & Plastic Materials
El Salvador (2003)	52	<b>100</b>	<b>100</b>	85	<b>100</b>	63		87
Nicaragua (2003)	<b>100</b>	72	80	87	88	<b>100</b>	92	79
Guatemala (2003)	64		83	<b>100</b>	79	87	89	74
<i>Algeria (2002)</i>	73			89	89	96		<b>100</b>
Philippines 2003)	66		92	83				
South Africa (2003)	86		97	74	80	88	69	64
<i>Morocco 2004</i>	81	79	91	75	75	76		60
Honduras (2003)	36		78	88	76	63	96	86
<i>Egypt (2004)</i>	51	66	77	77	55	86	<b>100</b>	57
<i>Egypt (2006)</i>	60	86	76	71	46	80	92	51
<i>Saudi Arabia (2005)</i>				89	59		55	
<i>Lebanon (2006)</i>	55		53	61			92	
<i>Morocco (2000)</i>	62	62	84	60	58	66		62
Zambia (2002)	46			75	48	88		
Brazil (2003)	48	54	72	68	56	49	65	
Sri Lanka (2004)	86		64	71	39			32
Bangladesh (2002)	49	34	60	69		55		
Ethiopia (2002)	71	25	45	56			55	
Ecuador (2003)	48	59	52	50	42	32	62	53
Thailand (2004)	42		56	49	35		52	34
China (2002)	39	41	54		38			
Pakistan (2002)	31	41	33	47		51		
India (2000)	36		38		37	46		
India (2002)	32	27	35	42	35	44		
Tanzania (2003)				33			31	

Note: \* Ranking is from countries with the most expensive labor to the ones with the least expensive one.

Source: Authors' calculations.

**Table 3: Firm-Level Relative Total Factor Productivity (country average, in % of country with the most productive firms)**

Country*	Textile	Leather	Garment	Agro Processing	Metal & Machinery Products	Chemical & Pharmaceutical Products	Wood & Furniture	Non Metal & Plastic Materials
South Africa(2003)	88		100	100	91	82	100	100
Brazil (2003)	100	100	87	100	100	100	91	
Morocco (2000)	80	81	79	79	70	90		71
Thailand (2004)	70		90	75	73		78	82
Morocco (2004)	73	64	77	77	70	79		80
Saudi Arabia(2005)				70	68		81	
Ecuador (2003)	69	74	76	73	75	72	78	64
El Salvador (2003)	76	70	66	64	61	69		76
Philippines (2003)	64		77	65				
Algeria (2002)	65			44	59	66		76
Honduras (2003)	61		72	55	57	84	50	54
Guatemala (2003)	65		67	54	62	56	54	73
India (2000)	67		63		58	58		
China (2002)	59	58	56		45			
Zambia (2002)	58			52	55	52		
Pakistan (2002)	55	58	56	54		48		
India (2002)	59	61	49	54	51	50		
Tanzania (2003)				55			53	
Sri Lanka (2004)	41		51	61	51			56
Bangladesh (2002)	51	46	57	50		44		
Nicaragua (2003)	49	51	45	47	42	50	44	52
Ethiopia (2002)	51	34	46	49			36	
Lebanon (2006)	35		39	40			37	
Egypt (2004)	41	36	35	39	34	33	36	43
Egypt (2006)	37	30	33	41	34	34	31	38

Note: \* Ranking is from countries with the most productive firms to the ones with the least productive firms.

Source: Authors' calculations.

