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- Trends in Public Recurrent Expenditure in Zambia 1964-1982

By

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DEDICATION

IN MEMORY OF MY LATE GRANDFATHERS

BULAWAYO KAYOLO

AND

MAPULANGA SIMUNZA

FOR THE ROLE THEY PLAYED IN SHAPING THE CLAN

NOVEMBER 1983

J.S. CHIMBWAYINGA

(iii)

DECLARATION

I, JOSIAH SIMUNZA CHIMBWAYINGA, hereby declare that this dissertation or any part of it has not previously been submitted for a degree in this or any other University.

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LIST OF TABLES

TABLE NO.

- 5.1.1 The Simple Aggregate public recurrent expenditure model (The regression results).
- 5.1.2 The Simple aggregate public recurrent expenditure model corrected for Serial Correlation (The regression results).
- 5.1.3 The aggregate public recurrent expenditure model (The correlation coefficient matrix).
- 5.1.4 The aggregate public recurrent expenditure model (The regression results).
- 5.1.5 The aggregate public recurrent expenditure model (The regression results excluding GNP per capita).
- 5.1.6 The aggregate public recurrent expenditure model (The regression results excluding urbanisation rate).
- 5.1.7 The Health public recurrent expenditure model (The correlation coefficient matrix).
- 5.1.8 The Health public recurrent expenditure model (The regression results).
- 5.1.9 The health public recurrent expenditure model (The regression results excluding the urbanisation rate).
- 5.1.10 The health public recurrent expenditure model (The regression results excluding GNP per capita).
- 5.1.11 The education public recurrent expenditure model (The correlation coefficient matrix).

- 5.1.12 The education public recurrent expenditure model (The regression results),
- 5.1.13 The education public recurrent expenditure model (The regression results only including GNP per capita),
- 5.1.14 The education public recurrent expenditure model (The regression results only including PESPO),
- 5.1.15 The Internal Security public recurrent expenditure model (The correlation coefficient matrix),
- 5.1.16 The Internal Security public recurrent expenditure model (The regression results),
- 5.1.17 The annual average crime model (The regression results),
- 5.1.18 The Internal Security public recurrent expenditure model (The regression results only on LUNEMP),
- 5.1.19 The Internal Security public recurrent expenditure model (The regression results only on LANVCR),
- 5.1.20 The Rural development public recurrent expenditure model (The correlation coefficient matrix),
- 5.1.21 The Rural development public recurrent expenditure model (The regression results),
- 5.1.22 The Rural development public recurrent expenditure model (The regression results excluding LGNP),
- 5.1.23 The Rural developing public recurrent expenditure model (The regression results excluding LCOPPR),
- 5.1.24 The aggregate public recurrent expenditure centralisation model (correlation coefficient matrix),

- 5.1.25 The aggregate public recurrent expenditure centralisation model (The regression results).
- 5.1.26 The aggregate public recurrent expenditure centralisation model (The plain regression model results).
- 5.2.1 The aggregate public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.2 The aggregate public recurrent expenditure stability model (The regression results).
- 5.2.3 The aggregate public recurrent expenditure stability model, (The regression results excluding LPOPCO).
- 5.2.4 The health public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.5 The health public recurrent expenditure stability model (The regression results).
- 5.2.6 The health public recurrent expenditure stability model corrected for serial correlation (The regression results).
- 5.2.7 The health public recurrent expenditure stability model corrected for serial correlation (The regression results excluding LGNPCO).
- 5.2.8 The education public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.9 The education public recurrent expenditure stability model (The regression results).
- 5.2.10 The improved education public recurrent expenditure stability model (The correlation coefficient matrix).

- 5.2.11 The improved education public recurrent expenditure stability model (The regression results).
- 5.2.12 The Internal Security public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.13 The Internal Security public recurrent expenditure stability model (The regression results).
- 5.2.14 The expanded internal security public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.15 The expanded Internal Security public recurrent expenditure stability model (The regression results).
- 5.2.16 The Reduced Internal Security public recurrent expenditure stability model (The regression results).
- 5.2.17 The new Internal Security public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.18 The new Internal Security public recurrent expenditure stability model (The regression results).
- 5.2.19 The rural development public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.20 The rural development public recurrent expenditure stability model (The regression results).
- 5.2.21 The expanded rural development public recurrent expenditure stability model (The correlation coefficient matrix).
- 5.2.22 The expanded rural development public recurrent expenditure stability model (The regression results).
- 5.2.23 The new rural development public recurrent expenditure stability

CONTENTS	Page
Acknowledgements	IV
List of Tables	V - VIII
Abstract	1 - 2
Chapter One <u>The Place of Government Expenditure Studies in the Economic Policy Formulation Process</u>	3
<u>INTRODUCTION</u>	3
The Significance of the study	4
Review of the Economy	5
Public and Private Sector Coexistence	6
Economic forecasting	6
Appraisal of the Government Policies	7
Chapter Two <u>The Review of Literature</u>	8
Wagner's Law of Public Expenditures	8
The Second type of Exploratory Study	9
Recent Public Expenditure Studies	11
Aims of the Study	16
Rationale	18
The Structure of the paper	19
Chapter Three <u>The Theoretical Models</u>	20
The Conceptual Definition of Development	20
Life-Sustenance	21
Self Esteem	22
Freedom from Servitude	23
Development or Liberation	23
Indicators of Development	24
The Social Indicators	26

The Validation of Indicators	27
The Public Recurrent Expenditure and the Definition of Development	28
Public Recurrent Expenditures and Development Indicators: A Simple Theoretical Model	29
Public Recurrent Expenditures and Development Indicators: An Aggregate Theoretical Model	32
Stability Theory	35
Chapter Four <u>Methodology</u>	38
Statements of Hypotheses	38
Health Hypothesis	40
Education Hypotheses	42
Internal Security Hypothesis	45
Rural Development Hypothesis	48
Centralisation Hypothesis	51
Stability Hypotheses	53
Expenditure Model	55
The Stability Model	59
The Data	59
Chapter Five <u>The Empirical Results</u>	63
Analysis of Empirical Results	63
The Expenditure Models	64
Simple Aggregate Public Recurrent Expenditure Model	64
The Aggregate Public Recurrent Expenditure Model	67
The Health Public Recurrent Expenditure Model	71
Education Public Recurrent Expenditure Model	75
Internal Security Public Recurrent Expenditure Model	80

Rural Development Public Recurrent Expenditure Model	84
Aggregate Public Recurrent Expenditure Centralisation Model	88
The Aggregate Public Recurrent Expenditure Stability Model	91
The Health Public Recurrent Expenditure Stability Model	93
The Education Public Recurrent Expenditure Stability Model	96
The Internal Security Public Recurrent Expenditure Stability Model	99
The Rural Development Public Recurrent Expenditure Stability Model	104
Chapter Six <u>Conclusions and Recommendations</u>	108
General Layout	108
The Simple Aggregate Public Recurrent Expenditure Model	108
The Aggregate Expenditure Model	111
The Health Public Recurrent Expenditure Model	114
The Education Public Recurrent Expenditure Model	116
Internal Security Public Recurrent Expenditure Model	118
The Rural Development Public Recurrent Expenditure Model	120
The Centralisation Model	122
The Aggregate Public Recurrent Expenditure Stability Model	124
Health Public Recurrent Expenditure Stability Model	125
Education Public Recurrent Expenditure Stability Model	126
Internal Security Public Recurrent Expenditure Stability Model	128
Rural Development Public Recurrent Expenditure Stability Model	129
Appendices	132-143
Bibliography	144-148

## ABSTRACT

Trends in public recurrent expenditures in Zambia 1964-82. This research project will examine the main determinants of the ratio and changes in the ratio of public recurrent expenditures to GNP on both the aggregate and disaggregate functional levels. The hypothesis is that the institutional reforms, level of economic development and population factors have contributed to the increase in the ratio of public recurrent expenditures to GNP. The research project will further examine the patterns or main features of these expenditure ratios in terms of their degree of centralisation and stability. On centralisation the hypothesis postulated is that centralisation is a function of GNP per capita and the population growth rate. On stability the research project will examine the relationship between the stability of expenditure ratios and the fluctuations in the GNP per capita and the population growth rate. The hypothesis postulated is that the stability of the expenditure ratios is a function of the fluctuations in the GNP per capita, population growth rate and other economic development indicators.

In order to carry out the task outlined above the study design employed will be on the level of hypothesis-testing. The inductive model building technique will be used to explore the determinants and the main features of the ratios of public recurrent expenditures. The time series multiple regression analysis will mainly be used. The dependent variables are the ratios of public recurrent expenditures to GNP, centralisation ratio and the coefficients of variations of the public recurrent expenditures to GNP ratios. The explanatory variables are the economic development indicators. The estimated coefficients of the explanatory variables will be tested by the regression technique and determined whether they are significant or not.



On the basis of the tested and significant coefficients of the explanatory variables some explanatory/predictive public recurrent expenditure and stability models for Zambia will be suggested both on the aggregate and the disaggregate functional levels.

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## CHAPTER ONE

### THE PLACE OF GOVERNMENT EXPENDITURE STUDIES IN THE ECONOMIC POLICY FORMULATION PROCESS

#### 1.1 INTRODUCTION

Despite the existence of a large body of literature on the subject of "Public Finance", scholars in this field of study biasedly concentrated on the analysis of taxation problems. The study of public expenditures was given scant attention and consequently relatively less is known in this area. This bias had already been pinpointed by C. Lowell Harris who wrote:

"The tremendous growth of government expenditures here and abroad has been one of the most striking economic development of recent years. Economic analysis of these changes has dealt primarily with the probable effects on levels of employment and prices.....Economists specialising in public finance have generally concentrated on taxation. Perhaps there is not much more the economist can say about spending. The nature of the problems especially the unavailability of bases for appraising results, make study difficult. Description plus the statement of rather obvious generalities may about exhaust the possibilities."<sup>1</sup>

The bias, subsequently, has been somewhat rectified in the more developed countries. Specifically the rectification of the

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1. C. Lowell Harris, "Public Finance", in Bernard F. Haley ed, A Survey of Contemporary Economics (Homewood ILL 1952) pp 261-2.

bias took place in North America and the countries of western Europe. For instance, Frederic L. Pryor in his empirical study of public expenditures lists about seventeen studies for the U.S.A alone<sup>2</sup>. This should not be surprising since Western Europe and later the U.S.A were the major economic powers of the World in the 18th and 19th Centuries. As these economies developed and grew in complexity, the need to analyse public expenditures was sharply felt. This sharply felt need was because public expenditure penetrates the whole fabric of any economic system.

Although there has been increasing interest in expenditure problems in the developed countries, the economists in the developing countries were slow to learn the lessons. However, economists in Latin America and in Asia followed the economists in the developed countries and started analysing public expenditure problems. It was after a long gestation period that economists in Africa, particularly those in West Africa, started analysing public expenditures. In the particular case of Zambia, the area is still little researched. There exists no comprehensive study on public expenditure in Zambia.<sup>3</sup>

## 1.2 THE SIGNIFICANCE OF THE STUDY

Public expenditures, as already pointed out above, penetrates the whole fabric of an economic system. They, therefore, are central to government economic policy formulation process. In

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2. Frederic L. Pryor, Public expenditure in Communist and Capitalist nations (George Allen & Unwin LTD 1968) pp 446-451.

3. Except general studies, eg C. Mupimpila, "The government budget and economic development: the experience of Zambia 1968-78", Unpublished M.A. thesis 1981 pp 40-57.

such milieu the study of public expenditures becomes indispensable in the formulation of government economic policies. The place of government expenditure studies in the economic policy formulation process may be broadly categorised into:

- (a) Review of the economy
- (b) Public and private sector co-existence
- (c) Economic forecasting
- (d) Appraisal of the government policies.

#### 1.2.1 REVIEW OF THE ECONOMY

The study of public expenditure commences with the review of the past. This is regardless of the type of study being undertaken. It may be time-series, cross-sectional or indeed pooled time series cross sectional study. At this stage of the review of the past, notable changes in the population, gross national product and government expenditures are analysed. Once the changes (and their direction) in these principal variables have been noted and found that they are not in conformity with the policies, then corrective measures are called for. These kinds of reviews must be very frequent in order to spot the areas of deviant behaviour and quickly rectify them before major damages can be caused to the development plan. The study of public expenditures in these conditions makes a useful contribution to the promotion of economic development in both the already developed and developing countries.

The other studies of public expenditure may assume a plan-by-plan review of the economy. In this course of analysis the

procedural aspects of plan preparation assist the reviewer to reconstruct the past. During the process of plan preparation, various government departments submit their proposals. The money for the proposals is not usually enough. Therefore, were the proposals funded in line with the government priorities? What was the policy at that time? What was the likely course of action? What can then be done? The answers to these questions help the government to have a sense of direction. And they can be answered only through the study of public expenditures.

#### 1.2.2 PUBLIC AND PRIVATE SECTOR CO-EXISTENCE

The government expenditures belong to the arsenal of the public sector. The public sector and the private sector are inter-related. The public sector has direct repercussions on the private sector (Public sector planning must take due cognizance of the extent and nature of activities prevailing in the private sector.) This is to ensure consistency and efficiency in the use of scarce resources. However in order for the public sector planner to achieve his aim, public expenditure studies must be undertaken to throw light on these issues. The co-existence of the public and the private sectors may be best illustrated through the economic forecasting concept,

#### 1.2.3 ECONOMIC FORECASTING

Economic forecasting is done through the construction of a model of the economy. By doing this, future profiles of the entire economy may be constructed. Once the probable future levels of the major macroeconomic variables have been determined,

it then follows that the other must develop in line with the ones already determined. For this, consultation all along the line must be effected. This is to ensure co-ordination. One of the components of economic forecasting is that of public expenditures. In this area then its contribution is a major one.

The other reason for the study of public expenditure rests on the fact that if the government wants to control the private sector one needs a complete knowledge of the public sector. This is because the two sectors are highly interdependent. This knowledge is acquired by undertaking public expenditure studies.

#### 1.2.4 APPRAISAL OF THE GOVERNMENT POLICIES

Once the economic forecasting has been done, what remains is to make periodic reviews of the economic policies and adjust them if necessary. The adjustment of these economic policies must be in line with the prevailing economic conditions. These conditions are unveiled through the public expenditure studies. This is how the appraisal of government policies becomes an indispensable policy input into the smooth running of the economy.

## CHAPTER TWO

### THE REVIEW OF LITERATURE

#### 2.0 WAGNER'S LAW OF PUBLIC EXPENDITURES

Viewed historically, the study of public expenditures is a German initiative. In the nineteenth Century, Adolph Wagner, the German economist took the first ever serious study of public expenditures. His results are now summarised in the famous Wagnerian law of public expenditures. However, this should not imply that there were no earlier studies on the subject. There were earlier studies but without placing main emphasis on public expenditures.<sup>4</sup>

But Wagner's study was explorative in nature and essence. This point has escaped the attention of many public finance scholars, consequently rendering much of their criticisms of him invalid. His study was to make intensive observations and to outline the main behavioural tendencies of public expenditures as the economy grew and developed. And from these observed regularities, he formulated a law of public expenditures. However, as will be demonstrated later, there is one valid criticism of the law. Wagner did not provide sufficient a priori reasons for the law. The task of the subsequent chapters is to provide these reasons. However, it is better at the outset, to have a clear understanding of what the law is all about.

The law states that during the course of economic development the share of public expenditures in the gross national product will increase. This means that the ratio of public expenditures to the gross national product would be increasing as the economy grew. This law, it must be

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4. J. Locke, Two Treatises Concerning Government (ed Morley, 1884) pp 203-16.

pointed out, applied only to countries experiencing economic development. The concept of economic development in Wagner's view meant the development of cultured people. This means that development is a process. It is a multi-dimensional process. In essence, the development of cultured people means changes in structure, attitudes and institutions of society. It must also involve the acceleration of economic growth, the reduction of inequality and the eradication of absolute poverty. In a way of summary, Wagner's view of economic development involves the liberation of man. This is not surprising since the Germany of Wagner's time was the most developed society in Western Europe. Consequently the academic environment was very conducive to pursue the studies of liberation theory.

The foregoing suggests there may be several variables that could be proxies for Wagner's concept of economic development. However, many public finance scholars have tended to pick only one variable. This is the second source of error in interpreting this law of public expenditures. The variable that is usually picked as the best single proxy for Wagner's concept of economic development is the gross national product per capita. However, although the choice of a single indicator of economic development is questionable, a systematic interrelationship exists between gross national product per capita and the other aspects of socio-political change.

## 2.1 THE SECOND TYPE OF EXPLORATORY STUDY

This represents the second group of researchers. Their task was to draw out any observable regularity of public expenditures. This was to be done through inductive studies. And from these studies, it was hoped, new hypotheses or laws of public expenditures would emerge.

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The common underlying motive of all these studies was to challenge Wagner's law of public expenditures. These studies as earlier pointed out were exploratory. They, like Wagner's study, provided little a priori reasoning for their theories. And these theories failed to offer a serious challenge to Wagner's law and consequently failed to explain the changing level and composition of public expenditures during the course of economic development. However, the researchers themselves did not realise that they were conducting exploratory studies.

In conducting their studies, they attempt to explain Wagner's law. They correctly use a formulation which while consistent with Wagner's law, is not attributed thereto. For instance, Gupta uses the formulation consistent with Wagner's law to test the Peacock and Wiseman hypothesis of the displacement effect.<sup>5</sup> Bird raised the same criticism and noted that Gupta used the correct and consistent formulation of Wagner's law to test a wrong hypothesis.<sup>6</sup> Williamson also used the appropriate formulation associated with Wagner's hypothesis and computed the elasticity values all with no reference to Wagner's law.<sup>7</sup> These elasticity values represent the percentage change in the ratio of public expenditures to the gross national product as a result of a unit percentage change in real per capita income. Pryor termed this elasticity a ratio-income elasticity in order to differentiate it from the simple income elasticity. However, Pryor does not test Wagner's

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5. GUPTA, S.B., "Public Expenditures and Economic Growth: A Time series analysis", Public Finance volume 17 number 4 1962 pp 289-312
  6. Bird, R.M., "Wagner's law of Expanding state activity," Public Finance Volume XXVI number 1 1971 pp 1-24.
  7. Williamson, J.G., "Public expenditures & revenue: An International Comparison" The Manchester School of Economics & Social Studies Volume 29 1961 pp 43-56.

hypothesis even though he mentions it. His aim was to derive hypotheses that may later be tested. Thorn also used the correct formulation, but with dummy variables added to represent qualitative factors in order to estimate the ratio-income elasticities again with no explicit reference to Wagner's law,<sup>8</sup> The weakness of all the cited works was that they were exploratory.

