EDUCATION PRODUCTION IN MALAYSIA: A CANONICAL CORRELATION ANALYSIS

BY
ANG GUAT CHENG
(EGA 020008)

SUBMITTED TO THE FACULTY OF ECONOMICS AND ADMINISTRATION, UNIVERSITY OF MALAYA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF ECONOMICS

SEPTEMBER 2004
ABSTRACT

National attention is now focused on the educational reforms. There is a need to acquire a better understanding of the education production in Malaysia using advanced multivariate analysis. Our starting point is the premise that the education production function is a real and potentially very useful tool for those concerned with improving the performance of schooling systems. This study employs Vinod’s (Vinod, 1968) adaptation of Hotelling’s Canonical Correlation Analysis to perform the parameter estimate for joint educational production with Cobb-Douglas functional form. It incorporated data from the national sources and IEA Third International Mathematics and Science Study – Repeated (TIMSS-R) 1999 into a comprehensive look at the relationship between educational inputs and outputs.

We have selected a small number of main determinants of academic achievement for Canonical Correlation Analysis. The differences in rural and urban school’s performance are disclosed by investigating their separate production functions. The results reveal that Malaysian secondary schools are more productive in the teaching and learning process of science than mathematics nationally. Comparing the performance between two educational outputs, this analysis suggests that average achievement in mathematics is higher than science at urban schools. Oppositely, rural schools perform better in science than mathematics. Overall, this input-output relationship conclude that instructional hour is an effective and important variable that could be used to offset the disadvantage in low level of out-of-school study time to the educational production function in rural areas. In other words, the analysis suggests that extra instructional time for rural schools and certain poor urban schools is essential in obtaining better academic achievement.
ACKNOWLEDGEMENT

This work could not have been accomplished without the guidance, consultation, and support of many people. Professor Shyamala Nagaraj asked thoughtful, penetrating questions and provided valuable advice and guidance for the study's conception. I am indebted to many people for their assistance in the preparation of this study, but would like to give special mention to the followings. My supervisor, Associate Professor Dr Noor Azina Bt Ismail provided constant understanding, guidance and advice from the conception to the conclusion of this research. I am very grateful to Dr. Hamidah Bt Yusof from Educational Planning & Research Division (EPRD) of Ministry of Education for her permission to use the data for this study, and to numerous individuals in her staff for their generous cooperation and help.

Thanks are also due to the staff of Faculty of Economics and Administration, the librarians of the University of Malaya, librarians from the Pusat Dokumentasi, EPRD of Ministry of Education for their guidance and services rendered to me in completing my project paper.

A special thank goes to my parents, for their love, support, concern and encouragement throughout the durations of the research. I also wish to express my gratitude to my friend, Low Ai Loon because she shared invaluable experience and advised me throughout the period of this study. Finally, I would like to say a special word of thanks to all my course mates and wish them all the best in their future undertakings.
# TABLE OF CONTENTS

ABSTRACT i
ACKNOWLEDGEMENT ii
TABLE OF CONTENTS iii
LIST OF FIGURES ix
LIST OF TABLES x

## CHAPTER 1  INTRODUCTION

1.1 OVERVIEW 1
1.2 EDUCATION REFORMS IN MALAYSIA 4
1.2.1 RURAL-URBAN DIFFERENCE IN EDUCATION 6
1.3 OBJECTIVES OF THE STUDY 8
1.4 SIGNIFICANCE OF THE STUDY 9
1.5 ORGANIZATION OF THE STUDY 9

## CHAPTER 2  LITERATURE REVIEW

2.1 SCOPE OF REVIEW 11
2.2 CONCEPTUAL AND METHODOLOGICAL ISSUES 13
2.3 STUDIES IN DEVELOPED COUNTRIES 15
CHAPTER 3  THEORETICAL BACKGROUND

3.1  ECONOMICS OF EDUCATION : THEORY OF PRODUCTION  26
    3.1.1  JOINT EDUCATIONAL PRODUCTION  29

3.2  THE IMPORTANCE OF MARGINAL ANALYSIS  31
    3.2.1  MARGINAL PRODUCT (MP) AND MARGINAL ELASTICITY (ME)  32
    3.2.2  MARGINAL RATE OF TECHNICAL SUBSTITUTION (MRTS)  33
    3.2.3  MARGINAL RATE OF OUTPUT TRANSFORMATION (MRT)  34