**Table 4: Estimations of Stochastic Production Frontiers**

Independent Variables	Dependant Variable: Value Added							
	Textile	Garment	Leather	Agro Processing	Metal & Machinery Products	Chemical& Pharmaceutical Products	Non Metal& Plastic Materials	Wood & Furniture
<b>Log (labor)</b>	0.659 (30.53)***	0.811 (42.69)***	0.826 (20.20)***	0.695 (31.22)***	0.877 (33.21)***	0.673 (22.21)***	0.886 (22.35)***	0.941 (29.18)***
<b>Log (capital)</b>	0.354 (24.87)***	0.260 (20.96)***	0.277 (11.00)***	0.404 (28.62)***	0.289 (18.52)***	0.444 (22.89)***	0.281 (13.54)***	0.228 (12.79)***
<b>Intercept</b>	2.007 (18.94)***	1.350 (9.22)***	1.419 (9.81)***	1.863 (13.99)***	1.716 (15.61)***	2.065 (15.39)***	1.419 (9.73)***	1.644 (11.51)***
$\sigma^2u$	0.33	0.22	0.80	0.73	1.12	0.39	1.30	0.79
$\sigma^2$	0.99	0.92	1.40	1.47	1.76	1.13	1.86	1.19
$\sigma^2u/\sigma^2$	0.33*** (6.17)	0.24*** (3.00)	0.57*** (6.33)	0.50*** (8.17)	0.64*** (12.80)	0.35*** (5.00)	0.70*** (10.00)	0.66*** (13.20)
<b>Observations</b>	2011	2800	634	2190	1622	1274	907	1033

Note: \* Significance level 10 %; \*\* 5 %; \*\*\* 1 %. Z statistics are into brackets. Regressions include country-dummy variables.

Source: Authors' calculations.

**Table 5: Firm-Level Technical Efficiency (country average, in % of country with the most productive firms)**

Country*	Textile	Leather	Garment	Agro Processing	Metal & Machinery Products	Chemical & Pharmaceutical Products	Wood & Furniture	Non Metal & Plastic Materials
South-Africa 2003	85		<b>100</b>	<b>100</b>	<b>100</b>	89	<b>100</b>	<b>100</b>
Brazil 2003	<b>100</b>	<b>100</b>	87	80	98	<b>100</b>	62	
Morocco 2004	58	70	81	70	<b>100</b>	72		92
Saudi-Arabia 2005				72	76		81	
Morocco 2000	67	76	80	71	68	83		70
Thailand 2004	64		93	67	65		47	66
Ecuador 2003	57	86	61	61	63	60	57	63
El Salvador 2003	40	62	65	58	55	63		66
Guatemala 2003	51		77	45	57	45	48	67
Honduras 2003	58		66	42	48	60	37	48
India 2000	47		66		45	34		
India 2002	42	56	66	41	46	32		
Pakistan 2002	43	49	61	40		31		
China 2002	46	45	51		35			
Philippines 2003	36		53	39				
Algeria 2002	33			35	39	38		54
Nicaragua 2003	22	55	41	34	38	30	31	49
Tanzania 2003				43			32	
Zambia 2002	29			30	41	21		
Sri Lanka 2004	17		37	26	33			39
Bangladesh 2002	24	41	32	28		19		
Ethiopia 2002	20	30	36	22			23	
Egypt 2004	21	30	21	17	22	17	19	32
Egypt 2006	17	15	22	22	25	14	19	24
Lebanon 2006	21		23	16			13	

Note: \* Ranking is from countries with the most productive firms to the ones with the least productive firms.

Source: Authors' calculations.

