AN EMPIRICAL ANALYSIS OF ADMINISTRATIVE ECONOMIC EFFICIENCY IN SABAH LOCAL GOVERNMENT: A DEA APPLICATION

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ABSTRACT

Malaysian local government reform has been addressed through various public policies aimed at improving its performance over the decades. An important question which arises is whether these technological and management programs have translated into performance gains, particularly in the corporate centres of local authorities (LAs). Using a panel data of two inputs and four outputs from 2000 to 2012, a two-stage double bootstrap Data Envelopment Analysis (DEA) method is employed to estimate administrative technical efficiency (TE) in the corporate centres of 17 LAs in the Malaysian state of Sabah. The results showed an overall inadequate mean of TE scores and minor fluctuations in TE scores over the years under analysis, illustrating the rigidity of management performance. On average, the LAs recorded TE scores of 0.52, which implied that the LAs should be able to increase output by 48% while maintaining the same amount of input. The big urban LAs performed better with the TE scores of 0.60; while the small urban LAs recorded lower TE scores of 0.43. Further analysis demonstrated that the environmental variable, urban population bore a negative relationship to the TE scores. Several public policy recommendations are proposed.

Keywords: Local government; management performance; data envelopment analysis; technical efficiency; two-stage double bootstrap.

INTRODUCTION

Local government systems worldwide face daunting challenges, not least severe fiscal constraints, and the Malaysian local government is of no exception. Given the exogenous limitations on municipal revenue in almost all jurisdictions globally, local authorities (LAs) have sought to improve performance through efficiency gains and attendant cost savings. While the empirical literature focused largely

on performance improvement through structural reform (see, for instance, Lago-Penas and Martinez-Vazquez, 2013), very little effort has been expended on examining empirically corporate overhead costs in local government. This paper seeks to address this gap in the empirical literature by analysing the administrative efficiency in the local government system of the Sabah state in Malaysia.

Local government makes up the third tier of government in Malaysia, after the federal and state levels of government. Within the structure of any given local authority, its corporate centre plays an important part in determining the efficiency with which the council operates. A municipal corporate centre performs multiple roles, including coordination, human resource management, and financial oversight (Andrews & Boyne, 2011; Midin et al., 2017). The efficiency of the municipal corporate centre is thus crucial to the overall performance of the local authority.

Local government reform has occurred through various short-term and long-term official policies to improve the effectiveness and efficiency of service delivery over the decades. Among others, these policies include Total Quality Management, Smart Local Government and Governance Agenda, Accountability Index, Government Transformation Programme (GTP) and citizen-centric governance (EPU, 2001; 2015).

An important question which arises is whether these technological and management programs are translated into performance gains, particularly in the corporate centres of LAs. In general, there are three types of department in a Malaysian LA (a) core-corporate, (b) supporting departments and (c) operational departments. Corporate centres consist of core corporate and supporting departments. Ting et al. (2014) have provided a comprehensive account of the institutional background of corporate centres of Sabah LAs.

In Malaysia, there is a substantial literature on local government which encompasses management, service delivery, finance and accounting, and information and communications technology (ICT). However, there is a paucity of relative economic efficiency studies with respect to the administrative performance of the local government in Malaysia. At the same time, the voluminous international empirical literature of local government productivity and efficiency has concentrated on specific output-production plant level rather than administrative production level.

Despite the implementation of the above reform, the National Audit Department of Malaysia (NADM) has reported a significant degree of prolonged inefficiency in the corporate centres in LAs (see, for instance, NADM, 2003; 2004; 2006; 2008; 2011). The local government has taken various measures to improve the performance of corporate centres (Lian & Rainey, 2003; NADM, 2008). Nonetheless, the high

public expectation and soaring cost of local administration further complicate the performance of corporate centres. Thus, an empirical analysis of corporate performance in the Sabah local government represents both an interesting and useful avenue of investigation.

In essence, the authors investigate the administrative economic efficiency of LAs in the corporate centres of the local government in Sabah for the period of 2000 to 2012. Put differently, the authors examine only the administrative efficiency at the corporate centres' level. The investigation of the administrative efficiency of the municipal service delivery either at the individual plant or aggregated level is beyond the scope of this study. Ting et al. (2014) did not advocate any structural change of Sabah LAs since their empirical results on administrative scale economies analysis showed minor economies of scale. An alternative dimension of the efficiency measurement at the corporate centre resides in technical efficiency (TE).