## 2.2 RECENT PUBLIC EXPENDITURE STUDIES

Common understanding of Wagner's law has now been reached by various researchers. The agreed verbal interpretation of Wagner's law is that the ratio of public expenditures to the gross national product will increase during economic development. The problem that remains to be resolved is the empirical formulation and specification of the law. Many researchers, in attempting to test Wagner's law, have employed empirical model specifications which are not consistent with Wagner's law. For instance Goffman<sup>9</sup> interprets Wagner's hypothesis as follows: As a country experiences economic development and growth an increase must occur in the activities of the public sector and the ratio of the increase, when converted into expenditure terms would exceed the rate of the increase in output per capita. In other words, the ratio of the increased public expenditure to the gross national product both aggregatively and by function would rise as the gross national product rose. This is consistent with the law propounded by Wagner. However, his basis for testing the law is inconsistent.

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8. Thorn R.S., "The Evolution of Public Finance during economic development," The Manchester School of Economics & Social Studies Volume 35 1967 pp 19-53.

9. Goffman I.J., "On the empirical testing of Wagner's law: A technical note", Public Finance volume XXIII number 3 1968 pp 359-64.

He suggests that in a test of Wagner's law, the income elasticity of public expenditure exceeds unity. As per capita income increases, public expenditure as a proportion of aggregate output also increases. The use of an elasticity measure which renders an income elasticity greater than unity is inconsistent with his verbal interpretation of the substance of Wagner's law.

Musgrave, in his book, also committed the same mistake.<sup>10</sup> His interpretation of Wagner's law is as follows: To interpret Wagner's law, Musgrave suggested a hypothesis in terms of the proportion of expanding scale of state activity. His suggestion was based on the point that the word scale relates to the share and not the absolute level of public expenditures. This is consistent with Wagner's law, but the resultant specification is not consistent with the law. What Musgrave specifically does is to test the nature of the change of the public goods' share in the total output as per capita national product rises and then looks at Wagner's law to provide some a priori reasoning that this share will rise. Wagner's law is not concerned about the nature of the change of the public goods' share in the total output as the economy grew and developed. The law is about the increases in the ratio of public expenditures to the gross national product as the economy grew and developed. That is the reason why Musgrave's specification is inconsistent with Wagner's law.

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Bird follows Goffman and Musgrave.<sup>11</sup> He states that "as per capita income rises in industrialising nations, their public sector

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10. Musgrave R.A. Fiscal Systems New Haven, Yale University Press 1969.

11. Bird R.M., op . cit pp 1- 24.

will grow in relative importance," He then suggests that the basis of Wagner's law is substantiated when the income elasticity of public expenditures for a significant number of expenditure categories is greater than unity. Income elasticity is evidently being defined by him as the percentage increase in public expenditure as a result of a unit percentage change in national income. This elasticity measure is not consistent with Wagner's law. The reasons for these are as given in the first paragraph of this section.

In a way of a summary we may say that this inconsistency which has arisen in the testing of Wagner's law may be stated in the following manner. In verbal terms these researchers are consistent with the law. This agreed upon verbal interpretation of the law in quantitative terms may be postulated as:

$$E_1/\text{GNP} = f(\text{GNP}/N) \dots\dots\dots (1)$$

where:

$E_1$  = Public expenditure on the  $i^{\text{th}}$  item (eg health)

GNP = Gross National Product

N = Population

Elasticity values for such a relationship are greater than zero if the ratio of public expenditure to GNP increased as per capita gross national product increased.

However these scholars use the following relation as the quantitative formulation of their agreed upon verbal interpretation of the law:

$$E_1 = f(\text{GNP}) \dots\dots\dots (2)$$

/.....

From the above relation estimates of income elasticities are obtained. These elasticities are usually greater than one. This is the root cause of the inconsistency earlier pointed out. The consistent formulation is the earlier one which yields elasticity values greater than zero.

There is a fourth group of researchers led by Professor Nicholas A. Michas<sup>12</sup> who came up with a more appropriate formulation with the functional form in Equation (1) as the starting point. The question to be answered was: What elasticity measure is most suitable for the test of Wagner's law? This is the problem which gave a lot of trouble to the previous groups of researchers. For this, Michas came out with an appropriate specification in a double logarithmic functional form:

$$\text{Log}(E_1/\text{GNP}) = \alpha + b \text{log}(\text{GNP}/N) \dots \dots \dots (3)$$

Where b is a measure of the ratio income elasticity. Actually the ratio income elasticity is given by:

$$b = \frac{d(E_1/\text{GNP})}{E_1/\text{GNP}} \bigg/ \frac{d(\text{GNP}/N)}{\text{GNP}/N} \dots \dots \dots (4)$$

Had the first group of researchers used Equation (1) instead of Equation (2) they could have been correct because Equation (1) would have directly corresponded with the more appropriate formulation given above. The elasticity measure would have been:

$$b^1 = \frac{d(E_1/N)}{E_1/N} \bigg/ \frac{d(\text{GNP}/N)}{\text{GNP}/N} \dots \dots \dots (5)$$

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12. Nicholas A. Michas, "Wagner's law of Public expenditures: What is the appropriate Measurement for a Valid Test?" Public finance volume XXX number 1 1975 pp 76-85.

Which is almost the same as the elasticity measure given above.

Actually the association to be precised is:

$$b = \frac{d(E_1/\text{GNP})}{E/\text{GNP}} \bigg/ \frac{d(\text{GNP}/N)}{\text{GNP}/N} = \frac{d(E_1/N)}{E/N} \bigg/ \frac{d(\text{GNP}/N)}{\text{GNP}/N} - 1$$

$$= b^1 - 1 \dots \dots \dots (6)$$

This implies that one can as well rely on the simple elasticity measure if only public expenditure and GNP are in per capita terms.

There is a fifth group of researchers who reject the use of the simple regression analysis given above. The use of single two-variable equation(3) where the ratio of public expenditure to GNP is regressed on the gross national product per capita is rejected. Hadjimatheou<sup>13</sup> demonstrated that the use of the ordinary least squares leads to an upward bias in the estimated ratio-income elasticity. This is due to serial correlation. The reason for the bias is the fact that at least part of the dependent variable is a component of income. However, even if the latter source of the bias were removed the estimated elasticity would still suffer from the bias as long as the regressor is an endogenous variable. The importance of the bias, in the context of the problem in question, derives from the fact that statistical acceptance or rejection of Wagner's law depends on the size of the income elasticity. The risk of drawing the wrong conclusion arises when the estimated elasticity, which is subject to an upward bias is statistically significant. To avoid this risk it was suggested by Hadjimatheou that a more sophisticated method of

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13. George Hadjimatheou, "On the empirical evidence on government expenditure development" Public Finance volume 31 number 1 1976 pp 144-49.

estimation such as Instrumental Variables, should be used. However, that the upward bias risk is not serious to warrant the use of a more sophisticated method of estimation will be demonstrated later.

In line with the above argument Clotfelter used two stage least squares to estimate the elasticities.<sup>14</sup> However, there is yet another group of researchers who utilize Michas's suggested specification but in an expanded form. They use multiple regression analysis in order to estimate the elasticities. Here more explanatory variables are included in the model. For instance Hartley and Mclean<sup>15</sup> use log-linear multiple regression analysis to test the hypotheses related to the growth of U.K. defence expenditure. Again Joseph E. Pluta<sup>16</sup> uses the same specification. This study also uses the log-linear multiple regression analysis.

### 2.3 AIMS OF THE STUDY

This study primarily addresses itself to two broad questions and these are:

- (a) What are the determinants of the ratio of public recurrent expenditure to the gross national product in Zambia?
- (b) What are the determinants of the main features or patterns of these ratios of public recurrent expenditures to the gross national product?

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- 14. Charles T. Clotfelter, "Public Spending for higher education: An empirical test of two hypotheses!" Public Finance volume 31 number 2 1976 pp 177-95.
  - 15. K. Hartley & P. Mclean, "UK defence expenditures," Public Finance volume 36 number 2 1981 pp 171-92.
  - 16. Joseph E. Pluta, "Real Public Sector growth & decline in developing Countries", Public Finance volume XXXVI number 3 1981 pp 439-54.

In this study public recurrent expenditure is defined to include the running expenses of the Government of Zambia institutions plus transfer payments, grants and subsidies.

In view of the above, the specific objectives of this study are to examine the main determinants of the ratio and changes in the ratio of public recurrent expenditures to GNP on both the aggregate and disaggregate functional levels. The study further examines the patterns or main features of these expenditure ratios in terms of their degree of centralisation and stability.

The aggregate public recurrent expenditure to GNP ratio plus the following four disaggregated functional level ratios are examined:

- (a) Health
- (b) Education
- (c) Internal Security
- (d) Rural development.

The purpose is to examine each of these selected expenditure categories, and understand its own individual peculiarities. If the analysis was restricted to the aggregate public recurrent expenditure to GNP ratio the peculiarities of each expenditure category would be obscured.

However, the aggregate public recurrent expenditure to GNP ratio is broadly and intensively examined. Firstly, the aggregate public recurrent expenditure to GNP ratio is examined in terms of one explanatory variable-the gross national product per capita.



Thereafter more explanatory variables are included in the model. These variables are population growth rate, urbanisation and a dummy variable representing economic reforms. Then both the aggregate and disaggregate functional ratios are examined in terms of their coefficients of variation. However, it is only the aggregate ratio that is examined in terms of its centralisation ratio.

The above then are the specific aims of the study. In summary, the aim of the study in perspective is to test the validity of Wagner's law and other hypotheses related thereto.

#### 2.4 RATIONALE

The reasons underlying this study are mainly three and these are in terms of contribution to:

- (a) Theory
- (b) Knowledge; and
- (c) Policy.

It is expected that the study will make significant contributions in the areas stated above. On the theoretical level, the study's contribution would be hopefully to extend the positive theory of public expenditure. For instance, the investigation of the determinants of the growth of these ratios and the measurement of the estimated elasticities would be helpful in extending or amending the positive theory of public expenditure. Again the study of the level at which certain expenditures are made would be quite helpful in evaluating the pros and cons of decentralising or centralising the expending of specified public funds.

On the level of knowledge, the study's contribution, it is hoped, would be towards the development of norms that will serve as the preliminary aids in investigating whether specific expenditures should be made or changed. This knowledge is got through the estimated elasticities. Finally on the level of policy, the project's contribution would be to help in making projections and economic planning models.

## 2.5 THE STRUCTURE OF THE PAPER

The first Chapter was merely introductory. The present Chapter is on literature review. In Chapter three, the theoretical models will be discussed. This discussion will be split into two parts. The first part will discuss the expenditure theories; and the second part will concentrate on the stability theories. In both cases, the discussion will commence with the presentation of the aggregate public expenditure and functional level theories. Thereafter the presentation of the stability theories both at the aggregate and disaggregate functional level will follow.

Chapter four is on methodology. Here, first the statement of the hypotheses is given. These hypotheses first range from the aggregate models down to the disaggregated functional levels. The section on the model and methodology follows. The aim here is now to operationalize the statements of hypotheses. This exercise of operationalising continues in the section on data. The methods of data collection and processing are given.

Chapter five gives the empirical results. Expenditure model results are given first and then followed by the results on stability models. Chapter six gives the conclusions and recommendations of the study.

## CHAPTER THREE

### THE THEORETICAL MODELS

#### 3.0 THE CONCEPTUAL DEFINITION OF DEVELOPMENT

The term 'development' has a long and rich history, but despite this fact little is known about its true inner meaning. For a brief synoptic view of this history see H.W. Arndt<sup>17</sup> and also M.P. Todaro<sup>18</sup>. A clear conceptual definition of development within the sociological context is given by Denis Goulet<sup>19</sup>. And therefore there is need to briefly review the main trends of thought around development over time.

As is pointed out by Arndt, Karl Marx was the first scholar to give the term 'development' a specifically economic connotation in 1887. Although he did this at this early time, scholars in both the Western and the Eastern World and of course not mentioning the third world were not yet clear as to what the term meant.

During those years after the second world war development was equated to growth in the gross national product per capita. However, this was quickly challenged on the grounds of the experience of accelerating the gross national product per capita.

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17. H.W. Arndt, "Economic Development: A Semantic History", Economic Development & Cultural Change volume 29 number 3 April 1981 pp 457-66.
  18. M.P. TODARO, Economics For A Developing World, Longman Group LTD LONDON 1977 pp 81-101.
  19. Denis Goulet, "The Cruel Choice, A new concept on the theory of development", Atheneum, New York, 1978 pp XII-XXI.

Although massive growth rates in gross national product per capita were achieved in the third world, absolute poverty still lingered. This was because acceleration of the gross national product per capita growth rates assumed that the benefits of this effort will trickle down to the masses. However, the masses remained poor and consequently the exclusive emphasis on accelerating the growth in the gross national product per capita had to be rejected and abandoned.

In essence, as M.P. Todaro has pointed out, development is represented by three core values. These three core values serve as the conceptual bases and practical guidelines for understanding the inner meaning of development. These core values are:

- (a) Life-sustenance
- (b) Self-esteem
- (c) Freedom from servitude.

These are the basic human needs. Thus all societies and cultures need these for survival and development. Let us then, in detail, understand each of these core values.

### 3.0.1 LIFE-SUSTENANCE

Life-sustenance, thus to perpetuate life, implies the ability to provide basic necessities of life. The basic necessities of life are

- (a) Food,
- (b) Shelter
- (c) Health
- (d) Protection.

The national economy must provide these to its citizens if development is to proceed and indeed this is a necessary condition for development but not a sufficient condition however.

### 3.0.2 SELF-ESTEEM

The second core value of development is self-esteem. This means, as M.P. Todaro put it, a sense of worth and self-respect. The vivid expression of this fact in the third world is the national liberation movements. The aim of these liberation movements is to gain a sense of worth and self-respect. To concretise this point we may quote M.P. Todaro:

"All peoples and societies seek some form of self-esteem although they may call it authenticity, identity, dignity, respect, honour or recognition. The nature and form of this self-esteem may vary from society to society and from one culture to another. However, with the proliferation of the modernising values of the developed nations, many societies in the Third World countries which may have possessed a profound sense of their own worth suffer from serious cultural confusion when they come in contact with economically and technologically advanced societies. This is because national prosperity has become an almost universal measure of worth. Because of the significance attached to material values in the developed nations, high value and esteem are nowadays increasingly conferred only on those countries who possess economic wealth and technological

power - those who have developed,"<sup>20</sup>

### 3.0.3 FREEDOM FROM SERVITUDE

Freedom from servitude is the third universal value of development. This means freedom from the alienating material conditions of life. Again we may quote Professor Todaro:

"Freedom from servitude here is not to be understood in the political or ideological sense (eg the free world), but in the more fundamental sense of freedom or emancipation from alienating material conditions of life and freedom from social servitudes of men to nature, ignorance, other men, misery, institutions and dogmatic belief. Freedom involves the expanded range of choices for societies and their members, together with the minimisation of external constraint in the pursuit of some social goal which we call development."<sup>21</sup>

### 3.1 DEVELOPMENT OR LIBERATION

The three core values discussed above constitute what we call development. However, a new concept of development mainly popularised by the Latin American Scholars is that of liberation. They say that the term 'development' conveys a pejorative connotation. True development comes through liberation from the domination by capitalist countries and their natural allies,

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20. M.P. Todaro, op. cit pg 97.

21. " " " " "

the local national oligarchies. However, the definitional aspects of development to be employed here is the one given earlier. The question we now face is to give an operational definition of this conceptual definition of development given above. Development is a multi-dimensional process. Therefore in order to operationalise this process a system of indicators must be developed.

### 3.2 INDICATORS OF DEVELOPMENT

The first question that needs an answer here is: What is an indicator? 'An indicator is something that points out something else', writes Donald McGranahan.<sup>22</sup> To quote him we may write:

"When an economic or social variable is used as an indicator it is not an indicator of itself and it is not an operational definition of that to which it points. For instance the temperature accurately given by use of a clinical thermometer is not an indicator of body temperature - it defines body temperature, but it is an indicator of sickness. Similarly, death rates do not indicate relative numbers of death but may indicate public health levels. The school enrolment ratio is a measure of the amount of school enrolment but it may be used as an indicator of the educational level of the country given various assumptions. In economic forecasting, orders on durable goods and plant and equipment contracts

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22. Donald McGranahan, "Development Indicators & Development Models" in Nancy Paster (Ed): Measuring Development (The role & adequacy of development indicators), Frank Cass London 1972 pg 91.

serve as indicators for detecting broad movements they directly measure".<sup>23</sup>

This implies that for a statistic to be an indicator some assumptions must be made before it can qualify as an indicator. Thus a theoretical framework is required. Thus development indicators are connected to the definition of development in two ways. Firstly given a conceptual definition of development, a development indicator may serve as the operational definition of development so defined. And this measure becomes a development indicator if the thing being indicated by it is a recognised goal of development. These two conditions must be fulfilled. Otherwise the supposed indicator would simply be a mere statistic.

On the other hand, certain goals of development are not measurable or are only partially recognisedly measured. In this case the development indicator only serves as a proxy variable of the one to which it points. The discrepancy is because the recognised goal of development cannot be expressed in quantitative terms. Therefore to make ends meet a proxy indicator for the true recognised goal of development is employed. This problem is particularly serious in the case of social indicators. This means therefore that the second approach discussed above will apply to the social indicators. The social indicators in this study are mainly the dependent variables in the regression models. And the dependent variables are not directly measurable and that is why the second approach of social indicators is employed. The explanatory

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23. Ibid.



variables in the regression models are measurable. They admit of a direct and full measure, and thus constitute an operational definition of a particular factor of development. Therefore the first approach will apply to these explanatory variables because these are the measurable indicators of development. Since social indicators are hard to understand, it is better at the outset to note the nature and essence of these variables.

### 3.3 THE SOCIAL INDICATORS

The aspects of development that will be analysed here, thus the dependent variables are all in the arena of social development. These are as given below:

- (a) Health
- (b) Education
- (c) Internal Security
- (d) Rural development.

All these aspects of development are not directly measurable so that the need to apply the second approach is felt. Therefore indicators serve as proxy variables for these entities. The assumed relationship between the indicators and the entities to which they point in these cases is usually based on a cause-effect relationship; so that regression analysis may be readily applied in analysing these aspects of development. It will be the task of the regression analysis to confirm or not to confirm the relationship and sometimes it indeed does not confirm the relationship. This means that the assumptions of the relationship are wrong.

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The problem of the confirmation of this cause-effect relationship is not the same as the problem of statistical accuracy and reliability of data. It might so happen that an indicator that is statistically inaccurate and unreliable may quite well prove the cause-effect relationship.<sup>24</sup> This then brings another point of validation of these indicators.

