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Firm-Level Productivity and Technical Efficiency in MENA Manufacturing Industry: The Role of the Investment Climate

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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 in average poorly, 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 be more competitive on the world market.

Firm-Level Productivity and Technical Efficiency in MENA Manufacturing Industry: The Role of the Investment Climate

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 the economies. This question has justified that a growing 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[1]. 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, who does not benefit from a diversified economy and a substantial manufacturing export capacity. Although MENA countries are, in 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[2]. Attractiveness of FDI has also been weak, as well as competitiveness and exports of manufacturing[3]. 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, as various studies point out MENA investment climate deficiencies[4]. These deficiencies have been reported as participating in the slow economic activity in the region[5].

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 as a support to policy reforms for an increased economic growth. The objective of this paper has been to help progress in that direction.

Drawing on the World Bank firm-surveys, this paper analyses the relationship between investment climate and firm-level productivity for a large number of countries (23 among which 5 MENA countries, see list of countries in *Annex 1*) and manufacturing industries (8)[6]. 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 others, as well as across countries in order to position MENA manufacturing firms amongst a wide range of firms from other regions. We reveal that enterprises in MENA perform in average poorly, compared to other countries of the sample. The exception is *Morocco*, whose various measures of firms' productive performance always rank close to the ones of the most productive firms in the sample. An originality of our approach has been, as well, to generate a few composite indicators of investment climate using Principal Component Analysis (*PCA*), which summarizes well the key dimensions of the investment climate. This has also allowed tackling the problem of multicolinearity when explaining firm productive performances with a wide range of correlated *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 investment climate (*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 investment climate (*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 to which extend the investment climate 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 in calculating productive performances without estimating a production function. Non parametric measure of productivity constitutes a simple and already meaningful way of assessing for example Productivity of Labor (*LP*) and Total Factor Productivity (*TFP*). Another way has been to calculate firms' productive performance from a parametric production frontier. This more sophisticated methodology allows 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 whatever the industrial sector. We can also consider all the relevant factors of the production technology. We then refer to the Total Factor Productivity (*TFP*). In this paper due to the limited time dimension for the production factors, two or three years at best, and no time dimension about the Investment Climate Assessment determinants (ICA), we only refer to productivity levels. Our analysis focuses on comparisons of firm-level productivity among enterprises, industries and countries[7].

In the empirical analysis, we first discuss Labor Productivity (*LP*). This indicator gives an idea of firm productive performance. It has the advantage not to be affected by the error in measurement of the capital stock. However, the technology is only partially described and then the productivity suffers from an omitted variable. Productivity of Labor can be complemented by calculations of a Unit Labor Cost defined as the ratio of firm average wage to firm 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 less the case when the *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 being calculated as the residual of the production function, it is considered as a random variable, what makes difficult to justify that some exogenous factors can explain productive differences.

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

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

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 done regarding 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 in regard to the most efficient firms that define an empirical production frontier. Firm-level Technical Efficiency (*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 σ^2 standard deviation. The second term represents the Technical Efficiency *(-u*). In our case we will suppose that *u* follows a truncated normal distribution[8]. 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.

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

With

- *y:* Production
- *x:* Production factors
- *β :* 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 β and δ) are simultaneously estimated by the likelihood estimation method. The stochastic version of the model can be written:

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

With

- y: Production
- x: Production factors
- z: Factors explaining Technical Efficiency
- v : External shocks
- u : Technical Efficiency
- β / δ: Parameters of the equation
- i: Firm index

3- The ICA Firms Surveys: Data Limitations

The World Bank Investment Climate (*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 in our sample 23 countries surveyed at the time our empirical work started (see list of countries in *Annex* 1)[9]. 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)[10]. *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 have intended to compare MENA performances to the ones of emerging countries which appears 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 the production technology variables and the necessity of a cleaning up when figures proved to be poorly transmitted or recorded. Some industries as well had to be merged, due to insufficient observations. In fine, 12 414 enterprises (3073 for the MENA region) regrouped in eight industries were retained when estimating production frontiers (see *Annex 2*)[11]. As for inputs and output, investment climate (IC) variables are subject to measurement errors. In the surveys, some firms did not report the full range of investment climate measures. Other firms reported numbers that were not credible. This is also due to the fact that most of investment climate 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 investment climate variables. Once outliers and incomplete observations are removed, 5002 observations were left, among which 1483 for the MENA region, what represent 34% of MENA initial population and 30% of the total number of enterprises with *IC* variables (see *Annex 2*)[12]. The *IC* variables considered here are the ones that we use to explain firms' Technical Efficiency (*TE)* (see sections 5 and 6).