**Table 6: Estimation Results: Common Model with Individual IC Variables (dependant variable: value added)**

Independent Variables	Textile	Leather	Garment	Agro Industry	Metal& Machinery Products	Chemical& Pharmaceutical Products	Wood & Furniture	Non Metal & Plastic Materials
<b>ln(l)</b>	0.657 (16.14)***	0.789 (28.82)***	0.735 (7.12)***	0.560 (13.32)***	0.871 (21.75)***	0.540 (11.09)***	0.883 (18.78)***	0.860 (10.18)***
<b>ln(k)</b>	0.321 (14.61)***	0.255 (14.93)***	0.242 (7.18)***	0.395 (24.64)***	0.268 (13.21)***	0.444 (20.01)***	0.235 (11.28)***	0.249 (8.81)***
<b>Intercept</b>	0.720 (1.55)	1.597 (4.21)***	1.993 (2.25)**	3.780 (5.79)***	1.654 (4.88)***	2.985 (6.08)***	0.157 (0.55)	1.251 (2.22)**
<b>Size</b>	0.018 (0.11)	-0.105 (0.21)	-0.092 (0.48)	-0.195 (2.57)**	0.600 (0.96)	-0.193 (1.92)*	-0.316 (1.29)	0.014 (0.07)
<b>Foreign</b>	-0.242 (0.53)	-0.384 (0.43)	-0.011 (1.30)	-0.005 (3.36)***	-0.397 (1.16)	-0.005 (1.88)*	-0.000 (0.01)	-0.007 (1.07)
<b>Export</b>	-0.006 (1.06)	-0.183 (1.43)	-0.007 (2.87)***	-0.001 (1.06)	-0.107 (0.97)	-0.005 (1.64)	-0.019 (1.22)	-0.009 (1.32)
<b>RegElect</b>	0.077 (0.54)	0.323 (0.60)	0.228 (1.94)*	0.042 (0.83)	1.006 (1.92)*	0.053 (0.86)	-0.025 (0.16)	0.068 (0.60)
<b>RegWeb</b>	-2.641 (2.43)**	2.138 (1.26)	0.329 (0.94)	-0.426 (2.07)**	0.768 (0.50)	-0.757 (3.39)***	-1.542 (1.77)*	-0.847 (1.57)
<b>Cred</b>	-1.011 (2.08)**	-2.421 (2.42)**	-0.403 (2.74)***	-0.144 (2.38)**	-1.842 (2.07)**	-0.085 (1.02)	-0.304 (1.25)	-0.554 (2.26)**
<b>AccessF</b>	0.006 (0.11)	0.118 (0.65)	0.059 (1.41)	0.044 (2.34)**	-0.022 (0.11)	0.068 (2.43)**	0.126 (1.74)*	-0.051 (1.22)
<b>Training</b>	-0.135 (0.43)	0.234 (0.33)	-0.142 (0.93)	-0.217 (3.23)***	0.428 (0.56)	-0.123 (1.22)	-0.400 (1.34)	-0.103 (0.59)
<b>EduM</b>	-0.148 (2.02)**	-0.282 (1.53)	-0.076 (2.08)**	-0.064 (3.03)***	-0.673 (2.61)***	-0.073 (1.96)*	-0.096 (1.46)	-0.158 (2.84)***
<b>ExpM</b>	-0.037 (2.26)**	0.045 (1.50)	-0.000 (0.05)	-0.003 (0.90)	0.014 (0.48)	-0.002 (0.38)	-0.006 (0.56)	-0.000 (0.04)
<b>RegLregul</b>	0.024 (0.13)	-0.827 (1.52)	-0.069 (0.50)	0.007 (0.10)	0.362 (0.70)	0.020 (0.20)	-0.112 (0.53)	-0.006 (0.05)
<b>RegCorrup</b>	0.081 (0.51)	0.074 (0.17)	0.168 (1.53)	-0.054 (0.96)	-0.272 (0.59)	-0.008 (0.11)	0.073 (0.52)	0.124 (1.40)
<b>Constant</b>	1.460 (2.87)***	-2.422 (1.25)	1.493 (2.00)**	3.388 (5.45)***	-2.612 (1.34)	2.358 (4.94)***	1.279 (1.91)*	1.568 (2.66)***

**Table 6 (Continued):**

<b>Independent Variables</b>	<b>Textile</b>	<b>Leather</b>	<b>Garment</b>	<b>Agro Industry</b>	<b>Metal&amp; Machinery Products</b>	<b>Chemical&amp; Pharmaceutical Products</b>	<b>Wood &amp; Furniture</b>	<b>Non Metal &amp; Plastic Materials</b>
<b>Observations</b>	942	380	1601	1494	838	695	774	480
<b>sigma_u</b>	0.75	1.69	0.77	0.90	1.46	0.75	1.10	0.64
<b>sigma_v</b>	0.86	0.81	0.54	0.43	0.76	0.46	0.57	0.67
<b>Wald chi2</b>	1351.45	2787.67	241.01	1306.40	2484.52	1060.30	1321.23	300.67
<b>Prob &gt; chi2</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: The one step procedure explains firm-level inefficiency. Variables Size, Foreign and Export are expected with a negative coefficient. All regressions contain country-dummy variables when estimating the production function.

\* Significance level 10%; \*\* 5%; \*\*\* 1%. Absolute value of z statistics are in parentheses.

