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115

SUMARIO

William Orlando Prieto Bustos y Joan Miguel Tejedor Estupiñán. Technical efficiency of local public institutions in Colombia

Gerardo José Ruiz-Rico Ruiz y Gerardo Ruiz-Rico Ruiz. Orientaciones legislativas para futuras políticas sociales en la nueva ley del deporte de Andalucía
Dharmabrata Mahapatra, Dukhabandhu Sahoo y Mrinali Mahanti. Growth and Inequality at the sub-regional and sub-sectoral level: Case of Service sector of Odisha, India

Alberto Turnes Abelenda y Xavier Vence Deza. Una aproximación a los flujos interterritoriales no explícitos derivados de la ejecución de obra pública financiada por el Estado en las CCAA. El caso de Galicia 2005-2012

Julio César Alonso Cifuentes y Jacobo Campo Robledo. Relación entre los niveles de precios de las siete principales ciudades de Colombia: Evidencia para el periodo 2000 – 2014

Esther Rando Burgos. La ordenación del territorio en Baleares bajo el prisma de la gestión territorial: Las Áreas de Reversión Territorial

Isaac Martín Lupiáñez. La atracción migratoria de las ciudades turísticas y la transformación del sistema urbano litoral mediterráneo español. Un análisis a escala local del período 1991 a 2011

Recensiones y reseñas bibliográficas

Documentación

I. Artículos

Technical efficiency of local public institutions in Colombia

Eficiencia Técnica de las Instituciones Públicas Locales en Colombia

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SUMMARY

The impact on local public government efficiency over poverty levels were estimated for 23 major cities in Colombia in 2010 by implementing a Data Envelopment Analysis followed by a Tobit model, as proposed in the recent literature on public efficiency analysis. The output is a *Multidimensional Poverty Index*, whereas institutional capacity is considered as an input, and it is measured using a *Fiscal Performance Index* (FPI) and a *Transparency Performance Index* (TPI). This allows to establish the extent of possible improvements of local institutions relative to the best practices frontier, and to identify which environmental factors are relevant when explaining the differences among relative efficiency scores. The main finding suggest that poor institutional settings increase the cost of poverty reductions, which means that all cities in the sample could improve performance on poverty without increasing spending. In terms of environmental factors population, unemployment rate, informal labor market share, and the distance of each city to the central government capital have negative impacts on the efficiency score, while internet access have a positive impact on the efficiency score for the sample of cities.

RESUMEN:

Utilizando un modelo teórico recursivo basado en la sinergia cognitiva medida por cinco dimensiones (económica, judicial, civil conflictiva, geográfica y urbana) como restricciones para permitir mejores resultados sobre la calidad institucional, la investigación muestra un vínculo entre el entorno económico, social y político con la eficiencia pública en los gobiernos locales. Los impactos sobre la eficiencia del gobierno público local de los diferentes niveles de avance para cada dimensión fueron estimados para 23 ciudades principales en Colombia en 2010 mediante la implementación de un Análisis de Envolvente de Datos seguido de un modelo Tobit, similar al que se ha propuesto en la literatura reciente de análisis de eficiencia pública.

1. INTRODUCTION

Evaluating municipal public-sector efficiency is considered a critical aspect in the management by results of decentralized public institutions. In particular, the effects that efficient municipal governments have on local development represent a growth factor in economic development, since they are associated with better results in the provision of adequate quantity and quality of public services. Recent specialized literature had shed light over the link between the relevance of public efficiency measurement to both policy making and accountability of local public governments. Among this research Balaguer-Coll (2004), Prior and Tortosa-Ausina (2004), Afonso and Fernandes (2005), Balaguer-Coll and Prior (2011), Pérez-López, Zafra-Gómez and Prior-Jiménez (2013), Antonis A., Manthos D. y Pantelis K. (2008) have shown how empirical estimations of public efficiency at a local level can be reached using both parametric and non-parametric methods given a input – output model identification in a given institutional setting.

The institutional setting for public institutions at local level in Colombia was changed in 1991 when the 1886 political constitution was replaced by a new constitution that has led the country towards a new decentralized public management era. According to article 237 of the new political constitution, territorial entities will become more autonomous in pursuing their own interests because of the political, administrative and fiscal instruments designed to transform the previous centralized public administration model. The expected result of this new institutional setting was that a public local administration where democratic processes, competence and function delegation, and budget management were the rule of law, will improve institutional quality of public institutions to provide goods and services relevant to local development. Since then, departments and municipalities have chosen their own governments to manage local public budget in order to provide services in education, health, water, culture, housing, social security, environment, sports and recreation, and transport among others. In this sense, public decentralized governments now finance their actions to fulfill its constitutional duty through both through a national participatory system managed by the central government, and local taxes.

Giving the new decentralized public management framework, this paper focuses on 23 cities in Colombia to shed light on the relationship of decentralization and better local government practices. In this sense, it provides new evidence on the Latin American context about how efficiency measurement can be linked to institutional improvements at local level, in terms of discouraging corruption and improving outcomes in poverty levels at the same time. Therefore, the results add to previous knowledge concerning local public institutions in Colombia and in Latin America according to which there is a margin of improvement in public

efficiency levels, when its performance is understood as a function of discretionary and non-discretionary factors. This is substantial for economic development in Colombia due to the relevance of public institutions at local level on areas that have been affected by internal conflict which had weakened the capacity of local communities to organize themselves around public initiatives. Knowing how much public institutions can be actually improved by local efforts will endure political mechanisms giving it the type of leadership that is required to shield the recently peace accord from political and economic rent seekers, which are an structural cause of violence in Colombia.