3.3  SUMMARY  35

CHAPTER 4  RESEARCH METHODOLOGY

4.1  INTRODUCTION  36

4.2  DATA DESCRIPTION  36
    4.2.1  SCHOOL DATA  40
    4.2.2  STUDENT DATA  41

4.3  MEASUREMENT OF THE VARIABLES  43
4.3.1 SCHOOL OUTPUTS 43
4.3.2 SCHOOL INPUTS 44
4.3.3 ENVIRONMENTAL INPUTS 45
4.4 COMPUTER PROGRAMMES USED 47
4.5 METHODOLOGY USED 47
4.5.1 EXPLORATORY DATA ANALYSIS 48
4.5.2 TESTING OF MEAN DIFFERENCE 49
4.5.3 SIMPLE REGRESSION ANALYSIS 51
4.5.4 CANONICAL CORRELATION ANALYSIS 51
4.5.4a WHY CHOOSE CANONICAL CORRELATION ANALYSIS? 52
4.5.4b PARAMETER ESTIMATES 54
4.5.4c SENSITIVITY ANALYSIS 57
4.5.4d PRACTICAL ISSUES 57
4.5.4e TEST OF SIGNIFICANCE 60
4.5.4f THE REDUNDANCY ANALYSIS 61
4.6 SUMMARY 62

CHAPTER 5 RESULTS AND ANALYSIS: NATIONAL LEVEL

5.1 INTRODUCTION 63
5.2 DESCRIPTION STATISTIC 63
5.3 SIMPLE REGRESSION ANALYSIS 64
5.4 PEARSON PRODUCT-MOMENT CORRELATION 68
5.4.1 CORRELATION BETWEEN INDEPENDENT VARIABLES 68
5.4.2 CORRELATION BETWEEN DEPENDENT VARIABLES 68
5.4.3 CORRELATION BETWEEN INDEPENDENT AND DEPENDENT VARIABLES 68
5.5 CANONICAL CORRELATION ANALYSIS 69
5.6 SENSITIVITY ANALYSIS 71
5.7 DIAGNOSTIC CHECKING 75
5.7.1 NORMALITY 75
5.7.2 OUTLIERS 77
5.7.3 MULTICOLLINEARITY 77
5.7.4 LINEARITY 78
5.8 THE MARGINAL ANALYSIS 79
5.9 SUMMARY OF MAIN FINDINGS 81

CHAPTER 6 RESULTS AND ANALYSIS: RURAL-URBAN LEVEL

6.1 INTRODUCTION 83
6.2 DESCRIPTION STATISTIC 83
6.2.1 SCHOOL OUTPUTS 83
6.2.2 SCHOOL INPUTS 85
6.2.3 ENVIRONMENTAL INPUTS 87
6.3 SIMPLE REGRESSION ANALYSIS

6.4 PEARSON PRODUCT-MOMENT CORRELATION

6.4.1 CORRELATION BETWEEN INDEPENDENT VARIABLES

6.4.2 CORRELATION BETWEEN DEPENDENT VARIABLES

6.4.3 CORRELATION BETWEEN INDEPENDENT AND DEPENDENT VARIABLES

6.5 CANONICAL CORRELATION ANALYSIS

6.6 SENSITIVITY ANALYSIS

6.7 DIAGNOSTIC CHECKING

6.7.1 NORMALITY

6.7.2 OUTLIERS

6.7.3 MULTICOLLINEARITY

6.7.4 LINEARITY

6.8 THE MARGINAL ANALYSIS

6.9 SUMMARY OF MAIN FINDINGS

CHAPTER 7  CONCLUSION

7.1 MAIN FINDINGS

7.2 POLICY IMPLICATIONS

7.3 LIMITATIONS OF THE STUDY

7.4 FUTURE RESEARCH
BIBLIOGRAPHY

APPENDIX A – SURAT PEKELILING IKHTISAS BIL. 1/2004

APPENDIX B – PERMISSION LETTER FROM BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN, KEMENTERIAN PENDIDIKAN MALAYSIA.

