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Creating Public Value Using ICT: An Efficiency And Productivity Assessment Approach

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Abstract

For over 3 decades, development actors have been involved in public sector reforms geared towards improved services. These reforms have been linked to the New Public Management paradigm, which emphasises public value creation in the public sectors one of which is education. This research set out to investigate the efficiency and productivity of ICT utilization in public value creation with respect to Adult Literacy Rates. The research employed the Data Envelopment Analysis (DEA) and Malmquist Index (MI) non-parametric research methodology with Arab States, Europe, Sub-Saharan Africa and World regions forming the Decision-Making Units. Findings show a relative efficient utilization of ICT in public value creation but an average decline in productivity levels.

Keywords: Information and Communication Technology, Public Value, Data Envelopment Analysis, Malmquist Index

1 Introduction

Many governments have heeded the call for increased investments in ICT with the aim to improve national development with respect to the Human Development Index (HDI). As such, the growth of Information and Communication Technology (ICT) in recent years has been remarkable in all countries and sectors throughout the world mainly because of it's perceived transformational power which favours productivity and efficiency (Kayisire & Wei, 2016). This is based on the assumption that increasing investments in ICT will lead to improvements in productivity and other aspects of development at the organizational and national levels (Samoilenko & Osei-Bryson, 2017a). It is therefore not a surprise that over the last three decades, research in national development has been expanded to certain intervening variables and social factors such as education (Desai, 1991; Anand & Ravallion, 1993; Bankole & Mimbi, 2017) as education has been determined to be important for social and economic development (Bankole & Assefa, 2017).

In it's strive to increase social and economic developments, governments have understood the need for public sector reform as it's importance in socio-economic development cannot be over-emphasized. The objective of public sector reform since its inception has been geared towards innovative ways of bringing about socio-economic development (Mimbi & Bankole, 2016a). Performance management is the concept of the New Public Management (NPM) that has its roots from the agenda of continuously doing better in public administration (Van Dooren et al. 2015). Public value is fundamental in public administration to ensure citizens satisfaction and trust (Moore 1995; Ott 2010). The increased pressure for citizens' demands for public value has contributed to the adoption of an entrepreneurial approach to governance (Blaug et al. 2006). Consequently, Under the banner of New Public Management (NPM), re-inventing governments has been touted as a solution to many government inefficiency related challenges (Mimbi & Bankole, 2016).

ICT as enabler of public sector reforms has been implemented to reinvent governments for improved performance (Bannister and Connolly 2014; Gauld et al. 2010). Along this line, information communication technology (ICT) is touted to have a potential in creating public value (Bannister and Connolly 2014). With respect to education, and in line with incorporating the use of ICT for improved efficiency, governments are more than ever before defining policies that show an emphasis on creating support mechanisms for the use of ICT in education whether it be in teaching and learning or in decision and policy making. However, the opinions on the bearings of ICT Infrastructure for development are in two perspectives vis a vis national development: The adoption of ICTs has the potential to empower communities and countries while secondly, the ICT revolution can lead to imbalances and inequalities through lack of ICT adoption, access and usage (Bankole, 2015), whichever way, the use of ICT is ever more becoming a factor in public interactions and public service rendering.

Therefore, certain questions arise with respect to whether this increasing use of ICT brings any corresponding value to the public and to rendering of public service(s). Most of the research in the area of Information Systems and value creations have focused mainly on business (private) values. Value creation in private organisation is different from that of public organisations. In private organisations, value creation is normally premised on economic value such as return on investment (ROI) while in public organisations, being the non-profit making entities, focus on public value creation (Pang et al. 2014; Moore 1995). International bodies and researchers have recognised the importance of ICT in public administration in creating public value. For example, the World Public Sector Report (WPSR) produced by the United Nations emphasises that ICT should be harnessed in public services to achieve socio-economic development. Importantly, it emphasises that ICT should be a tool for creating public value (WPSR 2015).

In this paper, we investigate the efficiency and productivity of ICT Infrastructure utilization in public value creation with respect to education. We do this by analysing the data of ICT, public values, and adult literacy rates using Data Envelopment Analysis (DEA) and Malmquist Index (MI). The Malmquist productivity index is considered the most appropriate tool for measuring changes in efficiency and productivity (Arjomandi et al., 2015). This paper explores further findings from Mimbi & Bankole, (2016a) and Oyerinde & Bankole, (2018) researches. The rest of the article is organized as follows: section two provides the background, section three discusses the theoretical framework, section four provides the research method-

ology, section fives provides the data analysis, section six provides the discussion of findings, section seven the limitations and section eight the conclusion.