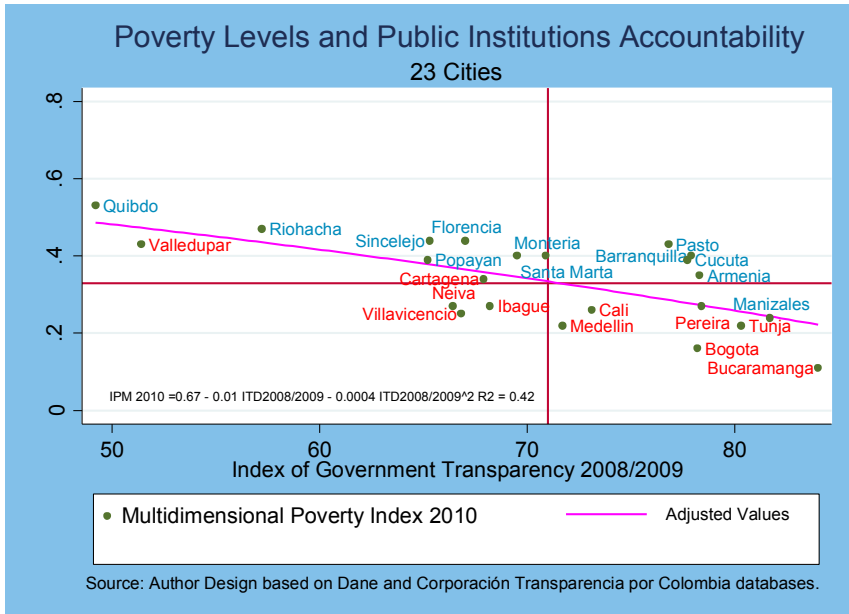
Therefore in this paper, an evaluation of public expenditure efficiency of a sample of Colombian municipalities is proposed by fitting a two stage Data Envelopment Analysis. In the first stage input and output relative efficiency scores are obtained in a model with an input variable defined either as a Fiscal Performance Index or a Transparency Performance Index, and an output variable defined as undesirable output measured by the Multidimensional Poverty Index. In the second stage, the relative efficiency scores become an independent variable of a Tobit model that uses environmental factors to explain gaps in local government performance. The sample of municipalities are chosen mainly because of information availability on input and variable of interest, giving the identification of the DEA and Tobit models. The sample of municipalities is also relevant at national level as long as it contains capital cities that are considered by the National Department of Planning (NDP) as urban centers with higher density levels, above the average economic performance, higher fiscal resources, and better quality of life which includes environmental care and lower criminal activity. As it is expected each municipality among the sample faces different challenges when implementing actions to reduce poverty levels, so that in the second stage a Tobit analysis is implemented to take into account environmental variables put together into five dimensions: (1) Economic performance, (2) Justice and violence, (3) Armed conflict, (4) Geographical factors, and (5) Urbanization factors.

The paper is organized as follows. Section 2, describes the motivation and stylized facts on local public administration in the chosen sample of cities. Section 3, presents a literature review on relative efficiency of local municipalities. Section 4 explains the methods including a DEA analysis as a way to estimate poverty reduction best practices, and a Tobit Model to study the effect of contextual factors on the distribution of local public government efficiency scores. Section 5 outlines the main findings of the research, whereas section 6 discusses the main results. The last section contains the main conclusions.

2. MOTIVATION AND STYLISED FACTS

The theoretical hypothesis on which institutional quality is related with social outcomes is depicted in charts 1 and 2. Poverty levels measured by the Multidimensional Poverty Index (MPI) in 2010 and the institutional quality measured by the Index of Government Transparency (IGT) in 2008 and 2009, show a negative average adjustment slope, indicating that the departments with institutional best practices measured by the index of transparency led to more significant reductions in the poverty rate (Chart 1). Also, the IPM is negative related with fiscal performance measured by a Fiscal Performance Index (IDF) as shown in Chart 2.

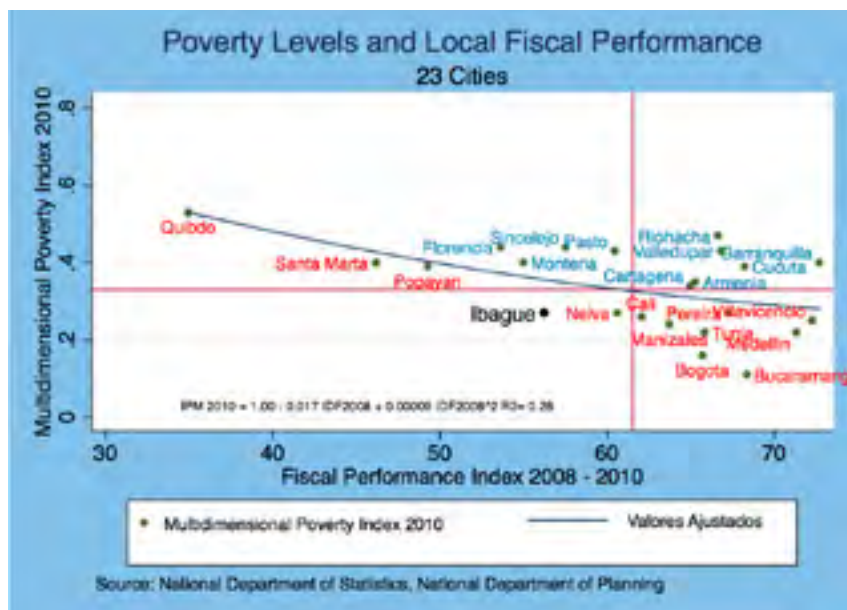
CHART 1



Why is there an inverse relationship between the fiscal performance and public transparency poverty outcomes? The hypothesis of this research suggests the existence of conditions that promote better governments in terms of management of public finances and accountability, in the cities whose performances on poverty outcomes are above average. In other words, cities with better public finances management and, where there is less lack of transparency or

corruption, are cities where the institutional quality improves, making it feasible to reach better results in the poverty strategy implementation.

CHART 2



3. LITERATURE REVIEW

Evaluating municipal public-sector efficiency is considered a critical aspect in the management by results of decentralized public institutions. In particular, the effects that efficient municipal governments have on local development represent a growth factor in economic development, since they are associated with better results in the provision of adequate quantity and quality of public services. The evidence in European literature shows the possibility of having municipal performance indicators that measure the relationship between resource usage and provision of services associated with improvements in the quality of life. The works of Balaguer-Coll (2004), Afonso and Fernandes (2005), Borger and Kerstens (1996), Boetti, Piacenza, y Turati (2010), Worthington and Dollery (2001), Balaguer-Coll and Prior (2010), Boetti, Piacenza, and Turati (2010), Giménez and Prior (2003), Bigerna Polinori

(2014), Balaguer-Coll, Prior D. and Tortosa-Ausina (2004), Borger et al (1994), Pérez-López, Zafra-Gómez and Prior-Jiménez (2013), García- Rubio, González-Gómez, and Guardiola (2013), Benny, Friedrich, and Kalb (2010), Nieswand and Seifert (2011), El Mehdi and Christian Hafner (2013), Kalb (2009), describe technical efficiency models of the municipal public sector where a relationship exists between input, product and quality in the provision of public services. The possibility of evaluating the management by results of public entities associated with the new models of decentralization of public administration proposed by these studies, suggests the relevance of having a measurement of the administrative capacity of local public entities to define the margin of public administration actions, be it to obtain better results with a different and optimized allocation of public resources, or to achieve the same results with less use of public resources.