From the perspective of policy-making, the empirical exploration of administrative TE could provide an additional insight of the possible efficiency improvement through management methods. The TE scores range between 0 and 1, with 1 indicating totally efficient of an LA. Performance measurement of TE is vital for evaluating and benchmarking performance, allocating budgets, promoting good governance, and sustaining resources (Krause et al., 2016).

The paper is divided into five main parts. Part 2 details the literature review of administrative intensity in the local government, while Part 3 outlines the model and methodology employed. Part 4 discusses the empirical results of the estimation process. The paper ends with some brief concluding remarks and policy implications in Part 5.

LITERATURE REVIEW OF ADMINISTRATIVE INTENSITY IN LOCAL GOVERNMENT

The relationship between administrative inputs and outputs is conceptualised in the administrative intensity literature. In general, administrative intensity is defined as the ratio of administrative personnel to production personnel (Melman, 1951). In general, the scholars use a set of independent variables such as output, institutional and environmental factors to examine its effect on the administrative input to determine the administrative intensity.

There is no consensus on what administrative outputs should be used to measure the administrative performance. In public administration, researchers employed various output indicators and these include (a) population (Andrews & Boyne,

2009; Avellaneda & Gomes, 2015), (b) employment (Kasarda, 1974; Haneda et al., 2012), and (c) own-source revenue (Lewis, 2006). Population remains the most widely used output indicator, despite debate on the use of population as an output (Boyne, 1995; Byrnes & Dollery, 2002). The choice of employment size as an output proxy also attracts criticism. The most obvious problem is the definitional dependency argument (Dogramaci, 1977; Millan & Daft, 1979) where the use of employees as a measure of output links inputs to each other.

The administrative inputs are represented by various indicators in the literature review, such as (a) administrative personnels (Clarke, 1982; 1983), (b) administrative expenses (Lewis, 2006; Andrews & Boyne, 2009), (c) administrative revenue (Haneda et al., 2012), (d) administrative personnel per capita (Kalseth & Rattso, 1995; 1998), and (e) geographical area (Haneda et al., 2012). The use of administrative inputs is also subjected to attack. For instance, administrative personnel are a heterogeneous variable in terms of quality, composition and amount of workload (Blau, 1972). This problem exists in LAs, particularly between big and small urban LAs, with the recruitment of employees focusing on administration in small urban LAs, while it is more technically orientated in big urban LAs, which further influences the administrative structure and its inputs.

In addition to output choice, most scholars also employ other independent variables to test their influence on the administrative intensity. Among others, these include political factors, structural complexity, socio-economic and environmental variables. The results of independent variables on the administrative intensity are mixed. Various methods are used by scholars to measure the administrative intensity, with the main emphasis on the method of ordinary least squares (OLS), followed by data envelopment analysis (DEA) and stochastic frontier analysis (SFA). Although widely used in the administrative intensity empirical literature, the average function or the OLS method is a misleading indicator of efficient production possibilities in both theory and practice (Worthington & Dollery, 2001).

Given the above theoretical and institutional challenges, the authors employ DEA to evaluate the administrative performance of Sabah LAs. There is a voluminous academic literature which relied on DEA to measure administrative efficiency at the local government level (Kalseth & Rattso, 1995; 1998; Haneda et al., 2012). However, Simar and Wilson (2007) contend that the use of DEA method has failed to account for serial correlation and bias of efficiency scores. Thus, Simar and Wilson (2007) developed a two-stage double bootstrap procedure which could solve these problems and lead to a more reliable result, which is detailed in the following section.

METHOD

Empirical Framework

Farrell (1957) proposed that the total economic efficiency (EE) of a firm consists of two components: (a) TE reflecting the firm's ability to obtain maximum output from a given set of inputs, and (b) allocative efficiency (AE) reflecting the firm's ability to use the inputs in optimal proportions, given their respective prices and production technology. The authors consider only TE as an indicator of performance, given minor economies of scale finding at the corporate centre (Ting et al., 2014).

A variable returns to scale (VRS) output-orientated DEA model is used to determine the estimates of TE of the LAs by employing the FEAR software program. The VRS output-orientated method is more suitable for measuring TE for three main reasons: administrative inputs are predetermined in annual budgets, rigidities of human capital (Hartog & van den Brink, 2007; Perrini & Vurro, 2010), and the limited recruitment of administrative personnel (Chua, 1997). It is thus advisable to hold inputs constant and seek the maximum possible proportional increase in administrative outputs.

