Parametric Meta-Technology Frameworks to Study Technical Efficiency of PPP development: comparative study MENA zone and Latin America

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Keywords : Directional meta-technology; directional technology-gap ratio; directional distance functions; Public-private partnership; MENA zone; America Latin zone.

Abstract The evolution of economic theory towards economic liberalism, observed since the 1970s, has accelerated the processes of deregulation and privatization. The ideology of the government has a strong influence on the processes of deregulation and privatization in the MENA and Latin America countries.

A doctrine, economic ideology adopted by the government determines how all elements of the economic system of the country work. However, only those which affect the success of PPP will be discussed.

The development divergence of PPP between different zones is a reality that we cannot hide. From this starting point, we view that each zone has its specific economic features. These features influence the development of PPP significantly. In fact the technology under which operates the country of each zone is not the same as the others. For this reason, to study cross-zone PPP efficiency, it's necessary to model for each zone (MENA zone and Latin America) its specific technology. After that, from theses different technologies we can construct an envelope technology that includes all the specific-zone technologies.

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1 INTRODUCTION

The Public-Private Partnership (PPP) is defined as a management concept allowing the State to entrust a private company with the design, financing, construction, management and maintenance of public equipment for a limited long period of time, which often depends on the depreciation period of the infrastructure and the financing arrangements.

The Public-Private Partnership remains one of the tools that decision-makers and public authorities have to encourage the increase of investment in infrastructure, while facing budgetary constraints.

In the past, the financing, construction, ownership and operation of infrastructure was exclusively the responsibility of the public sector. At present, since many governments can no longer afford to assume this role and this responsibility, PPPs are now emerging as an alternative that can sometimes offer advantages over conventional ones.

PPPs remain common as a mode of management around the world, particularly in the transport, utilities sector and collective equipment. In agriculture, the recent development of PPPs in irrigation meets different needs in terms of accelerating the pace of investment, avoiding the recurrent problems of unsustainable management of large collective perimeters and creating favorable conditions for the development of agriculture.

The interests of this type of partnership lie in the off-budget financing for the public partner, the high rate of return for the private partner, the short lead times for the projects included in this type of collaboration and the availability and quality of the public service provided. The PPP makes it possible to achieve an optimum of each stakeholder of the project realized in this context: a socio-economic optimum for the public partner, a financial profitability for the private partner and an acceptable fee for the consumer of the service provided.

The main theoretical foundations of Public-Private Partnerships can be summarized in four major theoretical approaches: transaction cost theory, agency theory, incomplete contract theory, and property rights theory.

Also, it is also important to note that economic theory sees PPPs as having the pros and cons not only of partnership, but also of the nature of the public-private relationship that is considered a particular relationship.

It is from this angle that we will try to analyze the partnerships and study their efficiency by comparing between two study areas, the MENA zone and Latin America.

1.1 Model

Arrogant a sample of K zone $k = (1,2 \ldots K)$ and the country in each zone operate under a zone-specific technology T^k. It is defined as the set of all possible pair of input and output and usually articulated as follow:

$$T^k \equiv \{(x,y) : x \geq 0, y \geq 0; x \text{ can produce } y\} \qquad (1)$$

Where $x \in \Re_+^N$ denote the input vector, while $y \in \Re_+^M$ denote the output vector for each country

Hayami and Ruttan (1971) describe the meta-production function as the envelope of commonly conceived production functions. Referring to this explanation, Battese and Rao (2002) and Battese et al. (2004) identify the meta-technology concept T^* as an over-arching technology, which envelops technology of each zone. The meta-technology function can be presented as follows:

$$T^* \equiv \begin{Bmatrix} (x,y) : x \in \Re_+^N, y \in \Re_+^M; \\ x \text{ can produce } y \text{ at least in one country technology } T^k \end{Bmatrix} \qquad (2)$$