Some of the most interesting facts in the reviewed literature of local public administration performance measurements in Europe indicate, in all cases, the existence of a margin of management of the local public administration to optimize the use of public resources. In particular, the level of efficiency of the municipal public sector is affected by both non-discretionary and discretionary factors. Of the non-discretionary factors of public management, the ones that stand out are: average household income, education level, geographical distance, population structure, pressure on key resources for human subsistence (such as water and electricity), the degree of rurality, and commercial activity. In terms of discretionary factors, the political budget cycle stands out, along with fiscal revenues defined either as subsidies and transfers, or as own revenues. According to the available evidence, there is a relationship between the nature of the income and the efficiency results. In this way, the municipalities that finance their current expenses with a greater share of own revenues in relation to subsidies and transfers, register better efficiency results. This implies a confirmation of the positive effects of decentralization for public administration. Even when the results are sensitive to internal factors of the public administration (such as the political ideology of the mayor), the institutional environment plays a preponderant role when explaining the variations in the estimation of municipal management efficiency, while defining the source and the use of public resources. Three relevant aspects that emerge from the literature reviewed in Europe have to do with the positive effects on efficiency increase in public resource usage when there is higher electoral participation, the relevance of isolating the relationship between production and quality of public services at a given level of resources, and the greater capacity of the private sector to reducing costs.

Technical efficiency studies in Australia have similar findings to those in Europe. The works of Woodbury and Dollery (2003), Worthington (2000), Worthington and Dollery, (2001), and Worthington and Dollery (2000), present evidence of the relevance of non-discretionary factors related to geographical and demographic conditions of the municipalities. However, they emphasize the capacity of regional councils in

the provision of service planning and regulation services as a discretionary aspect associated with the lower efficiency of rural municipalities compared to urban municipalities. Likewise, they point to the restrictions in combining inputs and products as an important source of inefficiency of local administrations. In particular, the legal expenses associated with the planning process are relevant when explaining the efficiency of urban municipalities, while the excessive hiring of personnel is configured as the main source of inefficiency in rural municipalities. Likewise, the inclusion of quality measures in the estimation of efficiency indexes produces few notable differences, which suggests a reduced influence of the quality of public services on the productivity of the local public administration sector.

Regarding the ability to reduce public administration costs, the institutional deregulation through which public-private partnerships are reached is an important element in the work of Po-Chi Chen et al (2009), MA García-Rubio, F González-Gómez, J. Guardiola (2013). At first instance, deregulation is effective so long as it implies the possibility of sharing resources and the inclusion of private governance advantages in public administration. This expands the possibilities of identifying performance models for public administration, while the provision of public services, both in quantity and quality, can be affected by political and budgetary institutions, as well as the fiscal capacity of the municipalities. In this way, the work of Lars-Erik, Falch and Tovmo (2007) describes the relevance of strong political leadership and high democratic participation as elements that favor increases in the efficiency of the local public administration.

Measuring performance of the local public administration is assumed to be associated with better public management practices, particularly in the provision of public services. However, the difficulty of measuring lies in the choice of outputs and inputs defined by a public governance that is not mediated by the market. Worthington (2001) indicates the complexity of measuring when there is a production function with multiple objectives which involves multiple inputs and products with visible results in the long term. This is the case of the efficiency of public administrations when providing the education service. The results that are initially attributed to a certain public management are inseparable from the improvements in skills in another area of public management. Regardless of the complexity of the public activity that increases the sensitivity of the efficiency estimates to the selected output, what is expected from the point of view of management by results is that the performance measurements affect the budgetary decisions, as documented by Melkers and Willoughby (2005) regarding the use of performance indicators that involve a comparative evaluation with external entities.

4. METHODS

To achieve the objectives of the research, a two-stage method is implemented. In the first stage, a DEA model is adjusted to estimate efficiency scores. In the second stage, a Tobit model is fitted to capture the effect of contextual factors of the distribution of the efficiency scores.

4.1. *Scope of the research*

The main aim of the paper is to provide empirical evidence for the determinants of local institutional quality for local public governments in 23 cities in Colombia. The research hypothesis assumes that there is a relationship between the institutions defined as formal and informal restrictions on which the economic incentive structure is displayed, with economic development measured by poverty reductions. For this purpose, a DEA model is adjusted for two particular specifications in which the *Multidimensional Poverty Index* (MPI) is considered a preferred outcome. In the first model, the input variable is a *Fiscal Performance Index* (FPI) and in the second model the input variable is a *Transparency Performance Index* (TPI). While the input variables are considered institutional variables by which local public institutional performance is assessed, the measured output variable is considered an economic development variable as it means reaching lower poverty levels. Thus, the relationship between institutions and economic development is presented from the perspective of the best practices of local public institutions. This institutional hypothesis have been explored previously in the literature of economic growth by Keefer, P & Knack, S. (1998), Kalmanovitz S.(1999), Lin, Justin and Nugent, Jeffrey, (1995), North D. (1994), Picciotto, R.and Wiesner, E. (1998), and Ugur (2010).

The gap for each local public institution of each capital city is defined by efficiency coefficients estimated using DEA models. A Tobit analysis of determinants is identified by declaring five economic, political and social dimensions, so that the effect of institutional quality can be obtained. The economic dimension is defined by per capita income levels, a “doing business” index that measures transaction costs, unemployment levels and informal market shares. The dimension of justice and violence consists of a justice efficiency partial index estimated using the number of claims admitted and the number of sentences known, along with the homicide rate for each city. The dimension of armed conflict is depicted through the number of battles with the guerrillas and the number of people displaced by the armed conflict. The geographical dimension, defined to capture political decentralization effects, is estimated by the distance of each major city to the central government capital, measured in kilometers. Finally, the dimension of urbanization in urban centers considers the urban population and internet ac-

cess, measuring the percentage of total population with internet access. Thus, institutional efficiency is controlled by the environmental factors pertaining to each of the 23 major cities in the study.

4.2. *DEA Framework*

From a theoretical perspective, efficient institutions are more frequent when there is a strong interaction between politic, cultural, economic, and scientific layers of local environments where public action takes place. In other words, where appropriate conditions don't exist to develop an intangible capital accumulation that makes the essential components such as creativity, tacit knowledge, science and technology, and leadership, it is likely that institutional quality with the same amount of resources will be lower, meaning that inefficient public institutions will be highly sensitive to initial political power endowment in a path dependence trajectory. In the literature of local development and endogenous growth there is an increasing trend to acknowledged the relevance of such factors when explaining growth regional gaps as it is presented in Albuquerque, F. (1997), Benhabib and Spigel (1994), Boisier S. (2009), Bosier, S. (1999), Cohard, J. (2009), Lucas, R. (1998), and Vázquez Barquero, A. (2005).