Since in measuring development, thus the dependent variables of this study, the second approach is adopted, the indicators are not a direct measure of that which they point . Therefore there is need to device a new way of selecting the indicators.

### 3.4 THE VALIDATION OF INDICATORS

Earlier on we stated that the cause-effect relationship may be analysed by regression analysis. Here again this approach is employed to validate these indicators. The indicator with the significant t-value will be selected as the best indicator of the aspect of development under discussion. However, this should not be treated as "the indicator" because in the course of time new relationships may evolve and therefore require new statistical testing and thus new indicators will be selected. These processes of reappraising and reassessing the development indicators should be continuous. There is another approach to the validation of the indicators. This is the use of expert consensus. This is simply

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24. Nancy Baster, "Development Indicators: An Introduction, The role & adequacy of development indicator," in Nancy Baster (Ed) Measuring Development, Frank, Cass, London, 1972 p 91.

based on intuition. The collective or general opinion as to whether the indicator is the best representative of that which it points is sought. If there is general agreement that it truly represents that which it points then it is validated as an indicator of that aspect of development.

### 3.5 THE PUBLIC RECURRENT EXPENDITURE AND THE DEFINITION OF DEVELOPMENT

Public recurrent expenditures as was earlier discussed are expenses which the government incurs for its own maintenance and for the maintenance of society and the economy as a whole. These expenses are incurred to run government institutions plus transfer payments (eg. ZNPF contributions), grants and subsidies.

The expenses incurred to run government institutions ultimately end up as payments for the salaries of government employees. As salaries, the monies go for the purchase of life sustaining goods. These include the purchase of food and payment for rent. Of course not all the payments due to the government employees accrue to them for some is taken by the government in terms of taxation. However, this should be viewed as payment for other social services, eg. health and national protections. This enables the government employees to provide basic necessities without which life would be impossible.

The grants and subsidies are the second type of public recurrent expenditure. Their function is to lower the prices of goods and services thereby making it easy for the people to acquire these. Thus the people are not alienated from the material conditions of life. This is because grants and subsidies

expand the range of choices for societies and their members.

The two expanded tasks of public recurrent expenditure outlined above make people feel secure. A sense of worth and self respect is bestowed on them. They no longer feel as tools of other people since they have all what they need. Thus in the language of liberation, the people are emancipated from misery. Of course not all the people are government employees. However, in the third world countries the government bureaucracies are relatively bigger and consequently employ quite larger percentage of the labour force.

As we have already understood previously, development can be defined in terms of the three core values. These core values are if we may repeat them:

- (a) Life-sustenance, (b) Self-esteem and (c) Freedom from servitude.

These three core values of development are the tasks of public recurrent expenditures discussed earlier. Therefore development and public recurrent expenditures are in fact the same. Public recurrent expenditure becomes an operational side of the development coin.

### 3.6 PUBLIC RECURRENT EXPENDITURES AND DEVELOPMENT INDICATORS: A SIMPLE THEORETICAL MODEL.

Since public recurrent expenditure is an operational side of the development coin, we can then state that a development indicator is also a public recurrent expenditure indicator. As was already pointed out the first economist to establish the

relationship between public recurrent expenditure and development was Adolph Wagner. He specified the relationship in terms of a development indicator--the gross national product per capita. As development proceeds, measured by the increases in the gross national product per capita, public recurrent expenditures will grow in relative terms.

The relationship between gross national product per capita and development as previously defined is sometimes not clear to understand.<sup>25</sup> Development as defined here may be viewed as increases in the gross national product per capita levels<sup>26</sup> of consumption. Therefore development implies the enhancement of an economy's power to produce goods and services per capita; for this is a prerequisite to raising levels of living. It is from this point of view that the gross national product per capita may be looked upon as an index of development though not the only one. Implicit within this point of view is a theoretical framework whose interpretation and the assumptions rest on this distinction:

The distribution question is different from the question of increasing the output per capita. This means that with a larger output per capita the question of distribution may be tackled easily, for it is possible at this level to redistribute the final

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25. Hyman P. Minsky, "Indicators of developmental status of an economy", Economic Development & Cultural Change vol VII, No.2, 1959 pp151-72.

26. Branko Horvat, "The relation between rate of growth and level of development," The journal of development studies number 3-4, April/July volume 10 1974 pp 382-394.

product. Therefore the gross national product per capita, though it is not the only index of development, is a good indicator of development and consequently the ratio of public recurrent expenditure to the gross national product. This point is demonstrated later. Let us then explain this cause-effect relationship.

Wagner's law of public expenditures in light of the gross national product per capita indicator of development can be interpreted like this: As the economy develops, i.e. as it increases the production of goods and services per capita, it is able to increase the public recurrent expenditure to GNP ratio. This is because the government can extract money from such an economy to finance its expenditures. In the third world government expenditures are real vehicles of development because the private sectors are still in their infancy. Therefore the GNP per capita as interpreted above is a supply factor in as far as the public recurrent expenditure to GNP ratio is concerned. However, it may be a demand factor as well, in the sense that the growth of GNP per capita makes the consumption levels to rise. This has obvious repercussions in the economy. Although we know that there are maldistributions of income in that few people increase their consumption, we also know that the forces of the demonstration effects of James S. Duesenberry's relative income theory are working.<sup>27</sup> This means that the masses also start demanding the goods and services. And in order to make them purchase these

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27. Edward Shapiro, "Macroeconomic Analysis," Harcourt Brace, Jovanovich, Inc, New York, 1974 pp 115-139.

and thereby raise their standards of living, a policy of subsidy is pursued. This has the consequence of expanding public recurrent expenditures. Thus the ratio of public recurrent expenditures to GNP grows.

### 3.7 PUBLIC RECURRENT EXPENDITURES AND DEVELOPMENT INDICATORS: AN AGGREGATE THEORETICAL MODEL

In the theoretical model of the previous section, gross national product per capita was the sole indicator of development. A brief review of the history of development points to the fact that this is not the general opinion. And indeed this has already been challenged. This is too narrow and not the way development is understood and used by most people. This implies that although per capita gross national product is used as an index of development, it should not be the sole indicator.

Alternative definition of development which is employed here was given earlier. What remains to be done is to offer a group of development indicators to point to development thus defined. And these indicators must perform better in describing, estimating and predicting the totality of the aspects of development so defined and consequently be better indicators of development as a group, than the per capita GNP alone.

Given the above point of view, the task now is to provide the other indicators which we think are better in explaining the variations in the ratio of public recurrent expenditure to GNP. These are :

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- (a) Urbanisation rate
- (b) Population growth rate
- (c) Economic reforms

And now let us understand how each of these indicators affect the development coin on both sides.

Urbanisation is a manifestation of fundamental structural changes in national economies undergoing their transformation from agrarian to industrial societies. Andrei Rogers wrote that urbanisation, the transition from a dispersed pattern of human settlement to one concentrated around cities and towns, is a process that has a beginning and an end.<sup>28</sup> This concept refers to a rise in the proportion of a total population that is concentrated in urban settlement. This measure is a function not only of urban growth but also of rural growth. Urbanisation, therefore is an indicator of development. It indicates the process of industrialisation. Since industrialisation and agricultural development are connected, in that as agriculture develops and becomes mechanised it releases workers to the industries in urban areas, thus enhancing urbanisation. When agriculture is mechanised and consequently industries are provided with workers, they both produce more goods and services both absolutely and on per capita basis. This constitutes what we have defined as development. And consequently proving that urbanisation is an indicator

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28. Andrei Rogers, "Sources of urban population growth and urbanisation, 1950 - 2000: A demographic Accounting," Economic Development and Cultural Change no 3 Volume 30 April 1982 pp 483-506.



of development as defined.

Population growth rate is another indicator of the development process. Population growth is also a process which has a beginning and an end. This concept refers to a rise in the total population of a country over time, especially over a year. Development as previously defined means the fulfilment of those three core values to the people, the populace of the country. Rapid population growth makes it hard for the national economy to meet these core values of development. The dependency burden thesis provides a powerful argument for the adverse effects of population growth on economic development.<sup>29</sup> Rapid population growth means that there will be a higher proportion of the population in the younger age categories. Consequently, this implies that there will be a higher ratio of persons in the dependent ages (the non working people) to those who are in the economically active age group.

The problem, according to this argument, is that with a high ratio of dependents to workers potential savings for investment are gobbled up. This dependency burden is a drag on domestic savings at the household level and also a dilemma at the macro-level when the government must invest more heavily in schools and health facilities for the young rather than in more physical commodity productive sectors.

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29. Charles Hirschman, "The uses of demography in development planning", Economic development & Cultural Change number 3 Volume 29 April 1981 pp 561-75.

Economic reform is a phrase which in the third world is treated almost as the panacea of under-development. Economic reform means or implies high rates of social, political and ideological transformation. This is the reorientation of the economic and social structures of the country. This calls for planning to improve income distribution and the institutions in the country. Therefore planning calls for a search for a rationally coordinated system of policy measures that can bring about and accelerate economic growth and development. Thus once implemented, this raises the levels of development. And the prerequisite for this is that the government expenditures must increase to effect this transformation. Not only increases on the absolute level but also relative to GNP since, given the nature of reforms, the increase in expenditure must be abrupt while the increase in GNP is slower. Thus the end result is that the quotient will rise.

In closing this section on public expenditure theory, we may state that as the three indicators discussed above increase over time then public recurrent expenditure will also have to increase. Since public recurrent expenditure to GNP ratio was previously defined to be the operational side of the development coin, then this ratio must increase during the course of development.

### 3.8 STABILITY THEORY

Public recurrent expenditures are important aspects of development since they have a direct bearing on the fulfilment of

the three core values of development. They directly contribute in a large way to life sustenance, self-esteem and freedom from servitude. This calls for the monitoring of these public recurrent expenditures. The important thing here is the analysis of the behavioural properties of public recurrent expenditure. These behavioural properties are in terms of stability and centralisation.

Stability of the public recurrent expenditure to GNP ratio is defined as the relative degree of fluctuation around its trend.<sup>30</sup> Stability evaluation is vital to maintain economic stability. For instance, in the developing countries, where the number of policy tools with which to maintain economic stability are few, evaluating the effects of variations in public recurrent expenditure to GNP ratio is a useful counter cyclical policy tool.

The degree of variation in the expenditure to GNP ratios may be interpreted to indicate the range of choices facing policy makers in determining the particular volume of an expenditure. For instance if the coefficients of variation of the health and education public recurrent expenditure to GNP ratios are respectively 5 and 50 percent, then such experience suggests that there are more options open to the decision-makers in regard to the education public recurrent expenditure to GNP ratio. If there

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30. Frederic L. Pryor, Public expenditures in communist and capitalist nations. (George Allen & Unwin LTD 1968) pp 79-80, 296-302.

are forces in the national economy that determine public recurrent expenditures, then a better measure of the range of options open to decision makers can be obtained by measuring the variations of these expenditures to GNP ratio after the influences of these expenditure to GNP ratio determinants have been removed. Even taking these determinants into account the same analysis will result.

The concepts of centralisation and decentralisation have been echoed in many academic and political circles. This stems from the concept of power to the people. The centralisation ratio of public recurrent expenditure is defined as the share which is directly made at the central government level. During this course of economic development this ratio will increase. This is especially so in the developing countries where the people with the knowhow are few to facilitate the process of decentralisation. And also in the countries with lopsided development where one sector of the national economy - enclave is developing faster than the other sectors of the economy. this enclave contributes larger and larger proportions of government revenue. The spending of these funds tends to be centralised because the educational levels are still low to effect the decentralisation of the expending of these funds. The implication of these points is that at least in the initial years of development the centralisation ratio will be higher and thereafter will start to drop.

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## CHAPTER FOUR

### METHODOLOGY

4.0. This study is based on Wagner's law of expanding state activity. This study is on the level of hypothesis-testing. In order to carry out the task of testing the hypotheses the various econometric techniques are employed to analyse the data. More precisely, time series multiple regression model is used. The suitable proxy variables representing economic reforms and development indicators are the explanatory variables, while the dependent variables are the ratios of public recurrent expenditures to GNP. This is the methodology adopted to carry out the task of testing the first six hypotheses.

In the case of the seventh hypothesis, the time series multiple regression model is again employed. This time the dependent variable is the centralisation ratio and the explanatory variables are the development indicators. The last set of hypotheses is on the stability of the ratios of the public recurrent expenditures to GNP. The time series multiple regression model is again used. The coefficients of variation of the ratios of public recurrent expenditures to GNP are the dependent variables, while the coefficients of variation of GNP per capita and population growth rate are the explanatory variables.

#### 4.1. STATEMENTS OF HYPOTHESES

The study's objectives require the formulation of a number of hypotheses. The first hypothesis concerns the aggregate public

recurrent expenditure to GNP ratio. This hypothesis was constructed in line with Wagner's true intent. As it was pointed out earlier on, Wagner was relating the growth of public recurrent expenditure to GNP ratio to the economic development of the country concerned. The hypothesis is that the level of economic development, economic reforms and population factors have contributed to the increases in this ratio in Zambia.

However, over time development was synonymous to the GNP per capita. The aggregate public recurrent expenditure hypothesis is therefore split into two parts. The first part of the hypothesis is that the aggregate public recurrent expenditure to GNP ratio is a function of GNP per capita only. The explanation for this functional relationship was given in Chapter three.

The GNP per capita as the only index of development has already been challenged. The second part of the hypothesis is that the aggregate public recurrent expenditure to GNP ratio is a function of the urbanisation rate, population growth rate, the economic reforms (dummy variable) and the gross national product per capita. The explanation of this functional relationship was also given in chapter three.

If the analysis is restricted to the aggregate public recurrent expenditure to GNP ratio, the peculiarities of each expenditure category would be obscured. In order to avoid this obscurity the following functional level public recurrent expenditure to GNP ratios are analysed:

- (a) Health
- (b) Education
- (c) Internal Security
- (d) Rural Development

This is an attempt at the examination of each of these expenditure categories and understand their own individual peculiarities. Therefore specific hypotheses are formulated for each expenditure category.

#### 4.2. HEALTH HYPOTHESES

The economics of health is a creation of the 1960's. The rising expenditures have been a major contributor to the development of disciplinary interest.<sup>31</sup> Expenditures have grown absolutely and relative to GNP.

Health represents some aspects of development. Health public recurrent expenditure to GNP ratio indicates what proportion of the economy's resources are devoted to the improvement of the population's health conditions. Development as defined in this study is therefore partly represented by the health public recurrent expenditure to GNP ratio. As development proceeds (and it can do so only if the levels of health of the population improve ), the total amount of money allocated to the health sector must increase absolutely and relatively.

The health hypothesis is that the health public recurrent expenditure to GNP ratio is a function of the GNP per capita, population growth rate and the urbanisation rate.

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31 K.A. FRENZEL & D.J. McCREADY , "HEALTH ECONOMICS: A SUBDISCIPLINE"  
Economic Development & Cultural Change volume 27 Number 2 January  
 1979

The GNP per capita plays the role of a supply factor. The increase of this supply factor means that the amount of goods and service per individual increases. Therefore, we can expect that the people will be in a position to acquire services that they were previously denied, including the health services. This is so because now the government is in a better position to extract revenue from the economy to finance the health sector. Therefore as GNP per capita increases then the health status of the people will improve. This is possible through increased public health recurrent expenditures both absolutely and relatively.

The relationship between the health public recurrent expenditure to GNP ratio and population growth rate will depend on the variable with a faster rate of increase. If population growth rate is faster than the increase in this ratio, then population growth rate will have an adverse effect on the ratio and consequently on the health status of the people. This is because the health services per capita will be thinly distributed or maldistributed leaving the people with very little health services. This is the view taken up by this study. On the other hand, if the population growth rate is slower than the expansion of the health public recurrent expenditure to GNP ratio, then population growth rate will have a positive relationship to the general health status of the people. This is because the population growth rate pushes the age structure of the population upwards. This lessens the dependency burden of the economy since men of working age are more than the school going age. These working men contribute significantly to the national treasures thereby increasing the health services per capita.



However this is rarely the case especially in the third world countries.

While the GNP per capita was a supply factor in as far as the health sector is concerned, urbanisation rate on the other hand is a demand factor. Urbanisation as earlier stated refers to a rise in the proportion of a total population that is concentrated in the urban settlements. As people cluster around these urban settlements the need for hospitals, good sanitation and running water becomes a must. These are essential to the improvement of people's lives and indeed this is an aspect of development. As the process of urbanisation proceeds then the requirements of health services will be felt because initially urbanisation brings dirt and diseases. And these should be eliminated. To do this the health services must be increased. Therefore, the health public recurrent expenditure to GNP ratio must be a positive function of the urbanisation rate.

In summary the health public recurrent expenditure hypothesis states that the public health recurrent expenditure to GNP ratio will increase in response to GNP per capita and urbanisation rate increases and will be inversely related to the population growth rate.

#### 4.3. EDUCATION HYPOTHESIS

The economics of education, like the economics of health, is a creation of the 1960's.

This is because researchers during this period hypothesized a relationship between education and economic growth<sup>32</sup>. And it was the 1960's which saw the establishment of a link between economic growth and development. This further point, therefore, implies that education was seen as a factor which promotes development. And recent studies have further concretised this relationship<sup>33</sup>.

In the light of the definition of development employed in this study there is need to concretise the relationship between education and development. Development is represented by the three core values discussed earlier and one of them is life-sustenance, which means the ability to provide the basic necessities of life. This ability is brought about by improvements in knowledge. By the elimination of ignorance people are liberated from mass absolute poverty. And this is part of development. In other words education represents some aspects of development and is indicated by the increases in the education public recurrent expenditure to GNP ratio.

It is hypothesized that the following variables have a relationship to the education public recurrent expenditure to GNP ratio:

- (a) GNP per capita
- (b) Percentage of student population the national population
- (c) Lagged economic growth rate.

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32 M.P. Todaro, "Economics for a Developing World", Longman Group Ltd., London 1977 pp 255-288

33 P.R. Mbock, "Education & Technical Efficiency in Small - Farm Production, " Economic Development & Cultural change Volume 29 Number 4 July 1981 pp 723-739.

The education public recurrent expenditure to GNP ratio is a positive function of GNP per capita. The relationship is the same as presented in the health hypothesis. The increase in the GNP per capita has the desirable consequence of improving the people's standards of living. This includes the education status of the people. Therefore, the education public recurrent expenditure to GNP will increase as the GNP per capita increases.