Another question relates to the endogeneity of the *IC* variables, due to the qualitative nature of investment climate factors. This is particularly true for perception variables (such as obstacles to operation) for which firms are asked to position their answer on a given scale[13]. The perception of the scale might 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, as well, may be proactive in reducing their investment climate constraints, for example by working with the authorities to limit inspections or secure more reliable power supply. In the empirical part, we assume this endogeneneity and use appropriate estimation techniques to evaluate the impact of the investment climate on the firms' productive performances. We measure in particular *IC* variables as city-sector averages of firm-level observations[14]. 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[15].

Exchange rate constitutes another source of uncertainty which may lead to over or under evaluate firms' productive performances. This rate is used to convert production and production factors into US dollars. 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 dollars which has the interest to be the rate that firms use for their economic calculations[16].

4- Firm-Level Productivity: MENA Performance Gap

In this section, we present our three measures of firm-level productivity: Productivity of Labor (*LP*), Total Factor Productivity (*TFP*) and Technical Efficiency (*TE*). The data have been pooled across the 23 countries of our sample. Firm-level productive performances are calculated for each of the 8 industries. Differences and similarities across countries have been analyzed. A pattern of generally low productive performances is observed in the MENA region, with however some countries showing better results.

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

Firm-level Productivity of Labor (*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 Raw Material -- excluding fuel[17]. It is assumed that firms are price takers and purchase raw material at world price. This assumption is reasonable for the industries which are competitive. Thus, the dollar value of raw material and the dollar value of output can be compared across countries.
Equation is as follows:

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

With

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

Table 1 displays the averages Labor Productivity (*LP*) while table 2 reflects the relative Unit Labor Cost. For each country, average productivity (Labor productivity and Unit Labor Cost) is expressed in percent 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 perform -- in average and in most industries -- the best. This result is consistent with the relatively high incomes in the two countries (2710 and 2780 dollars per capita respectively, see World Bank, 2005). *Morocco (2004)'s* firms also participate in the best performances of the sample, especially in *Metal & Machinery Products, Chemical & Pharmaceutical Products*, *Leather,* and *Agro-Processing.*

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	Chemic & Pharm 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

As far as other MENA countries are concerned, the ranking remains also 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, at around 1300 US dollars in 2003). In *Algeria*, firm-level Productivity of Labor (*LP*) ranks an intermediate position, close to *India* in *Agro-Processing* and *Chemical & Pharmaceutical Products,* but behind in *Textile* and *Metal & Machinery Products* (firms' performances are always lower than in China). Moroccan's firms remain the most performing ones in MENA, with levels of Labor Productivity (*LP*) far ahead from the two Asiatic giants (China and India), and close to the most productive firms/countries of the sample[18].

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**	**Chemic & Pharm Products**	**Wood & Furniture**	**Non Metal & Plastic Materials**
El Salvador (2003)	52	**100**	**100**	85	**100**	63		87
Nicaragua (2003)	**100**	72	80	87	88	**100**	92	79
Guatemala (2003)	64		83	**100**	79	87	89	74
***Algeria** (2002)*	*73*			*89*	*89*	*96*		**100**
Philippines 2003)	66		92	83				
South Africa (2003)	86		97	74	80	88	69	64
***Morocco** 2004)*	*81*	*79*	*91*	*75*	*75*	*76*		*60*
Honduras (2003)	36		78	88	76	63	96	86
***Egypt** (2004)*	*51*	*66*	*77*	*77*	*55*	*86*	**100**	*57*
***Egypt** (2006)*	*60*	*86*	*76*	*71*	*46*	*80*	*92*	*51*
***Saudi Arabia** (2005)*				*89*	*59*		*55*	
***Lebanon** (2006)*	*55*		*53*	*61*			*92*	
***Morocco** (2000)*	*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

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 on Productivity of Labor (*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 noticing that the Unit Labor Cost in MENA is one of the highest of our sample of countries. This is particularly true in *Algeria* and *Egypt* – countries where firm-level Productivity of Labor (*LP*) is among the lowest – but also in *Morocco* and to some extend in *Lebanon*. In MENA, the Unit Labor Cost tends to be higher than in the majority of Asian economies (*India*, *China*, *Sri Lanka*, *Bangladesh* and *Thailand*). In *China* and *India,* salaries (around 100 US dollars per month for unskilled workers) are far lower than in *Morocco* (more than the double). 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 all the most 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.