Institutional assessment focuses on public institutions (including the municipalities) to the extent that they have a comparative advantage relative to private institutions in the provision of incentives to align individual interests with collective interests. Therefore, the specification of an institutional scope on which the collective subject is determined is limited by the provision of credible and sustainable legal and behavioral frameworks defined by the production of public goods with increasing returns including justice, education, national defense, and health. Public sector failures, due to imperfect markets that distort the provision of services, restrict the private and public incentives' alignment, impeding simultaneously endogenous development and social transformation while reducing growth opportunities. However, institutional quality exceeds public goods provision as long as it contains elements including creativity, tacit knowledge and leadership that often times cover absent public local efforts at a local level. Therefore, public goods and institutional quality do not have the same nature regarding political and economic impacts on local endogenous growth initiatives.

For estimating the optimal frontier of best practices for the public institutions, the Data Envelopment Analysis (DEA) was implemented following the representation suggested by Farrell (1957) and later developed by Charnes et al. (1978). A detailed review of the theoretical development for the DEA methodology can be found in Cooper et al. (2004). Also, Emrouznejad et al. (2008) and Diamond A. & Medewitz J. (1990) present a review of empirical applications made during the last 30 years. Equally important

are the works related with the method for measuring the public sector of Crawford I., Klemm A., Simpson H. (2003), Coelli T.J. (1995) and Selva, M. L. M., Medina, R. P., & Marzal, C. C. (2014). Comparatively to the parametric methodologies, two advantages in using the DEA non-parametric approach stand out. First, the methodology does not require imposing functional assumptions on the frontier shape nor in the distribution of data, or on error's distribution of a parametric regression. A second advantage is the reduced information requirements necessary to obtain reliable efficiency scores compared with the large data requirements for reliable estimates of parametric models. The major disadvantage to the methodology underlies parametric sensitivity to measurement error because adjustments are made to the observed data instead of the average data. The main references regarding the DEA application in public organization environments considered in this paper are Antonis A. et al. (2008), Afonso, A., et al. (2006), Afonso, A. (2005), and Cherchye L. (1998) where estimates related to the Human Development Index of relative efficiency are presented, the performance of macroeconomic indicators, and public-sector performances respectively.

The DEA model assumes each city hall has a certain level of institutional quality which represents a potential reduction on poverty levels. The model is oriented to inputs and includes the constraint that allows variable returns to scale. Such a transformation alternative is described by the following function:

$$MPI_i = f(Y_i), \forall i, 1, \dots, n \quad [1]$$

Where MPI_i represents the results in a multidimensional poverty index for each city hall and Y_i represents the institutional quality for each local public institution i . When $MPI_i < f(Y_i)$ city hall i becomes inefficient at a given institutional quality level Y_i to reduce poverty levels measured by MPI because there are other city halls that using the same level of institutional quality reach lower poverty levels. Equation [1] does not impose any particular assumption regarding input/output relationship because it does not use particular forms of the production function.

The linear optimization problem through which the inefficiency index is estimated can be described as a comparison of institutional technologies in a space of inputs and outputs. The inputs are represented by the revenue's management practices (either by a Fiscal Performance Index or a Transparency Performance Index) available to achieve reductions in poverty and the products represented by reductions in the output y_i defined by Multidimensional Poverty Index (MPI). Institutional technology space can be described as a combination of input and output vectors so that the optimal boundary will consist of a combination of best practices in using resources concerning obtaining products. Charnes et al. (1978), and Cooper et al. (2007) described a mathematical approach of the method of data envelopment analysis. When calculating the distance of each city hall to the best practice, the model solves the optimization problem presented in equation (2).

$$\begin{aligned}
 & \text{Min } \theta \\
 & \theta, \lambda \\
 \text{s.a. } & -y_i + Y\lambda \geq 0 \\
 & \theta x_i + X\lambda \geq 0 \\
 & \lambda \geq 0 \\
 & n1' \lambda = 1
 \end{aligned} \tag{2}$$

The linear program described in (2) aims to estimate the parameters θ and λ for each municipality. The variable θ is an estimation of the efficiency score of each municipality in using inputs for reaching a given level of output. When $\theta_i = 1$, the municipality i is efficient because it reaches a constant level of output using a lower level of inputs, compared to the sample of municipalities. When $\theta_i < 1$, the municipality i is inefficient because it reaches the same constant level of output but with a higher level of inputs, compared to the sample of municipalities. The variable λ is estimated to create a virtual optimal frontier of best practices and it indicates how relevant is each efficient municipality on the optimal virtual frontier. The data used to estimate θ and λ is taken from the matrix X and matrix Y that contain the inputs and outputs of all municipalities in the sample, while x_i and y_i represent the inputs and outputs of the municipality that is being evaluated. Finally, the constraint $n1' \lambda = 1$, provides convexity to the optima frontier allowing it to have variable returns to scale.

Because the inputs are a Fiscal Performance Index (FPI) and a Transparency Performance Index (TPI), lower levels of inputs are understood by the model as having a better institutional efficiency in allocating public resources to reduce poverty. In this sense, the model is fitted to emphasize the impact of better institutional practices on poverty. Then the estimation is oriented to inputs due to fact that the municipalities have control on their own institutional practices under decentralization of public administration.

Once θ and λ has been calculated the sample of city's halls are organized according to their results in three different categories: weak efficient institutions, strict efficient institutions, and inefficient institutions. When using more inputs than those technologies classify as optimal, then it would be considered a weak efficient institution because there is a waste of resources compared with best practices. When it uses the same amount of inputs by those technologies on the optimal frontier in achieving the same outputs then it will be considered a strictly efficient technology because there is not waste of resources. Finally, when it uses the same amount of resources, but it reaches a lower output compared with the optimal frontier practices then it will be considered an inefficient decision unit.

4.3. The Tobit Model

Because the DEA model does not specify any feature of the local productive systems relevant to understanding institutional development, a second stage of analysis is implemented using a Tobit model. The purpose of the model is to explore the main characteristics of the efficiency score distribution among local governments. To identify main sources of change on the local efficiency distribution, five different dimensions of local economic systems were included: (1) Local economy performance, (2) Local performance on justice administration and violence reduction, (3) Local armed conflict related with the presence of guerrilla encounters, (4) Distance in kilometers to the central administration, and (5) Local urbanization. Each of these 5 dimensions were measured with selected variables to fit the following Tobit model:

$$ES^* = \beta_0 + X\beta + \mu, \mu|X \sim \text{Normal}(0, \sigma^2) \\ ES = \max(0, ES^*) \quad [3]$$

Where ES^* is the local efficiency scores estimates, and X is a vector of independent variables containing five different dimensions of local economies.

