

EVALUATING EDUCATIONAL PRODUCTION FUNCTION OF THE GCE (ORDINARY LEVEL) STUDENTS THROUGH CANONICAL CORRELATION ANALYSIS: A CASE STUDY IN PASSARA ZONE, SRI LANKA

Dilhani E.V.D.

Department of Economics, University of Ruhuna, Sri Lanka

ABSTRACT

Economics of education emphasizes the importance of education investment in economical development. C.W.W.Kannangara, father of the free education system of Sri Lanka introduced the free education system to Sri Lanka. And also, the government spends more on the task. This study estimated the Education Production Function (EPF) for G.C.E. Ordinary Level students in Passara education zone, Sri Lanka. Multivariate analysis technique used to evaluate empirical data of the study. The EPF is based on Cobb-Douglas type production function by using Canonical Correlation Analysis (CCA). The EPF estimations show student's self-learning hours are the most affected factor on student's cognitive achievements. Sleeping hours, scarcity of education resources at home are negatively effect on children's education. It seems that students who live in Passsara education zone are weak in Time Management ability. So, it is an important point should be developing.

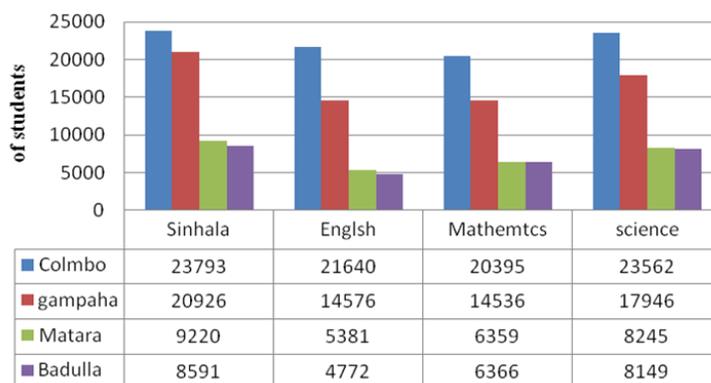
KEYWORDS

Canonical Correlation Analysis (CCA), Cobb-Douglas production function, Economics of Education, Education Production Function (EPF), Multivariate analysis.

1. INTRODUCTION

Educational Economists emphasize that, if a nation languishes in knowledge and skills, its development will remain forever a mirage. Since the free education policy was introduced to Sri Lanka by CWW Kannangara, the Government of Sri Lanka has allocated every year a fraction of its budget to the task of implementing the education, and it involves a considerable amount of public funds. Education is the most powerful weapon to buildup human capital. The people who born in Sri Lanka fortunate to associate a pearl of great price the free education system in Sri Lanka. There for, Sri Lanka has a high literacy level among other developed countries. Education researchers had number of problems in empirical studies such as, difficulties in identification of one outputs severed for other outputs, inability to identify the effects of specified input to output and etc. (Ranashinghe, 1990). Education researches emphasis that the primary education is not enough to increase the literacy rate in Sri Lanka (Athurupana et al, 2006). So, the secondary education of Sri Lankais in a critical point whether it improves the efficiency of children's education. By the way, the G.C.E. Ordinary examination (O/L) is the final state of secondary education level. That's filtering people in to higher education and a part say good bye for the school education and they move in to general society. Such a situation like thisthe objective of the study begins to evaluate Education Production Function (EPF) of G.C.E. O/L examination by

using multivariate analysis techniques as a case study in Passara education zone. The G.C.E. O/L examination results in Badulla district comparatively is in low level among other districts. Evidence are in figure 01.



Source of data: Department of examination.

Figure 1: students O/L performance in some selected districts

According to the researchers, economic condition is an important factor in connection with the education (Brempong K.G. and Gyapong, 1990). This study used a canonical correlation-analysis to evaluate the most affected factors on education production of the GCE Ordinary Level students in the Passara Educational Zone, Sri Lanka.

2. LITERATURE REVIEW

The literature background of the study basically have divided to two main parts as,

- Theoretical Background
- Technical Background

The theoretical background started from few decades ago. That means “Economics of Education” has started as a theoretical concept in sub fragment of “Economics” circa 1960. Economics of education explain the relationship of education towards the economic development of a country. Psacharopoulos (2004) cited it as, “...the 1960, were characterized by attempts to estimate the rate of return to investment in human capital or the contribution of education to economic growth, the 1970s and 1980s were dominated by attempts to test for the existence of screening, and from the 1990s to date the focus is on identifying education externalities. In economic growth and quantifying non-market effects...”