The percentage of student population to the national population is a demand factor in as far as the education public recurrent expenditure to GNP ratio is concerned. As this percentage increases over time, it calls for a greater share of the gross national product to be devoted for the purpose. This has already been pointed out by the dependency burden thesis. As the percentage increases the educational services per capita will be progressively thinner and thinner. If standards have to be maintained and if they have to be improved then this calls for the expansion of the share of the public education recurrent expenditure in GNP. If this is not done then the public educational services per capita will decline over time and this is underdevelopment. Thus for this part of development to proceed, the educational public recurrent expenditure to GNP ratio <sup>must</sup> increase in response to the increases in the percentage of student population to the total national population; otherwise the situation of underdevelopment will be experienced. With less educational services per capita either the quality of education will deteriorate or the dropouts problem will be experienced or both.

The lagged economic growth rate factor is also a demand factor in as far as this ratio is concerned. The previous year's economic growth rate, the expansion rate of the economy in the year behind, has demand repercussion in as far as the demand for skilled workers is concerned. Thus as the economy expands it demands skilled workers to man the established projects. This is then transmitted to the educational system which is required to train the men for the jobs created by the general expansion in the economy. This means that the expansion of the educational facilities is due to the derived demand in the expanding economy. In order to meet the manpower requirements of this expanding economy the educational public recurrent expenditure to GNP must increase over time.

In summary, the educational public recurrent expenditure hypothesis is that the ratio of education public recurrent expenditure to GNP is a positive function of the GNP per capita, the percentage of the student population to total national population and the lagged economic growth rate.

#### 4.4. INTERNAL SECURITY HYPOTHESIS

In chapter three, one core value of development that was discussed was self-esteem. This was defined as a sense of worth and self-respect. That means not being used as a tool by others for their own ends. There, this was discussed on the general theoretical level. No attempt was made to concretise or operationalise the meaning of self-esteem. It is the task of this section to do exactly this.

Firstly, the question to answer here is: What indicator of development points to the aspect of development called self-esteem? The term self-esteem means to feel secure. However, this security will be narrowed down to internal security only and external security will be left out. Internal security means protection from being used as a tool by others for their own ends. The government protects its citizens through the provision of police force services and other law reinforcement services. The indicator for this aspect of development is the internal security public recurrent expenditure to GNP ratio. As the ratio increases it means that internal security services per capita also increases. And thereby possibly making it easy to realise the self-esteem aspect of development.

It is hypothesized that this ratio is a positive function of the following variables:

- (a) GNP per capita
- (b) Annual average crime rate
- (c) Unemployment rate

The internal security public recurrent expenditure to GNP ratio is a positive function of the GNP per capita. Although this increases the amount of goods and services per capita, the need for increased allocation out of the gross national product for security purposes will be felt. This is due to the unequal distribution of the national product. This means the ratio of internal security public recurrent expenditure to GNP will increase over time. Thus more and more of the gross national product will be allocated for the protection of the national assets created during the course of development.

And as the annual average crime rate increases, that is, as threats to the national property increase due to the inequalities felt, then the state responds to this by expanding security services absolutely and on per capita basis. These are financed by expanding internal security public recurrent expenditures. This implies that the internal security public recurrent expenditure to GNP ratio will rise.

The unemployment rate variable is the third determinant of the increases in the internal security public recurrent expenditure to GNP ratio. As people become unemployed it then becomes difficult for them to obtain meaningful means of livelihood. They in turn resort to crime. Thus the people's self-esteem is infringed. They become a tool for the ends of these criminals. In order to restore the self-esteem aspect of development, the state responds by providing security services. Thus the ratio of the internal security public recurrent expenditure to GNP will increase.

In summary we may state that the internal security public recurrent expenditure to GNP ratio.. is an indicator of some aspect of development called self-esteem. In the course of development people must feel more and more secure. And this can be done through provision of internal security. This means the internal security public recurrent expenditure to GNP ratio must increase. The determinants of such a state of affairs, it is hypothesized, are GNP per capita, annual average crime rate and the unemployment rate.

It is also hypothesized that the relationship is positive.

#### RURAL DEVELOPMENT HYPOTHESIS

The aspects of development that are discussed here are life-sustenance, freedom from servitude and consequently self-esteem. In this context we again give brief but full meaning to these phrases. As before life-sustenance will mean the ability to provide the necessities of life. These inevitably include food, clothing and shelter. These necessities of life are produced. For instance food and clothing mainly come from the agricultural sector. To increase the production of these necessities of life, money must be spent in the agricultural sector in the form of extension services and payment to the ministry of agriculture and water development personnel so that they can organise this sector for better and increased output. The indicator of this aspect of development is the rural development public recurrent expenditure to GNP ratio. As this ratio increases we can also be sure that the gross national product is increasingly being allocated for this aspect of development.

The freedom from servitude implies freedom to choose from among many life-sustaining goods and services. As it was pointed out earlier, these goods and services are the products of the agricultural sector. In order for this sector to produce these goods and services, thus expand the range of human choice, the sector needs money. This calls for increases in the rural development public recurrent expenditures, which in turn implies that the rural development public recurrent

expenditure to GNP ratio must increase. For such an increase will indicate that the country under study is pursuing this aspect of development.

It is hypothesized that the rural development public recurrent expenditure to GNP ratio is a function of the GNP per capita, copper prices and the previous year index of agricultural exports. In all the hypotheses so far stated, the GNP per capita was a supply factor and in this context too, it is a supply factor. It is a supply factor in the sense that as the GNP per capita increases, that is as the amount of services and goods available to an individual increases, the government will be in a position to extract revenue through taxation and thereby finance public recurrent expenditures in the rural development sector. This implies the transfer of income from the urban sector to the rural sector. This fact is because most taxable individuals in the societies of the third world countries come from the urban sector. Viewed from another angle, the GNP per capita can be a demand factor for the rural development. As the GNP per capita increases the amount of goods and services per individual increases. However, this is first manifested through the increased monetary power at the command of these individuals. And the studies of consumption have indicated that when individuals have the purchasing power they will first expand their demand for food products. Although the first response to this is increases in food prices, production will have to be increased also. And indeed this is the problem of many third world countries.



The consequence of the expansion of such services is to allocate a large fraction of the gross national product to the rural development services.

The previous year index of agricultural exports is an important factor in as far as the rural development public recurrent expenditure is concerned. This index indicates the amount of exports out of the total agricultural produce. If the country has a favourable export market the index will be continuously increasing. And there will be need to continuously expand the agricultural produce both for the home and export market. And to do so there is need for intensive and extensive services to the rural sector. This has the implication of allocating more government revenue to finance rural development services. Given a slower growing gross national product it means more of it will have to be surrendered to the rural sector. The result is an increased rural development public recurrent expenditure to GNP ratio.

In summary, therefore, the rural development public recurrent expenditure to GNP ratio, being an indicator of life - ~~sustenance~~ and freedom from servitude aspect of development, is a positive function of the GNP per capita, copper prices and the previous year index of agricultural exports. At least this is the hypothesis being advanced here.

4.6.

#### CENTRALISATION HYPOTHESIS

In Chapter three the centralisation ratio of public recurrent expenditure was defined as the share which is directly

made at the central government level. What determines the growth of this ratio in the course of development? It is hypothesized that the centralisation ratio is a positive function of the GNP per capita and population growth rate.

When GNP per capita increases, especially in enclave sector type of economies, the need for central control of the expending of public funds is felt. This is because the rest of the sectors of the economy, specifically the education sector, are lagging behind. Thus there is shortage of skilled manpower to man the would be decentralised institutions. The last resort therefore is to centralise the expending of public funds. That is to say, as development proceeds the centralisation ratio will grow and approach unity.

The population growth rate factor also acts in a similar way to the GNP per capita. As the population growth rate increases the percentage of young people increases. As in the dependency burden thesis, this implies the relatively fewer working people. In countries such as Zambia, the fact of relatively fewer workers will mean even relatively fewer skilled educated workers to man would-be decentralised institutions. These then call for pooling of these fewer skilled educated workers to the headquarter offices of government ministries and consequently implying tougher central control of expending of public funds. The centralisation ratio grows with the economy. However, this is a finite process. Once the country invests in the education sector, there will come a time when the country will start to reap the benefits of these massive investments in education.

The people will be trained for the responsible jobs of manning the decentralised institutions. Once this stage has been reached then the people will call for decentralisation and the centralisation ratio will start to decline until an 'optimum' decentralisation level has been reached; which implies that there is no hundred percent centralisation or decentralisation.

In summary, therefore, we state that the centralisation ratio is a positive function of the GNP per capita and the population growth rate. While this is purported to be the case, it is only so in the early stages of development. Once a certain level of development has been reached the centralisation ratio becomes an inverse function of the GNP per capita and the population growth rate. However, before this transition from being a positive to being an inverse function of these determinant factors, there will be a state of no clear relationship between these variables.

#### 4.7. STABILITY HYPOTHESES

This section deals with the aggregate and the functional level stability hypotheses. The rationale for this is that the explanatory variables are the same. These are the GNP per capita coefficient of variation and the population growth rate coefficient of variation. The dependent variable is the aggregate public recurrent expenditure to GNP ratio coefficient of variation, and the same is done at the functional expenditure levels.

In chapter three, the stability of an expenditure was defined as the relative degree of the fluctuation around its trend. Since the expenditure hypotheses have advanced the relationships between the expenditure to GNP ratios and other explanatory variables, we can extend this to the stability of these ratios. This extension then means that the stability of these ratios is a positive function of the stability of the explanatory variables chosen. These explanatory variables are GNP per capita coefficient of variation and the population growth rate coefficient of variation.

If the GNP per capita fluctuates around its trend and since GNP per capita itself determines the changes in the expenditure to GNP ratios then its variations will make the expenditures to GNP ratios to fluctuate. As the amount of goods and services at the disposal of an individual citizen varies then the standards of living of individuals will vary in accordance with this behaviour of the expenditure to GNP ratio. This repercussion starts from the GNP per capita coefficient of variation. When the GNP per capita coefficient of variation increases the expenditure to GNP ratio coefficient of variation will increase. On the other hand if the GNP per capita decreases from higher levels then there is always great propensity to maintain previous levels of living standards. In order to achieve this the government subsidises the purchase of commodities. This means the expenditure to GNP ratio coefficient of variation is a positive function of the GNP per capita coefficient of variation.

The population growth rate, as defined earlier, means the expansion rate of the population. The population growth rate coefficient of variation means the way the population growth rate fluctuates around its trend. As this coefficient of variation increases, the dependency burden problem will vary accordingly. And accordingly the expenditure to GNP ratio coefficient of variation will vary. Therefore, the expenditure to GNP ratio coefficient of variation is a positive function of the population growth rate coefficient of variation.

#### 4.8. THE EXPENDITURE MODELS

In general all the hypotheses that we discussed above advance positive relationships between the dependent variables and the explanatory variables. Therefore, the following relationship holds for the majority of the hypotheses:

$$Y_i = f(x_1, x_2, \text{---}, x_n)$$

The Cobb-Douglas function is used in this study. The hypothesized functional relationship to be investigated may be expressed as:

$$Y_i = \alpha x_{1i}^{B_1} x_{2i}^{B_2} \text{---} x_{ni}^{B_n} \cdot U$$

The Cobb-Douglas model may be transformed into a linear form to facilitate the estimation purposes. The log-linear transformation used in this study is the following:

$$\log(Y) = \alpha + B_1 \cdot \log(X_{1i}) + B_2 \cdot \log(X_{2i}) + \dots + B_n \log(X_{ni}) + U$$

Where:

Y = individual functional level expenditure to GNP ratio,

centralisation ratio or coefficient of variation,

$X_{ji}$  = individual  $j$ th explanatory variable

$\alpha$  = intercept term

$B_j$  = Elasticity of  $Y$  with respect to  $X_{ji}$

$U$  = Error term

For the various public recurrent expenditure to GNP ratio the equations are estimated from the 1960 to 1982 data. For the centralisation ratio, the equation is estimated for the period 1973-1981. And the stability equations estimation is from 1961 - 1981 data.

The simple aggregate public recurrent expenditure model has only one explanatory variable and this is GNP per capita. The loglinear model to be estimated is the following:

$$LEAGGR : = \alpha + B_1 \cdot LGNP_1 + U$$

where:

$LEAGGR$  : = Log (Aggregate public recurrent expenditure to GNP ratio)

$LGNP$  = Log (GNP per capita)

The other terms are as defined earlier.

The aggregate public recurrent expenditure model has many explanatory variables. The log - linear transformation for this model is :

$$LEAGGR = \alpha + B_1 \cdot LGNP + B_2 \cdot DUMMY + B_3 \cdot LPOP + B_4 \cdot LURBAN + U$$

Where:

LEAGGR: = Log (Aggregate public recurrent expenditure to GNP ratio)

LGMP = Log (GNP per capita)

DUMMY = represents economic reforms

LPOP = Log (Population growth rate)

LURBAN = Log (urbanisation rate)

The economic reforms in this model is represented by a dummy variable. We do not take logarithm of a dummy variable because it does not make sense to take logarithm of zero.

The health public recurrent expenditure model's log-linear transformation is

$$\text{LHPEX} = \alpha + B_1 \text{LGMP} + B_2 \text{LPOP} + B_3 \text{LURBAN} + U$$

where:

LHPEX = Log (Health public recurrent expenditure to GNP ratio)

And the other variables are as explained in the aggregate public recurrent expenditure model.

The education public recurrent expenditure model has three explanatory variables. The model to be estimated is:

$$\text{LEAGGR} = \alpha + B_1 \text{LGMP} + B_2 \text{LPESPO} + B_3 \text{LEAFCG} + U$$

where:

LEAGGR = Log (Education public recurrent expenditure to GNP ratio)

LGMP = Log (GNP per capita)

LPESPO = Log (Percentage of student population in the national population)

LEAFCG = Log (Lagged Economic growth rate)

In case of the internal security public recurrent expenditure model, the equation to be estimated is the following:

$$LIPUFEX = \alpha + B_1 \cdot LGNP + B_2 \cdot LANVCR + B_3 \cdot LUEMP + U$$

Where:

$LIPUFEX$  = Log (internal security public recurrent expenditure to GNP ratio)

$LGNP$  = Log (GNP Per capita)

$LANVCR$  = Log (Annual average crime rate)

$LUEMP$  = Log (Unemployment rate)

The last expenditure model is the rural development. The log-linear model to be estimated is:

$$LFUDEX = \alpha + B_1 \cdot LGNP + B_2 \cdot LCOPPR + B_3 \cdot LPYIND + U$$

Where:

$LFUDEX$  = Log (Rural development public recurrent expenditure to GNP ratio)

$LGNP$  = Log (GNP per capita)

$LCOPPR$  = Log (Copper prices)

$LPYIND$  = Log (Previous year index of agricultural exports)

#### THE CENTRALISATION MODEL

This model's log-linear form is the following:

$$LCENTR = \alpha + B_1 \cdot LGNP + B_2 \cdot LPOP + U$$

Where

$LCENTR$  = Log (Centralisation ratio)

$LGNP$  = Log (GNP Per capita)

$LPOP$  = Log (Population growth rate)

This is the equation that is going to be estimated.



#### 4.9. THE STABILITY MODEL

In the case of the stability model, we present both the aggregate and the functional level stability models in this section. The rationale for this move was given in the section on the stability hypotheses.

The equation to be estimated is:

$$LAPCOV = \alpha + B_1 \cdot LGNPCO + B_2 \cdot LPOPCO + U$$

Where:

$LAPCOV$  = Log (Aggregate public recurrent expenditure to GNP ratio or any other functional level ratio coefficient of variation)

$LGNPCO$  = Log (GNP per capita coefficient of variation)

$LPOPCO$  = Log (population growth rate coefficient of variation).

#### 4.10 THE DATA

This section is divided into two broad categories namely:

- (a) Dependent variable data
- (b) Explanatory variable data.

The constituent parts of these sub-sections are considered below.

##### THE DEPENDENT VARIABLE DATA

This sub-section includes data on the following variables:

- (a) Aggregate public recurrent expenditure to GNP ratio
- (b) Health public recurrent expenditure to GNP ratio
- (c) Education public recurrent expenditure to GNP ratio
- (d) Internal security public recurrent expenditure to GNP ratio.
- (e) Rural development public recurrent expenditure to GNP ratio.

- (f) Centralisation ratio
- (g) Aggregate public recurrent expenditure to GNP ratio coefficient of variation,
- (h) Health public recurrent expenditure to GNP ratio coefficient of variation
- (i) Education public recurrent expenditure to GNP ratio coefficient of variation,
- (j) Internal security public recurrent expenditure to GNP ratio coefficient of variation
- (k) Rural development public recurrent expenditure to GNP ratio coefficient of variation,

The expenditure ratios were calculated using the following formula:

$$R = \frac{X}{Y}$$

Where:

R = The desired expenditure ratio

X = Aggregate or functional level public recurrent expenditure.

Y = Gross national product.

The formula for the centralisation ratio is as follows:

$$CENTR = \frac{AGGPUC}{AGGPI}$$

Where:

CENTR = Centralisation ratio

AGGPI = Aggregate public recurrent expenditure

AGGPUC = Aggregate public recurrent expenditure expended only at central government level.

The coefficients of variation of the ratios may be calculated using the formula given below.

$$APCOV = \frac{S}{X}$$

Where

APCOV = Aggregate or functional level ratio coefficient of variation.

S = Standard deviation of the expenditure to GNP ratio

X = Moving average of the expenditure to GNP ratio.

The sources of data for the above variables were the financial reports 1960-1981, published by the the Republic of Zambia's government printers, Lusaka. The data for 1982 were obtained from the then unpublished financial report, Ministry of finance Headquarters, Lusaka.

#### 4.II. THE EXPLANATORY VARIABLE DATA

This sub-section include data on the following variables:

- (a) GNP per capita
- (b) Population growth rate
- (c) Urbanisation rate
- (d) Economic reforms (Dummy variable)
- (e) Percentage of student population to total national population.
- (f) Large economic growth rate
- (g) Copper prices
- (h) Previous year index of agricultural exports
- (i) Annual average crime
- (j) Unemployment rate
- (k) GNP per capita coefficient of variation.

- (l) Population growth rate coefficient of variation
- (m) Unemployment rate coefficient of variation
- (n) Copper price coefficient of variation
- (o) percentage of student population coefficient of variation.

Among the explanatory variables, the one that needs an explanation is the dummy variable. Since the economic reforms, the Mulungushi and Matero reforms, were announced in 1968 and 1970 respectively, the years 1960 to 1967 inclusive take the value of zero and the <sup>years</sup> 1968 to 1982 the value of unity in the model.