Data for the Fiscal Performance Index (FPI), the Multidimensional Poverty Index (MPI) and the Transparency Performance Index (TPI) come from the National Department of Planning, the National Department of Statistics, and Transparency for Colombia initiative. The FPI and the MPI are available for 2010, while the TPI is available for 2008/2009. The FPI reflects general characteristics of the financial management of local authorities related with income and expenditure management, sustainability of spending and saving capacity. IDF measures fiscal management of every municipality regarding risk, vulnerability, sustainability and creditworthiness on a scale of 0-100 where values near zero indicate a lesser performance while values near 100 reflect a higher performance. Concerning the MPI index, Angulo (2011) describes it as an index that measures poverty based on performance in five dimensions: educational conditions, children and youth, labor, health, and housing and utilities. Each of these components has a similar relative weight on which the aggregation is performed. A greater deficiency in any of the sub-indexes that make up the different dimensions implies a higher percentage of families in poverty. Finally, the TPI measures the risk of corruption as a lack of fulfilling public institution protocols in visibility, institutional enforcement, and sanction and control. Visibility refers to insufficient capacity to get transparency of their actions. Institutional enforcement concerns the lack of capacity to get public employees to work according to the established norms. Sanction and control are related with the insufficient capacity to apply internal sanctions when needed.

To identify the determinants of local institutional quality, technical efficiency coefficients for each of the local governments in 23 cities were contrasted with variables within the economic and social environment. The environmental variables that affect the quality of local institutions are defined in five dimensions. The economic dimension is described by per capita income, transaction costs of doing private business, the unemployment rate, and informal market share. The justice and violence dimension is depicted by a partial index of the judiciary system efficiency and the frequency of homicides in each city. The armed conflict is composed by numbers of battles with guerrillas groups and an index of displaced population. The geographical dimension is used to capture political decentralization factors by measuring distance in square kilometers from the central government capital. Finally, the urban dimension uses the number of inhabitants living in urban centers and the number of people with internet access. Table 1 describes each dimension according to the expected impact, variables, units and sources of data.

Two pitfalls of model fitting in the second stage related with the Tobit analysis are relevant. First, it reckons coefficients for only 21 cities and 11 independent variables for 2010 so that conclusions are sensitive to sampling issues. Second, the institutional endogeneity issue is left out of the economic identification model. Then, conclusions are also sensitive to the endogenous institutional issue if the assumption of exogenous relationship is not met. Therefore, the sample of municipalities are chosen mainly because of information availability on input and variable of interest, giving the identification of the DEA and Tobit models. Although the sample of municipalities is relevant at national level as long as it contains capital cities that are considered by the National Department of Planning (NDP) as urban centers with higher density levels, above the average economic performance, higher fiscal resources, and better quality of life which includes environmental care and lower criminal activity, it is not statistical representative of the universe of municipalities in Colombia. In terms of the econometric fitting, this means that the results of the Tobit model are representative only to the municipalities that are included in the sample so that those results can not be extended to all municipalities in Colombia. In this regard, having the expected economic relationship (coefficient expected sign) is considered evidence in favor of not rejecting the null hypothesis of environmental factors explaining gaps on the relative efficiency score for the municipalities in the sample.

TABLE 1
**DIMENSIONS, HYPOTHESES, AND DATA SOURCES FOR
 ENVIRONMENTAL VARIABLES**

Dimension	Hypotheses	Variables	Units	Source
Economic Performance	The economic dimension should have a positive effect on institutional efficiency as it approaches the impact of market development	Per capita income	Dollars	City Hall information.
		Transaction costs of doing business	Ranking prepared by the "Doing Business"	World Bank
		Unemployment rate	Number of workers seeking employment out of the total labor force	Colombian National Department of Statistics
		Informal Market Share	Number of production units with less than 10 workers	Colombian National Department of Statistics
Justice and Crime	The dimension of justice and crime to the extent it reflects greater judicial efficiency and fewer homicides should have a positive impact on institutional efficiency. Lower partial efficiency levels and higher homicides restrict individual and organizational leadership.	Efficiency of the justice system	Percentage of judicial claims entering the system of total sentences reached	Judicial Statistics of the Supreme Judicial Council.
		Homicides	Murders in each city	National Police criminal investigation branch.
Armed Conflict	The dimension of armed conflict should be negatively related to institutional efficiency to the extent that a greater amount of fighting and displacement reduce institutional capacity to diminish poverty	Fights with the guerrillas	Number of battles between the armed forces and the guerrillas in each city	Humanitarian Information Integrated System
		Displacement	Number of people displaced compared with number of people received in each city due to the armed conflict	Colombian government
Geography	It assumes that political decentralization is relevant to institutional efficiency. It determines the leadership of public organizations in the implementation of decentralization.	Distance of the central administration	Kilometers	National Geographic Institute
Urbanization	The dimension of urbanization suggests a positive impact on institutional efficiency to the extent that there is increased access to internet, and a negative impact on the extent where urban population increases	Population in urban areas	Percentage of the department's total population living in cities	Population Census 2005
		Internet Access	Percentage of internet users	Ministry of Communications

Source: Authors design.

5. RESULTS

Understanding the theoretical specification and the methodological approach established in the previous section, an optimal frontier of local public practices was estimated by using an input-oriented DEA model to local governments in 23 capital cities in Colombia. According to the identification of the economic model, the government has a comparative advantage in giving scope to the legal framework upon which private incentives are specified due to public goods provision. In this regard, local government has the power to make both physical and social investments seeking to strengthen and improve the lives of citizens by promoting economic development, but it has limited power to change institutional quality as an endogenous process at a local level. Then, a failure of the government in promoting institutional infrastructure and the implementation of the required investment due to regulatory capture of public interest by private interest, increasing political returns of organizations, and imperfect information on the political transaction, could be offset by a certain level of endogenous institutional accumulation. Therefore, institutional quality would be higher in environments where endogenous conditions are present regardless of public local government resources, offering to tackle economic development issues like poverty levels.

Two models were adjusted by following the DEA methodology. In the first model, a synthetic indicator of financial performance called the Fiscal Performance Index (IDF) is used as an input variable while the Multidimensional Poverty Index (MPI) is used as an output variable. Table 2 presents efficiency estimates made for the first non-parametric model.