The meta-technology can be also expressed as follow:

$$T^* \equiv \text{Convex Hull}\{T^1 \cup T^2 \cup \ldots \cup T^K\} \ (3)$$

The technology T can be completely characterized by the directional technology distance function originally introduced by Chambers et al (1996). This function allows a country to obtain the optimal composition of input and output by searching simultaneously the maximum of expansion and contraction of inputs and outputs respectively. It is generally expressed as:

$$\vec{D}_{T^k}(x,y;g_x g_y) = \max\{\beta^k (x - \beta^k g_x, y + \beta^k g_y) \in T^k\} \ (4)$$

Where β^k gives the distance between the observation $\boldsymbol{(x,y)}$ and a point on the technology frontier defined for the zone k, while $g = (g_x, g_y)$ is a directional vector, with $g_x \in \Re_+^N$ and $g_y \in \Re_+^M$ establishing the direction in which technical efficiency is measured. It is generally assumed that $(g_x, g_y) = (1,1)$. In the case where $\vec{D}(x,y;g_x g_y) = 0$, the country is considered technically efficient. While if $\vec{D}(x,y;g_x g_y) > 0$, the country is assumed to be technically inefficient.

Indeed as we have defined the meta-technology T^* above, we conceptualize the directional meta-technology distance function $\vec{D}_{T^*}(x,y;g_xg_y)$ assumed to be an envelope function of the directional technology distance functions of the different countries and can be expressed as follows:

$$\vec{D}_{T^*}(x,y;g_xg_y) = \max\left\{\beta^*(x-\beta^* g_x, y+\beta^* g_y)\in T^*\right\} \tag{5}$$

For a given zone k, and as a result of the meta-technology definition we have:

$$\vec{D}_{T^*}(x,y;g_xg_y) \geq \vec{D}_{T^k}(x,y;g_xg_y) \tag{6}$$

We parameterize the directional distance function as Färe et al. (2005) did, and we opt for a quadratic flexible functional form that must satisfy the restrictions imposed by translation property and restrictions for symmetry. Thus, the directional distance function is parameterized as follows:

$$\begin{aligned}\vec{D}(x,y;g_x,g_y,t,\theta) &= \alpha_0 + \sum_{n=1}^{N}\alpha_n x_n + \sum_{m=1}^{M}\beta_m y_m + \\ &1/2\sum_{n=1}^{N}\sum_{n'=1}^{N}\alpha_{nn'}x_n x_{n'} + 1/2\sum_{m=1}^{M}\sum_{m'=1}^{M}\beta_{mm'}y_m y_{m'} + \\ &\sum_{n=1}^{N}\sum_{m=1}^{M}\gamma_{mn}y_m x_n + \delta_1 t + 1/2\delta_2 t^2 \\ &+ \sum_{n=1}^{N}\psi_n t x_n + \sum_{m=1}^{M}\eta_m t y_m + \varepsilon\end{aligned} \tag{7}$$

- ✓ Usual symmetric restrictions

$$\alpha_{nn'} = \alpha_{n'n} \quad n \neq n'$$

$$\beta_{mm'} = \beta_{m'm} \quad m \neq m' \tag{8}$$

- ✓ Restrictions imposed by the translation property

$$\sum_{m=1}^{M}\beta_m g_y - \sum_{n=1}^{N}\alpha_n g_x = -1$$

$$\sum_{n=1}^{N}\gamma_{nm} g_y - \sum_{m'=1}^{M}\alpha_{nn'} g_{x'} = 0$$

$$\sum_{m'=1}^{M}\beta_{mm'} g_{y'} - \sum_{n=1}^{N}\gamma_{nm} g_x = 0$$

$$\sum_{m=1}^{M}\eta_m - \sum_{n=1}^{N}\psi_n = 0 \tag{9}$$

Where $\theta = (\alpha,\beta,\gamma,\delta,\eta,\psi)$ is the parameter vector to be estimated whereas $\varepsilon \overset{iid}{\mapsto} N(0,\sigma_\varepsilon^2)$ presents the random error term and the trend variable explains technical progress.

In the first step, we must estimate the parameters of the frontier $\theta^k = (\alpha^k,\beta^k,\gamma^k,\delta^k,\eta^k,\psi^k)$ of each zone k by using a deterministic linear programming procedure proposed by Aigner and Chu's (1968).