2 Background

The concept of public value (PV) can be traced from the new public service theory. PV has been influential in public services reform initiatives since the mid-nineties. This concept is linked to the seminal work of Moore (1995). Public value refers to value that citizens and their representatives seek in relation to strategic outcomes and experience of public services (Moore 1995). Public value also refers to the value created by government through services, laws regulation and other actions (Kelly et al., 2002). Public value focuses on performance evaluation of public organisation in delivery of services (social outcomes) as desired by the collective (Mimbi & Bankole, 2016b). Brewer et al., (2006) argue that ICT public value creation as a priority refers to embracing the information revolution as a means of improving governance and enhancing the democratic process. It therefore focuses on the wider notions of valued public services and efficiency that call for more accountability of public managers (Blaug et al. 2006).

With performance management being one of the growing research areas in Computer Information Systems and Public Administration, there seems to be a resultant growth, particularly in governments, driven by increased citizen demands for government accountability in service delivery (Mimbi & Bankole, 2016a). It has therefore become important to determine the efficiency of governments in converting inputs into outputs and measuring the resultant productivity over time. ITU (2006) contends that the best way to examine ICT impacts is to assess its efficiency in producing outputs. This means that ICT is an input which is used to produce output (public values). Efficiency is a measure of how well the government resources are utilised to achieve specific goals (Neely et al. 1995), while productivity is essentially a study of how this efficiency changes over a period of time.

Mimbi & Bankole (2016) have shown that ICT value creation is a performance (efficiency) phenomenon that can be analysed using the DEA methodology. DEA is appropriate where the objective of the investigation is to evaluate efficiency of a production organisation, or regional groupings as shown by Oyerinde & Bankole (2019), in which inputs are converted into final outputs (Saranga and Moser 2010). Since ICT and public value represent input and output respectively, then DEA is an appropriate methodology to analyse the present phenomenon. As such, DEA provides performance managers with a comprehensive measurement that enables them to take strategic actions on DMUs performance that lag behind their peers (Easton et al. 2002). Many researchers have investigated efficiency using DEA (Bankole et al. 2011a; Bankole et al., 2011b; Kayisire and Wei 2015; Mimbi and Bankole 2016a; Oyerinde & Bankole 2018). We can furthermore assess the efficiency productivity over time to determine if there is any growth or otherwise as shown by Oyerinde & Bankole (2019).

3 Research Methodology

For this study, time series data from the United Nations Educational, Scientific and Cultural Organization (UNESCO); adult literacy rates, the International Telecommunication Union (ITU); individuals with computers, internet and mobile phones as well as World Bank; governance indicators (control of corruption, government effectiveness, regulatory quality and

rule of law) were obtained as shown in Table 1. This is used as this research is in furtherance of Mimbi & Bankole (2016a) which categorized public value into: duty oriented public value; socially oriented public value; and service oriented public value, and Oyerinde & Bankole (2019) research which investigated efficiency and productivity of ICT Infrastructure Utilization. Available data was collected and aggregated into the following regional groupings: Arab States, Europe, Sub-Saharan Africa and World regional aggregates. These formed the four Decision Making Units (DMU's). Data for the years 2010-2016 was collected in percentages of the country population, with the ratio values computed annually as shown in Table 2. We employed Data Envelopment Analysis and Malmquist Index methodologies to calculate the Relative Efficiency and Productivity of the regions respectively.

S/N	VALUE / DIMENSION	INPUT / OUTPUT
1	ICT Infrastructure	Individuals Using Mobile Phones (I)
		House Holds with Computers (I)
		Individuals Using Internet (I)
2	Duty Oriented Public Value	Voice and Accountability (O)
3	Service Oriented Public Value	Government Effectiveness (O)
		Press Freedom (O)
4	Socially Oriented Public Value	Rule of Law (O)
		Control of Corruption (O)
5	Education	Adult Literacy Rates (O)