The average efficiency index for the local governments for 23 capital cities is 0.76, meaning that the best practice frontier on poverty outcomes could be reached by improving the public institutions performance measured by the IDF in 24%. After discounting the effect of scale from differences in production technologies, the average efficiency is reduced to 0.60, implying a 40% gap to increase institutional performance. The best performance for 2010 is Bucaramanga while the worst performance was Quibdó. All cities have technologies with increasing returns to scale when comparing to the optimal frontier, but Barranquilla, Montería, and Bucaramanga are in the virtual best practice upon which all local governments are compared.

Using the sustainable and solvent categories proposed by a characterization given by the National Department of Planning (DNP, 2011) for the IDF, Table 2 presents a contrast with estimates of efficiency and pure efficiency (efficiency scores without scale efficiency). The sustainable category refers to an IDF between 70 and 80, while the solvent category is reached with an IDF greater than 80 in a scale of 0 to 100. In the first case, financial management allows a city hall to fulfill financial commitments, and concurrently it allows raising income to guarantee public invest-

ments. In the second case, financial management meets budget law requirements (Law 617 of 2000), and it also generates savings with higher public investment and a higher share of own resources related to what it receives from central government.

TABLE 2
EFFICIENCY ESTIMATIONS
MODEL 1
INPUT: FISCAL PERFORMANCE INDEX
OUTPUT: MULTIDIMENSIONAL POVERTY INDEX

City	IDF 2010*	IMP 2010**	Efficiency Score 1	1-IE	Efficiency Score 2	1-IEP	Returns to Scale
Neiva	77,99	0,27	0,82	0,18	0,48	0,52	Increasing
Pereira	79,23	0,27	0,82	0,18	0,51	0,49	Increasing
Florencia	80,05	0,44	0,63	0,37	0,41	0,59	Increasing
Armenia	80,17	0,35	0,73	0,27	0,47	0,53	Increasing
Quibdó	80,39	0,53	0,53	0,47	0,35	0,65	Increasing
Bogotá	80,98	0,16	0,94	0,06	0,64	0,36	Increasing
Riohacha	81,40	0,47	0,60	0,40	0,42	0,58	Increasing
Cartagena	82,26	0,34	0,74	0,26	0,54	0,46	Increasing
Cali	83,16	0,26	0,83	0,17	0,64	0,36	Increasing
Sincelejo	83,24	0,44	0,63	0,37	0,49	0,51	Increasing
Ibagué	83,36	0,27	0,82	0,18	0,64	0,36	Increasing
Tunja	83,53	0,22	0,88	0,12	0,70	0,30	Increasing
Villavicencio	83,59	0,25	0,84	0,16	0,66	0,34	Increasing
Popayán	83,85	0,39	0,69	0,31	0,56	0,44	Increasing
Pasto	84,06	0,43	0,64	0,36	0,52	0,48	Increasing
Valledupar	84,32	0,43	0,64	0,36	0,53	0,47	Increasing
Cúcuta	84,71	0,39	0,69	0,31	0,59	0,41	Increasing
Medellín	84,81	0,22	0,88	0,12	0,75	0,25	Increasing
Manizales	85,28	0,24	0,85	0,15	0,75	0,25	Increasing
Santa Marta	86,53	0,40	0,67	0,33	0,65	0,35	Increasing
Bucaramanga	87,01	0,11	1,00	0,00	1,00	0,00	---
Montería	88,50	0,40	0,76	0,24	0,76	0,24	Increasing
Barranquilla	89,43	0,40	0,83	0,17	0,83	0,17	Increasing
Average	83,38	0,33	0,76	0,24	0,60	0,40	

* DNP (2010) Desempeño fiscal de los departamentos y municipios.

**DANE

Source: Authors design.

There is an improvement in institutional efficiency when a local institution improves their IDF performance from sustainable to solvent. Subtracting the differences in production technologies, solvent cities have an efficiency score of 0.65 against 0.48 of sustainable performances. Then, reaching the optimal frontier cities with solvent institutions should increase their results by improving institutional performance by 35%, while cities with sustainable institutions should be have best practices by increasing their institutional performance by 52%. IDF ranges allows clarifying the relationship between financial management and actions for the development to the extent that better management implies greater saving's capacity, higher investment, greater capacity to generate own resources, reduce dependence transfers of central government and greater self-financing of the operating costs. Therefore, solvent institutions are closer than sustainable institutions to the optimal management frontier as it is shown on Table 3.

TABLE 3
FISCAL PERFORMANCE EFFICIENCY SCORES

IDF Category	City	%	Average Efficiency	1 – Average Efficiency	Average of pure technical Efficiency	1 – Average of pure technical efficiency
Sustainable	Neiva, Pereira, Florencia, Armenia, Quibdó	26	0,75	0,25	0,48	0,52
	Bogotá, Riohacha, Cartagena, Cali, Sincelejo, Ibagué, Tunja, Villavicencio, Popayán,					
Solvent	Pasto, Valledupar, Cúcuta, Medellín, Manizales, Santa Marta, Bucaramanga, Montería, Barranquilla.	74	0,76	0,24	0,65	0,35

Source: Authors design.

In the second model, a synthetic indicator of government accountability called the Department Transparency Index (ITD) is used as an input variable while the Multi-dimensional Poverty Index (MPI) is used as an output variable. The ITD is an analytical tool designed to identify institutional practices that increase the risk of corruption in public entities. The instrument allows local authorities to prevent corruption by facilitating the assessment of its institutional characteristics. Three elements make up the index: visibility factors, institutional factors, and control and punishment factors. Visibility factors identify issues such as e-government, accountability, advertising of local public planning, hiring practices, and citizen's services. Institutional factors relate to the areas of planning and management that include the existence of information systems management, structure planning, talent management and recruiting management. Finally, control and sanction factors measure aspects like

disciplinary management and fiscal responsibility. Table 3 presents efficient estimates to the second model.