In a second step, using MATLAB software, we estimate the parameters of the meta-frontier $\theta^* = (\alpha^*,\beta^*,\gamma^*,\delta^*,\eta^*,\psi^*)$ that envelopes the estimated stochastic frontiers for the different zone.

In the third and final step, we can estimate the directional technology gap ratio for each zone. This index allows to classifyzones that have countries which are more efficient than the others.

Battese et al. (2004) have introduced the notion of technology gap ratio in the cases of output distance function and input distance function. In this paper we will develop this concept in the case of a directional distance function and it will be named the directional technology gap ratio.

The directional technical efficiency of each country of an observed input-output combination is defined as:

$$DTE^k(x,y) = \vec{D}_{T^k}(x,y;g_xg_y) \tag{10}$$

The directional technology gap ratio can be defined using the directional technology distance function from technologies T^k and T^* as:

$$DTGR^k(x,y) = \frac{\vec{D}_{T^*}(x,y;g_xg_y)}{\vec{D}_{T^k}(x,y;g_xg_y)} \tag{11}$$

Using the definition of directional technical efficiency the directional technology gap ratio can be defined as

$$DTGR^k(x,y) = \frac{DTE^*(x,y)}{DTE^k(x,y)} \tag{12}$$

A new decomposition of the directional technical efficiency for an observed pair (x, y) can be assessed at the meta-technology.

$$DTE^{*}(x,y) = DTE^{k}(x,y) * DTGR^{k}(x,y) \quad (13)$$

This equation shows that directional technical efficiency measured while referring to the meta-technology can be decomposed into the product of the directional technology efficiency assessed with reference to the zone-specific technology “k” and the directional technology gap ratio between the zone-specific technology “k” and the meta-technology.

This directional technology gap ratio, developed above, is an indicator of the distance between the directional technology frontier of the zone-k and the directional meta-technology frontier. Indeed, we suggest that if the average of directional technology gap ratio calculated for a zone-k is the smallest, then this country is classified as technically more developed than other zones, because its technology is assumed to be the nearest to the meta-technology frontier.

To improve the effect of the macroeconomic divergences between MENA zone and the Latin American zone we model the directional technology gap ratio as a linear function of a set of exogenous factors presented by the macroeconomic variables. Due to our data structure we opt for a panel linear regression. The time-invariant specific-zone part of the error term is correlated with the explanatory macroeconomic variables. Likewise, while basing ourselves on *Hausman*test, we choose the fixed effects regression rather than random effects because in our case the use of random effect regression provides biased results. The model is depicted as follows:

$$DTGR^{k}(x,y) = \zeta_0 + \zeta_i Z_{it} + \vartheta_{it} \quad (14)$$

Where ζ_0 is the specific-zone effect, Z_{it} is a vector of observed exogenous factors that are assumed to influence the directional technology gap ratio, ζ_i is a vector of parameters to be estimated and $\vartheta_{it} \overset{iid}{\mapsto} N(0,\sigma^{2}_{\vartheta t})$ is an error term.

1.2 Meta-frontier graph

In a two dimension plan of one input one output, T^{*} presents the meta-technology frontier, $\{T^1, T^2 \ldots T^k\}$ were T^k designates the technology frontier of the zone k, and $(-g_x, g_y) = (-1,1)$ is the directional vector (figure 1).

Let’s take the case of the frontier T^1 in Figure 1**;** the vectors’ distance $\vec{AB}$ and $\vec{AC}$ indicate respectively $\vec{D}_{T^1}(x,y;g_x g_y)$ and $\vec{D}_{T^*}(x,y;g_x g_y)$. Whereas the difference between the two vectors $\vec{AC} - \vec{AB}$ gives the vector distance $\vec{BC}$, this vector indicates the distance between the technology frontier T^1, of zone1, and the meta-technology frontier. We can explain this example as follow: to operate efficiently country $A(x,y)$ must reduce its input by the amount β^1 and increase its output by the same amount β^1. It will be then located at the point $B(x-\beta^1, y+\beta^1)$. Thus this country becomes domestically efficient, but not internationally efficient. Indeed to be internationally efficient, this country $A(x,y)$ must reduce its input by the amount β^* and increase its output by the same amount β^*.