4.2-Firm-Level Total Factor Productivity

In this section, firm-level Total Factor Productivity (*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.

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

With

- $Y_{i,j}$: Value Added
- $L_{i,j}$: Number of Permanent Workers
- $K_{i,j}$: Gross Value of Property, Plant and Equipment
- β: 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 Productivity of Labor, results are presented in percent of the average *TFP* of the most performing country. Conclusions are quite similar than for Productivity of Labor. A first conclusion concerns the ranking of the most performing countries. As previously, *South Africa* and *Brazil* present, in most industries, the most performing firms. These countries are again followed by *Morocco*, which firms' performances are quite good in most industries. When compared to *Brazil*, *Moroccan* firms show a *TFP* gap of 10 to 30 percent depending on the industry, what 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 than for Productivity of Labor (*LP*). As previously, *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 Productivity of Labor[19].

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	Chemic & Pharm 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

4.3- Firm-Level Technical Efficiency

Firm-level Technical Efficiency 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*). Same hypotheses and definitions as before apply to input and output variables.

$$\mathrm{Log}(Y_{\mathrm{i,j}}) = \alpha \,\mathrm{Log}\,(K_{\mathrm{i,j}}) + \beta \,\mathrm{Log}\,(L_{\mathrm{i,j}}) + dum_{\mathrm{i,}} - u_{\mathrm{i,j}} + v_{\mathrm{i,j}} \qquad (7)$$

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
- α, β: 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 has been 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 have justified this choice; against an alternative assumption consisting in 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 little 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 the 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: Estimations of Stochastic Production Frontiers

	Dependant Variable: Value Added							
Independent Variables	**Textile**	**Garment**	**Leather**	**Agro Processing**	**Metal & Machinery Products**	**Chemic & Pharm Products**	**Non Metal & Plastic Materials**	**Wood & Furniture**
Log (labor)	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)***
Log (capital)	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)***
Intercept	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)***
σ^2u	0.33	0.22	0.80	0.73	1.12	0.39	1.30	0.79
σ^2	0.99	0.92	1.40	1.47	1.76	1.13	1.86	1.19
σ^2u/ σ^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)
Observations	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 4 also specifies the percentage of the residual explained by the Technical Efficiency (*TE*). In all industries, the efficiency term accounts for a significant part of the 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 from 24% of the error term in *Garment* to 70% 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 in percent of the average *TE* of the most performing country. In average, our results for Technical Efficiency (*TE*) are close to the ones obtained for the non parametric *TFP* under the hypotheses of constant returns to scale. The ranking of countries, in particular, remains unchanged. Only in *Garment* and *Leather*, *Moroccan's* firms are surpassed by *Thailand* and *Ecuador* respectively. Ranking of MENA countries, as well, is unchanged.

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	Chemic & Pharm Products	Wood & Furniture	Non Metal & Plastic Materials
South-Africa 2003	85		**100**	**100**	**100**	89	**100**	**100**
Brazil 2003	**100**	**100**	87	80	98	**100**	62	
***Morocco** 2004*	*58*	*70*	*81*	*70*	**100**	*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

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 whatever the method we use, to what extent can we impute the variance of the TEs to some factors proceeding of the investment climate?

5- Assessing the Investment Climate of the Manufacturing Industries

The World Bank Investment Climate (*ICA*) surveys provide information on a large number of investment climate (*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 strength of result is due to the particular selection of variables. Another solution to overcome these problems consists in generating a few composite indicators. Because we intend to determine which investment climate variables are more detrimental to firm performances, we tried to take into consideration an as large as possible set of *IC* variables which are not typically used in the literature. Since these variables are likely to be correlated, we applied Principal Component Analysis (*PCA*) to produce a limited number of composite indicators[20].