In this paper, the authors use a two-stage approach to perform efficiency analysis. In the first stage, a DEA efficiency estimator is employed to get TE scores for individual LA. The authors specify the technology set as follows:

$$T = \{(x, y) \in R_+^{N+M} \mid x \text{ can produce } y\} \qquad (1)$$

where $x \in R_+^N$ is a vector of N inputs used to produce a vector of M outputs, $y \in R_+^M$. The upper boundary of *T*, which represents the technology frontier, is of interest of efficiency measurement. Inefficient LAs operate at points in the interior of *T*, with the distance from each point in *T* to the frontier representing inefficiency, while those that are efficient operate on the frontier.

The authors employ a VRS output-orientated DEA model as follows:

$$\begin{aligned} &\max_{\phi_{it},\lambda_{it}} \phi_{it} \\ &\text{st. } \phi_{it} y_{it} - y'\lambda_{it} \le 0, \\ &\quad X\lambda_{it} - x_{it} \le 0, \\ &\quad J\lambda_{it} = 1 \text{ and} \qquad (2) \\ &\quad \lambda_{\text{it}} \ge 0. \end{aligned}$$

where y_{it} is the output quantity for the *i*th LA in the *t*th period, x_{it} is the N x 1 vector of input quantities for the *i*th LA in the *t*th period, y is the $L_k T$ x 1 vector of output quantities for all L_k LAs in all T periods, X is the N x $L_k T$ matrix of input quantities for all L_k LAs in all T periods, J is an $L_k T$ x 1 vector of ones, λ_{it} is an $L_k T$ x 1 vector of weights, and ϕ_{it} is a scalar.

By solving the above equation, the value of ϕ_{it} is calculated. $\phi_{it} - 1$ is the proportional increase in outputs that could be achieved when the input quantities of the *i*th LA in the *t*th period are held constant. Thus, $1/\phi_{it}$ is the estimated output orientated TE measure that takes the value between zero and one.

The bootstrap procedure obtained bias-corrected DEA estimates of TE and used them as the dependent variable in the second stage regression. This approach is used because it would improve the statistical efficiency of the parameter estimator in the second stage truncated regression. Following Simar and Wilson (2007), the truncated regression model in the second stage is specified as follows:

$$0 < \hat{\hat{\theta}}_i = z_i \beta + \varepsilon_i \leq 1 \qquad (3)$$

where $\hat{\hat{\theta}}_i = \hat{\theta}_i - bias(\hat{\theta}_i)$ is the bias-corrected estimator of TE and bias $(\hat{\theta}_i)$ is the bootstrap bias estimate of $\hat{\theta}_i$. For valid inference about β, a second bootstrap procedure is applied to the truncated regression in (3). See Simar and Wilson (2007) for the details of the double bootstrap procedures.

Data Source and Input-output Specification

In this paper, the authors analyze the administrative TE of 17 out of the total 24 LAs in Sabah. Seven LAs are excluded from the sample in order to standardize the functions performed by the LAs. All the Sabah LAs are located in the rating areas which are more urbanised. The LAs also provide services to the rural areas. Nonetheless, the rural development mainly falls under the responsibility of the state government.

The Ministry of Local Government and Housing categorises all urban LAs into two, namely big urban LAs and small urban LAs based on geographical location and number of population (Chua, 1997). In this paper, we follow this categorisation and as a result, there are nine big urban LAs and eight small urban LAs.

The authors employ a panel data with two inputs and four outputs to construct efficiency indices. All except STAFF, LOC and UPOP of the eight variables rely on audited financial statements published in the Sabah State Government Gazette by

the state government, suggesting a high reliability of data. The data of STAFF and LOC are obtained from the Ministry of Local Government and Housing (MLGH) while UPOP from the Department of Statistics Malaysia. All monetary values are measured in Ringgit Malaysia (RM) and deflated to 2010 = 100 in order to adjust for price movements. Table 1 provides a summary of sources of the inputs-outputs specification.

Table 1: Inputs-outputs and Environmental Variables Specification

Variables	Unit of measurement	Details	Data source/ Years
Inputs			
ASALARY	Ringgit Malaysia (RM)	Basic salaries of full time administrative personnel	Sabah State Government Gazette 2000–2012
ADEXP	Ringgit Malaysia (RM)	Other administrative expenses	Sabah State Government Gazette 2000-2012
Outputs			
STAFF	Number	Total employees	Ministry of Local Government and Housing (MLGH) 2000–2012
OWNREV	Ringgit Malaysia (RM)	Own-source revenue	Sabah State Government Gazette 2000–2012
RULE	Ringgit Malaysia (RM)	Intergovernmental grants	Sabah State Government Gazette 2000–2012
MO	Ringgit Malaysia (RM)	Expenses on maintenance and services provisions	Sabah State Government Gazette 2000–2012
Environmental Variables			
LOC	Dummy variable	Location, 0 = small urban LAs, 1 = big urban LAs	Ministry of Local Government and Housing (MLGH) 2000-2012
UPOP	Number	Urban population	Department of Statistics, Malaysia