2 EMPIRICAL APPLICATIONS

2.1 Dataset and variables definition

2.1.1 Dataset

Our study concerns a comparative study between the countries of two zones Zone MENA and Latin America for the period from 2006 to 2015.

The list of countries in our study presented in the following table

The list of countries in MENA zone	The list of countries in Latin America zone
Algeria	Brazil
Bahrain	Mexico
Egypt	Colombia
Iran (Islamic Republic of)	Argentina
Iraq	Peru
Israel	Venezuela
Jordan	Chile
Kuwait	Ecuador
Lebanon	Guatemala
Libya	Cuba
Morocco	Haiti
Oman	Bolivia
Qatar	Dominican Republic
Saudi Arabia	Honduras
State of Palestine	Paraguay
Syrian Arab Republic	Nicaragua
Tunisia	El Salvador
United Arab Emirates	Costa Rica
Yemen	Panama
	Uruguay

Having defined the methodological approach to be followed, we focus on the selection and measures of variables. Input output definition

To apply our model empirically, we must specify at first that input and output are used in the production process.

2.1.2 Variables definition

Output variable	
Y1it	variable to explain: the number of public-private partnership contracts in a region i, in year t.
Y2it	the amount of public-private partnership contracts in a given region i, in year t
Imput variable	
x_1	GDP per_capita
x_2	inflation rate
x_3	public expenditure GDP
Control variable	
z_1	governance efficiency
z_2	corruption control

Table 1 : Descriptive statistics of variables by zone

		Mena	America Latin
Inputs			
x_1	Mean	15.57	8,494
	SD	20.74	6,196
x_2	Mean	6.17	2.6
	SD	5.59	3.1
x_3	Mean	5.89	7.2
	SD	7.55	4.7
Outputs			
y_1	Mean	2.67	3.65
	SD	3.23	4.74
y_2	Mean	39835.54	52086.00
	SD	40758.04	63138.78
Control variable			
z_1	Mean	70.692	98.995
	SD	70.438	92.223
z_2	Mean	38.915	63.222
	SD	18.868	12.196

Notes: This table reports the mean and the cross-sectional standard deviation (SD) of each variable by zone. Notations used in the table are defined as follows: x_1 = GDP per_capita.; x_2 = inflation rate; x_3 = public expenditure GDP; y_1 = number of ppp contract ; y_2 = amount of ppp contract;; z_1 = governance efficiency; z_2 = corruption control .