The estimation of the study is typically based on the concept of “Education Production Function” (EPF). This is a major concept in “Economics of education”. EPF derive a broad conceptual framework to the estimations of education input output relation. Education production function concept has started with the “Coleman report” in 1966. That made a major change in education research tradition. Coleman report emphasised the need of a clear technical framework for the input output analysis in education field. The EPF based on cobb-Douglas type production function often. But EPF does not explain about the cost reduction and profit maximition. EPF uses to figure the relationship between education inputs and outputs at various situation.

The second part of the literature review compile with the technical development of educational studies. There are number of researcheshave done related to education with empirical analysis.

Statistical tests help to have a clear and significant decisions. There are some selected articles to discuss the technical development in education field here.

Eric A. Hanushek is a famous researcher in educational contest. He has done number of educational researches and gave some suggestions to education field. Hanushek's study in 1979 is about the conceptual and empirical issues in the estimation of educational production function. He emphasised that the understanding and measuring education performance are important at designing policies regarding with teacher's accountability, educational finance systems and social integration. He denoted that student's personal characteristics, family background, peer's effect, school continuation and student's attendance as the explanatory variables in student's educational outcome. As well as, student's cognitive achievements and attitudes towards the school have used to measure the student's educational outcome. Especially he discuss about the structure of the education outcome. There are some argument about the education outcome it is a single output, simultaneous output or joint output. Hanushek cited that education outcome is a joint production. He have used Canonical Correlation Analysis (CCA) as a statistical technique to estimate the relationship between two set of variables.

Chizmar and Zak (1983) have molded multiple outputs in education production functions. There were 175 students in the sample. There were two dependent variables in the study, those were attitudes score at the end of course and test score of economics at the end of the courses. The independent variables of the study were attitudes score at deigning of course, students expected grade, student's evaluation of the professor given at the conclusion of the course, Attitude score at beginning of course, effort index, composite score, student's age. They have compared three empirical approaches Vinod's adaptation, Harold Hotelling's Canonical Correlation Analysis (CCA), Ordinary Least Square method (OLS) and Two Stage Least Square method (2SLS) to investigate which one models multiple outputs plays an important role in economic education production function parameter estimates and consequent. Finally, they mention that CCA is the best approach to estimations in education quantities.

Brempong and gyapong have done there evaluation about the characteristics of education production function with the application of canonical correlation analysis. They have used socioeconomic characteristics of communities as the inputs of the education process. As the educational outputs they have used the Mathematics and English scores. Finally they have emphasis that two factors are affecting on students cognitive achievement such as the quality of the school resources and the student's outside environment from the school.

These researches show the effected factors on student's education. And those give a clear image that education is a joint production and Canonical correlation analysis is the most suitable technique to estimate the relationship between two set of variables. According to this situation methodology and finding are cited beyond.

3. METHODOLOGY

Number of researches cited that cognitive achievement of a person is hard to measure as a numerical value. But traditionally researches have used test scores as the one of measurement of the cognitive achievement. Some researchers has estimated the education production function for one education outcome. Some are argued that human's education possibility doesn't appear in one subject. Researchers have estimated EPF one by one separately for few subjects and then they have solved those by using simultaneous equations. Some are argued that education outcome can't separate and it is a joint and multiple production. By the way, Researches have used Education Production Function (EPF) to derive a logical framework for their studies. The estimations of Education Production Function have taken by using statistical techniques such as,

Ordinary Least square (OLS), two stage least squares (2SLS), Multivariate Analysis of Variance (MANOVA), multiple regression Analysis, Canonical correlation Analysis (CCA) etc. Recently, researchers have pointed to the Canonical correlation analysis for education researches because of the appearance and accuracy of the technique.

Canonical Correlation Analysis (CCA) is a technique to estimate the correlation between two or more sets of variable. CCA measure the linear relationship between two multi-dimensional variables. It represent correlation coefficients. More than one canonical correlations will be found each corresponding to a different set of basis vectors/ canonical variates. Canonical variates accounted for by the particular variable. Canonical Correlation Analysis is also considered as the Multivariate Multiple Regression (MMR). Often called set correlation,

$$\begin{aligned} \text{Set 1} &= (Y_1, Y_2, \dots, Y_p) \\ \text{Set 2} &= (X_1, X_2, \dots, X_q) \end{aligned}$$

P doesn't have to equal q

In general canonical correlation is a method that basically does multiple regression but it can figure this way in general,

$$\varphi_1 Y_1 + \varphi_2 Y_2 + \dots + \varphi_p Y_p = \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_q X_q$$