Source: Authors' estimations



**Table 7: Estimation Results: Common Model with Aggregated IC Variables (*dependant variable: value added*)**

<b>Independent Variables</b>	<b>Textile</b>	<b>Leather</b>	<b>Garment</b>	<b>Agro Industry</b>	<b>Metal &amp; Machinery Products</b>	<b>Chemical &amp; Pharmaceutical Products</b>	<b>Wood &amp; Furniture</b>	<b>Non Metal &amp; Plastic Materials</b>
ln(l)	0.637 (16.01)***	0.778 (27.90)***	0.879 (15.19)***	0.551 (12.54)***	0.885 (25.26)***	0.578 (11.84)***	0.836 (17.87)***	0.923 (15.50)***
ln(k)	0.337 (15.06)***	0.252 (16.57)***	0.196 (7.40)***	0.397 (24.54)***	0.258 (13.11)***	0.447 (20.05)***	0.248 (11.91)***	0.254 (9.31)***
Intercept	1.081 (2.01)**	2.149 (5.93)***	1.326 (4.62)***	4.302 (5.77)***	1.883 (5.90)***	2.868 (4.26)***	1.738 (4.54)***	1.223 (2.78)***
Size	-0.809 (1.54)	-0.333 (1.77)*	-0.037 (0.33)	-0.212 (2.75)***	-0.159 (0.22)	-0.198 (1.99)**	-0.490 (2.22)**	0.273 (1.10)
Foreign	-0.426 (0.90)	-0.006 (0.76)	-0.014 (0.50)	-0.005 (3.48)***	-0.541 (1.05)	-0.006 (1.72)*	0.004 (0.54)	-0.019 (1.28)
Export	-0.016 (0.81)	-0.020 (1.95)*	-0.078 (1.81)*	-0.001 (1.14)	-0.114 (1.04)	-0.008 (1.49)	-0.017 (1.53)	-0.186 (1.08)
RegInfra	0.762 (2.52)**	-0.079 (0.66)	-0.057 (0.95)	0.014 (0.27)	0.833 (1.83)*	0.204 (2.35)**	0.262 (1.71)*	0.318 (2.32)**
Human cap	-0.716 (1.76)*	-0.138 (0.79)	-0.116 (1.08)	-0.253 (5.03)***	-1.174 (1.52)	-0.147 (1.71)*	-0.488 (2.33)**	-0.768 (2.24)**
RegGov	-0.259 (1.21)	-0.072 (0.72)	0.185 (2.48)**	-0.047 (1.48)	0.706 (1.70)*	-0.068 (1.39)	-0.060 (0.54)	0.136 (0.86)
Finance	0.778 (2.40)**	0.219 (1.68)*	0.035 (0.50)	0.124 (3.86)***	0.257 (0.54)	0.148 (2.67)***	0.330 (2.36)**	-0.208 (1.26)
Constant	-0.961 (0.95)	0.162 (0.19)	0.506 (1.84)*	3.243 (4.82)***	-6.121 (2.83)***	1.508 (2.32)**	0.703 (1.04)	-0.522 (0.71)
Obs	929	433	1555	1481	826	741	750	461
sigma_u	1.31	1.11	0.25	0.91	1.98	0.70	1.10	0.56
sigma_v	0.86	0.60	0.73	0.37	0.65	0.56	0.53	0.75
Wald chi2	1579.56	2375.90	925.66	1343.79	3117.04	1010.55	1490.81	893.91
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: The one step procedure explains firm-level inefficiency. The expected sign of the IC aggregated variables is positive for RegInfra, RegGov and Fin, and negative for H (see definition of variables in Section 5). Variables Size, Foreign and Export are also expected with a negative coefficient. All regressions contain country-dummy variables when estimating the production function. \* Significance level 10%; \*\* 5%; \*\*\* 1%. Absolute value of z statistics are in parentheses.

Source: Authors' estimations.

## Annex 1: List of Countries

<b>MENA*</b>	<b>LAC</b>	<b>AFR</b>	<b>SAS</b>	<b>EAP</b>
Algeria (2002)	Brazil (2003)	Ethiopia (2002)	Bangladesh (2002)	China (2002)
Egypt (2004/2006)	Ecuador (2003)	South Africa (2003)	India (2000/2002)	Philippines (2003)
Morocco (2000/2004)	El Salvador (2003)	Tanzania (2003)	Pakistan (2002)	Thailand (2004)
Oman (2003)	Guatemala (2003)	Zambia (2002)	Sri Lanka (2004)	
Lebanon (2006)	Honduras (2003)			
Saudi Arabia(2005)				
Syria (2003)	Nicaragua (2003)			

Notes: **MENA**: Middle East and North Africa; **LAC**: Latin America and the Caribbean; **AFR**: Sub Sahara Africa; **SAS**: South Asia; **EAS**: East Asia.