The sources of the data for the explanatory variables except the annual average crime were the Monthly Digest of Statistics 1964 - 1982. These are published by the Central Statistical Office, Lusaka. The data on the annual average crime was obtained from Northern Rhodesia police annual reports 1960 - 1963 and the Zambia police annual reports 1964 - 1976. These two series were published by the government printers, Lusaka. For the period 1977 - 1982 the data were obtained from the unpublished Zambia police annual reports.

CHAPTER FIVETHE EMPIRICAL RESULTS5.0 ANALYSIS OF EMPIRICAL RESULTS

This Chapter is divided into two broad sections. The first section presents the results of all the expenditure models and the Centralisation model. The second section presents the results of the stability models.

The nature and form of the presentation of the empirical results will be divided into three stages. The first stage is descriptive. The means, standard deviations and the correlation matrices are presented and discussed. The second stage is the presentation and evaluation of the parameter estimates. This is the stage when the parameter estimates of the models are examined to see whether they pass the statistical criteria. These criteria are in terms of the t-statistics and the F-statistics. The third stage is the subjection of these parameter estimates to the econometric criteria.<sup>35</sup> These criteria are in terms of the Durbin-Watson statistic and the severity of the multicollinearity problem. Once the model has simultaneously fulfilled these two criteria then it is established. If the model fails to fulfil one or both of these two criteria we then re-examine the whole model. This re-examination is in terms of re-specification and re-estimation of the model. Then the whole three-stage procedure is repeated.

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35. A. Koutsoyiannis, Theory of Econometrics, The Macmillian press LTD LONDON 1981 pp 177.

### 5.1.0 THE EXPENDITURE MODELS

In this section, we present the empirical results in the following order:

- (a) Simple aggregate public recurrent expenditure model
- (b) Aggregate public recurrent expenditure model
- (c) Health public recurrent expenditure model
- (d) Education public recurrent expenditure model
- (e) Internal Security public recurrent expenditure model
- (f) Rural development public recurrent expenditure model
- (g) Centralisation model.

#### 5.1.1 SIMPLE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL

The aggregate public recurrent expenditure to GNP ratio (EAGGR) averaged around 0.1913 while the gross national product per capita (GNP per capita) averaged around K275.80 over the 1960 - 1982 period. The EAGGR varied more than the GNP per capita. The standard deviation for EAGGR was 0.3529 while that of GNP per capita was only 0.1963.

The correlation coefficient between EAGGR and the GNP per capita was 0.87389. This high value of the correlation coefficient indicates that there is a close relationship between the EAGGR and the GNP per capita.

The regression analysis was carried out to determine whether the variations in EAGGR can be explained by the variations in the GNP per capita. The regression results were as presented in table 5.1.1 below (with t-statistic in parentheses)

TABLE 5.1.1

THE SIMPLE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

---


$$\text{LEAGGR} = - 4.57106 + 1.57862 \text{ LGNP}$$

(8.4432)\*\*

$$\text{Multiple R} = 0.87889 \quad R^2 = 0.77243 \quad \bar{R}^2 = 0.76161 \quad \text{SER} = 0.1723$$

$$F(1/21) = 71.287^{**} \quad \text{DW} = 0.57492$$


---

Where:

LEAGG = Log (Aggregate public recurrent expenditure to GNP ratio)

LGNP = Log (Gross national product per capita)

\*\* = Statistic significant at both one and five percent levels of significance.

\* = Statistic significant at only five percent level of significance

---

This model had both the t-statistic and the F-statistic significant at both the one percent and five percent levels of significance. However, the low Durbin-Watson statistic indicates that positive first order serial correlation is present in the estimated residuals. In order to rectify the problem of positive first order serial correlation, the generalized defferencing procedure was applied. The serial correlation coefficient was estimated using the Theil-Nagar formula. The serial correlation coefficient (P) obtained was 0.7255879 (see appendix I for detailed calculations). The estimated serial correlation coefficient was used to transform the data. The regression was run on this transformed data and the results were as follows:

/.....

TABLE 5.1.2

THE SIMPLE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
CORRECTED FOR SERIAL CORRELATION

THE REGRESSION RESULTS

---


$$\text{LEAGGR} = 0.45296 + 0.33493 \text{ LGNP}$$

(2.97)\*\*

$$\text{Multiple R} = 0.54394 \quad R^2 = 0.29388 \quad \bar{R}^2 = 0.26235 \quad \text{SER} = 0.10095$$

$$F(1/21) = 8.824^{**} \quad \text{DW} = 1.48121 \quad P = 0.7255879.$$


---

Where: Variables are as defined earlier.

These statistics were obtained from the transformed equation which used the generalized differencing process. The result is that the intercept term has increased, while the slope coefficient which in the log-linear model is the same as the elasticity value, the multiple R, the R-square, the adjusted R-square, the standard error of the regression, the F-statistic and t-statistic have all declined. However, the F-statistic and the t-statistic are still significant at the one percent and the five percent levels of significance. And also the Durbin-Watson statistic now indicates the absence of positive first order serial correlation.

This established model indicates that EAGGR is not elastic to changes in the GNP per capita. The regression indeed only explains 26.23 percent of the variations in the EAGGR. This point is pursued further in the next chapter. The low elasticity value and explanatory power of this model has already been explained in the context of development by G.M. Meier.<sup>36</sup> However, we explain this in the context of the hypotheses advanced in the previous chapter..

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36. Gerald M. Meier, Leading issues in Economic development: studies in International poverty, Oxford University Press LONDON 1970 Pg5.



### 5.1.2 THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL

The aggregate public recurrent expenditure to GNP ratio (EAGGR) averaged as before around 0.1913 with a standard deviation of 0.3529. The average of the GNP per capita is as before K275.80 with a standard deviation of 0.1965. The dummy variable representing the economic reforms averaged 0.6522 with a standard deviation of 0.4870. The population growth rate has the mean of 0.03480 with the standard deviation of 0.2263. The urbanisation rate on the other hand averaged around 0.2227 with a standard deviation of 0.1147.

The correlation among these variables is shown in the table below:

TABLE 5.1.3

#### THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL THE CORRELATION COEFFICIENT MATRIX

	EAGGR	LGNP	LPOP	LURBAN	DUMMY
EAGGR	1.0000				
LGNP	0.87889	1.0000			
LPOP	- 0.28688	-0.31476	1.0000		
LURBAN	0.83887	0.97855	- 0.30596	1.0000	
DUMMY	0.87434	0.87263	-0.21443	0.87184	1.0000

Where:

- EAGGR = Log (Aggregate public recurrent expenditure to GNP ratio)  
 LGNP = Log (GNP per capita)  
 LPOP = Log (Population growth rate)  
 LURBAN = Log (Urbanisation rate)  
 DUMMY = (Economic reforms)

All the correlation coefficients are positive except that of the population growth rate and each of the other explanatory variables and the dependent variable. The highest correlation coefficient is that between the urbanisation rate and the GNP per capita. This is due to the way the national accounts are compiled. This high correlation coefficient between the two explanatory variables points to the probable severity of the multicollinearity problem. All the correlation coefficients are satisfactorily high except those between the population growth rate and the other variables in the model.

The step-wise regression procedure was used to analyse the model. The explanatory variables were incorporated in the analysis in the following order:

- (a) GNP per capita
- (b) Dummy (Economic reforms)
- (c) Urbanisation rate
- (d) Population growth rate.

The regression results were as presented in table 5.1.4 below with t-statistics in parentheses.

TABLE 5.1.4

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

---


$$\text{EAGGR} = - 7.09544 + 2.00157 \text{ LGNP} + 0.37328 \text{ DUMMY} - 2.19783 \text{ LURBAN} - 0.06892 \text{ LP}$$

(2.401458)\*\*      (2.6321)\*\*      (1.5515)      (0.446T)

$$\text{Multiple } R = 0.91833 \quad R^2 = 0.84353 \quad \bar{R}^2 = 0.80851 \quad \text{SER} = 0.154$$

$$F(4/18) = 24.223^{**} \quad \text{DW} = 1.2254.$$


---

Variables are as defined earlier.

The Durbin-Watson statistic indicates that serial correlation is not a problem here. The table shows that only two slope coefficients are significant at the one and five percent levels of significance. The slope coefficients for the urbanisation rate and the population growth rate are insignificant even at the five percent level. The insignificance of the slope coefficient of the urbanisation rate is surprising given the high correlation coefficient between this variable and the dependent variable. This might be due to the severity of the multicollinearity problem in the model. This problem might be because of the high correlation coefficient between the GNP per capita and the urbanisation rate. This makes it difficult to interpret the slope coefficients of these two variables.

To rectify this problem one of these two variables has to be excluded from the model. Two separate regression models were estimated. The first model excluded the GNP per capita and the second model excluded the urbanisation rate from the analysis.

When the regression was run excluding the GNP per capita from the analysis, the following results were obtained.

TABLE 5.1.5

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING GNP PER CAPITA

---


$$\text{EAGGR} = -0.70459 + 0.44277 \text{ DUMMY} + 0.87783 \text{ LURBAN} - 0.10701 \text{ LPOP}$$

(2.34973)\*\*                      (1.29692)                      (0.62209)

$$\text{Multiple R} = 0.89058 \quad R^2 = 0.79313 \quad \bar{R}^2 = 0.76047 \quad \text{SER} = 0.173$$

$$F(3/19) = 24.28221^{**} \quad \text{DW} = 0.75052$$


---

The variables are as defined earlier.

---

The dummy variable's slope coefficient continue to be highly significant. However, the slope coefficients of the urbanisation rate and the population growth rate are still insignificant. This model is actually worse than the last one because now there is a new problem of positive first order serial correlation indicated by the low Durbin-Watson statistic.

The second regression model excluded the urbanisation rate. The step-wise regression procedure incorporated the explanatory variables in the analysis in the following order:

- (a) GNP per capita
- (b) Dummy (Economic reforms)
- (c) Population growth rate.

The regression results are presented in table 5.1.6 below with t-statistics in parentheses. This model is better than the one excluding the GNP per capita. This model has two slope coefficients significant at the five per-cent level of significance.

TABLE 5.1.6

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING URBANISATION RATE

---


$$\text{EAGGR} = - 3.06359 + 0.83236 \text{ LGNP} + 0.33403 \text{ DUMMY} - 0.06580 \text{ LPOP}$$

(2.255)\*                      (2.3082)\*                      (0.4110)

$$\text{Multiple R} = 0.90685 \quad R^2 = 0.82238 \quad \bar{R}^2 = 0.79433 \quad \text{SER} = 0.160$$

$$F(3/19) = 29.32253^{**} \quad \text{DW} = 0.76877$$


---

The variables are as defined earlier.

---

However, the slope coefficient of the population growth rate remains insignificant. This model just like the one excluding the GNP per capita has introduced the problem of positive first order serial correlation which was not originally present. This is indicated by the low Durbin-Watson statistic.

The two models constructed both failed to improve the regression results. Multicollinearity here might not be a problem to impair the interpretation of the slope coefficients in the original aggregate public recurrent expenditure model. The Hainovsky test was applied to test for the severity of Multicollinearity. It was found that multicollinearity in the original aggregate public recurrent expenditure model was not severe as to impair the interpretation of the slope coefficients (see appendix II for detailed explanation). Therefore, the model results presented in table 5.1.4 are the established results. All the conclusions should be based on these results.

### 5.1.3 THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL

The health public recurrent expenditure hypothesis stated that the health public recurrent expenditure to GNP ratio (HPEX) was a positive function of the GNP per capita and the urbanisation rate and that it was an inverse function of the population growth rate.

The HPEX averaged around 0.01246 with a standard deviation of 0.6762. The health public recurrent expenditure to GNP ratio (HPEX) varied more violently than the aggregate public recurrent expenditure to GNP ratio (FAGGR).

The association levels among the model's variables are given in table 5.1.7 below.

TABLE 5.1.7

THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL  
THE CORRELATION COEFFICIENT MATRIX

	HPEX	LGDP	LPOP	LURBAN
HPEX	1.0000			
LGDP	0.69461	1.0000		
LPOP	- 0.77566	- 0.32118	1.0000	
LURBAN	0.71013	0.97857	-0.31164	1.0000

Where:

HPEX = Log (Health public recurrent expenditure to GNP ratio)

Other variables are as defined earlier.

The highest correlation coefficient is that between the urbanisation rate and the GNP per capita. Since these are explanatory variables, there is a possibility of severe multicollinearity. Among the correlation coefficients between the dependent variable and each of the three explanatory variables, the highest value occurs between the dependent variable and the population growth rate although its sign is negative. This is followed by the urbanisation rate and the dependent variable's correlation coefficient. However, there is not much difference between this correlation coefficient and that between the HPEX and the GNP per capita.

When the step-wise regression procedure was applied to analyse the model the explanatory variables were incorporated in the analysis in the following order:

- (a) Population growth rate
- (b) Urbanisation rate
- (c) GNP per capita

The regression results obtained are shown in table 5.1.8 below with t-statistics in parentheses. The regression results show that the population growth rate has a negative slope as hypothesized.

TABLE 5.1.8  
THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

---


$$\text{HPEX} = - 0.22681 - 1.8445 \text{ LPOP} + 4.455 \text{ LURBAN} - 0.8375 \text{ LGNP}$$

(6.5282)\*\*      (1.7346)\*      (0.557)

$$\text{Multiple R} = 0.92040 \quad R^2 = 0.84714 \quad \bar{R}^2 = 0.82301 \quad \text{SFR} = 0.2845$$

$$F(3/19) = 35.099^{**} \quad DW = 1.67681$$


---

The variables are as defined earlier.

Its size indicates that HPEX is elastic to changes in this explanatory variable. The slope coefficient is also highly significant at both the five and one percent levels of significance. The urbanisation rate has a positive slope coefficient again as hypothesized. The slope coefficient which is the same as the elasticity indicates that HPEX is very elastic to changes in the urbanisation rate. The GNP per capita has a negative slope coefficient contrary to what was hypothesized. It is also insignificant even at the five percent level. This is a problem that must be resolved.

The regression plane is significant at both the five and one percent levels of significance as indicated by the F-statistic. The explanatory power is satisfactory. The first order positive serial correlation is absent as indicated by the Durbin-Watson statistic. However, the problem is the sign and insignificance of the GNP per capita slope coefficient.

The reason for this problem might be the severity of the multicollinearity problem in the model. When the Haitovsky test was applied to this

model (see appendix II for calculations) it was found that multicollinearity is severe between the urbanisation rate and the GNP per capita. In order to solve this problem one of these variables had to be dropped from the model.

Two separate regression models were run. The first one excluded the urbanisation rate explanatory variable from the analysis. The second one excluded the GNP per capita from the analysis. The first model's regression results are presented in table 5.1.9 below.

TABLE 5.1.9

THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING THE URBANISATION RATE

---


$$\text{HPEX} = - 8.75979 - 1.83780 \text{ LPOP} + 1.70923 \text{ LGNP}$$

$$(6.20121)** \quad (4.99949)**$$

$$\text{Multiple R} = 0.90716 \quad R^2 = 0.82294 \quad \bar{R}^2 = 0.80523 \quad \text{SFR} = 0.298$$

$$F(2/20) = 46.477** \quad \text{DW} = 1.66439$$


---

This model has succeeded in reversing the sign of the GNP per capita slope coefficient. It is now positive as was stated in the hypothesis. It is also highly significant at five and one percent levels of significance. The regression's explanatory power is satisfactory as indicated by the F-statistic. However, this model must be compared to the other model excluding the GNP per capita.

The regression results of the Health public recurrent expenditure model excluding GNP per capita are presented in table 5.1.10 below.



TABLE 5.1.10

THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING GNP PER CAPITA

---


$$\text{HPEX} = -22.9811 - 1.83143 \text{ LPOP} + 3.05874 \text{ LURBAN}$$

(6.61959)\*\*      (5.5931)\*\*

$$\text{Multiple R} = 0.91905 \quad R^2 = 0.84465 \quad \bar{R}^2 = 0.82911 \quad \text{SER} = 0.2795$$

$$F(2/20) = 54.3695^{**} \quad \text{DW} = 1.6831$$


---

This is a better model than the model whose results were presented in table 5.1.9. It has a greater explanatory power. The F-statistic and the t-statistics are even more significant than before. This means that the HPEX is highly elastic to changes in the population growth rate and the urbanisation rate. And further the Durbin-Watson statistic has increased implying absence of serial correlation of the first order. This is, therefore, the model we should adopt.

#### 5.1.4 EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL

The education public recurrent expenditure to GNP ratio (EAGGR) was hypothesized as a positive function of the gross national product per capita (GNP per capita), the percentage of student population to total national population (PESPO) and the lagged economic growth rate (LAFCG).

This ratio has averaged over the period under consideration around 0.02794 with a standard deviation of 0.3380. The PESPO has a mean of 0.1751 with a standard deviation of 0.1125. The LAFCG has a mean of 0.03980 with a standard deviation of 1.1234. In the case of the GNP per capita this is as stated earlier. On the

/.....

average the PESFO has varied the least and it has the largest mean.. The LAECG has varied the most and this is the general characteristic of the third world countries, Their economic growth rates are very unstable.

The correlation among the model's variables is shown in table 5.1.11 below.

TABLE 5.1.11  
THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL  
THE CORRELATION COEFFICIENT MATRIX

	EAGGR	LGNP	LPESFO	LLAECG
EAGGR	1.0000			
LGNP	0.84867	1.0000		
LPESFO	0.91162	0.87177	1.0000	
LLAECG	- 0.06975	0.09356	0.14223	1.0000

Where:

EAGGR = Log (Education public recurrent expenditure to GNP ratio)

LGNP = Log (GNP per capita)

LPESFO = Log (Percentage of total student population to total national population).

LLAECG = Log (lagged economic growth rate).

The table shows that there is close correlation between the dependent variable and the LPESFO. The correlation coefficient is as expected because the increases in the ratio should be due to the increases in the percentage of the student population in the national population. There is also a high correlation coefficient between the

/.....

dependent variable and the GNP per capita. The correlation coefficient between the dependent variable and the LLAECG was unexpectedly negative. However, the absolute size of this coefficient is small. Among the explanatory variables there is a high correlation coefficient between the LPESFO and LGNP. This is a possible source of multicollinearity problem. This point is pursued further later.

The step-wise regression procedure was applied in analysing the model. The explanatory variables were included in the analysis in the following order:

- (a) Percentage of student population to total national population.
- (b) Lagged economic growth rate
- (c) GNP per capita.