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 bases 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 complete 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: Obstacle for the operation of the enterprise[21] caused by deficiencies in (***a***) Telecommunications, (***b***) Electricity, and (***c***) Transport; (***d***) The presence of a firm Generator, (***e***) and the percentage of electricity coming from that source; 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 enterprises operations and investments. Infrastructures are considered, as well, as a complementary factor to other production inputs. In particular, infrastructure stimulates private productivity by raising profitability of investment[22]. Furthermore, infrastructure also increases firms' productive performances by generating externalities across firms, industries and regions[23].

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 deficient (***a***) Skill and Education of Available Workers; (***b***) Education level[24] 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[25]. 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). New technologies generally require significant organizational changes, which are better handled by a skilled workforce (see Bresnahan, Brynjolfsson and Hitt, 2002). Human capital gives also the opportunity to the enterprises 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, and (***b***) Access to Financing; (***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, what leads to an increased productivity through higher capitalistic intensity and technical progress embodied in the new equipments. 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 has helped, as well, to increase the number of observations by integrating in the sample firms for which information is insufficient.

All four aggregated indicators have been generated at the branch level, thus defining in each country the specific investment climate of each industry. This has implied to produce 32 aggregated indicators (four indicators for each of the eight industries) by applying Principal Component Analysis (*PCA*)[26]. 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 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. What 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' Technical Efficiency (*TE*)[27].

6.1- Common Model with Individual Indicators of Investment Climate

Our empirical model considers a same representation for all industries. This model is estimated at the branch level, thus allowing the coefficients to vary across branches. We explain the Technical Efficiencies (*TE*) by regressing the logarithm of the production factors (capital and labor), as well as various plants 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:

$$\ln(y_{i,j}) = c_i + \acute{\alpha}_1 \ln(l_{i,j}) + \acute{\alpha}_2 \ln(k_{i,j}) + \beta\, Size_{i,j} + \gamma\ Foreign_{i,j} + \delta\ Export_{i,j}$$

$$+ \varepsilon_1\ RegElect_{i,j} + \varepsilon_2\ RegWeb_{i,j} + \lambda_1\ Cred_{i,j} + \lambda_2\ AccessF_{i,j} + \eta_1\ EduM_{i,j} + \eta_2\ ExpM_{i,j}$$

$$+ \eta_3\ Training_{i,j} + \mu_1\, RegLregul_{i,j} + \mu_2\, RegCorrup_{i,j} + c + v_{i,j}: \qquad (8)$$

With:

$y_{i,j}$	Value Added[28]
$l_{i,j}$:	Number of Permanent Workers

$k_{i,j}$:	Gross Value of Property, Plant and Equipment
$Size_{i,j}$:	Size of the firm
$Foreign_{i,j}$:	Foreign capital *(% of firm's capital)*
$Export_{i,j}$:	Export *(% of firm's sales)*
$RegElect_{i,j}$:	Electricity delivery (*obstacle for the enterprise, regional average*)
$RegWeb_{i,j}$:	Utilization of Internet (*regional average*)
$Cred_{i,j}$:	Overdraft facility or credit line
$AccessF_{i,j}$:	Access to financing (*obstacle for the enterprise, regional average*)
$EduM_{i,j}$:	Level of education of the top manager (*number of years*)
$ExpM_{i,j}$:	Experience of the top manager (*number of years*)
$Training_{i,j}$:	Training of workers
$RegLreg_{i,j}$:	Labor regulation (obstacle for the enterprise, regional average)
$RegCorrup_{i,j}$:	Corruption (obstacle for the enterprise, regional average)
$c_{i:}$	Country-Dummy variables
c:	Intercept
$v_{i,j}$:	Error terms
i / j:	Enterprise and country index respectively

The choice of *IC* variables has been 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 well the various aspects of the investment climate and cover properly 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 have considered the city/region averages (*Reg* preceding the variable). This has been the case for Electricity delivery (*RegElect*); Access to Internet (*RegWeb*); Labor regulation (*RegLreg*), and Corruption (*RegCorrup*). The number of explanatory variables, however, has been limited by the multicolinearity between several *IC* variables when estimating the *TE* frontier models.