Descriptive statistics of inputs-outputs in the three groups are summarised in Table 2. On average, big urban LAs incur higher basic salaries (ASALARY) and 'other administrative expenses' (ADEXP) compared to small urban LAs. Administrative inputs are utilised to serve an average employment size (STAFF) of 251 and 44 in big and small urban LAs respectively. Other outputs produced by big urban LAs also exhibited higher figures in terms of own-source revenue (OWREV), intergovernmental grants (RULE), and expenses on maintenance and services provision (MO) arising from a wider range of administrative functions. On average, there are 47613 people who reside in big LA rating areas, and 10666 people live in small LA rating areas.

Table 2: Descriptive Statistics of LAs, 2000 – 2012

Descriptive statistics	Inputs		Outputs				Environmental variables	
	ADEXP	ASALARY	STAFF	OWNREV	RULE	MO	LOC	UPOP
All LAs (N=221)								
Mean	762950	424749	153	6553421	2135753	2304059	1	30226
Standard Error	66721	26526	13	728493	132913	282702	0	2939
Median	391957	288511	79	1975364	1563043	447027	1	15483
Standard Deviation	991874	394337	191	10829820	1975890	4202663	1	43695
Minimum	37227	55134	12	168019	6228	6930	0	741
Maximum	5689544	1983953	810	47442122	12156061	20383502	1	190698
Big urban LAs (N = 117)								
Mean	1210916	621340	251	11396836	2860110	4144537	1	47613
Standard Error	109197	41991	20	1211277	212034	472759	0	4951
Median	714506	429488	130	4376857	2242576	1911430	1	26012
Standard Deviation	1181147	454201	220	13101960	2293499	5113666	0	53557
Minimum	105098	194596	76	1102553	83421	87495	1	4544
Maximum	5689544	1983953	810	47442122	12156061	20383502	1	190698
Small urban LAs (N = 104)								
Mean	258989	203585	44	1104580	1320851	233521	0	10666
Standard Error	20978	7914	2	73310	105082	30842	0	1065
Median	199803	208601	41	993673	1008437	125019	0	5748
Standard Deviation	213930	80705	19	747615	1071627	314525	0	10863
Minimum	37227	55134	12	168019	6228	6930	0	741
Maximum	1461020	509532	85	5531708	5906910	2310354	0	37453

The traditional inputs used by the corporate centre should be land, labour, capital and raw materials. However, the data on quantities and prices of these inputs are unavailable. ASALARY is used analogously for the administrative personnel since administrative personnel are heterogeneous, following Kalseth and Rattso (1995; 1998) and Lewis (2006). The ADEXP refers to the expenses of 'raw materials' which occur at the corporate level to facilitate administrative functions (Sabah State Government Gazette, 2015).

It is difficult to determine the ideal outputs of corporate functions. Municipal corporate centres administer human resource matters such as keeping records of staff profiles, communication with staff, human resources training, payroll of staff, and legal advice. Thus, STAFF is a suitable output variable of the corporate centre, which is commonly used in organisational studies.
The corporate centre governs the entire operation of an LA (Chua, 1997). Accordingly, OWNREV is used to indicate the effort and time spent by the corporate centre, following Lewis (2006). The RULE consists of two categories: (a) government contribution (GC), and (b) special revenue (CAPITAL). The LAs comply a set of rules and regulations determined by the higher levels of government to ensure a stable flow of resources, which are common in local government literature (Balaguer-Coll & Prior, 2009; Kalb, 2010).

The MO refers to the expenditure on maintenance and operation costs of service provision (Sabah State Government Gazette, 2015). The MO is thus used to proxy the efforts contributed by the corporate centre on these mandatory functions and social responsibilities.

Following the international and local government empirical evidence, two important environmental variables are included; location (LOC) and urban population (UPOP). The LOC refers to the location of an LA, as a dummy variable with 1 = big urban areas, while 0 = small urban areas. There are 9 LAs located in big urban rating areas, while 8 LAs located in small urban areas. The UPOP refers to the urban population who made municipal services from the LAs. In Malaysia, the LAs only provide services in rating area where the tax payers reside.