Table 1. Input/Output Variables

DEA is a well-known non-parametric linear programming method for measuring the relative efficiency (Thanassoulis et al., 2011; Bankole et al., 2011a). DEA is a data-oriented method for evaluating the performance (efficiency) of entities known as Decision Making Units (DMUs) (Bankole et al., 2011a) which uses input-output data to compute an efficient production frontier produced by the most efficient DMU's (Bollou, 2006; Oyerinde & Bankole, 2018). DEA, unlike a parametric method, is context specific with respect to the interpretations of the results of the analysis, which are restricted to the sample and should not be generalized beyond the sample (Samoilenko & Osei-Bryson, 2017b). DEA, therefore, can then be viewed as a multiple-criteria evaluation methodology where DMUs are alternatives, and DEA inputs and outputs are two sets of performance criteria where one set (inputs) is to be minimized and the other (outputs) is to be maximized (Cook et al., 2014). In DEA, these multiple criteria are generally modelled as in a ratio form, e.g., the CCR ratio model (Charnes et al., 1978; Cook et al., 2014) which is expressed as:

Maximise:

$$h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

Subject to:

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1$$

Where:

$$j = 1, \dots, n, v_r v_i \geq 0; r = 1, \dots, s; i = 1, \dots, m.$$

where x_{ij} and y_{rj} represents DEA inputs and outputs of the jth DMU, and u_r ,$v_i \geq 0$ are unknown variable weights to be determined by the solution of the problem (Charnes et al., 1978).

Region	Year	Individuals Using Internet	Individuals Using Mobile Phones	House Holds with Computers	Voice and Accountability	Governance Effectiveness	Press Freedom	Rule of Law	Control of Corruption	Adult Literacy Rates
Arab States	2010	0.2439	0.8789	0.2900	-1.0666	-0.3043	0.3071	-0.3255	-0.3537	0.7059
	2011	0.2648	0.9921	0.3282	-1.0467	-0.3548	0.3343	-0.3880	-0.3918	0.7236
	2012	0.3012	1.0540	0.3480	-0.9841	-0.3941	0.3343	-0.3891	-0.3936	0.7351
	2013	0.3282	1.1044	0.3853	-1.0119	-0.4057	0.3262	-0.4144	-0.3966	0.7378
	2014	0.3628	1.1037	0.4164	-1.0109	-0.4291	0.3176	-0.4193	-0.4566	0.7437
	2015	0.3966	1.0931	0.4298	-1.0270	-0.4478	0.3043	-0.4557	-0.4672	0.7481
	2016	0.4180	1.0713	0.4326	-1.0200	-0.4970	0.2957	-0.5030	-0.4817	0.7525
Europe	2010	0.6657	1.1502	0.7190	0.7002	0.7306	0.6796	0.6940	0.5829	0.9913
	2011	0.6777	1.1693	0.7423	0.6877	0.7333	0.6776	0.6968	0.5891	0.9920
	2012	0.6998	1.1863	0.7605	0.6958	0.7588	0.6736	0.6983	0.6093	0.9922
	2013	0.7174	1.1982	0.7764	0.6840	0.7765	0.6690	0.7042	0.6131	0.9924
	2014	0.7381	1.1885	0.7776	0.6826	0.8077	0.6628	0.7752	0.6207	0.9925
	2015	0.7533	1.1817	0.7849	0.6905	0.7945	0.6582	0.7404	0.6241	0.9927
	2016	0.7791	1.1802	0.7959	0.6630	0.7832	0.6548	0.7249	0.6316	0.9930
Sub-Saharan Africa	2010	0.0665	0.4540	0.0545	-0.5488	-0.7880	0.4267	-0.7171	-0.6346	0.5942
	2011	0.0820	0.5248	0.0611	-0.5507	-0.7552	0.4258	-0.7079	-0.6459	0.6104
	2012	0.1004	0.5910	0.0672	-0.5764	-0.7618	0.4221	-0.7073	-0.6753	0.6211
	2013	0.1214	0.6555	0.0700	-0.5720	-0.7704	0.4214	-0.7084	-0.6788	0.6260
	2014	0.1453	0.7078	0.0793	-0.4987	-0.8009	0.4226	-0.6550	-0.6818	0.6333
	2015	0.1759	0.7637	0.0868	-0.4843	-0.7922	0.4195	-0.6603	-0.6657	0.6389
	2016	0.1989	0.7457	0.0964	-0.4883	-0.8050	0.4119	-0.7059	-0.6733	0.6462
World	2010	0.3371	0.9062	0.3793	-0.0195	-0.0029	0.5264	-0.0114	-0.0005	0.8456
	2011	0.3635	0.9569	0.4085	-0.0202	-0.0012	0.5283	-0.0137	-0.0065	0.8460
	2012	0.4042	0.9998	0.4345	-0.0200	-0.0010	0.5257	-0.0130	-0.0065	0.8536
	2013	0.4303	1.0454	0.4589	-0.0196	-0.0007	0.5226	-0.0130	-0.0067	0.8549
	2014	0.4595	1.0703	0.4780	0.0084	-0.0065	0.5178	-0.0084	-0.0058	0.8581
	2015	0.4916	1.0824	0.4922	0.0084	-0.0062	0.5142	-0.0082	-0.0057	0.8602
	2016	0.5171	1.0899	0.5045	0.0084	-0.0061	0.5090	-0.0083	-0.0055	0.8625