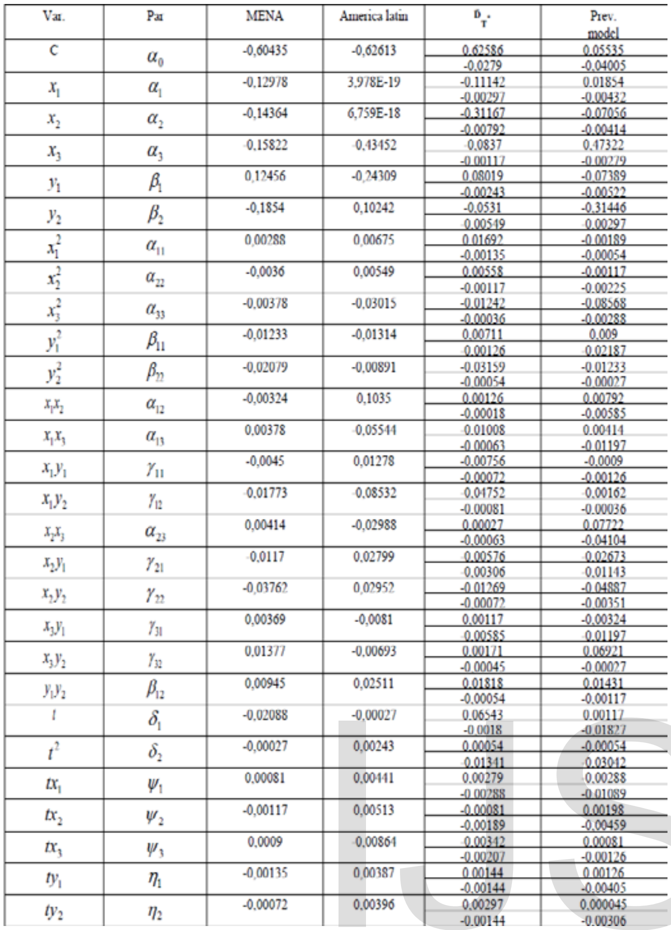
2.2 Results and Interpretation

For the purpose of the present study, we are attracted to analyze cross country differences in mean efficiency levels of PPP and to determine the macroeconomic divergences effect on the PPP system efficiency of each zone. First, we attempt to define the efficiency levels of PPP based on a common frontier by pooling the data set of all countries, as well as on separate zone-specific technologies for each country. As a result, we obtain different productive efficiency estimates for each zone frontier, the meta-technology and the common technology frontiers of the PPP (see table 2). The output and input specifications and other variables turned out to be statistically significant for the two models, meta-technology model and common technology model.

Usually, most studies estimate a common technology frontier without holding account of different factors that can influence the different country. These approaches do not allow us to adequately compare efficiency levels across zone. However, the meta-technology approach allows us to properly compare technical efficiency levels and to determine potential differences between zone.

Table 2 reports the zone-specific technology estimated parameters. The last two columns of this table show the estimated parameters of the meta-technology and the common technology, respectively, using a parametric linear programming. Standard errors attached to these frontiers are obtained through a parametric bootstrapping method. Treating the sample as if it were the population, we randomly draw with replacement for 1000 new datasets of the same size as the original sample. For each generated dataset, the new meta-frontier parameters are estimated by linear programming. Therefore, there are 1000 parameter estimates for each coefficient. The estimated standard error of a meta-frontier parameter is calculated as the standard deviation of the 1000 new parameter estimates. However, there are substantial differences between the meta-technology coefficients and the corresponding coefficients of the common technology. Moreover, we observe that the majority of the bootstrapped standard deviations of the meta-technology parameters are relatively small to the corresponding coefficients in the common technology. As a consequence the estimated parameters of the meta-technology are more significant than those of the common technology.

Table 2: Parameters estimation of Frontiers and meta-frontier technology



Var.	Par	MENA	America latin	$\vec{D}_T^*$	Prev. model
C	α_0	-0,60435	-0,62613	0.62586 -0.0279	0.05535 -0.04005
x_1	α_1	-0,12978	3,978E-19	-0.11142 -0.00297	0.01854 -0.00432
x_2	α_2	-0,14364	6,759E-18	-0.31167 -0.00792	-0.07056 -0.00414
x_3	α_3	0,15822	0,43452	0.0837 -0.00117	0.47322 -0.00279
y_1	β_1	0,12456	-0,24309	0.08019 -0.00243	-0.07389 -0.00522
y_2	β_2	-0,1854	0,10242	-0.0531 0.00549	-0.31446 0.00297
x_1^2	α_{11}	0,00288	0,00675	0.01692 -0.00135	-0.00189 -0.00054
x_2^2	α_{22}	-0,0036	0,00549	0.00558 -0.00117	-0.00117 -0.00225
x_3^2	α_{33}	-0,00378	-0,03015	-0.01242 -0.00036	-0.08568 -0.00288
y_1^2	β_{11}	-0,01233	-0,01314	0.00711 0.00126	0.009 0.02187
y_2^2	β_{22}	-0,02079	-0,00891	-0.03159 -0.00054	-0.01233 -0.00027
x_1x_2	α_{12}	-0,00324	0,1035	0.00126 -0.00018	0.00792 -0.00585
x_1x_3	α_{13}	0,00378	0,05544	0.01008 -0.00063	0.00414 -0.01197
x_1y_1	γ_{11}	-0,0045	0,01278	-0.00756 -0.00072	-0.0009 -0.00126
x_1y_2	γ_{12}	0,01773	0,08532	0.04752 -0.00081	0.00162 -0.00036
x_2x_3	α_{23}	0,00414	-0,02988	0.00027 -0.00063	0.07722 -0.04104
x_2y_1	γ_{21}	0,0117	0,02799	0.00576 0.00306	0.02673 0.01143
x_2y_2	γ_{22}	-0,03762	0,02952	-0.01269 -0.00072	-0.04887 -0.00351
x_3y_1	γ_{31}	0,00369	-0,0081	0.00117 0.00585	-0.00324 0.01197
x_3y_2	γ_{32}	0,01377	-0,00693	0.00171 -0.00045	0.06921 -0.00027
y_1y_2	β_{12}	0,00945	0,02511	0.01818 -0.00054	0.01431 -0.00117
t	δ_1	-0,02088	-0,00027	0.06543 -0.0018	0.00117 -0.01827
t^2	δ_2	-0,00027	0,00243	0.00054 0.01341	-0.00054 0.03042
tx_1	ψ_1	0,00081	0,00441	0.00279 -0.00288	0.00288 -0.01089
tx_2	ψ_2	-0,00117	0,00513	-0.00081 -0.00189	0.00198 -0.00459
tx_3	ψ_3	0,0009	0,00864	0.00342 -0.00207	0.00081 -0.00126
ty_1	η_1	-0,00135	0,00387	0.00144 -0.00144	0.00126 -0.00405
ty_2	η_2	-0,00072	0,00396	0.00297 -0.00144	0.000045 -0.00306