TABLE 4
EFFICIENCY ESTIMATIONS. MODEL 2
INPUT: TRANSPARENCY PERFORMANCE INDEX
OUTPUT: MULTIDIMENSIONAL POVERTY INDEX

City	ITD 2008/2009*	IMP 2010	Efficiency Score 1	1-E	Efficiency Score 2	1-IEP	Scale Returns
Quibdó	49,2	0,53	0,53	0,47	0,17	0,83	Increasing
Valledupar	51,4	0,43	0,64	0,36	0,21	0,79	Increasing
Riohacha	57,2	0,47	0,60	0,40	0,22	0,79	Increasing
Popayán	65,2	0,39	0,69	0,31	0,32	0,68	Increasing
Sincelejo	65,3	0,44	0,63	0,37	0,29	0,71	Increasing
Neiva	66,4	0,27	0,82	0,18	0,39	0,61	Increasing
Villavicencio	66,8	0,25	0,84	0,16	0,41	0,59	Increasing
Florencia	67	0,44	0,63	0,37	0,31	0,69	Increasing
Cartagena	67,9	0,34	0,74	0,26	0,37	0,63	Increasing
Ibagué	68,2	0,27	0,82	0,18	0,41	0,59	Increasing
Santa Marta	69,5	0,40	0,67	0,33	0,35	0,65	Increasing
Montería	70,9	0,40	0,67	0,33	0,37	0,63	Increasing
Medellín	71,7	0,22	0,88	0,12	0,50	0,50	Increasing
Cali	73,7	0,26	0,83	0,17	0,49	0,51	Increasing
Pasto	76,8	0,43	0,64	0,36	0,44	0,56	Increasing
Cúcuta	77,7	0,39	0,69	0,31	0,49	0,51	Increasing
Barranquilla	77,9	0,40	0,67	0,33	0,49	0,51	Increasing
Bogotá	78,2	0,16	0,94	0,06	0,69	0,31	Increasing
Armenia	78,3	0,35	0,73	0,27	0,54	0,46	Increasing
Pereira	78,4	0,27	0,82	0,18	0,61	0,39	Increasing
Tunja	80,3	0,22	0,88	0,12	0,71	0,29	Increasing
Manizales	81,7	0,24	0,85	0,15	0,75	0,25	Increasing
Bucaramanga	84	0,11	1,00	0,00	1,00	0,00	---
Average	70,6	0,33	0,75		0,46		

*Transparencia por Colombia, ITD (2008/2009)

Source: Authors design

By using adjusted efficiency estimates for the IDF-MPI DEA model, the relative importance of each of the dimensions is fitted with a Tobit model following the specifications of Ji and Lee (2010), and Afonso et al (2006). Table 5 confirms several of hypotheses established for each environmental dimension.

TABLE 5
EFFICIENCY DETERMINANTS. TOBIT MODEL
DEPENDENT VARIABLE: IDF INSTITUTIONAL EFFICIENT COEFFICIENT

Dimension	Variable	Estimate
Economic	Log of income per capita	-0.0636435 (-1,53)
	Log of "Doing Business" index	0.1264397*** (2,84)
	Unemployment rate	-0.0159361*** (-3,45)
	Informal Market Share	-0.0067458** (-2,99)
Justice and Violence	Partial efficiency index	0.1918837 (1,35)
	Log of number of homicides	-0.0223102 (-1,28)
Geographical	Distance in square kilometers to the central government capital	-0.1255765*** (-3,88)
	Log of number of fighting encounters with guerrilla groups	0.039383 (1,59)
Armed conflict	Displaced population	-0.1091944 (-1,29)
	Urban Population	-0.0090443*** (-3,23)
Urban	Internet access	2.82306** (2,86)
	Estimated standard deviation	0.0336699
$\hat{\sigma}_\epsilon$	Number of observations	20

Source: Authors' design

$\hat{\sigma}_\epsilon$ Estimated standard deviation

Z statistics are presented in parentheses.

*, **, *** represents significance levels at 10, 5 and 1 percent respectively.

By using Transparency for Colombia (2009/2008) categories for the ITD, Table 3 presents a contrast with estimates of efficiency and pure efficiency. There are three categories for the Transparency Index: high risk, medium risk,

moderate risk or corruption. According to chart 1 and table 4, the higher the risk of corruption, the lower the results on poverty. Therefore, a strengthening in local capacities to reduce the risk of corruption is associated to better results on poverty levels and with the efficiency of public local institutions in reducing it. On average, a high risk local institution might increase by 80% its institutional performance results to reach the best practice frontier. However, a moderate risk local institution could increase their results in institutional performance by 36% to reach the best result among cities.

The Tobit analysis results suggest that in the economic dimension, the unemployment rate and informal market share have a positive impact over institutional efficiency, while the transaction costs business index increases institutional efficiency. The estimated impact of income per capita reflects an inverse relationship with the efficiency suggesting potential diversion of resources by taxation or by informality. In other words, per capita GDP relationship with the efficiency might be nonlinear so that there is a threshold at which the impact of successive increases in GDP per capita stops being negative and becomes positive.

In the dimension of justice and violence, justice sector efficiency in resolving cases, measured by numbers of sentences achieved regarding numbers of cases entering the system, improves public sector institutional efficiency, while a reduction in homicides increases institutional efficiency. In the geographic decentralization dimension measured by geographical distance, it was found that being further away from the central government capital reduces institutional efficiency. This result is contrary to what was expected, as political decentralization should have had a positive impact on individual and organizational leadership. However, here the component of path dependence might be greater than the synergy component, so that in some cities institutional development might be caught on a low-level equilibrium of institutional quality.

Armed conflict, measured by guerrilla battles with military forces, might have a positive impact on local institutional efficiency as it imposes an order in terms of local resources used to control violent acts. Displaced population is negatively related with institutional efficiency when the number of people entering a city's boundary are greater than the number of people leaving from the armed conflict. In the dimension of urbanization, an increase in the urban population reduces institutional efficiency, while increasing access to internet improves institutional capacity of the public sector. The standard deviation of the regression indicates a reasonable fit of the model to changes in institutional efficiency. The number of observations equals the number of observations used in Ji and Lee (2010) and Afonso et al (2006).

6. DISCUSSION

Regarding the recent literature on the topic and the current decentralization model of the public administration in Colombia, the paper contributes to policy making in three relevant ways. First, it provides a measurement of institutional capacity of local government in capital cities to reduce poverty, instead of focusing in a specific public service supply or in a combined index of performance. Second, it uses a non-parametric methodology where an optimal frontier analysis is implemented as an alternative to average regression analysis, when dealing to the modeling of the effects of lacking optimal institutional settings at a local level. Third, it uses a Tobit analysis to explore how institutional relative efficiency scores respond to environmental variables so as to explain differences in efficiency scores by controlling for socioeconomic variables. In this sense, the main innovation is to focus in the cost of having inefficient institutional settings allocating public resources to reduce poverty. In this sense and from a theoretical point of view, this research provides evidence on how institutions as organizations, namely public local governments, play a key role on improving local development to a point that local public administration practices affect results on poverty for a given level of public resources. Therefore, it gives evidence to understand the link between local public administration and local development so that policy makers can further identify both internal and external factors that may affect their effort to fulfill social demands.