At the last step the following regression results were obtained:

TABLE 5.1.12

THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

---


$$\text{EAGGR} = -1.55870 + 2.30048 \text{ LPESFO} - 0.05937 \text{ LLAECG} + 0.34357 \text{ LGNP}$$

(4.705954)\*\*      (2.465)\*      (1.23491)

$$\text{Multiple R} = 0.93371 \quad R^2 = 0.88118 \quad \bar{R}^2 = 0.86241 \quad \text{SFR} = 0.1254$$

$$F(3/19) = 46.9671^* \quad \text{DW} = 1.01259$$


---

The variables are as defined earlier.

---

/.....

In table 5.1.12 we note that the lagged economic growth rate has a negative slope coefficient which is contrary to what was stated in the hypothesis. Although the slope coefficient itself is significant at the five percent level of significance there is need to improve this model. The slope coefficient for the GNP per capita is low and insignificant. These two problems may be rectified if their sources were the severity of the multicollinearity problem in the model. However, the Haitovsky test proved that multicollinearity in this model was not severe (see appendix II for calculations).

Two attempts to try to improve the model's results were made. Two separate two variable regression models were run. The first one had the GNP per capita as its explanatory variable while the second one had the PESPO as the explanatory variable.

The regression results for the first model are presented in table 5.1.13 below.

TABLE 5.1.13

THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS ONLY INCLUDING LGNP

---


$$\text{EAGGR} = - 5.18295 + 1.4598 \text{ LGNP}$$

(7.353)\*\*

$$\text{Multiple R} = 0.84867 \quad R^2 = 0.72024 \quad \bar{R}^2 = 0.70691 \quad \text{SER} = 0.183$$

$$F(1/21) = 54.0634^{**} \quad \text{DW} = 0.5056$$


---

The variables are as defined earlier.

---

The GNP per capita slope coefficient shows that the ratio is elastic to changes in this explanatory variable. And the slope coefficient is highly significant. Although the regression line is highly significant, the low Durbin-Watson statistic indicates that there is first order positive serial correlation. This implies that the F-statistic, the t-statistic and the R-square are optimistically high. This model does not improve the earlier regression results and is therefore dropped.

The regression results for the model including only the PESPO are presented in table 5.1.14 below.

TABLE 5.1.14

THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS ONLY INCLUDING PESPO

---


$$\text{EAGGR} = - 3.192 + 2.7394 \text{ LPESPO}$$

(10,164)\*\*

$$\text{Multiple R} = 0.91162 \quad R^2 = 0.83105 \quad \bar{R}^2 = 0.8230 \quad \text{SER} = 0.142$$

$$F(1/21) = 103.297^{**} \quad \text{DW} = 0.76023$$


---

The variables are as defined earlier.

Although there is a general improvement over the results of the model with GNP per capita as the only explanatory variable, the Durbin-Watson statistic is still low which implies that the results are optimistically high. This model should as well be dropped from consideration. And instead the model whose regression results are presented in table 5.1.12 should be the basis for our conclusions.

### 5.1.5 INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL

The internal security public recurrent expenditure hypothesis stated that the internal security public recurrent expenditure to GNP ratio (IPUEX) is a positive function of the GNP per capita, annual average crime and the unemployment rate.

The IPUEX has a mean of 0.01362 over the 1960-82 period with a standard deviation of 0.1575. The annual average crime has a mean of 68680 cases with a standard deviation of 0.0577. The unemployment rate has a mean of 0.7244 with a standard deviation of 0.0230. The mean and standard deviation of GNP per capita is as presented earlier. It can be noted from the above descriptive statistics that the unemployment rate has the smallest standard deviation. This means that unemployment is a difficult problem to deal with.

The levels of association among these variables is given by the correlation coefficient matrix in table 5.1.15 below.

TABLE 5.1.15

#### THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL THE CORRELATION COEFFICIENT MATRIX

	IPUEX	LGNP	LANVCR	LUNEMP
IPUEX	1.0000			
LGNP	0.48912	1.0000		
LANVCR	0.48422	0.85211	1.0000	
LUNEMP	0.49044	0.82540	0.90939	1.0000

Where:

IPUEX = Log (Internal security public recurrent expenditure to GNP ratio).

/.....

LGNP = Log (GNP per capita)

LANVCR = Log (Annual average crime)

LUNETF = Log (Unemployment rate)

The correlation coefficients between the dependent variable and each of the explanatory variables are low. However, the correlation coefficients between each pair of the explanatory variables are very high. This points to probable analytical problems.

The step-wise regression procedure incorporated the explanatory variables in the model in the following order:

- (a) Unemployment rate
- (b) Annual average crime
- (c) GNP per capita.

The regression results obtained at the last step are presented in table 5.1.16 below.

TABLE 5.1.16

THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

$$\text{IPUEX} = - 4.252 + 1.8943 \text{ LUNETF} + 0.5297 \text{ LANVCR} + 0.0368 \text{ LGNP}$$

(0.562)                      (0.366)                      (0.118)

Multiple R = 0.4995     $R^2 = 0.2495$      $R^{-2} = 0.131$     SER = 0.1468

F(3/19) = 2.1057              DW = 2.29

The variables are as defined earlier.

The signs of the slope coefficients are as hypothesized. However, the explanatory power of the model is low and indeed all the statistics are insignificant. The only statistic that is satisfactory is the Durbin-Watson statistic. This statistic indicates that first order serial correlation is absent from the model. The model, therefore, had to be abandoned.

A new improved model had to be constructed. However, before a new model is constructed we have to identify the problems of the abandoned model. A closer look at the correlation coefficient matrix points to the possibility of the severity of the multicollinearity problem. However, this should be resisted because if multicollinearity was severe in the model the explanatory power could have been higher. Thus the problem of the model is not the severity of the multicollinearity problem only.

Since R-square is low and all the statistics are insignificant, the problem of the abandoned model is not merely multicollinearity. However, in view of the functional relationship between the two explanatory variables, which we establish below, we seek to examine if any improvement in the model, even if it be marginal, can be brought about by adjusting for this functional relation.

The problem of the abandoned model was because of the existence of a functional relationship between two explanatory variables. The annual average crime is a function of the unemployment rate. And indeed this model was estimated and the following regression results were obtained:

.../.....



TABLE 5.1.17

THE ANNUAL AVERAGE CRIME MODEL  
THE REGRESSION RESULTS

$$\text{LANVCR} = 5.157 + 2.284 \text{ LUNEMP}$$

(10.02)\*\*

$$\text{Multiple } R = 0.9094 \quad R^2 = 0.82698 \quad \bar{R}^2 = 0.8188 \quad \text{SER} = 0.025$$

$$F(1/21) = 100.38^{**} \quad \text{DW} = 0.7278$$

The variables are as defined earlier.

The statistics of this model are highly significant. The Durbin-Watson statistic is satisfactory. The explanatory power of the model is high and therefore we concluded that the annual average crime is a function of the unemployment rate.

The chain reaction has now been established. The chain reaction starts from the unemployment rate to the annual average crime to the IPUEx. However, in order to clear all doubts two two-variable regression models were estimated. The first of these models states that IPUEx is a function of LUNEMP, while the second model states that IPUEx is a function of LANUCR.

The model which states that IPUEx is a function of LUNEMP had the following regression results:

TABLE 5.1.18

THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS ONLY ON LUNEMP

$$\text{IPUEX} = -1.395 + 3.354 \text{ LUNEMP}$$

(2.58)\*\*

$$\text{Multiple } R = 0.4904 \quad R^2 = 0.2405 \quad \bar{R}^2 = 0.2044 \quad \text{SER} = 0.1405$$

$$F(1/21) = 6.651^* \quad \text{DW} = 2.31$$

The variables are as defined earlier

---

The regression results have concretised this functional relationship. The F-statistic and the t-statistic are both significant. The explanatory power is almost as good as the original model's. However, these results should be compared to the second model's results.

The second model is the one which states that IPUEX is a function of the annual average crime. The following regression results were obtained:

TABLE 5.1.19

THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS ONLY ON LANUCR

---


$$\text{IPUEX} = - 8.262 + 1.322 \text{ LANUCR}$$

(2.536)\*\*

$$\text{Multiple R} = 0.4842 \quad R^2 = 0.2345 \quad \bar{R}^2 = 0.1980 \quad \text{SER} = 0.1410$$

$$F(1/21) = 6.432* \quad \text{DW} = 2.2$$


---

The variables are as defined earlier

---

This model on the average is as good as the model in table 5.1.18. However, because of the chain reaction proved earlier we take the model in table 5.1.19. Therefore the conclusions and recommendations will be based on this chain reaction.

5.1.6 RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL

The hypothesis is that the rural development public recurrent expenditure to GNP ratio (FUDEX) is a positive function of GNP per capita, copper price and the previous year index of agricultural exports. This ratio has a mean of 0.01326 with a standard deviation

of 0.5739 over the 1960-32 period. The copper prices averaged about K669.70 with a standard deviation of 0.3441 over the same period. While the previous year index of agricultural exports has a mean of 121.2 with a standard deviation of 0.1794. The GNP per capita's mean and standard deviation are as stated earlier.

The ratio has the largest standard deviation and is followed by copper prices. The explanation for the violent fluctuation of the ratio is that this sector was neglected from the beginning and it is only recently when the trend was started to be reversed. And for the copper prices the large standard deviation is accounted for by the instability in the world market for third world's primary product exports.

The correlation coefficients associated with this model are shown in table 5.1.20 below

TABLE 5.1.20

THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL  
THE CORRELATION COEFFICIENT MATRIX

	RUDEX	LGNP	LCOPPR	LPYIND
RUDEX	1.0000			
LGNP	0.91034	1.0000		
LCOPPR	0.90222	0.94843	1.0000	
LPYIND	0.43038	0.27554	0.27807	1.0000

Where:

RUDEX = Log (Rural development public recurrent expenditure to GNP ratio)

LGNP = Log (GNP per capita)

LCOPPR = Log (Copper price)

LPYIND = Log (Previous year index of agricultural exports).

/.....

The correlation coefficients between the ratio and each of the explanatory variables are high except that between the ratio and LPYIND. The correlation coefficient between the GNP per capita and copper price is the highest and might be the source of the possible severity of the multicollinearity problem.

When the model was estimated, the step-wise regression procedure incorporated the explanatory variables in the analysis in the following order:

- (a) GNP per capita
- (b) Previous year index of agricultural exports
- (c) Copper price.

The regression results obtained at the last step are presented in table 5.1.21 below. The t-statistics are in parentheses in all the models in this Chapter.

TABLE 5.1.21  
THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS

---


$$\text{RUDEX} = - 8.52 + 1.524 \text{ LGNP} + 0.601 \text{ LPYIND} + 0.5924 \text{ LCOPPR}$$

(2.05)\*                      (2.23)\*                      (1.39)

$$\text{Multiple R} = 0.9361 \quad R^2 = 0.8762 \quad \bar{R}^2 = 0.8567 \quad \text{SER} = 0.2173$$

$$F(3/19) = 44.84^{**} \quad \text{DW} = 1.62$$


---

The variables are as defined before.

Although the two slope coefficients are significant, they are so only at the five percent level. The other slope coefficient for LCOPPR is

/.....

insignificant. Although the explanatory power is satisfactory the model may be improved. The possibility of improvement lies in the investigation of the multicollinearity problem. And indeed multicollinearity is severe in the model (see appendix II). This occurs between the LGNP and LCOPPR. In order to solve this problem one of these two variables has to be dropped from the model.

The question of which variable to drop was solved by estimating two models. The first model **excluded** LGNP and the regression results obtained were the following:

TABLE 5.1.22

THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING LGNP

---


$$\text{RUDEX} = - 7.167 + 1.415 \text{ LCOPPR} + 0.622 \text{ LPYIND}$$

(9.374)\*\*                      (2.150)\*

$$\text{Multiple } R = 0.9214 \quad R^2 = 0.8439 \quad \bar{R}^2 = 0.8338 \quad \text{SER} = 0.234$$

$$F(2/20) = 56.19^{**} \quad \text{DW} = 1.67$$


---

The slope coefficient for LCOPPR has improved and is now significant at five and one percent levels of significance. The slope coefficient for LPYIND remains significant and is almost the same size as before. The explanatory power of this model is satisfactorily high. However, this model should be compared to the other one.

The other model excluded the LCOPPR from the analysis. At the last step in the step-wise regression procedure the following regression results were obtained:

/.....

TABLE 5.1.23

THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL  
THE REGRESSION RESULTS EXCLUDING LCOPPR

$$RUDEX = - 9.276 + 2.502 LGNP + 0.621 LFYIND$$

(9.973)\*\*      (2.262)\*

$$\text{Multiple } R = 0.92930 \quad R^2 = 0.86360 \quad \bar{R}^2 = 0.84996 \quad \text{SER} = 0.22$$

$$F(2/20) = 63.314** \quad DW = 1.36$$

---

This model has a higher explanatory power and the t-statistics and the F-statistic are slightly higher than those in table 5.1.22. Although the Durbin-Watson statistic has slightly declined we may conclude that this model is better than the one in table 5.1.22. Therefore, the conclusions should be based on this model in table 5.1.23.

#### 5.1.7 AGGREGATE PUBLIC RECURRENT EXPENDITURE CENTRALISATION MODEL

The hypothesis was that Centralisation ratio (CFNTR) was a positive function of the GNP per capita and the population growth rate. The statement of the hypothesis was given earlier,

The CFNTR has a mean of 0.9900 with a standard deviation of 0.0039 over the 1973 - 1981 period. Over the same period the GNP per capita averaged about K407.96 with a standard deviation of 72.23 while the population growth rate has a mean of 0.0323 with a standard deviation of 0.0006.

The correlation coefficient matrix for this model is presented in table 5.1.24 below.

/.....

TABLE 5.1.24

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE CENTRALISATION MODEL  
THE CORRELATION COEFFICIENT MATRIX

	LCENTR	LGNP	LPOP
LCENTR	1.0000		
LGNP	0.3883	1.0000	
LPOP	0.2767	0.55219	1.0000

Where:

LCENTR = Log (Centralisation ratio)

Other variables are as defined earlier.

There are very low correlation coefficients between the dependent variable and each of the two explanatory variables. However, the correlation coefficient between the two explanatory variables is high but not such as to be a source of the multicollinearity problem.

The step-wise regression procedure first incorporated the LGNP in the analysis and then LPOP followed. At the last step the following regression results were obtained:

TABLE 5.1.25

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE CENTRALISATION MODEL  
THE REGRESSION RESULTS

$$LCENTR = 0.00497 + 0.00771 LGNP + 0.01973 LPOP$$

(0.753)                      (0.2)

$$\text{Multiple } R = 0.3954 \quad R^2 = 0.1563 \quad \bar{R}^2 = -0.1249 \quad SER = 0.0018$$

$$F(2/6) = 0.556 \quad DW = 2.17$$

The variables are as defined earlier.

The model does not explain anything. All the statistics are insignificant. Although the Durbin-Watson statistic is satisfactorily indicating the absence of positive first order serial correlation, the model has to be abandoned.

A plain regression model, not the log-linear one, was constructed. The step-wise regression procedure picked the explanatory variables in the same order as before. The following regression results were obtained:

TABLE 5.1.26

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE CENTRALISATION MODEL  
THE PLAIN REGRESSION MODEL RESULTS

---


$$\text{CENTR} = 0.96652 + 0.00002 \text{ GNP} \text{PER} + 0.47286 \text{ POPGRO}$$

(0.8420)                      (0.1581)

$$\text{Multiple R} = 0.419 \quad R^2 = 0.1754 \quad \bar{R}^2 = -0.0995 \quad \text{SER} = 0.004$$

$$F(2/6) = 0.6381 \quad \text{DW} = 2.18$$


---

Where:

CENTR = Centralisation ratio

GNPPER = GNP per capita

POPGRO = Population growth rate.

---

This model does not also explain the functional relation. Nevertheless, explanation as to why these models do not explain anything will be given in the next Chapter.



## 5.2.0 THE AGGREGATE PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

The hypothesis is that the aggregate public recurrent expenditure to GNP ratio coefficient of variation (APCOV) is a positive function of the GNP per capita coefficient of variation (GNPCO) and an inverse function of the population growth rate coefficient of variation (POPCO). The APCOV has a mean of 0.2218 with a standard deviation of 0.2697 over the 1961 - 1981 period. The GNPCO averaged about 0.225 with a standard deviation of 0.2763 over the same period. While the POPCO has a mean of 0.1093 with a standard deviation of 0.1409.

The correlation between APCOV and each of the two explanatory variables and that between each of the two explanatory variables is given in table 5.2.1 below.

TABLE 5.2.1

### THE AGGREGATE PUBLIC RECURRENT EXPENDITURE STABILITY MODEL THE CORRELATION COEFFICIENT MATRIX

	LAPCOV	LGNPCO	LPOPCO
LAPCOV	1.0000		
LGNPCO	0.68645	1.0000	
LPOPCO	0.07479	0.16276	1.0000

Where:

LAPCOV = Log (APCOV)

LGNPCO = Log (GNPCO)

LPOPCO = Log (POPCO)

The highest correlation coefficient is between the dependent variable and the LGNPCO and is followed by that between the two explanatory variables.

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The least is that between the dependent variable and the LPOPCO.

The step-wise regression procedure first picked the LGNPCO as the better explanatory variable than the LPOPCO. At the last step the following regression results were obtained: These are presented in table 5.2.2 below:

TABLE 5.2.2

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE REGRESSION RESULTS

---


$$\text{LAPCOV} = - 0.28678 + 0.67595 \text{ LGNPCO} - 0.07264 \text{ LPOPCO}$$

(3.99)\*\*                      (0.2191)

$$\text{Multiple R} = 0.6875 \quad R^2 = 0.473 \quad \bar{R}^2 = 0.4140 \quad \text{SER} = 0.2064$$

$$F(2/18) = 8.065^{**} \quad \text{DW} = 0.8842.$$


---

The variables are as defined earlier.

---

The slope coefficient for LPOPCO is insignificant. The model might be improved by dropping this variable from the analysis.

The new model excluding LPOPCO was estimated and the following regression results were obtained:

TABLE 5.2.3

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE REGRESSION RESULTS EXCLUDING LPOPCO

---


$$\text{LAPCOV} = - 0.2209 + 0.6699 \text{ LGNPCO}$$

(4.115)\*\*

$$\text{Multiple R} = 0.6865 \quad R^2 = 0.4712 \quad \bar{R}^2 = 0.4434 \quad \text{SER} = 0.2012$$

$$F(1/19) = 16.932^{**} \quad \text{DW} = 0.93621$$


---

Of the two models analysed this one is better. The explanatory power is higher. The Durbin-Watson statistic indicates that the positive first order serial correlation with experimental error, is absent from the model. The conclusions will be based on this model.