Notes: This table reports the mean and the cross-sectional standard deviation (SD) of each variable by zone. Notations used in the table are defined as follows: x_1 = GDP per_capita.; x_2 = inflation rate; x_3 = public expenditure GDP; y_1 = number of ppp contract ; y_2 = amount of ppp contract;; z_1 = governance efficiency; z_2 = corruption control .

Comparing the inefficiency scores, we find a considerable variation between the inefficiency scores assessed from the common frontier and those assessed from the meta-technology, respectively (see table 3). The Mena zone have recorded the average inefficiency scores as follow: 0,2901 0,1989 0,2264 comparing with American Latin zone (0,1527 0,2143 0,2615)arising from the common, zone-specific, and meta-technology frontiers, respectively. Inefficiency scores, for most PPP systems, resulting from the common model seem to underestimate the efficiency level for the sample zone. As we have supposed at the beginning of this study, the hypothesis of simple common technology to compare PPP efficiency induces a strong bias across-zone comparisons and yield misleading results. This view is supported by prior findings in the literature. Also noting that, the order of zone, while taking account of the efficiency criteria as a basis, has changed from the model of a common frontier to the meta-frontier model. The most efficient PPP system is that of the Latin American zone with an average inefficiency score of 15.27% referring to the common frontier model.

On the other hand, referring to the meta-frontier model, the most efficient PPP system is that of MENA zone with an average inefficiency score of 19.90%.

Table 3: Efficiency estimate by Zone

		MENA zone	America latin
Model 1		0,2597	0,1734
Model 2	$\vec{D}_T^k$	0,1799	0,1754
	$\vec{D}_T^*$	0,2156	0,2157
Model 1		0,3507	0,1697
Model 2	$\vec{D}_T^k$	0,1864	0,1879
	$\vec{D}_T^*$	0,2469	0,2546
Model 1		0,3449	0,1357
Model 2	$\vec{D}_T^k$	0,2154	0,2548
	D_T^*	0,2234	0,2977
Model 1		0,2539	0,1510
Model 2	$\vec{D}_T^k$	0,2143	0,1945
	$\vec{D}_T^*$	0,2314	0,2514
Model 1		0,2242	0,1394
Model 2	$\vec{D}_T^k$	0,1738	0,2165
	$\vec{D}_T^*$	0,1954	0,2549
Model 1		0,3073	0,1468
Model 2	D_T^k	0,2235	0,2564
	$\vec{D}_T^*$	0,2459	0,2945
Model 1		0,2901	0,1527
Model 2	$\vec{D}_T^k$	0,1989	0,2143
	D_T^*	0,2264	0,2615

Notes: This table reports a comparison of the average annual inefficiency scores estimated by the model 1 and model 2 for each zone reported by year and for all the period. Model 1 is the common technology frontier. In the model 2 the inefficiency scores are assessed first referring to the zone-specific technology frontier $\vec{D}_T^k$. In a second stage we assess the inefficiency scores referring meta-technology frontier $\vec{D}_T^*$.