The main finding of the research shows that the average efficiency index for local governments in 23 capital cities is 0.76 when the *Fiscal Performance Index* is the input variable, and 0.75 when the input variable is the *Transparency Performance Index*. In terms of an input oriented DEA model, the average results on technical efficiency for the two models mean that the best practice frontier could be reached by improving financial performance by 24%, by the same token, the best practice frontier could be reached by improving the transparency index in 25%. These results mean that local public institutions could actually increase their results on poverty reductions by improving its finance management and organizational practices.

The results also show that environmental control variables play a substantial role in explaining efficiency gaps. Within the five dimensions declared as environmental variables, what stands out is the positive impact of a lower transaction cost level measured by the ranking of the "Doing Business" index, the negative impact of the unemployment rate, and the negative impact of informal market share within the economics dimension, the negative impact of the distance of each city to the central government capital within the geographic dimension, the positive impact of internet access, and the negative impact of urban population

within the urban dimension. Both the justice and violence dimension and the armed conflict have the expected positive effect for increasing judiciary efficiency and the negative effect of force displacement due to internal conflict. But their estimated coefficients are not statically significant.

The empirical observation according to which there is an inverse relationship between institutional best practices in financial management and accountability with poverty results, provides an empirical base to study environmental conditions that could make a difference between the sample of cities. The suggested methodological approach used a two-stage analysis combining the first stage with the DEA model analysis and a second stage with the Tobit model analysis. Using data from 2010 of 23 cities in Colombia, institutional efficiency scores were calculated in the first stage and then used as a dependent variable in the second stage of the analysis.

From a theoretical and methodological approach, two efficiency frontiers were adjusted. The input used in the first optimal frontier is the IDF index while the second frontier uses the ITD index as an input variable. When comparing the estimated efficiency scores for both models, there was a high positive correlation between the top financial performance and less risk of corruption with the highest rates of poverty efficiency results measured by the IPM. This result agrees to the existence of a margin of management of the local public administration to optimize the use of public resources that have been found in previous work in Australia and Europe.

Albeit information constrains that affect the statistical inference in the second stage of the analysis, this results also agree with international evidence in Europe and Australia. In particular, the finding about the relevance of average household income, education level, geographical distance, and population structure as relevant non-discretionary factors of public management on previous studies, correlates to the negative impact of the unemployment rate, and the negative impact of informal market share within the economics dimension as well as having a negative impact of the distance of each city to the central government capital within the geographic dimension, the positive impact of internet access, and the negative impact of urban population within the urban dimension. In this sense, results are in the same line of previous work done by Balaguer-Coll (2004), Afonso and Fernandes (2005), Borger and Kerstens (1996), Boetti, Piacenza, y Turati (2010), Worthington and Dollery (2001), Balaguer-Coll and Prior (2010), Boetti, Piacenza, and Turati (2010), Giménez and Prior (2003), Bigerna Polinori (2014), Balaguer-Coll, Prior D. and Tortosa-Ausina (2004), Borger et al (1994), Pérez-López, Zafra-Gómez and Prior-Jiménez (2013), García- Rubio, González-Gómez, and Guardiola (2013), Benny, Friedrich, and Kalb (2010), Nieswand and Seifert (2011), El Mehdi and Christian Hafner (2013), Kalb (2009) in Europe, and previous work done by Woodbury and Dollery (2003), Worthington (2000), Worthington and Dollery, (2001), and Worthington and Dollery (2000), in Australia.

Also, this research shows results in the same line of analysis with recent literature when it concluded that among the determinants that are positively related with institutional efficiency, the ones that stand out are: transaction costs measured by an index of doing business, access to the internet, a partial index of the judiciary system efficiency, distance in square kilometers from the central government capital, the unemployment rate, the percentage urban population, the informal market share measured by productive units with less than 10 employees, number of homicides, and the number of displaced population due to the armed conflict.

In terms of discretionary factors, there exists several ways of improving current results. According to international evidence, the political budget cycle along with fiscal revenues defined either as subsidies and transfers or as own revenues, have a strong significant effects so that the nature of the income of local governments play a role on efficiency results. In this way, the municipalities that finance their current expenses with a greater share of own revenues in relation to subsidies and transfers, register better efficiency results. Moreover, the international results are sensitive to internal factors of the public administration (such as the political ideology of the mayor). This means that the institutional environment plays a preponderant role when explaining the variations in the estimation of municipal management efficiency, while defining the source and the use of public resources. Furthermore, international results show a strong relevance of isolating the relationship between production and quality of public services at a given level of resources when explaining efficiency gaps among local governments. Based on this, there are several futures venues to improve the current results besides increasing the number of observations in the sample. Particularly, including qualitative and quantitative variables to measure the relationship between the nature of the income and the efficiency results, will improve economic and statistical inference both for the sample and for the universe of municipalities. In this sense, the municipalities that finance their current expenses with a greater share of own revenues in relation to subsidies and transfers, may register different efficiency results. Also, including variables to measure the ability to reduce public administration costs through public-private partnerships is reached is an important element to improve current results. Having positive effects on these new dimensions will imply a strong confirmation of the positive effects of decentralization for public administration.

7. CONCLUSIONS

The main findings showed an average of public local efficiency of 76% when an input oriented DEA model is adjusted using a Financial Public Performance index (FPI) as input and the Multidimensional Poverty Index (MPI) as output. After correct-

ing for technology differences, public average efficiency score went down to 60%, meaning that the local government can increase their performance by 40% to reach the best practice frontier in poverty results measured by IPM. The best performer in both DEA models was the municipality of Bucaramanga, while de worst performer was the municipality of Quibdo. While the results are not to be expand to the whole population of municipalities in Colombia giving to sampling issues, the results show convergence to international evidence in terms of environmental factors. However, there at least two ways to improve current results besides increasing the number of observations all related to modeling discretionary factors. First, including quality variables in terms of municipality outputs. Second, including public organizational environment to capture the effects of the political cycle, the nature of fiscal revenues weather they are own resources o central government resources, and the ability to reduce public administration costs through public-private partnerships.

To narrow the gap performances between cities in reduction of unemployment levels, informal markets and transaction costs of doing business are required. There is also a positive significant impact of internet access and a negative impact of increasing urban population. The decentralization process is showing a negative impact over local public efficiency measured by the distance in kilometers towards the central government capital. Other relevant dimensions include the armed conflict and the judiciary system efficiency that show negative and positive impacts, as expected.

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