Table 2 Regional Data Collected

Malmquist Productivity Index (MPI) measures the productivity changes along with time variations and can be decomposed into changes in efficiency and technology with DEA like non-parametric approach. Productivity decomposition into technical change and efficiency catch-up necessitates the use of a contemporaneous version of the data and the time variants of technology in the study period. The MPI can be expressed in terms of distance function (E) as Equation (1) and Equation (2) using the observations at time t and t+1.

$$MPI_I^t = \frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$MPI_I^{t+1} = \frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

where I denotes the orientation of MPI model.
The geometric mean of two MPI in Equation (1) and Equation (2) gives the Equation

$$MPI_I^G = (MPI_I^t MPI_I^{t+1})^{1/2} = [\left(\frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)}\right).\left(\frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)}\right)]^{1/2} \dots\dots\dots\dots\dots\dots\dots\dots (3)$$

The input oriented geometric mean of MPI can be decomposed using the concept of input oriented technical change (TC) and input oriented efficiency change (EC) as given in the Equation

$$MPI_I^G = (EC_I).(TC_I^G) = \left(\frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)}\right).\left[\left(\frac{E_I^t(x^t, y^t)}{E_I^{t+1}(x^t, y^t)}\right).\left(\frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^{t+1}, y^{t+1})}\right)\right]^{1/2} \dots\dots (4)$$

The first and second terms represent the efficiency change (EC) and the technology change (TC) respectively. MPI given by Equation (3) and Equation (4) can be defined using DEA like distance function. That is, the components of MPI can be derived from the estimation of distance functions defined on a frontier technology. Färe et al., (1994) provided the formal derivation of MPI and it is the most popular method among the various methods that have been developed to estimate a production technology (Coelli et al., 2005; Thanassoulis 2001). By utilizing both CRS and VRS DEA frontiers to estimate the distance functions in Equation (4), the TC can be decomposed into scale efficiency (SC) and pure technical efficiency (PC) components. SC is given in equation (5) and PC is given in equation (6) (Lee et al., 2011).

$$SC = [\frac{E_{vrs}^{t+1}(x^{t+1}, y^{t+1})/E_{crs}^{t+1}(x^{t+1}, y^{t+1})}{E_{vrs}^{t+1}(x^t, y^t)/E_{crs}^{t+1}(x^t, y^t)}.\frac{E_{vrs}^t(x^{t+1}, y^{t+1})/E_{crs}^t(x^{t+1}, y^{t+1})}{E_{vrs}^t(x^t, y^t)/E_{crs}^t(x^t, y^t)}]^{1/2} \dots\dots (5)$$

$$PC = \frac{E_{vrs}^{t+1}(x^{t+1}, y^{t+1})}{E_{crs}^t(x^t, y^t)} \dots\dots\dots\dots\dots (6)$$

Conceptually, however, the mechanism for estimating changes in a DMU using DEA is intuitive as the position of a DMU changes over time and is thus measured by means of MI. The change in the position of a DMU, and the corresponding value of MI, is comprised of two components, the changes in Efficiency (EC) and changes in Technology (TC). With regards to the changes in MI, a value equal to 1 means no change in productivity, while a value of greater than 1 or less than 1 reflects a growth or decline in productivity respectively (Samoilenko & Osei-Bryson, 2017b).