Other individual variables consist in: the percentage of sales exported by the firms (*Export*), the percentage of foreign ownership in firms' capital ($Foreign_{i,j}$), and the firm size ($Size_{ij}$). 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[29]. 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 countries 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*) has been estimated on unbalanced panels, going from 380 observations (in *Leather*) to 1601 observations (in *Garment*) depending on the industry. A Cobb-Douglass production function has been chosen to estimate the production frontiers. We have also maintained our previous assumption as regard the specification of the technology, as well as of the *TEs*. Although the sample size modifies 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[30]. Sector-based estimates are presented in Table 6.

A first set of conclusions concerns the production frontier models. Our regressions confirm the choice to estimate a production frontier by industry. Elasticites of capital and labor reveal to be different from one industry to another. Impact of capital is strong in *Chemicals & Pharmaceutical Products*, *Agro-Processing* and, to a lower extend, *Textile*. On the opposite, elasticity of labor is high in *Metal & Machinery, Non Metal & Plastic Materials, Wood & Furniture, Leather,* and *Garment*. These industries look like being more intensive in labor, although two of them (*Metal & Machinery* and *Non Metal & Plastic Materials*) are usually considered as applying more capitalistic technologies in developed countries. This result is confirmed by the computation of the ratio of the two elasticities (capital/ labor). All coefficients are highly significant (at 1% level), what stresses the robustness of our results. Another result shows that we are close to the constant returns to scales, legitimating 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 well significant at this stage of estimations.

More interesting, our estimations verify that differences in the investment climate participate in firms' *TEs* discrepancies. This is true for all aspects of the investment climate, 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.

Table 6. Estimation Results: Common Model with Individual *IC* Variables
(Dependant Variable: Value Added)

Independent Variables	**Textile**	**Leather**	**Garment**	**Agro Industry**	**Metal& Machinery Products**	**Chemic & Pharm Products**	**Wood & Furniture**	**Non Metal & Plastic Materials**
ln(l)	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)****
ln(k)	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)****
Intercept	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)***
Size	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)*
Foreign	-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)*
Export	-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)*
RegElect	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)*
RegWeb	-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)*
Cred	-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)***
AccessF	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)
Training	-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)*
EduM	-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)***
ExpM	-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)*
RegLregul	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)*
RegCorrup	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)*
Constant	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)****
Observations	942	380	1601	1494	838	695	774	480
sigma_u	0.75	1.69	0.77	0.90	1.46	0.75	1.10	0.64
sigma_v	0.86	0.81	0.54	0.43	0.76	0.46	0.57	0.67
Wald chi2	1351.45	2787.67	241.01	1306.40	2484.52	1060.30	1321.23	300.67
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. 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.

This finding appears, 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[31]. 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 should be more 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 be able to compete efficiently.

As for Business-Government 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 probably 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 as a determinant of productivity in only one sector: *Garment* (what is a reasonable result for this sector, knowing the high export rate in some developing countries). Identically, regressions results are poor in two sectors: *Leather* and *Wood & Furniture*[32]. These difficulties explain why we decided to focus our analysis on a few composite indicators of investment climate. These indicators are tested econometrically in the next section.

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 much more *IC* variables than previously[33]. 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:

$$\ln(y_{i,j}) = c_i + \acute{\alpha}_1 \ln(l_{i,j}) + \acute{\alpha}_2 \ln(k_{i,j}) + \beta\, Size_{i,j} + \gamma\, Foreign_{i,j} + \delta\, Export_{i,j}$$

$$+ \varepsilon_1 RegInfra_{i,j} + \varepsilon_2\, {}_{,}RegGov_{i\,j} + \varepsilon_3\, Human_{i,j} + \varepsilon_4\, Finance_{i,j} + c + v_{i,j}: \qquad (10)$$

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 which four dimensions are now significant with the expected sign[34]. 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.