RESULTS

Table 3 presents an original and a bias-corrected mean TE of LAs. The results show that the bias-corrected TE scores are, on average, lower than the uncorrected TE scores, suggesting that the uncorrected TE scores are upward biased. Thus, only bias-corrected TE scores results were being analysed here. The bias-corrected TE scores would provide more meaningful discussion of the performance particularly in the big urban LAs, where the gap is more apparent. The overall mean of bias-corrected TE scores is 0.52 in Sabah LAs, which implies that the LAs shall be able to increase output by 48% while maintaining the same amount of input. Specifically, the big urban LAs performed better with the TE scores of 0.60; while the small urban LAs recorded lower TE scores of 0.43. In general, the big urban LAs are equipped with better financial resources, human capital and ICT, and located in highly populated and urbanised areas. The small urban LAs face harsh financial and human resource constraints, labour intensive, and are situated in ‘economic backwater’ areas with smaller populations.

Table 3: Original and Bias-corrected TE Scores in LAs

DMU	Mean	Median	Min	Max	SD
Big Urban Las					
A	0.43 (0.54)	0.37 (0.42)	0.19 (0.26)	0.69 (1.00)	0.16 (0.24)
B	0.56 (0.66)	0.57 (0.66)	0.41 (0.48)	0.73 (1.00)	0.10 (0.14)
C	0.55 (0.63)	0.56 (0.63)	0.38 (0.45)	0.65 (0.75)	0.08 (0.09)
D	0.67 (0.80)	0.68 (0.80)	0.46 (0.57)	0.83 (1.00)	0.13 (0.15)
E	0.49 (0.62)	0.42 (0.51)	0.31 (0.41)	0.76 (1.00)	0.15 (0.23)
F	0.76 (0.95)	0.75 (0.95)	0.69 (0.83)	0.83 (1.00)	0.04 (0.06)
G	0.74 (0.98)	0.79 (1.00)	0.41 (0.95)	0.83 (1.00)	0.11 (0.02)
H	0.68 (0.96)	0.68 (0.99)	0.55 (0.85)	0.78 (1.00)	0.07 (0.05)
I	0.52 (0.64)	0.51 (0.61)	0.31 (0.37)	0.69 (1.00)	0.13 (0.19)
Small Urban Las					
J	0.37 (0.47)	0.36 (0.41)	0.24 (0.29)	0.62 (0.91)	0.13 (0.20)
K	0.43 (0.58)	0.42 (0.48)	0.16 (0.20)	0.69 (1.00)	0.15 (0.27)
L	0.44 (0.63)	0.45 (0.63)	0.15 (0.29)	0.71 (1.00)	0.18 (0.25)
M	0.45 (0.49)	0.45 (0.49)	0.33 (0.37)	0.57 (0.62)	0.07 (0.07)
N	0.60 (0.73)	0.60 (0.70)	0.34 (0.41)	0.83 (1.00)	0.15 (0.21)
0	0.41 (0.55)	0.39 (0.49)	0.18 (0.38)	0.62 (1.00)	0.11 (0.19)
P	0.35 (0.40)	0.33 (0.36)	0.24 (0.29)	0.54 (0.60)	0.08 (0.09)
Q	0.37 (0.43)	0.36 (0.42)	0.25 (0.29)	0.47 (0.53)	0.06 (0.07)
Big Urban LAs	0.60 (0.75)	0.62 (0.75)	0.19 (0.26)	0.83 (1.00)	0.15 (0.22)
Small Urban LAs	0.43 (0.53)	0.40 (0.48)	0.15 (0.20)	0.83 (1.00)	0.14 (0.21)
All LAs	0.52 (0.65)	0.51 (0.61)	0.15 (0.20)	0.83 (1.00)	0.170.24)

Notes: The figures in the parenthesis refer to the original mean TE of LAs. The DEA results show that the bias-corrected TE scores were, on average, lower than the uncorrected TE scores, suggesting that the uncorrected TE scores were upward biased. The one-way Anova and Kruskal Wallis tests record statistical differences in mean and median respectively for bias-corrected TE in all, big and small urban LAs.

Some distinctive TE scores of the LAs, as detailed in Table 3 are briefly highlighted here. In the big urban LAs, LA F records the highest mean TE scores (0.76) and is followed closely by LA G (0.74), while LA A shows the lowest mean TE scores (0.43). Both LA F and LA G are located in highly urbanised areas with better financial resources and human capital to operate the management of an LA. On the other hand, in the small urban LAs, LA N records the highest mean TE scores (0.60) whereas LA P registers the lowest mean TE scores (0.35). Although LA N is located in a small urban area, LA N demonstrates the characteristics of a rapid growing urbanised area.