4 Analysis

The Input-Oriented Data Envelopment Analysis was carried out to determine the relative efficiencies using the KonSi Malmquist Index Software. The Analysis was run for each year to determine the relative efficiency for each of the DMU's. Table 3 shows the average efficiency results for the time period, 2010-2016, where:
t-1 – Base time moment
t – New time moment
CRS (t-1) – CRS efficiency in base moment relative to base frontier
CRS (t) – CRS efficiency in analyzed moment relative to new frontier
CRSMix (t,t-1) – CRS efficiency in analyzed moment relative to base frontier
CRSMix2 (t-1,t) – CRS efficiency in base moment relative to new frontier
VRS (t-1) – VRS efficiency in base moment relative to base frontier
VRS (t) – VRS efficiency in analyzed moment relative to new frontier

REGION	CRS(t-1)	CRS(t)	CRSMix(t,t-1)	CRSMix2(t-1,t)	VRS(t-1)	VRS(t)
Arab States	0.8359	0.8246	0.7759	0.9101	0.8591	0.8418
Europe	1.0000	1.0000	1.0280	1.0521	1.0000	1.0000
Sub-Saharan Africa	1.0000	1.0000	1.0892	1.2949	1.0000	1.0000
World	1.0000	1.0000	0.9548	1.0751	1.0000	1.0000

Table 3 Average Efficiency Results

The choice of an Input-Oriented model is based on the emphasis here on value creation with the utilization of ICT's. The input-oriented models have been adopted in measuring the efficiency of ICT utilization with respect to its desired outputs as evidenced by Mimbi & Bankole (2016a); Oyerinde & Bankole (2018). See Table 6 in Appendix A for more detailed results.

The Malmquist Index Analysis was carried out using the KonSi Malmquist Index Software. Table 4 shows the average productivity values for the time period, 2010-2016, for the more detailed results see Table 5 in appendix A. For this research we use the Adjacent base method. This method assumes that each time moment is selected as the base moment and the moment next to base is considered as the analyzed time moment. Each moment is subsequently selected as the base moment and the one next to it the analyzed moment and so on. Calculations are performed for the following time moment pairs:
t_1 *and* t_2
t_2 *and* t_3
…
t_{n-1} *and* t_n
Which can further be represented as:
$MI(t_1t_2)\ MI(t_2t_3)\ \ldots\ MI(t_{n-1}t_n)$

REGION	EC	PC	SC	TC	MI
Arab States	0.9836	0.9746	1.0100	0.9282	0.9130
Europe	1.0000	1.0000	1.0000	0.9910	0.9910
Sub-Saharan Africa	1.0000	1.0000	1.0000	0.9188	0.9188
World	1.0000	1.0000	1.0000	0.9418	0.9418

Table 4 Average Productivity Results

In investigating the productivity, we use the classic Malmquist Index calculation model defined by Färe et al., (1994) and expressed as:

$MI = EC * TC = PC * SC * TC$

where:

MI - Malmquist Index
EC – Efficiency Change
TC - Technical Change
PC - Pure efficiency Change
SC - Scale efficiency Change

5 Discussions and Limitations

From the results of the analysis, we can infer that public value is being created, albeit not at optimal efficiency with respect to Arab States. This is deduced from the average relative efficiency scores obtained and shown in Table 3. However, with regards to productivity assessments of the public value created, on the average all regions are in a state of decline of productivity and as such there is room for improvements in utilizing their ICT infrastructure with respect to public value creation. However, regardless of its efficiency, from this research we can see that ICT shows a potential in public value creation as suggested by many scholars (Bannister & Connolly, 2014; Jaeger & Bertot, 2010; Mimbi & Bankole, 2016).

The main Limitations to this study were the availability of data for some countries in their respective regions. Where data was unavailable, the research made up for this by means of extrapolation. While we have been able to provide credible results using DEA and MI to measure efficiency and productivity in this paper, there may be no concrete performance evidence with relation to the different regions due to the unavailability of complete data to carry out intra-regional analyses.

6 Conclusion

The present study was set to investigate the efficiency and productivity of ICT utilization in public value creation with respect to Adult Literacy Rates. For over 3 decades, development actors have been involved in public sector reforms geared towards improved services. These reforms have been linked to the New Public Management paradigm, which emphasises public value creation in the public sectors one of which is education. With governments developing policies and implementation of ICT's in enhancing educational quality, there is a need to understand the value created by government in this public service.