This isn't really what happens. But it shows the way in general. The model of the EPF is assuming Cobb-Douglas type production function. The Cobb-Douglas production function derive on basic two concepts such as cost reduction concept and profit maximization concept. But in Education Production Function estimation those two are ignored. The model of Education Production Function (EPF) is as follow,

$$\begin{aligned} \text{SINSC}^{\alpha_1} \cdot \text{SCISC}^{\alpha_2} \cdot \text{MATSC}^{\alpha_3} \cdot \text{ENGSC}^{\alpha_4} = & \beta_0 \cdot \text{AGE}^{\beta_1} \cdot \text{GNDR}^{\beta_2} \cdot \text{FRTM}^{\beta_3} \cdot \text{SLTM}^{\beta_4} \cdot \text{ATEND}^{\beta_5} \cdot \text{STUHR}^{\beta_6} \cdot \text{TIHR}^{\beta_7} \cdot \text{MOTED}^{\beta_8} \cdot \text{FATED}^{\beta_9} \cdot \text{FYHLED}^{\beta_{10}} \cdot \text{INCM}^{\beta_{11}} \cdot \text{HOMER}^{\beta_{12}} \cdot \text{PEER}^{\beta_{13}} \cdot \text{STR}^{\beta_{14}} \cdot \text{EXFIVE}^{\beta_{15}} \cdot \text{OJPYT}^{\beta_{16}} \cdot u \end{aligned}$$

This study uses the cross sectional data in secondary education field in Sri Lanka. The study area is Passara educational zone in Badulla district. There are 26 schools in Passara zone. Ten schools selected as the sample by using two step cluster sampling method. Students who are in grade 11 was the sampling frame. The analysis of the research based on primary and secondary data. There were 206 students in the sample. There are multiple dependent variables in this study. Test score of Mathematics (MATSC), Science (SCISC), English (ENGSC) and Sinhala (SINSC) have used as the education out come and independent variables were selected from four sections such as student family background, student characteristics, peer's effect on children's education and mediation of other related parties for children's education. Secondary data approach uses to collect the test score of regarding subjects by using teacher's records. The input variables if not the independent variables of the study are as follow under two main categories.

Independent Variables (Scale)-

- AGE -Age (Months)
- INCM -Gross month salary of household
- FRTM -Free hours per day
- SLTM -Sleeping hours per day
- ATEND -Number of school present days in considering year
- TIHR -Number of tuition class hours per week
- STUHR -Number of self-study hours per week

- PEER -Education level of the buddy
- STR -Student Teacher ratio of the classes
- EXFIVE -Ratio of the teachers who have Experian more than 5 year

Independent Variables (Categorical)-

- GNDR - Gender
- FATED- Father’s education level
- MOTED - Mother’s education level
- FYHLED - Education level of the most helpful person for the student’s education at the home
- HOMER - Ability in uses of educational resources at home
- OJPYT - Mediation of objected parties for student’s education

To investigate the relationship between these multiple inputs and output used the canonical regression analysis.

4. FINDINGS AND DISCUSSION

Canonical correlation analysis (CCA) is used to find pairs of linear combinations of each group of variables that are highly correlated. The estimation endowed four canonical functions with canonical vitiates of 0.7, 0.57, 0.3 and 0.29. There are four multivariate statistics which calculated by the STAT software such as Wilk’s Lamda, Pillai’s trace, Lawley-Hotelling trace and Roy’s largest root tests. These all tests are highly significant at all significant level in the research.

Table 01- Education production function estimation

Measures of overall model fit for EPF with all dependent variables			
CANONICAL FUNCTION		CANONICAL CORRELATION	
1		0.6779	
2		0.5796	
3		0.3671	
4		0.3211	
Test of significance of all canonical correlations			
STATISTICS	VALUE	F-STATISTICS	PROBABILITY
Wilk’s Lambda	0.278	3.568	0.000
Pillai’s trace	1.033	3.336	0.000
Hotellings trace	1.627	3.799	0.000
Roy’s ger	0.850	8.145	0.000

Source: Author’s calculation

According to the EPF estimations student’s self-learning hours is the most affected course in student’s cognitive achievements. The free time of the students, peer’s education level and income level also positively affected to the student’s education outcome. In the other way, EPF shows that Student’s sleeping hours, scarcity of education resources at home are negatively influence to the children’s education. But the low income level of the house hold and the low

education level of the parents in the location is directly affected to the low efficiency level of student education level.

