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Dept. Of Educational Administration,
University of Lagos, Akoka, Lagos, Nigeria.

EDUCATION PRODUCTION FUNCTIONS AND THEIR IMPLICATION FOR EDUCATIONAL POLICY IN NIGERIA

- Ngozi E. Uzoka *Ph.D*

Abstract

This paper focused on the production function. The study attempted to examine how the relationship between resource inputs and outputs are mediated by internal process and also ascertained how much each input variable contributes to the output measure either alone or interacting with other inputs. The study adopted the descriptive survey design. One hypothesis was formulated to guide the investigation. The sample for the study consisted 32 out of the 349 secondary schools in Lagos State. The subjects were stratified and randomly selected. The statistical technique used was Pearson Product Moment Correlation Coefficient. The result of the data analysis showed that there was a significant relationship between the inputs variables' contribution either alone or interacting with each other and the output measure. The study concluded by recommending that policy makers and administrators should be more specific on what counts as inputs and outcomes and they should be aware of the idea that inputs vary in their prices, as a result, the decision making rule is to allocate resources in such a way that equality exist among the ratios of each inputs marginal productivity and price.

Introduction

How to improve educational productivity has always been on the research and policy agenda. Although educational spending has been on the increase, students' achievement has not improved or changed dramatically (Mullis, Owen and Phillips, 1990). While there are many ways in which the educational system has made use of the additional resources, the productivity dilemma is that outcome, such as students' achievement, has not increased at the same rate as resources (Odden and Massy, 1992). Policy makers would however like to see higher levels of achievement for the educational investment made.

Economists have conducted research on educational productivity and they relate inputs, such as expenditure per pupil, to outcome such as academic achievements of students. This type of research has rarely shown any consistent linkage between inputs and outcomes (Hanushek, 1986, Monk, 1990). Although there are many problems that are associated with this type of research (Monk, 1990), the approach persists with the usual conclusion that educational resources are not strongly linked with educational outcomes. Nevertheless, the quest for ways to improve educational productivity has continued. Monk (1990) reviews educational production function research and observes that many of the more recent studies

identified several strong positive connections between resource measures, including expenditures per pupil and student achievement.

There is a drive toward raising the level of educational production and sometimes coupled with concerns over improving efficiency. Monk (1990) suggests three parts of production model and these are: the outcome sought, the necessary ingredients or inputs, and the process that transforms inputs into specified outcomes. These three parts are linked together by a production function. Production function shows the maximum amount of outcome possible for alternative combination of inputs. If the supply levels of various inputs are known and the production function is known, it becomes very easy to calculate the maximum possible level of outcome.

Analysts have made little progress toward showing what makes education distinct from other forms of production. Production function is commonly represented by the use of Mathematical notation. An example is: $S = F(t_1, t_2, t_3 — t_n)$, where S represents the outcome, the t_s (t_1 through t_n) represent the n different ingredients, and F represents the mathematical function that summarises the transformation process. It has been mentioned that it is a process that can be represented by a well defined series of mathematical operations but nothing has been said about what these operations entail. Hence the need for this study to analyse education production function and its implication for educational policy in Nigeria.

Literature Review

This review of literature shows the inputs and outputs/outcomes in education production function. Many factors have been viewed as inputs in the schooling process. They are teachers' quality, which is measured by their qualification and experience, teachers' salary, running cost, capital cost, etc. There are however, other input variables in education that cannot be expressed in monetary terms, and they are school size, student/teacher ratio and class size. There is also another input that is crucial and that is student time. To ignore the time of any of the students would be to follow a course which leads to the treatment of student cost as zero. To record a measure of time would be a salutary reminder to teachers of the importance of using the scarce time of learners as productively as possible.

Although this variable is very important, there is a problem of measurement. Oguntoye (1978) enumerates some problems involved in calculating student time. For instance, what time should be calculated? Should it be the time spent in class alone or should it include all the time the student spent in doing assignments after school? The question is, how could this be measured accurately.

There are two major categories of inputs to education, and they are the schooling inputs which are the ones mentioned above and the non-schooling inputs. These variables cannot be influenced by any policy decisions and they are very difficult to quantify. Among these variables are family background factors like parents' education, family income and size,

parents' occupation and many others. The reason why these variables are used is that these socio-economic variables are proxy measures for the motivation and aptitudes of the students. Since they are predetermined, schooling can only build on them and change them over a long period of time.