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Appendix A

REGION	t-1	t	EC	PC	SC	TC	MI
Arab States	2010	2011	0.9660	0.9140	1.0560	0.9360	0.9040
Europe	2010	2011	1.0000	1.0000	1.0000	0.9720	0.9720
Sub-Saharan Africa	2010	2011	1.0000	1.0000	1.0000	0.9440	0.9440
World	2010	2011	1.0000	1.0000	1.0000	0.9320	0.9320
Arab States	2011	2012	0.9630	0.9470	1.0170	0.8960	0.8620
Europe	2011	2012	1.0000	1.0000	1.0000	0.9920	0.9920
Sub-Saharan Africa	2011	2012	1.0000	1.0000	1.0000	0.8490	0.8490
World	2011	2012	1.0000	1.0000	1.0000	0.9280	0.9280
Arab States	2012	2013	0.9970	1.0020	0.9950	0.9150	0.9120
Europe	2012	2013	1.0000	1.0000	1.0000	0.9860	0.9860
Sub-Saharan Africa	2012	2013	1.0000	1.0000	1.0000	0.9080	0.9080
World	2012	2013	1.0000	1.0000	1.0000	0.9440	0.9440
Arab States	2013	2014	0.9910	0.9960	0.9950	0.9110	0.9030
Europe	2013	2014	1.0000	1.0000	1.0000	1.0350	1.0350
Sub-Saharan Africa	2013	2014	1.0000	1.0000	1.0000	1.0220	1.0220
World	2013	2014	1.0000	1.0000	1.0000	0.9500	0.9500
Arab States	2014	2015	1.0040	1.0180	0.9870	0.9380	0.9410
Europe	2014	2015	1.0000	1.0000	1.0000	0.9760	0.9760
Sub-Saharan Africa	2014	2015	1.0000	1.0000	1.0000	0.9080	0.9080
World	2014	2015	1.0000	1.0000	1.0000	0.9460	0.9460
Arab States	2015	2016	1.0010	1.0140	0.9870	0.9830	0.9840
Europe	2015	2016	1.0000	1.0000	1.0000	0.9700	0.9700
Sub-Saharan Africa	2015	2016	1.0000	1.0000	1.0000	0.8710	0.8710
World	2015	2016	1.0000	1.0000	1.0000	0.9550	0.9550

Table 5 Detailed MI Productivity Results

t-1	t	CRS(t-1)	CRS(t)	CRSMix(t,t-1)	CRSMix2(t-1,t)	VRS(t-1)	VRS(t)
2010	2011	0.8856	0.8551	0.8011	0.9466	0.9563	0.8743
2010	2011	1.0000	1.0000	0.9942	1.0513	1.0000	1.0000
2010	2011	1.0000	1.0000	1.1557	1.2980	1.0000	1.0000
2010	2011	1.0000	1.0000	0.9436	1.0856	1.0000	1.0000
2011	2012	0.8551	0.8233	0.7369	0.9538	0.8743	0.8279
2011	2012	1.0000	1.0000	1.0200	1.0363	1.0000	1.0000
2011	2012	1.0000	1.0000	0.9897	1.3725	1.0000	1.0000
2011	2012	1.0000	1.0000	0.9572	1.1124	1.0000	1.0000
2012	2013	0.8233	0.8209	0.7503	0.8998	0.8279	0.8294
2012	2013	1.0000	1.0000	1.0132	1.0429	1.0000	1.0000
2012	2013	1.0000	1.0000	1.0202	1.2372	1.0000	1.0000
2012	2013	1.0000	1.0000	0.9517	1.0671	1.0000	1.0000
2013	2014	0.8209	0.8137	0.7465	0.9070	0.8294	0.8261
2013	2014	1.0000	1.0000	1.1098	1.0361	1.0000	1.0000
2013	2014	1.0000	1.0000	1.3145	1.2578	1.0000	1.0000
2013	2014	1.0000	1.0000	0.9636	1.0684	1.0000	1.0000
2014	2015	0.8137	0.8170	0.7824	0.8865	0.8261	0.8407
2014	2015	1.0000	1.0000	1.0175	1.0685	1.0000	1.0000
2014	2015	1.0000	1.0000	1.0195	1.2377	1.0000	1.0000
2014	2015	1.0000	1.0000	0.9548	1.0678	1.0000	1.0000
2015	2016	0.8170	0.8175	0.8382	0.8669	0.8407	0.8523
2015	2016	1.0000	1.0000	1.0132	1.0772	1.0000	1.0000
2015	2016	1.0000	1.0000	1.0357	1.3663	1.0000	1.0000
2015	2016	1.0000	1.0000	0.9576	1.0493	1.0000	1.0000

Table 6 Detailed DEA Efficiency Results