Table 7. Estimation Results: Common Model with Aggregated *IC* Variables

(Dependant Variable: Value Added)

Independent Variables	Textile	Leather	Garment	Agro Industry	Metal & Machinery Products	Chemic &Pharm Products	Wood & Furniture	Non Metal & Plastic Materials
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

Findings by industry bring, as well, quite interesting comments. Human capital (*Human*), Infrastructure (*Infra*), and Financing Constraints (*Finance*) appear to be the most statistically significant investment climate factors for firm-level productivity. All three broad indicators explain quite well 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 front of a deficit of their 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 conclusions of the previous model. As mentioned before, this result may be due to the fact that most of these industries face international competition. This fragility justifies that a 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 don't always better explain productivity. This is somehow the case of *Metal & Machinery Products* and *Agro-Processing*, but essentially of *Garment* for which a very few aspects of the investment climate seem to help firms to perform better[35]. No improvement is seen, either, in *Leather*, which is again poorly explained by the model. This loss is, however, largely compensated by the tremendous gain of information through the large set of *IC* variables now explaining firm-level productive performances, as well as by the validation of another variable of interest: the Government-Business Relation (Gov)[36].

Another addition of the model consists in validating the role of more plants characteristics in explaining firm-level Technical Efficiency. This is the case of the variable *Size*, which justify scales economies in four industries instead of two previously: *Wood & Furniture* and *Leather* in addition to *Agro-Processing* and *Chemicals & Pharmaceutical Products*. This constitutes an interesting result that would justify a policy of concentration of small enterprises, which importance in developing countries is well known. Concentration could be seen as a powerful means of boosting 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*), what confirms the exposure to international competition of these two industries. Increase the export capacity of some industries appears, though, as another mean to stimulate firm's efficiency and to contribute to industrial take off.

7- Conclusions

In this paper, we show that MENA manufacturing enterprises perform in average poorly compare 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*). Exception is Morocco, whose various measures of productivity rank close to the ones of the most productive countries. These average low performances have been linked to MENA investment climate deficiencies, which are adding to the cost born by the firms and handicapping MENA industrial efficiency and competitiveness.

To explain MENA disparity in industrial performances, we have focused on the role of four broad measures of investment climate, generated by the *PCA* of a large set of *IC* variables. We show that differences in quality of various infrastructures, in experience and level of education of the labor force, in cost and access to financing, as well as, to a lower extent, in several dimensions of the government-business relation explain in a significant way 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 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, as well as of export capacities. Our result shows, therefore, that enhancing investment climate constitutes a powerful engine for productivity and competitiveness of the manufacturing industry, as well as for industrial take off.

Our study allows, moreover, identifying some industries where technical efficiency depends particularly on investment climate limitations. This is the case of *Textile* and *Metal & Machinery Products*, as well, to a lower extent, of *Non Metal & Plastic Material and Garment*. An improvement of various dimensions of the investment climate (depending on the sectors) would show a comparatively stronger impact in these industries, which could then play a leading role in the development of an efficient manufacturing industry. This result constitutes all the more an important means of appreciation of the positive impact of investment climate improvement, since MENA suffers a deficient integration into the world economy. Our results show, in addition, that in some industries, the size and to a lower extent the export capacity appear as another means of boosting industrial efficiency, thus competitiveness. In fact, with the implementation of a broad economic reform agenda, MENA's export-capacity strengthening could become a priority. Improving manufacturing productivity could thus represent a powerful factor of economic growth and convergence of the MENA region. Targeting reforms on small and medium enterprises, as well as on those investment climate variables and industries that most favor productivity and competitiveness could constitute an important element of a national strategy of growth and employment.

Actually, like other developing countries, MENA is increasingly concerned about improving competitiveness and productivity, as the region face the intensifying pressure of globalization. The World Bank firm-surveys provide a standard instrument for identifying key obstacles to firm-level performances and prioritize policy reforms. This instrument can 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 diversify their economy and benefit, in addition, from low labor costs.

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Annex 1: List of Countries

MENA*	LAC	AFR	SAS	EAP
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)			

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

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

Sources: Authors' calculations.