#### 5.2.1 THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

It was hypothesized that the health public recurrent expenditure to GNP ratio coefficient of variation is a function of the population growth rate coefficient of variation (POPCO) and the GNP per capita coefficient of variation (GNP). This functional relationship, it was stated, is positive.

The health public recurrent expenditure to GNP ratio coefficient of variation (HECOV) has a mean of 0.4201 with a standard deviation of 0.2263 over the 1961 - 81 period. And for the two explanatory variables their individual means and standard deviation are as given in the first stability model.

The correlation between the health public recurrent expenditure to GNP ratio coefficient of variation (HECOV) and each of the two explanatory variables and also the correlation between these two explanatory variables is given in table 5.2.4 below:

TABLE 5.2.4

#### THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL THE CORRELATION COEFFICIENT MATRIX

	LHECOV	LGNP	LPOPCO
LHECOV	1.0000		
LGNP	0.4798	1.0000	
LPOPCO	0.9404	0.1709	1.0000

Where:

LHECOV = Log (HECOV)

LGNP = Log (GNP per capita coefficient of variation)

LPOPCO = Log (POPCO)

---

The highest correlation coefficient is between LHECOV and LPOPCO. This is followed by the one between LHECOV and LGNP and the smallest is that between the explanatory variables.

The step-wise regression procedure first incorporated the LPOPCO into the analysis and then LGNP followed. The following regression results were obtained at the last step.

TABLE 5.2.5

THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

THE REGRESSION RESULTS

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$$\text{LHECOV} = 1.1656 + 1.421 \text{ LPOPCO} + 0.2714 \text{ LGNP}$$

(35.663)\*\*      (13.255)\*\*

$$\text{Multiple } R = 0.995 \quad R^2 = 0.9893 \quad \bar{R}^2 = 0.9881 \quad \text{SER} = 0.0047$$

$$F(2/18) = 828.74^{**} \quad DW = 0.55507$$


---

The variables are as defined earlier.

---

Although the explanatory power, the F-statistic and the t-statistics are high, the low Durbin-Watson statistic indicates that all these are optimistically high. Positive first order serial correlation is present in the model.

/.....

In order to rectify this problem the serial correlation coefficient was estimated using Theil-Nagar formula. Thereafter the method of generalized differencing was used to transform the model (see appendix I for calculations). The transformed model was estimated and the following regression results were obtained:

TABLE 5.2.6

THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
CORRECTED FOR SERIAL CORRELATION  
THE REGRESSION RESULTS

$$\text{LHECOV} = 0.21323 + 1.3632 \text{ LPOPCO} - 0.1702 \text{ LGNECO}$$

(5.818)\*\*                      (0.7403)

Multiple R = 0.9493     $R^2 = 0.9012$      $\bar{R}^2 = 0.8903$     SER = 0.0892

F(2/18)      = 82.124\*\*      DW = 2.051

The problem of positive first order serial correlation has been solved. However a new problem has emerged. This is the negative slope coefficient of LGNECO and the fact that it is insignificant.

The model was improved by dropping LGNECO from the analysis and the following results were obtained.

TABLE 5.2.7

THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
CORRECTED FOR SERIAL CORRELATION  
THE REGRESSION RESULTS EXCLUDING LGNECO

$$\text{LHECOV} = 0.1996 + 1.2088 \text{ LPOPCO}$$

(12.95)\*\*

Multiple R = 0.9478     $R^2 = 0.8982$      $\bar{R}^2 = 0.8929$     SER = 0.088

F(1/19)      = 167.6897\*\*      DW = 1.861

Although the Durbin-Watson statistic has declined, the model is better than that in table 5.2.6. All the inferences, therefore, should be based on this analytical model.

5.2.2 THE EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

The education public recurrent expenditure to GNP ratio coefficient of variation (EDUCO) has averaged about 0.1458 with a standard deviation of 0.2952 over the twenty-one year period. The means and standard deviations for the two explanatory variables are the same as those presented in the first stability model.

The correlation coefficients between EDUCO and each of the two explanatory variables and the correlation coefficient between the two explanatory variables is given in table 5.2.8.

TABLE 5.2.8

THE EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE CORRELATION COEFFICIENT MATRIX

	LEDUCO	LGNPCO	LPOPCO
LEDUCO	1.0000		
LGNPCO	0.82806	1.0000	
LPOPCO	- 0.11001	- 0.14657	1.0000

Where:

LEDUCO = Log (EDUCO)

Others are as defined earlier.

The correlation coefficient between LEDUCO and LGNPCO is positive and high; while that between LEDUCO and LPOPCO is negative. And so is that between the two explanatory variables. The reason for the negative signs

of the two correlation coefficients is that the EDUCC and POPCC change in the opposite directions. This is because EDUCC increases when the education public recurrent expenditure to GNP ratio increases and this makes population growth rate to decrease because educated people practise birth control. The consequence of this is that POPCC decreases.

In the step-wise regression procedure the first variable picked was LGNPCO and then the LPOPCO was incorporated into the analysis. The regression results obtained were:

TABLE 5.2.9

THE EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE REGRESSION RESULTS

$$LEDUCC = - 1.3897 + 2.227 LGNPCO + 0.02432 LPOPCO$$

(6.213)\*\*                      (0.0894)

$$\text{Multiple } R = 0.82813 \quad R^2 = 0.68581 \quad \bar{R}^2 = 0.65089 \quad SER = 0.174$$

$$F(2/18) = 19.645** \quad DW = 0.748$$

Although the slope coefficient for LPOPCO assumed the sign hypothesized, it is insignificant. And plus the fact that the correlation coefficients associated with this variable are negative, calls for improvement are overwhelming.

In order to improve the results POPCC was replaced by the percentage of student population to the national population coefficient of variation (PESCC). The rationale was that this is also a population variable and it is more directly associated with the education public recurrent expenditure to GNP ratio coefficient of variation (EDUCC). The following correlation coefficient matrix was obtained.



TABLE 5.2.10THE IMPROVED EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODELTHE CORRELATION COEFFICIENT MATRIX

	LEDUCO	LGNPCO	LPESCO
LEDUCO	1.0000		
LGNPCO	0.82894	1.0000	
LPESCO	0.80094	0.55867	1.0000

Where:

LPESCO = Log (PESCO)

Others are as defined earlier.

The aim of replacing LPOPCO with LPESCO has been achieved. The correlation coefficients are both positive and high.

On the step-wise regression LGNPCO was again picked first and later the LPESCO was incorporated. The following regression results were obtained:

TABLE 5.2.11THE IMPROVED EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODELTHE REGRESSION RESULTS

$$\text{LEDUCO} = 0.208 + 0.593 \text{ LGNPCO} + 1.815 \text{ LPESCO}$$

(5.091)\*\*                      (4.508)\*\*

$$\text{Multiple R} = 0.9236 \quad R^2 = 0.8531 \quad \bar{R}^2 = 0.8367 \quad \text{SFR} = 0.119$$

$$F(2/18) = 52.25^{**} \quad \text{DW} = 1.02$$

/.....



Indeed this is a better model. The F-statistic and the t-statistics are highly significant. The explanatory power is very high. The conclusions will be based on this model's results.

5.2.3 THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

Over the 1961-81 period, the internal security public recurrent expenditure to GNP ratio coefficient of variation (INCOV) averaged about 0.4567 with a standard deviation of 0.0605. Again the means and standard deviations of the two explanatory variables are the same as those presented in the first stability model.

The association levels between the dependent variable and each of the two explanatory variables and the association level between the two explanatory variables are given in table 5.2.12.

TABLE 5.2.12

THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE CORRELATION COEFFICIENT MATRIX

	LINCOV	LGNPCO	LPOPCO
LINCOV	1.0000		
LGNPCO	0.38496	1.0000	
LPOPCO	- 0.19833	0.16271	1.0000

Where:

LINCOV = Log (INCOV)

Other variables are as defined before.

The correlation coefficients are low and the one between LINCOV & LPOPCO is even negative. This points to analytical problems to be encountered.

The step-wise regression procedure first incorporated the LGNPCO explanatory variable and later the LPOPCO was incorporated. The regression results obtained were the following:

TABLE 5.2.13

THE INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE REGRESSION RESULTS

---


$$\text{LINCov} = - 0.3902 + 0.094 \text{ LGNPCO} - 0.1152 \text{ LPOPCO}$$

(2.03)\*                      (1.27)

$$\text{Multiple R} = 0.4671 \quad R^2 = 0.2182 \quad \bar{R}^2 = 0.1313 \quad \text{SER} = 0.06$$

$$F(2/18) = 2.51 \quad \text{DW} = 0.6488$$


---

In this model only one slope coefficient is significant. The explanatory power of the model is low. Besides DW indicates positive **first order** serial correlation. There is, therefore, a need to construct ~~another~~ another model.

The model that was constructed was an expanded version of the last one. A new variable, the unemployment rate coefficient of variation (UMPCO) was added. The rationale was that the variable LUNEMP helped to explain the variations in IFUEV and therefore it was thought the UMPCO could also explain the INCOV.

The correlation coefficient matrix obtained is the following:

TABLE 5.2.14

THE EXPANDED INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY  
MODEL                      THE CORRELATION COEFFICIENT MATRIX

/.....

	LINCOV	LGNPCO	LPOPCO	LUMPCO
LINCOV	1.0000			
LGNPCO	0.38496	1.0000		
LPOPCO	- 0.19833	0.16271	1.0000	
LUMPCO	0.4024	0.54342	0.13553	1.0000

Where:

LUMPCO = Log (UMPCO)

Other variables are as defined earlier

The new variable has the largest correlation coefficient with the dependent variable. And indeed the step-wise regression first incorporated this variable in the analysis. The second and the third variables to be incorporated were LPOPCO and LGNPCO respectively. The following regression results were obtained:

TABLE 5.2.15

THE EXPANDED INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY  
MODEL

THE REGRESSION RESULTS

$$\text{LINCOV} = - 0.3674 + 0.0677 \text{ LUMPCO} - 0.1213 \text{ LPOPCO} + 0.0595 \text{ LGNPCO}$$

(1.192)                      (1.35)                      (1.10)

Multiple R = 0.528     $R^2 = 0.2784$      $\bar{R}^2 = 0.1511$     SER = 0.056

F(3/17) = 2.19                      DW = 1.0024

This model is worse than the earlier one. Now none of the slope coefficients are significant. The explanatory power has not improved much. The only statistic that has improved is the Durbin-Watson statistic. The

/....

positive first order serial correlation has now been eliminated.

The new model had to be constructed. The new model dropped LPOPCO from the analysis. This was because the slope coefficient for LPOPCO is negative contrary to the hypothesis.

The new reduced model was estimated and the following results were obtained:

TABLE 5.2.16

<u>MODEL</u>	<u>THE REGRESSION RESULTS</u>
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$$\text{LINCON} = - 0.2592 + 0.0633 \text{ LUMPCO} + 0.052 \text{ LGNPCO}$$

(1.092)                      (0.940)

Multiple R = 0.4485     $R^2 = 0.2812$      $\bar{R}^2 = 0.1124$     SER = 0.057

F(2/18)      = 2.266              DW = 0.8392

This model is also very unsatisfactory. None of the slope coefficients are significant. The explanatory power of the model is still unsatisfactory. Therefore a new model dropping both the original explanatory variables was constructed.

The new model's two explanatory variables are unemployment rate coefficient of variation (UMPCO) and annual average crime coefficient of variation (ACVCO). When the model was estimated the following correlation coefficient matrix was obtained;

/.....



TABLE 5.2.17THE NEW INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITYMODELTHE CORRELATION COEFFICIENT MATRIX

	LINCOV	LACRCO	LUMPCO
LINCOV	1.0000		
LACRCO	0.07598	1.0000	
LUMPCO	0.3215	- 0.66164	1.0000

Where:

LACRCO = Log (ACRCO)

Other variables are as defined earlier.

There is now no negative correlation coefficient between the dependent variable and each of the two explanatory variables. As before the highest positive correlation coefficient is between the LINCOV and LUMPCO.

The step-wise regression procedure first incorporated the LUMPCO into the analysis and later the LACRCO was included. The following regression results were obtained:

TABLE 5.2.18THE NEW INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITYMODELTHE REGRESSION RESULTS

$$\text{LINCOV} = - 0.19395 + 0.0935 \text{ LUMPCO} + 0.06791 \text{ LACRCO}$$

(2.4313)\*                      (1.8881)\*

$$\text{Multiple } R = 0.5016 \quad R^2 = 0.2516 \quad \bar{R}^2 = 0.1684 \quad \text{SER} = 0.06$$

$$F(2/18) = 3.0249 \quad DW = 1.129$$

/.....

This model is better than the last one. Here both slope coefficients are significant. The Durbin-Watson statistic now indicates that positive first order serial correlation is absent from the model. Although the explanatory power is still low we accept this model and the conclusions should be based on this analysis.

#### 5.2.4 THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

It was hypothesized that the Rural development public recurrent expenditure to GNP ratio coefficient of variation (RUDCO) is a positive function of GNPCO and POPCO. The RUDCO has averaged about 0.4094 with a standard deviation of 0.2288. While the means and standard deviations for the two explanatory variables are as given earlier.

The correlation coefficients for this model are given below:

TABLE 5.2.19

#### THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY MODEL THE CORRELATION COEFFICIENT MATRIX

	LRUDCO	LGNPCCO	LPOPCO
LRUDCO	1.0000		
LGNPCCO	- 0.15741	1.0000	
LPOPCO	0.11273	0.16279	1.0000

Where:

LRUDCO = Log (RUDCO)

Other variables are as defined earlier.

The correlation coefficient between LRUDCO and LGNPCCO is unexpectedly negative. The two variables fluctuate in the opposite direction. This



is because this sector is largely foreign-financed. Thus even if the economic conditions at home are bad, the sector is able to obtain foreign funds and thus the ratio expands.

The step-wise regression procedure first picked the LGNPCO explanatory variable and lastly the LPOPCO was picked. The regression results were:

TABLE 5.2.20

THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE REGRESSION RESULTS

---


$$\text{LRUDCO} = - 0.263 - 0.1495 \text{ LGNPCO} + 0.2308 \text{ LPOPCO}$$

(0.7733)                      (0.6083)

$$\text{Multiple R} = 0.211 \quad R^2 = 0.044 \quad \bar{R}^2 = - 0.062 \quad \text{SER} = 0.24$$

$$F(2/18) = 0.42 \quad \text{DW} = 0.713$$


---

The two slopes are insignificant and the model's explanatory power is very low. This is an unsatisfactory model. A new expanded model had to be constructed.

This expanded model included the copper price coefficient of variation (COPCO) as the third explanatory variable. When the model was estimated the following correlation coefficient matrix was obtained:

TABLE 5.2.21

THE EXPANDED RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY MODEL  
THE CORRELATION COEFFICIENT MATRIX

/.....

	LRUDCO	LGNPCO	LCOPCO	LPOPCO
LRUDCO	1.0000			
LGNPCO	- 0.53659	1.0000		
LCOPCO	0.20880	0.29495	1.0000	
LPOPCO	- 0.61052	0.77604	- 0.24768	1.0000

Where:

LCOPCO = Log (COPCO)

Other variables are as defined earlier.

The new variable is associated with positive correlation coefficients and this is as expected.

The step-wise regression procedure this time picked the variables in the following order:

(a) LPOPCO (b) LGNPCO (c) LCOPCO

And the following regression results were obtained:

TABLE 5.2.22

THE EXPANDED RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY  
MODEL

THE REGRESSION RESULTS

$$LRUDCO = - 0.673 + 0.0105 LPOPCO + 0.3332 LGNPCO + 0.167 LCOPCO$$

(0.032)                      (1.34)                      (1.3)

Multiple R = 0.65990     $R^2 = 0.43554$      $\bar{R}^2 = 0.386$     SER = 0.186

F(3/17)    = 4.37\*                      DW = 1.8593



This model is better than that in table 5.2.20 above. The regression is now significant. The Durbin-Watson statistic now indicates the absence of positive first order serial correlation. However, the slope coefficients are insignificant. This might be due to multicollinearity in the model. The LPOPCO was dropped from the model because it had the least slope coefficient. This was done to improve the regression results.

This new model was estimated and the following regression results were obtained:

TABLE 5.2.23

THE NEW RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY  
MODEL

THE REGRESSION RESULTS

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$$\text{LRUDCO} = - 0.67 - 0.3413 \text{ LGNPCO} + 0.171 \text{ LCOPCO}$$

(3.53)\*\*                      (2.17)\*

$$\text{Multiple R} = 0.65992 \quad R^2 = 0.43550 \quad \bar{R}^2 = 0.373 \quad \text{SFR} = 0.1812$$

$$F(2/18) = 6.943^{**} \quad \text{DW} = 1.853$$


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This model is satisfactory. The slope coefficients are now significant. The conclusions will be based on this model.

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CHAPTER SIXCONCLUSIONS AND RECOMMENDATIONS6.0. THE GENERAL LAYOUT

This chapter is divided into two broad sections. The first section deals with all the expenditure models plus the centralisation model. The expenditure models are in their turn divided into sub-sections. The first sub-section deals with the simple aggregate public recurrent expenditure model. This is followed by the aggregate public recurrent expenditure model. Then the functional level public recurrent expenditure models in the following order will be presented: (a) Health (b) Education (c) Internal security and (d) Rural development. In each sub-section the conclusions and recommendations pertaining to these expenditure models will be presented. The last sub-section in this section will be the centralisation model. Here again the conclusions and recommendations will be presented.

The second section of this chapter is on the stability models. This section is also divided into sub-sections. This first sub-section deals with the conclusions and recommendations pertaining to the aggregate public recurrent expenditure stability model. The sub-sections that follow present the functional level stability models. The order of presentation is as given in expenditure models.

6.1. THE SIMPLE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL

This model was an attempt to establish a causal functional relationship between the aggregate public recurrent expenditure to GNP ratio and the GNP per capita.

The specific causal functional relationship that was tested was that the aggregate public recurrent expenditure to GNP ratio was a function of the GNP per capita. The GNP per capita here is employed as the index of development. This means the aggregate public recurrent expenditure to GNP ratio will increase in response to increases in the level of development as measured by the GNP per capita. This is the way the law of public expenditures advanced by Wagner has been interpreted.

When the model was subjected to statistical and econometric tests, the statistical criteria were fulfilled. The explanatory power and the slope coefficient were both significant. This confirms Wagner's law as interpreted by many scholars. The GNP per capita is indeed an index of development. Since the aggregate public recurrent expenditure to GNP ratio was significantly explained by the GNP per capita, this tentatively confirms the hypothesis.