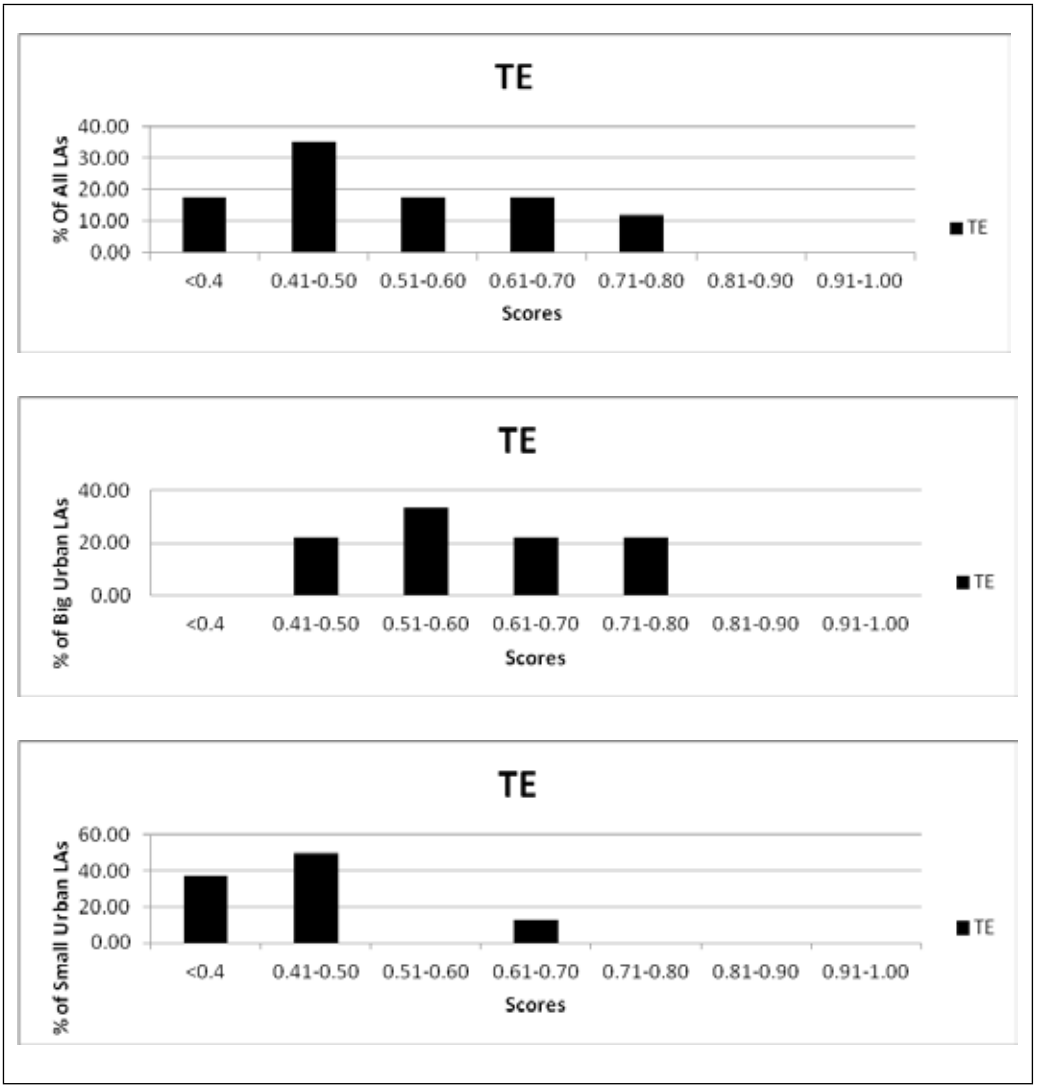

Figure 1: Percentage Distribution of TE of All, Big Urban and Small Urban LAs.

The higher TE scores by the big urban LAs compared to small urban LAs are further illustrated by the percentage of TE distribution in all, big and small urban LAs, as exhibited in Figure 1. Overall, the highest percentage of TE scores is recorded at 35% which falls between 0.41-0.50, as shown in Figure 1. Accordingly, 33% of big urban LAs record the highest TE scores between 0.51-0.60 and the remaining percentage is 22% in 0.41-0.50, 22% in 0.61-0.70 and 22% in 0.71-0.80. On the other hand, 87% of these LAs score TE below 0.50 and only 13% score between 0.61-0.70.