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

Textiles
Nobs: 1998

	TE	TFP	LP
TE	1		
TFP	0.7077*	1	
LP	0.7615*	0.6012*	1

Leather
Nobs: 634

	TE	TFP	LP
TE	1		
TFP	0.7703*	1	
LP	0.6427*	0.6756*	1

Garment
Nobs: 2796

	TE	TFP	LP
TE	1		
TFP	0.5571*	1	
LP	0.5675*	0.6370*	1

Agro-Processing
Nobs: 2184

	TE	TFP	LP
TE	1		
TFP	0.7047*	1	
LP	0.7814*	0.5861*	1

Metals & Machinery Products
Nobs: 1604

	TE	TFP	LP
TE	1		
TFP	0.7483*	1	
LP	0.7762*	0.6810*	1

Chemicals & Pharmaceutic Products
Nobs: 1270

	TE	TFP	LP
TE	1		
TFP	0.7349*	1	
LP	0.7542*	0.6270*	1

Wood & Furniture
Nobs: 1031

	TE	TFP	LP
TE	1		
TFP	0.8456*	1	
LP	0.8885*	0.7532*	1

Non-Metallic & Plastic Materials
Nobs: 901

	TE	TFP	LP
TE	1		
TFP	0.7394*	1	
LP	0.8028*	0.6293*	1

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

Notes

[1] See at the macroeconomic level Bosworth and Collins (2003); Djankov and 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 and al. (2005); Eifert and 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).

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

[7] Measuring productivity in level, 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 allows, in particular, unbalanced panels with short term dimension, measurement errors, or constant value of *IC* variables (see Escribano and Guasch, 2005).

[8] Although there is a wide range of choices as regard 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).

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

[10] The year of the survey is into brackets. *Lebanon* and *Saudi Arabia* are, however, less represented than the other countries of the region. In the case of *Lebanon*, the low number of observations makes sometimes results difficult to interpret. For *Saudi Arabia*, firms' surveys cover only 3 of the 8 branches 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 is of 20% to 25% for the whole sample of countries, what is lower than for MENA. This means that answers in MENA were, in average, less satisfactory than in the other countries of the sample. As for the contribution of MENA to the whole sample, when estimating the production frontiers, it varies from 11% in *Wood & Furniture* to 37% in *Non Metal & Plastic Materials* (25% in average for the whole manufacturing industry, see Annex 2), what is a bit less than, but consistent with, the contribution of MENA to the initial sample.

[12] This percentage is of 45 in the whole sample, what shows that firms in MENA 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.

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

[14] We ensure to get a sufficient number of observations by city and sector.

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

[16] The choice of an adequate exchange rate depends, among other things, on the exchange rate regime of the country. In 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 Labor Productivity (*LP*). For Total Factor Productivity (*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. Using current exchange rate introduces, as well, a bias for example when fixed exchange rate policy leads to an overvaluation of the currency or when the floating rate suffers from overshooting.
Current exchange rate has the advantage to represent 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 dollar, are surely more problematic for our analysis. *PPP* conversion rate is useful when comparing purchase 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, 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.

[17] In the surveys, data on Total Purchases of Raw Materials (excluding fuel) are more available compared to those on Direct Raw Material Costs.

[18] It can be noted that firms in *Saudi Arabia* seem to perform very well in the sectors covered by the survey (*Agro-Processing, Metal & Machinery Products,* and *Wood & Furniture*).

[19] Interpretation of results is, however, more difficult for some countries. This is the case of *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 two surveys for *Morocco* and *Egypt* allows more than one hundred observations by branch. *Morocco,* for example, benefits from 500 enterprises in *Garments*. In *Saudi Arabia*, firms present quite good productive performances, although most of the branches suffer also from a relative small number of observations. In *Wood & Furniture*, firm-level *TFP* is one of the highest of the sample. This result confirms the conclusion reached for Productivity of Labor.

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

[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).

[26] The principal components of the initial variables were extracted for each aggregated indicators. 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 eighenvalues 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^2). 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).

[28] We will recall that the Value Added is calculated as the "Total Sales" – "Total Purchase of Raw Material" (excluding fuel).

[29] The new literature on international trade associates firms' size with increasing returns to scale, market imperfections and product heterogeneity linked to technological innovation. The literature on corporate governance, as well, 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 previous estimation (see table 5).

[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*). On the opposite, *Agro-Processing, Chemical & Pharmaceutical Products, Garment,* and *Textile* display a broader set of factors explaining firms' productivity gains.

[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 obstacle for the operation of the firms. On the opposite, *H* being constituted of variables which are supposed to improve Technical Efficiency, a negative coefficient is expected for this variable (see section 5 for the definition of the axes of the composite indicators).

[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.*