The directional technology gap ratio is too imperative to managers as well as government policy-makers. This ratio assesses the possible enhancement in efficiency by changing the governance countries system. In addition to governance (in this study introduce conditions, the government has the possibility to change the Implementation of PPP. for that we used 2 controls variables to explain the quality of the governance (governance efficiency and corruption control).

Noting that zone-specific technology, in extreme cases, can be only tangent to the meta-technology; in this case, the directional technology gap ratio equals one. From table 4, we note a considerable divergence between the average values of directional technology gap ratio between the two zones. From this table, we observe during our period of survey, that the little value of this ratio is 1.077 is assigned to the Latin American zone. While the highest value of directional technology gap ratio is 1.22 and it is assigned to Mena zone.

Table 4: The directional technology gap ratio by Zone

	MENA	America Latin
DTE^{k}	0,1799	0,1477
DTE^{*}	0,2156	0,1579
$DTGR^{k}$	1,1984	1,0691
DTE^{k}	0,1864	0,1721
DTE^{*}	0,2469	0,1925
$DTGR^{k}$	1,3246	1,1185
DTE^{k}	0,2154	0,1988
DTE^{*}	0,2234	0,2164
$DTGR^{k}$	1,0371	1,0885
DTE^{k}	0,2143	0,1842
DTE^{*}	0,2314	0,2151
$DTGR^{k}$	1,0798	1,1678
DTE^{k}	0,1738	0,1964
DTE^{*}	0,1954	0,2132
$DTGR^{k}$	1,1243	1,0855
DTE^{k}	0,2235	0,1764
DTE^{*}	0,2459	0,1987
$DTGR^{k}$	1,1002	1,1264
DTE^{k}	0,1989	0,1793
DTE^{*}	0,2264	0,1990
$DTGR^{k}$	1,1383	1,1099

Notes: Different notations used in this table are defined as follows: DTE^{k} : the directional technical efficiency for country k ; DTE^{*} : the directional technical efficiency assessed from the meta-technology; $DTGR^{k}$: directional technology gap ratio for country k.

To study the effect of cross-country governance divergences on the directional technology gap ratio value, we model this.

Table 5: governance effect on the directional technology gap ratio

variables	Coefficients	t-ratio	Probability
corruption control	-0.0020341	-2.7505	0.0238
governance efficiency	0.0066149	3.5468	0.0013
Fixed Effects Menazone 0.017870 Latin America zone 0.013012			
R-squared	0.8297		
Adjusted R-squared	0.7564		
Prob.(F-statistic)	0.000000		

3 CONCLUSION

The development divergence between different zones is a reality that we cannot hide. From this starting point, we view that each zone has its specific economic features. These features influence the development of PPP significantly. In fact the technology under which operates the country of each zoneis not the same as the others. For this reason, to study cross-zonePPP efficiency, it's necessary to model for each zone its specific technology. After that, from theses different technologies we construct an envelope technology that includes all the specific-zone technologies.

Our results show that, first the estimated parameters of the meta-technology frontier are more significant than those of the common technology frontier. Second we find a significant divergence in the results between the two frontiers, the zone order has been changed and most inefficiency scores become underestimated in the meta-technology approach. Third, in assessing the directional technology gap ratio we discover that the PPP Latin America system is technologically the least developed, whereas PPP MENA system is technologically the most-developed one while referring to the other PPP systems of our sample. Finally, the regression of this ratio on the governance indicators gives us a significant influence of the corruption control and the governance efficiency. Therefore, the concluding remark of these regression results is that each zone must minimize the corruption control and increase the governance efficiency to insure the technological development of its PPP system.

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