The trend of TE scores in the three groups over the decade is illustrated in Figure 2. In general, there is a minor fluctuation of TE scores in Sabah LAs

from 2000 to 2012, suggesting rigidity of management performance by the LAs.

The administrative TE is mainly determined by the human capital, where effects of the human capital can only be manifested over a long period of time with uncertain outcomes. When the sample is divided into big and small urban LAs, a more noticeable pattern of movement of TE scores could be observed.

The big urban LAs outperform small urban LAs over the years. This result is not surprising given the better available resources in big urban LAs to implement, sustain and enforce any policies. In other words, the big urban LAs have benefited from a series of management innovations implemented over the decade. In particular, the big urban LAs demonstrate frequent fluctuation in TE scores from 2000 to 2012. The frequent and unstable fluctuations of TE scores reveal that big urban LAs are confronted by frequent changes in management policies.

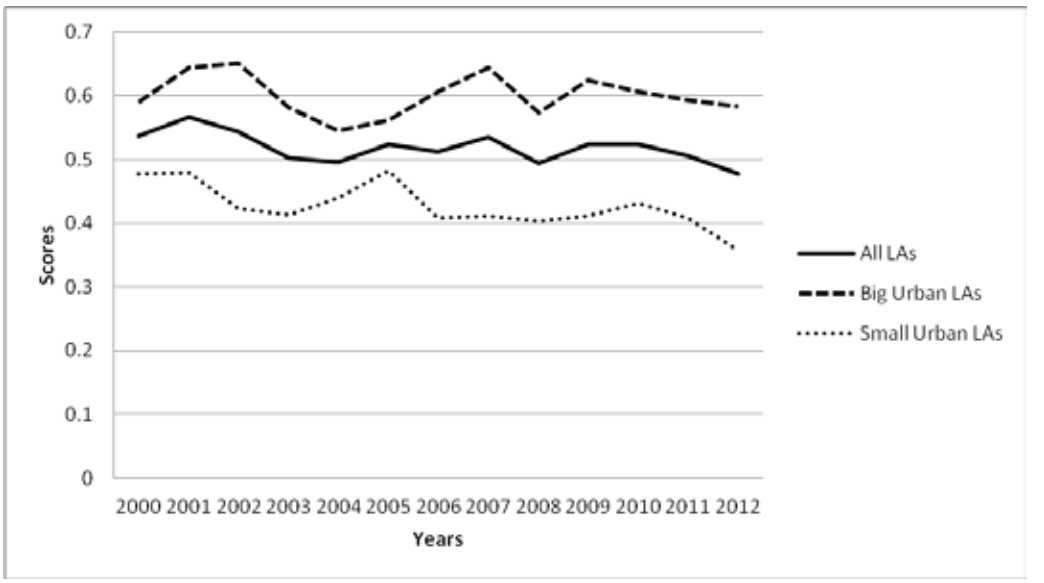

Figure 2: Annual Mean TE Scores of All, Big and Small Urban LAs.

On the other hand, the small urban LAs exhibit a more stable and minor variation of TE scores from 2000 to 2005, and then a stagnant and declining pattern from 2005 to 2012. This pattern is constrained by a lack of financial resources and human capital, such as financial and technical expertise (Setapa & Yee, 2003) and a low implementation and awareness of ICT (Siddiquee, 2008).

Both groups reveal a similar pattern where better achievement in TE scores is recorded from 2000 to 2005. The higher TE scores could be caused by management innovations in the workplace and better-defined responsibility at the management

level in the earlier 2000s. However, these higher TE scores did not continue but displayed a declining pattern afterwards. This declining trend in TE scores corroborates with the findings of inefficiency management, such as unsatisfactory financial and services quality of the LAs, as highlighted in the annual audit reports. Although major policies such as the implementation of performance-based work culture in 2005 and Accountability Index performance in 2007 have sustained the TE scores of the LAs, the TE scores of LAs continue to record a downtrend pattern after 2005. This decline could be caused by other reasons, which could be investigated further in future work.