APPENDIX C – DETAILS OF PER CAPITA GRANT FOR MALAYSIAN SCHOOLS
<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Jointness in multiple outputs production system</td>
<td>31</td>
</tr>
<tr>
<td>3.2</td>
<td>Marginal Rate of Technical Substitution</td>
<td>33</td>
</tr>
<tr>
<td>3.3</td>
<td>Marginal Rate of Output Transformation</td>
<td>34</td>
</tr>
<tr>
<td>4.1</td>
<td>Canonical Correlation Analysis Network</td>
<td>53</td>
</tr>
<tr>
<td>5.1</td>
<td>Normal P-P plots of standard residuals for school outputs</td>
<td>75-76</td>
</tr>
<tr>
<td>5.2</td>
<td>Box-plot for standardized residuals by school outputs</td>
<td>77</td>
</tr>
<tr>
<td>5.3</td>
<td>Scatter plot of canonical variables</td>
<td>78</td>
</tr>
<tr>
<td>6.1</td>
<td>Box-plots for school outputs by school location</td>
<td>84</td>
</tr>
<tr>
<td>6.2</td>
<td>Box-plots for school inputs by school location</td>
<td>86</td>
</tr>
<tr>
<td>6.3</td>
<td>Box-plots for environmental inputs by school location</td>
<td>87-88</td>
</tr>
<tr>
<td>6.4</td>
<td>Normal P-P plots of standard residuals for school outputs</td>
<td>102</td>
</tr>
<tr>
<td>6.5</td>
<td>Box-plots for standardized residuals of school outputs</td>
<td>103</td>
</tr>
<tr>
<td>6.6</td>
<td>Scatter plot of canonical variables : Rural sample</td>
<td>105</td>
</tr>
<tr>
<td>6.7</td>
<td>Scatter plot of canonical variables : Urban sample</td>
<td>105</td>
</tr>
<tr>
<td>TABLE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2.1</td>
<td>Education input-output studies: A review of results</td>
<td>16</td>
</tr>
<tr>
<td>2.2</td>
<td>Selected studies of school effects in Asian Economies</td>
<td>23-25</td>
</tr>
<tr>
<td>4.1</td>
<td>Per capita grant on non-teaching recurrent costs</td>
<td>41</td>
</tr>
<tr>
<td>4.2</td>
<td>Definition of the variables used</td>
<td>46</td>
</tr>
<tr>
<td>4.3</td>
<td>Expected sign of the educational inputs</td>
<td>47</td>
</tr>
<tr>
<td>5.1</td>
<td>Descriptive statistics for school outputs, school and environmental inputs</td>
<td>64</td>
</tr>
<tr>
<td>5.2</td>
<td>Simple regression equation for explaining achievement in Mathematics</td>
<td>65</td>
</tr>
<tr>
<td>5.3</td>
<td>Simple regression equation for explaining achievement in Science</td>
<td>66</td>
</tr>
<tr>
<td>5.4</td>
<td>Pearson product-moment correlation coefficient matrix for school inputs and environmental inputs</td>
<td>68</td>
</tr>
<tr>
<td>5.5</td>
<td>Pearson product-moment correlation coefficient matrix for achievement scores, school inputs and environmental inputs</td>
<td>69</td>
</tr>
<tr>
<td>5.6</td>
<td>Measures of overall model fit for Canonical Correlation Analysis</td>
<td>70</td>
</tr>
<tr>
<td>5.7</td>
<td>Multivariate Test of Significance</td>
<td>70</td>
</tr>
<tr>
<td>5.8</td>
<td>Canonical fit estimates of the Cobb-Douglas production function: full model</td>
<td>71</td>
</tr>
<tr>
<td>5.9</td>
<td>Canonical fit estimates of the Cobb-Douglas production function: modified model</td>
<td>73</td>
</tr>
<tr>
<td>5.10</td>
<td>One-sample Kolmogorov-Smirnov Test comparing distribution of standard residuals of school output</td>
<td>76</td>
</tr>
<tr>
<td>5.11</td>
<td>The significant of Auxiliary Regression for testing the presence of Multicollinearity</td>
<td>78</td>
</tr>
<tr>
<td>5.12</td>
<td>Estimated relationships between inputs and outputs</td>
<td>79</td>
</tr>
</tbody>
</table>
TABLE 6.17  Marginal Rates of Substitution derived from Cobb-Douglas
Production Function Estimates of Table 6.11, Table 6.12, 6.15 and
Table 6.16