If giving educational institutions greater choice in how they use resources is to result in improvements in teaching and learning, then logically there must be a link between the resource inputs and the resulting educational outputs/outcomes for students. There are however, well known problems in defining educational outputs because many of them are intangible and there are considerable disagreements; often ideologically founded, about what are desirable educational aims and objectives and also a host of issues surrounding the conceptualization and measurement of the standards.

Some pertinent questions that should be asked here among others are, what exactly are schools supposed to produce and how can they measure those outcomes? Obviously, one cannot specify production functions for schools until exactly what should be produced has been first determined and this raises some thorny questions of values. Although various authors describe educational output as a difficult concept to define, Akangbou (1985) regards output as the end-product of a period of schooling. He is of the view that a more appropriate way of measuring educational output is by looking at the academic achievement. The explanation is that using academic performance as educational output measure is a way of applying "quality" criterion to output measurement as they do in the industrial sector. Outputs which are much more difficult to measure are the effects of school on pupils' attitude, beliefs and behaviour.

Purpose of the Study

The purpose of the study was to examine how the relationship between resource inputs and outputs are mediated by internal process. It investigated the contribution of each input variable to the output measure either alone or interacting with other inputs.

Hypothesis

One hypothesis was formulated to guide the study. It states that,

"There is no significant relationship between how much each input variable contributes either alone or interacting with each other and the output measure."

Methodology

The research design adopted for the study was descriptive survey. The population for the study was all the secondary schools in Lagos State. The stratified random sampling technique was applied in the selection of eight out of the 20 Local Education Districts (LEDs). Four secondary schools were randomly selected from each of the eight LED bringing the total to 32 out of the 349 secondary schools.

The questionnaire used for data collection was constructed by the researcher. The questionnaire was divided into two sections. Section A, sought Bio-Data and section B contained some specific questions relevant to the study. The questionnaire was scrutinized by some research experts from the University of Lagos for face validity. There was no need for reliability because the questionnaire sought factual information. The statistical technique used for data analysis was Pearson Product Moment correlation.

Results and Discussion

Below is the result of tested hypothesis. The hypothesis posited that there is no significant relationship between how much each input variable contributes either alone or interacting with each other and the output measure. Correlation analysis was carried out in this study to examine the degree of correlation among some input variables which are the independent variables and the output (the dependent variable), which is academic performance of students at SSCE.

Table I: Correlation Matrix of the Variables, 2000, 2001, 2002, 2003

2000

VI	V2	V3	V4	V5	V6	V7	V8
V1 1.0000							
V2 .8303	1.000						
V3 -.6343	-.0042	1.000					
V4 -.7169	-.7067	-.5553	1.000				
V5 -.4735	.0560	-.3284	.3122	1.000			
V6 .8857	.9407*	.1527	-.6454	-.0528	1.000		
V7 -.6513	-.1567	-.5059	.5986	.9459*	-.2333	1.000	
V8 -.8725	-.4647	-.4369	.6055	.8047	.6207	.8694	1.000
V9 .4211	.3565	-.6785	.3990	.2088	3113	.1012	.1517

2001

VI	V2	V3	V4	V5	V6	V7	V8
V1 1.0000							
V2 .7398	1.000						
V3 -.5061	.7471	1.000					
V4 -.8143	-.5858	.7611	1.000				
V5 -.8143	-.1585	-.3539	.8592	1.000			
V6 -.5309	-.3181	.0158	-.5580	.8846	1.000		
V7 .7641	-.0532	.1370	-.7047	.9654*	.9476	1.000	
V8 .6508	-.6728	-.7870	.9487*	.7200	-.3817	-.5143	1.000
V9 .5389	.4867	-.2305	.4979	.0503	.3441	.1304	1.0689

2002

VI	V2	V3	V4	V5	V6	V7	V8
V1 1.0000							
V2 .0112	1.000						
V3 -.1103	-.0058	1.000					
V4 .2379	-.3089	.2940	1.000				
V5 .1619	-.8219	-.2471	-.2035	1.000			
V6 .2557	.6089	.5200	.0494	.9668*	1.000		
V7 -.5805	-.7648	-.7586	-.1747	.6913	.6383	1.000	
V8 .3828	-.0380	-.7600	.1770	.0871	.1133	-.2176	1.000
V9 .4702	.2901	-.0853	.6203	.2912	.3727	.2129	.1834

2003

VI	V2	V3	V4	V5	V6	V7	V8
V1 1.0000							
V2 -.3419	1.000						
V3 .2518	-.0226	1.000					
V4 .6020	.2531	.4598	1.000				
V5 -.9078	.3549	-.4532	-.3970	1.000			
V6 .2509	-.1198	.0026	.6605	.1164	1.000		
V7 -.7195	.1886	-.1989	-.0772	.8912	.4902	1.000	
V8 .2172	.0281	-.8743	-.0848	.0416	.1221	.1399	1.000
V9 .3919	.5759	-.1319	.6396	.3342	.5796	.0365	.1920