Table 4: Bootstrap Results on TE Scores

Limit: Lower = 1 Upper = +inf					Number of obs = 221 Wald chi2(2) = 14.06	
Log likelihood = -149.60					Prob > chi2 = 0.0009	
Efficiency	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal –based [95% Conf. Interval]	
LOC	-0.12837	0.23706	-0.54	0.588	-0.59301	0.33625
UPOP	-0.00003	0.00007	-3.47	0.001	-0.00004	0.00001
Cons	1.65632	0.22333	7.42	0.000	-1.21861	2.09402
Sigma	0.99388	0.12426	8.00	0.000	0.75034	1.23742

In the second stage truncated regression model, the Simar and Wilson (2007) procedure is used to bootstrap the DEA scores to make valid inferences about the effect of environmental variables on LAs' TE. The dependent variable is bias corrected TE, while the independent variables are urban population (UPOP) and location of an LA (LOC). A positive (negative) coefficient indicates a positive (negative) marginal effect on TE. The results in Table 4 show that the coefficient of UPOP is negative and significant at 1%, while the coefficient of LOC is insignificant.

Larger UPOP thus tends to decrease TE scores given the complexity and coordination problems posed by larger urban population on the corporate centres of Sabah LAs. This corroborates the findings of Clarke (1982) and Oh (1995) who unveiled higher administrative costs. However, these findings contradict Andrews and Boyne (2009), Kalseth and Rattso (1995) and Noell (1974) who found lower administrative costs, and Ting et al. (2014) and Lewis (2006) who found population to be insignificant. The result of UPOP in this paper should be treated with caution because of the trivial coefficient size of UPOP on the TE scores.

CONCLUSION

This paper has attempted to address a significant gap in the empirical literature on the local government by empirically examining administrative efficiency in Sabah local government. The authors employed a two-stage, semi-parametric approach and bootstrap procedures (Simar and Wilson, 2007) to estimate DEA TE scores and make valid inferences about the impact of environmental variables on the 17 Sabah LAs' efficiency from 2000 to 2012. Despite the lack of availability of data and the nature of the multi-functionality of corporate centres, the existing four outputs are nonetheless relevant proxies for efficiency analysis which embraced the management of human resource matters (STAFF), tax monitoring and collection capacity (OWNREV), bureaucratic compliance (RULE), and mandatory and social responsibilities (MO). Administrative salary (ASALARY) and administrative expenses (ADEXP) represented inputs which are necessary in order to conduct the standard administrative functions of an LA.

The major finding of this paper is that overall mean of TE scores was average and the minor fluctuation of TE scores over the years indicated the rigid nature of management performance in corporate centres of LAs. On average, the LAs recorded TE scores of 0.52, which implied that the LAs should be able to increase output by 48% while maintaining the same amount of input. The big urban LAs performed better with the TE scores of 0.60; while the small urban LAs recorded lower TE scores of 0.43. The environmental variable, urban population had a negative relationship with the TE scores. The findings thus represent a substantive addition to the empirical understanding of the administrative intensity of local government.

Several policy implications emerge from our administrative TE findings. Given empirical evidence of average TE scores (0.52) and previous empirical findings of trivial economies of scale at the corporate centres (Ting et al., 2014), management improvement is timely and more important for all LAs, especially small urban LAs, rather than structural change aimed at increasing the population size of LAs.

The TE measure indicates the possible efficiency improvement through management methods. These methods include both administrative personnel and management components of administrative departments. The efficiency improvement through management methods, as noted below, are more suitable to be applied in the corporate centres of small urban LAs which are more administratively-orientated rather than property-service orientated (Ting et al., 2014).

In addition, the LAs could create a new mechanism for the suitable apportioning of administrative costs at corporate and operational levels. Currently, the classification

of administrative costs is not uniform across the LAs, and the apportioning of administrative cost is aggregated at the corporate level rather than at each individual department. The accurate apportioning of administrative costs could generate a more meaningful efficiency analysis of corporate centres and also at the production level.

Although the external variable, UPOP, had a negative relationship with the administrative TE scores, the size of its coefficient was trivial. The authors thus do not advocate structural change, such as mergers of LAs. However, environmental variables are still important to the several aspects of local government reorganisation, such as financial feasibility and effectiveness of service delivery. In Sabah LAs, population determines local economic development, and this, in turn influences the fiscal viability of an LA.

Thus, changes in the external variables of UPOP and LOC could still have substantial consequences for the performance of the local government system.

The policy implications, as suggested above, are vital to advance the performance of LAs. It will improve the service management methods, allocate corporate overhead costs efficiently, and ensure sustainability of resources. The authors suggest that future research work should focus on the development of administrative outputs and inputs, as outlined earlier, and examine the administrative TE of each specific department, like human resources, accounting and ICT separately. Future researchers could use other methods such as Malmquist index or windows DEA to analyse TE in a dynamic perspective and include other environmental variables to add additional insights on their impact on efficiency measurement. Nevertheless, the findings suggest that the TE scores were average and UPOP played a trivial influence on the corporate centres in Sabah LAs.

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