## Annex 2: ICA Surveys: Data Limitations

<b>Industries/ (number of firms And %)</b>	<b>Textile</b>	<b>Garment</b>	<b>Leather</b>	<b>Agro- Processing</b>	<b>Metal&amp; Machinery Products</b>	<b>Chemical&amp; Pharmaceutical Products</b>	<b>Non Metal &amp; Plastic Materials</b>	<b>Wood &amp; Furniture</b>	<b>Total</b>
Total Enterprises	2496	3794	821	2815	2163	1728	1159	1317	16293
MENA Enterprises (% total)	761 (30%)	906 (24%)	257 (31%)	655 (23%)	758 (35%)	364 (21%)	487 (42%)	199 (15%)	4387 (27%)
Total Frontier (% total enterprises)	1998 (80%)	2796 (74%)	634 (77%)	2184 (78%)	1604 (74%)	1270 (73%)	897 (77%)	1031 (78%)	12414 (76%)
MENA Frontier (% total MENA) (% total frontier)	541 (69%) (26%)	711 (78%) (25%)	167 (65%) (26%)	436 (67%) (20%)	538 (71%) (34%)	241 (66%) (19%)	335 (69%) (37%)	120 (59%) (11%)	3073 (70%) (25%)
Total with IC variables	942 (38%)	1604 (42%)	380 (46%)	1525 (54%)	841 (39%)	738 (43%)	478 (41%)	778 (59%)	5002 (45%)
MENA with IC variables (% total MENA)	215 (28%)	371 (41%)	91 (35%)	228 (35%)	258 (34%)	95 (26%)	162 (33%)	63 (32%)	1483 (34%)
(% total IC)	(23%)	(23%)	(24%)	(15%)	(31%)	(13%)	(34%)	(8%)	(30%)

Sources: Authors' calculations.

### Annex 3: Spearman Correlation Coefficient of the Three Measures of Firm-Level Productivity

Textiles				Leather			
Nobs: 1998				Nobs: 634			
	TE	TFP	LP		TE	TFP	LP
<b>TE</b>	1			<b>TE</b>	1		
<b>TFP</b>	0.7077*	1		<b>TFP</b>	0.7703*	1	
<b>LP</b>	0.7615*	0.6012*	1	<b>LP</b>	0.6427*	0.6756*	1

Garment				Agro-Processing			
Nobs: 2796				Nobs: 2184			
	TE	TFP	LP		TE	TFP	LP
<b>TE</b>	1			<b>TE</b>	1		
<b>TFP</b>	0.5571*	1		<b>TFP</b>	0.7047*	1	
<b>LP</b>	0.5675*	0.6370*	1	<b>LP</b>	0.7814*	0.5861*	1

Metals & Machinery Products				Chemicals & Pharmaceutical Products			
Nobs: 1604				Nobs: 1270			
	TE	TFP	LP		TE	TFP	LP
<b>TE</b>	1			<b>TE</b>	1		
<b>TFP</b>	0.7483*	1		<b>TFP</b>	0.7349*	1	
<b>LP</b>	0.7762*	0.6810*	1	<b>LP</b>	0.7542*	0.6270*	1

Wood & Furniture				Non-Metallic & Plastic Materials			
Nobs: 1031				Nobs: 901			
	TE	TFP	LP		TE	TFP	LP
<b>TE</b>	1			<b>TE</b>	1		
<b>TFP</b>	0.8456*	1		<b>TFP</b>	0.7394*	1	
<b>LP</b>	0.8885*	0.7532*	1	<b>LP</b>	0.8028*	0.6293*	1

Note: \*: significant at 1%,  
 TE: Technical Efficiency, TFP: Total Factor Productivity, LP: Labor Productivity.  
 Source: Authors' calculations.