Table no 02: Canonical fit estimation of the Cobb-Douglas type Education Production Function

VARIABLE	COEFFICIENT	P> t
Education Out comes		
SCISC	0.1130	0.002
SINSC	0.8090	0.021
MATSC	0.5964	0.802
ENGSC	1.0334	0.708
Education Inputs		
AGE	0.1275	0.000
GNDR	1.123	0.703
FRTM	0.4327	0.058
SLTM	-0.7956	0.036
ATEND	0.3878	0.802
TIHR	0.6295	0.804
STUHR	0.1679	0.156
MOTED	0.0824	0.008
FATED	0.3926	0.651
FYHLED	-0.2729	0.142
INCM	0.0338	0.437
HOMER	-0.6717	0.796
PEER	0.1404	0.133
STR	0.3412	0.008
EXFIVE	1.5461	0.000
OJPTY	-0.6257	0.002

Source: Author's calculation

5. CONCLUSION

The primary statistical analysis of the research figure that students spent more time to tuition classes and to sleep. But the ultimate results of EPF estimation prove student's self-study hours are more fruitful than above factors. Students waste their valuable time for useless things. So, it seems that students who live in passara education zone are weak in Time Management ability. Unfortunately the variables which figure the school characteristics in regarding study area have rejected from the EPF estimation. The free education system of Sri Lanka is maintained by the poor lessee in whole country. Lessee's expectations are towards to the good education outcome of their children. As well as they do this noble investment for the next country and next generation. In the teeth of these matters the EPF give evidences to change the existing education system. The Student Centred Learning process (SCL) is a best way to build up the efficiency of student's education process. As well as the EPF mention that the economic situation in student's home affects to the children's education directly. After revise these knotty, the controllers should have a responsibility to keep the better education situation in rural areas also. And also, Policy implications within the government schools are, it is better to convert school education system towards to the student's centred learning system as well as Student's Time Management ability should Provide or motivate.

REFERENCES

- [1] Johnson R.A, Wichern D.W, 1992, applied multivariate statistical analysis, 3rd edn, Prentice-Hall, ISBN 81-203-1045-4.
- [2] Joseph F.H, Anderson R.E, Tatham R.L, Black C.W, 1998, Multivariate data analysis, 5th edn, Prentice-hall.
- [3] Agunloye O. Olajde, Sielike C. Catherine, Jnik Stephen Ole, 2005, A multivariate analysis of education productivity in urban Georgia high school, Georgia.
- [4] Brempong, K.G. & Gyapong A.O. (1991) Characteristics of education production functions: an application of canonical regression analysis. *Economics of education review*, 10(1), 7-17, Great Britain.
- [5] Cheng, A. G. & Ismail, N.A. (2005). Analyzing education production in Malaysia using canonical correlation analysis, *International education journal*, 6(3), 308-315. <http://iej.cjb.net>.
- [6] Chizmar F. John, Zak A. Thomas, 1983, Modeling multiple output in education production function, *Research in economic education*, Vol 73, no2.
- [7] Hanushek, E.A. (1979) conceptual and empirical issues in the estimation of education production function. *The journal of human resources*, 14(3), 351-388. <http://links.jstor.org/sici?sici=0022-166x%28197922%2914%3A3%3C351%3ACAEIIT%3E2.o.Co%3B2-H>.
- [8] Psacharopoulos, G. (2004). *Economics of education: from theory to practice*. Brussels economic review-cahiers economies de braxellers.47
- [9] Central bank, 2012, Central bank annual report, Sri Lanka.
- [10] Department of census and statistics, 2013, *Statistical handbook*, Colombo, Sri Lanka
- [11] Department of examination, 2011, 21-Sinhala language & literature, G.C.E. (O/L) examination-2011, Evaluation report, Colombo, Sri Lanka.
- [12] Department of examination, 2011, 31-English language, G.C.E. (O/L) examination-2011, Evaluation report, Colombo, Sri Lanka.
- [13] Department of examination, 2011, 32-Mathematics, G.C.E. (O/L) examination-2011, Evaluation report, Colombo, Sri Lanka.
- [14] Department of examination, 2011, 34-Science, G.C.E. (O/L) examination-2011, Evaluation report, Colombo, Sri Lanka.
- [15] Department of examination, 2011, *Statistical hand book 2005-2007*, research & Development branch, Colombo, Sri Lanka.
- [16] Department of examination, 2011, *Statistical hand book 2008-2010*, research & Development branch, Colombo, Sri Lanka.
- [17] Department of examination, 2012 32-Mathematics, G.C.E. (O/L) examination-2012, Evaluation report, Colombo, Sri Lanka.
- [18] Department of examination, 2012, 21-Sinhala language & literature, G.C.E. (O/L) examination-2012, Evaluation report, Colombo, Sri Lanka.
- [19] Department of examination, 2012, 31-English language, G.C.E. (O/L) examination-2012, Evaluation report, Colombo, Sri Lanka.
- [20] Department of examination, 2012, 34-Science, G.C.E. (O/L) examination-2012, Evaluation report, Colombo, Sri Lanka.