Source: Data from Field Work

Keys

VI	School size
V2	Average teachers' qualification
V3	Average teachers' experience
V4	Average teachers' salary
V5	Per pupil teachers' salary
V6	Average running cost
V7	Average running cost
V8	Per pupil capital expenditure
V9	Performance of students at SSCE

The correlation matrix of the major variables for the years 2000, 2001, 2002, and 2003 shows that the variables; school size (V1), average teachers' qualification (V2), average running cost (V6) and per pupil running cost (V7) were moderately correlated with the dependent variable (V9). Average teachers' experience (V3) was inversely correlated with the dependent variable. Although, per pupil capital expenditure (V8) was positively correlated with the dependent variable, the coefficient was very low. The null hypothesis was therefore rejected since there is a significant relationship between the input variables' contribution either alone or interacting with each other and the output measure.

The table shows that school size (V1) when correlated with the dependent variable, the correlation coefficients, were .4211, .5389, .4702 and .3910 in 2000, 2001, 2002 and 2003 respectively. In the case of average teachers' salary (V4) in the years 2000 and 2001, the variable was moderately correlated with the correlation coefficients of .3990 and .4979, while in 2002 and 2003, the correlation coefficients were high, that is, .6203 and .6896 respectively.

The results further show high intercorrelation among the variables. School size, average teachers' salary and average running cost were intercorrelated. At the same time, average teachers' salary and average running cost on one hand, per pupil teachers' salary and per pupil running cost on the other were intercorrelated. Thus, multicollinearity occurs when two or more of the independent variables are strongly related to one another.

This production function is saying nothing other than that outcomes and inputs are linked systematically in some, as yet to be specified fashion. The investigation revealed that input variables such as school size, average teachers' qualification, average teachers salary, per pupil teachers' salary, average running cost and per pupil running cost, acquired from the environment undergo a process of transformation into outputs/outcomes which are exported back to the environment.

The general environment is influenced by the major technological, social, political and economic forces which operate in the society. The specific environment is made up of the parents, the local community, the local education district and other educational organizations, government and its agencies. Butler (1991) asserts that the task environment in order to

survive, needs to pursue ends that specify the needs of its stakeholders to a larger extent. The educational institutions exchange resources and support for its output. Most of the resources to educational institutions depend most of the time on the population of students, and also on additional specific grants for stated purposes. Educational institutions occasionally receive donations from philanthropic organizations, non-governmental organizations, old students' associations, etc. in the form of finance or real inputs.

The issue of flexibility of self-management comes in at this juncture and this has to do with tying institutions into market economy through the medium of money, which gives the ability to decide on the mix of real resources to purchase. The financial resource allocation to institutions are used to get real resources in the form of staff, materials, and other services. This first intermediate transformation is planned and recorded through budgets. The real resources acquired and financed through the budgets, are used in conjunction with other real resources like the buildings on ground, plant and equipment to produce what can be called 'intermediate outputs' or what Preedy (1997) calls 'operating services' which support teaching and learning indirectly. However, the need for the creation and maintenance of appropriate physical environment has to be stressed in which learning can take place. MacPherson, (1997) adds that administrative services must be provided to aid learning and investment should take place in maintaining and developing members of staff.

Implication for Policy Makers in Nigeria

The goal of much production analysis is to estimate the underlying production function(s) that characterizes a given activity. A cursory look at what is going on in the school system seems to suggest that the awareness is not there, whereas the knowledge of production functions allows one to know what is possible to produce from a given set of inputs. This is important because administrators and planners presumably know how much of various inputs are being devoted to a production process. If relevant production function is known, the measures of supply can be put into the Mathematical expression and calculate the maximum amount of outcome that is possible to expect. Anything short of this indicates technical inefficiency and can prompt efforts to identify the source.

In Nigeria, experience has shown that educational administrators have limited discretion over the internal operation of schools. In other words, even if an administrator knows that when a particular kind of resource is employed in a particular way with a particular kind of students, it is highly productive, he has not got the capability to engineer the use of the resource in the indicated fashion. This is because the resource might be made available, but the degree to which it is actually used is an entirely different matter. The availability of the resource can be taught of as a necessary but hardly a sufficient condition for ensuring the resource's use.

Part of the problem faced by administrators is that they have limited control over teachers and their activities. Also they have the problem of not being allowed to make use of their discretion because they are under the authorities of both the school management boards and Ministry of Education. Moreso, school officials sometimes have little clear guidance over what they are expected to produce. As noted earlier, educational outcomes are numerous

and this raises the problem of how much of one desirable outcome relative to another should be produced. This problem is compounded by the fact that individual teachers are likely to disagree fundamentally over what to be produced and how it should be produced.

First of all, policy makers must become more specific on what counts as inputs and outcomes. They should devise ways by which to measure quantitative and qualitative dimensions of inputs and outcomes that are identified. It is also necessary for policy makers to clarify the nature of the function linking the inputs with outcomes.

Estimation of the production function will enable policy makers to have insights into how productive the various inputs are. It will also enable them to obtain measures of how successful the production function is at explaining the production process being studied. It has been shown that it is not all that possible to arrive at a production function that perfectly explains all of a production process. However, this will enable policy makers to be aware that a production function might be capable of explaining about 60 or 70% of the variation in the production outcomes. The remaining variation that is not explained can be taken to be what remains unknown about the production process.

Policy makers should be aware of the idea that inputs vary in their prices. According to the production function, an input may appear to be highly productive but at the same time be highly priced. However, with knowledge about productivity in addition to knowledge about prices, policy makers can reach unambiguous conclusions about the improvement of allocative efficiency. The best inputs are those with high productivities relative to their prices, whereas the least attractive inputs are those with low productivities and high prices. More precisely, the decision making rule is to allocate resources in such a way that equality exists among the ratios of each inputs marginal productivity and price.

Conclusion and Recommendation

The paper has attempted to analyse the inherent difficulties associated with identification and specification of inputs and outputs/outcomes in educational production functions and the application of this to education has been examined. It comes to clear conclusion that there is a link between the resource inputs and the resulting educational outputs/outcomes for students. However, before production functions can be helpful to policy makers in education, it is necessary to specify what constitutes the input/outcome of the production process.

On the nature of the process that transforms inputs into outputs/outcomes, it was gathered that input variables: school size, average teachers' qualification, average teachers' salary, per pupil teachers' salary, average running cost and per pupil running cost, acquired from the task environment undergo a process of transformation through educational process into output/outcome which are exported back into the environment.

In the case of how much each input variable contributes to the output measure, it was found that there was a relationship between the two set of variables (the input variables and the output variable). Some input variables like school size, average teachers' salary and qualification, per pupil teachers' salary and running cost and average running cost

were found to be correlated with the dependent variable and there was a high intercorrelation among the variables.

In conclusion, policy makers should become more specific on what count as inputs and outcomes. Ways should be devised by which to measure quantitative and qualitative dimensions of inputs and outcomes that were identified. The clarification of the nature of the function linking together the inputs and outcomes is very important.

Attempts should be made to estimate the production function because this will enable policy makers and administrators to obtain measures of how successful the production function is at explaining the production process since production function is only capable of explaining about 60 or 70 percent of the variation in the production outcomes.

Policy makers and administrators should also be aware of the idea that inputs vary in their prices, as a result the decision making rule is to allocate resources in such a way that equality exist among the ratios of each inputs marginal productivity and price.

References

Akangbou, S.D.(1985). *The Economics of educational planning in Nigeria.* New Delhi: Vicas Publishing House PVT Ltd.

Butler, R. J. (1991). *Designing organizations: A decision making perspective.* London : Routledge.

Hanushek, E. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature*, 24, 1141-77.

MacPherson, A. (1997). Measuring added value in schools. In A. Horris, N. Bennett & M.S. Preedy (Eds.), *Organisational effectiveness and improvements in education.* Buckingham: Open University Press.

Monk, D.H. (1990). Educational finance: An economic approach. New York: McGraw-Hill.

Mullis, I.U.S. Owen, E. H. & Phillips, G.W. (Eds.) (1990). *Accelerating academic achievement: A summary of findings from 20 years of NAEP.*

Odden, A. & Massy, W. (Eds.) (1992). *Educational funding for schools and universities: Improving productivity and equity.* Los Angeles: University of Southern California, Centre for Research in Educational Finance, Consortium for Policy Research in Education.

Oguntoye, A.O.O. (1978). *Cost and production functions in education: An economic analysis of secondary education in Ogun State of Nigeria.* Unpublished doctoral dissertation, University of Winsconsin – Madson.

Preedy, M., Glatter, R. & Levacic, R. (Eds.) (1997). *Educational management: Strategy, quality and resources.* USA: Open University Press.