However, this model did not pass the econometric criteria test. The problem was the presence of first order positive serial correlation. The explanatory power and the slope coefficient were optimistically high. This problem was rectified by applying the method of generalized differencing. Although the regression line remained highly significant after the first order positive serial correlation was rectified, the explanatory power of the model drastically declined. This confirmed that the GNP per capita should not be the sole index of development - a point which has already been made in the economic development literature.

Development should be explained by a number of indicators. However, since the slope coefficient remained highly significant we may conclude that GNP per capita must always be included in the group of indicators that serve as the indices of development. This point is further emphasized when we consider the aggregate public recurrent expenditure model.

The elasticity measure also declined after the application of the method of generalized differencing. This true elasticity measure reflects the fact that the growth of aggregate public recurrent expenditure to GNP ratio (EAGGR) was not in line with the ability of the national economy to finance these aggregate public recurrent expenditures. As will be pointed out later in the chapter, the growth of the aggregate public recurrent expenditures has been more in response to need rather than ability to finance them. The problem of not matching need and ability is that the element of external financing becomes prominent and in times of a short-fall in external financing, internal suffering becomes inevitable. This brings discontent in society and the repercussions are always disastrous especially in the third world countries.

In the case of Zambia the aggregate public recurrent expenditure to GNP ratio must be expanded according to the expansion in the GNP per capita. The people must be taught that sacrifices must be made for the attainment of the contemplated standards of living. The EAGGR must expand in accordance with the ability of the national economy to tax the economic entities.

The significance of the regression line and the slope coefficient confirms the law of public expenditures advanced by Wagner as interpreted by many scholars. This invalidates George Hadjimatheou's point that the use of ordinary least square method leads to an upward bias of the estimated elasticity measure<sup>37</sup>. Through the application of the method of generalized differencing the problem can be rectified and there is no need to use the instrumental variable method. The estimated elasticity using the ordinary least square method after the application of the method of generalized differencing yields the desired results. These results pass the first order statistical and the second order econometric criteria tests.

## 6.2. THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL

The low explanatory power of the simple aggregate public recurrent expenditure model leads us to the conclusion that though the GNP capita is an important index of development it should not be the only one. Thus other indicators must be included to help explain the development of the FAGGR. The inclusion of many indicators of development is in accordance with Wagner's true interpretation of his law. Development to Wagner meant the development of cultured peoples. What he meant by the phrase "the development of cultured people" is not specifically interpreted in the public finance literature. However, one point is clear. To him development should be seen as a complex rounded term incorporating not only GNP per capita but also the social, economic and political aspects of development.

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<sup>37</sup> George Hadjimatheou op . cit pp 144-149

Indeed the other aspects of development must be included also. Therefore the following indicators were chosen to explain the variations in EAGGR: (a) GNP per capita, (b) economic reforms, (c) urbanisation rate and (d) population growth rate.

The step-wise regression picked the GNP per capita as the best indicator of development among these indicators listed above. We conclude therefore by re-emphasizing further the fact the GNP per capita though not the only indicator of development is an important one. Thus though we should not equate development represented by the EAGGR to the GNP per capita, this index is an important component part of the **totality** of ~~what~~ is called development.

The second variable to be picked was the dummy variable representing the economic reforms. This confirms the peoples' attitude towards reforms. The reforms are seen as the panacea of development problems. The high significance of the slope coefficient established this point as a fact. However, the elasticity measure is low indicating the relative inelastic nature of the EAGGR to the economic reforms. The reason is that the implementation of these economic reforms were not pursued vigorously. This is clearly described by Anthony Martin<sup>39</sup>. Had the economic reforms been pursued vigorously the EAGGR was going to be responsive to these reforms and the elasticity

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38 Anthony Martin, "Minding their own Business. Zambia's Struggle against western control" Penguin Books Harmondsworth Middle sex England 1975 pp 203-221.

value could have been larger. However, the significance of the slope coefficient indicates that the economic reforms were responsible for the structural break in the Zambian Economy. Therefore, these reforms were important and they should be implemented and supplemented further.

The third variable to be picked was urbanisation rate. The slope coefficient's sign was negative indicating the adverse nature of Zambia's urbanisation rate to development. As the urbanisation rate increases development declines. The large elasticity value indicates our responsiveness to gear the expenditures to our needs. Although the slope coefficient was insignificant even at five percent level of significance, Zambia's urbanisation rate must be checked. This again should be in accordance with the ability of the national economy to provide the necessities of life for the people who come to the urban centres. The neglect of this point means the urban-dwellers will subtract instead of supplementing the development efforts, as is the case now.

The last variable to be incorporated into the regression analysis was the population growth rate. The slope coefficient has a negative sign again indicating the adverse nature of this variable to the development efforts. Although the elasticity is low, the high population growth rate Zambia is experiencing means that the adverse effect is great. The population growth rate does not change easily and tends to remain at its high level. This implies that this variable has added serious adverse effects to development. Therefore all efforts must be made towards the reduction of the population growth rate.

These efforts must be made earlier since this variable does not change easily.

In general this has confirmed Wagner's law as we have empirically interpreted it. However this should not be treated as the only way the law should be interpreted. One can choose quite different indicators and try them, but one point should be clear: the GNP per capita should not be left out.

### 6.3. THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL

The health recurrent expenditure to GNP ratio (HPEX) was hypothesized to be a function of the GNP per capita, the urbanisation rate and the population growth rate. When the step-wise regression was applied to this model, the population growth rate was picked first as the best variable. The elasticity value is large implying that the HPEX is very responsive to changes in the population growth rate. Due to the negative sign of this slope coefficient this variable must be reduced and the earlier the better.

The second variable that was incorporated was the urbanisation rate. This has a positive slope coefficient as opposed to the negative slope coefficient this variable has in the aggregate public recurrent expenditure model. This means that urbanisation rate increases promote the health status of the people. This is not a contradiction but this reflects the nature of the health expenditures. As people crowd around the urban centres it becomes easy for the authorities to provide them with medical services.



And indeed even the elasticity measure confirms this point, the HPEX is highly elastic to the urbanisation rate. However, this should not mean that the urbanisation should be pushed anyhow like the earlier programme of village regrouping tried to do. It must be controlled and one way to do this is to match the urbanisation programme with the ability of the health authorities to provide the necessary medical facilities. Thus the urbanisation rate should be tied to the ability of the national economy to finance the health expenditures. Otherwise urbanisation process may be pursued so far as to become a burden as it is now in most third world countries including Zambia.

The last variable that was incorporated into the regression analysis was the GNP per capita. This emphasizes the earlier point that the expenditure development has been tilted more to the felt need than the ability to finance these expenditures. The positive slope coefficient confirms that the GNP per capita is a supply factor in as far as the health status of the people is concerned. The relatively low elasticity means that the HPEX is inelastic to the GNP per capita. And indeed this slope coefficient is insignificant even at five percent level of significance.

However because of the close correlation coefficient between the urbanisation rate and the GNP per capita, it was not easy to interpret the slope coefficients because of the problem of multicollinearity. Therefore, either the urbanisation rate or the GNP per capita had to be dropped from the analysis.

Two separate regression models were run, one excluding the urbanisation rate and the other excluding the GNP per capita. It was noticed that the regression model excluding the GNP per capita was better. This means that the HPEX is better explained by the demand factors. The two slope coefficients were high and significant.

The point to understand clearly here is that we do not call for reduction in the health public recurrent expenditure ratio (HPEX) but the matching of the increases in HPEX to the ability of the national economy to finance this sector. In as far as the model is concerned this confirms Wagner's law of public expenditures.

#### 6.4. THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL

This model had the educational public recurrent expenditure to GNP ratio (EAGGR) as the dependent variable. The explanatory variables were the GNP per capita, the percentage of the student population to the national population (PESPO) and the lagged economic growth rate (LAECG).

The step-wise regression picked the PESPO as the best explanatory variable. The need was the over-riding concern of the authorities when they were expanding the education public recurrent expenditures. This is again confirmed by the significant regression line. The slope coefficient is not only highly significant but it indicates that EAGGR is elastic to the changes in PESPO.

The education planners should take account of this point when planning future education public recurrent expenditures.

At the second step the lagged economic growth rate was incorporated into the regression analysis. Though the sign of the slope coefficient was unexpectedly negative, the absolute size was small. Thus the EAGGR is not responsive to this variable. The education public recurrent expenditure was expanded with very little regard to the need of the national economy for the skilled manpower. Unemployment was the obvious consequential result. Although it is better to have educated citizens even though they are unemployed, this brings educated discontent. We hope the current education reforms will help to rectify this problem.

The GNP per capita was the last variable to be incorporated into the regression analysis. The slope coefficient's sign was as expected. The GNP per capita is a booster of the EAGGR. The low slope coefficient indicates that EAGGR is not sensitive to the changes in the GNP per capita. This implies that the education public recurrent expenditures were not in accordance with the ability of the national economy to finance them. The element of external finance has then been the driving force of the expenditure expansion. The consequence is the problem of dependency. Without external financing teachers' salaries can not be paid and this brings social and political problems. It is better for Zambia to struggle on its own with the minimum of foreign financing, and, in this way have

an independent strategy of development.

In general a more balanced development of the education public recurrent expenditure in accordance with the explanatory variables is needed. Since this is already in accordance with PESCO, efforts should be directed to the realignment of the public education recurrent expenditures to the LAECG and the GNP per capita. This problem is real because the two elasticities are low.

This model has confirmed the hypothesis advanced above. Wagner's law of public expenditures has been again confirmed by the education public recurrent expenditure model. The model's regression results passed the first order statistical and the second order econometric criteria tests and therefore the model or hypothesis has been established.

#### 6.5. INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE MODEL

The adopted model established the hypothesis that the internal security public recurrent expenditure to GNP ratio (IPUEX) was the positive function of the annual average crime. The regression line was significant but the explanatory power was low. We conclude that there are other explanatory variables that can contribute to the explanation of the variations in the IPUEX. This is a very difficult model and the many explanatory variables that were tried bear witness to this point.

At the end the annual average crime explanatory variable was picked as the best among all the explanatory variables tried. The slope coefficient was positive and was interpreted to mean that if the annual average crime increases the IPUEx increases. This is to defend the self-esteem aspect of development. The slope coefficient indicates that IPUEx is elastic and highly significantly related to the annual average crime.

We conclude that the internal security public recurrent expenditure was geared to the annual average crime. However, since annual average crime is a function of the unemployment rate it is better to follow this chain reaction when planning these expenditures. As was pointed out earlier the annual average crime is highly elastic to the changes in the unemployment rate. Therefore the IPUEx can be regulated through the annual average crime by controlling the unemployment rate. The unemployment rate is the source of the adverse effect on the self-esteem aspect of development. To promote the self-esteem aspect of development unemployment rate must be brought down.

It is clear from the findings that the GNP per capita is not an important cause of the expansion in the IPUEx. The elasticity measure is low implying the insensitiveness of the IPUEx to the changes in the GNP per capita. This again emphasizes the overriding role of need in the determination of the levels of the internal security expenditures.

This demonstrates the fact that the self-esteem aspect of development has been over time threatened by discontent. And probably as we proceed in future Zambians will be increasingly denied this aspect of development. To safeguard against this, the policy should focus on the reduction of the unemployment rate.

#### 6.6. THE RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE MODEL

This model had as its dependent variable the rural development public recurrent expenditure to GNP ratio (RUDEX). The explanatory variables were the GNP per capita, copper prices and the previous year index of agricultural exports. The ratio, it was hypothesized, was a positive function of these three explanatory variables.

The step-wise regression picked the GNP per capita as the best in explaining the variations in the RUDEX. The regression line and slope coefficient were highly significant. The RUDEX is elastic to changes in the GNP per capita. The rural development public recurrent expenditure expansion was in accordance with the GNP per capita. This should continue.

At the second step the previous year index of agricultural export was incorporated into the regression analysis. Although the slope coefficient is significant the size is small.

Thus the external demand for Zambia's agricultural exports has not been an important driving force for the expansion of the rural development public recurrent expenditures. This is because Zambia exports very little agricultural commodities and instead imports large quantities of agricultural products. Zambia must therefore strive to satisfy her own food requirements first. Thereafter the expansion of the rural development expenditures must be in conformity with the previous year index of agricultural exports. Since Zambia is already exporting some agricultural products, it could be better to right away tie the expenditures to this index and later it could be easier to continue this when the country expands its exports.

The last explanatory variable to be incorporated was copper prices. Although the slope coefficient was insignificant its size is almost the same as that of the previous year index of agricultural export. The insignificance was due to the problem of multicollinearity. To solve this problem two separate regressions were run; the first excluding the GNP per capita and the second excluding the copper price variable. It was found that the slope coefficient for the copper price was significant and very elastic. This was as expected. However, the first model was inferior to the second model. Therefore, the second model was chosen as the better one. The explanatory power was large. This was adopted for the added reason that the slope coefficient for the previous year index of agricultural exports assumed the same size.

We conclude by saying that the RUDEX has been geared to the GNP per capita. This should continue.

In closing this section on the expenditure models, we can conclude that the RUDEX and the aggregate public recurrent expenditure to GNP ratio were geared to the GNP per capita. The health, education and internal security public recurrent expenditure to GNP ratios were better explained by the demand factors than the supply factors. We recommend therefore that all the expenditure categories should be linked to the ability of the national economy to finance these expenditures.

The significance of all the regressions and the slope coefficients confirms that the various models have been established. This confirmation of the hypotheses indicates the validity of Wagner's law of public expenditures.

#### 6.7. THE CENTRALISATION MODEL

The empirical results of this model were statistically insignificant at the five per cent level of significance. Both the multiplicative and ordinary centralisation models were tried. In both cases the empirical results were statistically insignificant. The explanatory power and the slope coefficients attained the "best linear unbiased efficient estimates" condition. Therefore inferences can be made about them.



The low explanatory power of the model and the insignificance of the slope coefficients indicates that there is no establishable relationship between the centralisation ratio (CENTR) and the GNP per capita and the population growth rate over this period. The insignificance of the slope coefficients and the regression are the reflection of the transition period from centralisation to decentralisation. This point can not be over-emphasized given the fact that policy implementation is a long and slow process. It takes a long time for the results of policy to be clearly noticed. This is known as the policy - effectiveness lag. This is the time which elapses before the decentralisation policy implemented takes effect. It has been found that the lag is usually long and variable in the developed countries despite their relatively efficient implementation tools; This lag is, therefore, likely to be longer and more variable in developing countries like Zambia. This is the reason why no clear-cut relationship was established and confirmed between the centralisation ratio and the two explanatory variables.

The high centralisation ratios over this period indicates that the status quo has been maintained. The calls for decentralisation have been heard but implementation has not been effective, at least not to the present. Knowing quite well the merits and demerits of decentralisation, the implementation of the policy of decentralisation must now be pursued with vigour. And to do so there is need to conduct more research in this area so that more light can be

thrown on this subject.

#### 6.8. THE AGGREGATE PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

It was hypothesized earlier that the aggregate public recurrent expenditure to GNP ratio coefficient of variation (APCOV) is a positive function of the GNP per capita coefficient of variation (GNPCO) and an inverse function of the population growth rate coefficient of variation (POPCO).

The step-wise regression picked GNPCO as a better explanatory variable than POPCO. However, the slope coefficient of the GNPCO is inelastic. Although the slope coefficient is small it is highly significant. The fact that it is significant follows directly from the aggregate public recurrent expenditure model.

At the second step the POPCO was incorporated into the analysis. The sign of the slope coefficient was negative. This means when the POPCO increases it reduces the APCOV. Thus the aggregate public recurrent expenditure to GNP ratio tends to be stationary or stable. The low elasticity indicates the insensitiveness of the APCOV to changes in the POPCO.

For the reasons of the low and insignificant slope coefficient of the POPCO this variable was dropped from the model. A two variable model was constructed. The slope coefficient of the GNPCO though not high was highly significant.

Since the APCOV is our policy variable this should be monitored closely. The higher the APCOV the more options there are that are open to the decision makers. Therefore the aggregate public recurrent expenditures may be easily altered in the manner the decision makers want them to be if the APCOV is high. Since we found out that the GNPCO promotes the APCOV this variable must be used as a lever by decision makers when determining the volume of the aggregate public recurrent expenditure for any fiscal year.

#### 6.9. HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

This functional level stability model has the health public recurrent expenditure to GNP ratio coefficient of variation (HECOV) as its dependent variable. The two explanatory variables were the GNP per capita coefficient of variation (GNPCO) and the population growth rate coefficient of variation (POPCO). In the first model that was run on the computer two slope coefficients were highly significant and elasticities indicated the great sensitivity of the HECOV to changes in the GNPCO and the POPCO. However, the model had to be abandoned due to the presence of first order positive serial correlation.

The necessary correction for the first order positive serial correlation was done by applying the method of generalized differencing. This new model was run on the computer. POPCO was picked as the better explanatory variable than GNPCO.

The slope coefficient was greater than unity. Thus the HECOV is elastic to changes in the popco. The slope coefficient was highly significant.

At the second step the GNPCO was incorporated into the regression analysis. The slope coefficient was negative and insignificant. Its low size indicates the insensitivity of the HECOV to changes in the GNPCO. However, the source of this low absolute size and insignificant slope coefficient was the multicollinearity problem in the model. To rectify this problem the GNPCO was dropped from the model.

In the two variable model the POPCO'S slope coefficient remained significant. Therefore we conclude that the determinant of the changes in the HECOV is the POPCO. The policy makers must therefore monitor this variable when determining the volume of the health public recurrent expenditures.

## 6.10

### EDUCATION PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

This model has the education public recurrent expenditure to GNP ratio coefficient of variation (EDUCO) as its dependent variable. There are two explanatory variables. These are the GNP per capita coefficient of variation (GNPCO) and the population growth rate coefficient of variation (POPCO).

The GNPCO performed better than the ~~POPCO~~ in the explanation of the variation in the EDUCO. The estimated slope coefficient for this variable and the regression line were both highly significant. The size of the slope coefficient indicated the high sensitiveness of the EDUCO to changes in the GNPCO. The elasticity value is elastic.

At the second step the ~~POPCO~~ was incorporated into the regression analysis. The GNPCO slope coefficient continued to be high and very significant. However the slope coefficient of the ~~POPCO~~ was low and insignificant. This indicates the insensitiveness of the EDUCO to changes in the ~~POPCO~~. The elasticity measure was very close to zero. This is surprising since this sector is geared to the promotion of the people's welfare. It was expected that the relative growth of the education public recurrent expenditure would be in accordance with the variations in the population growth rate. To rectify this unexpected anomaly another population variable was incorporated into the model. The new variable is the percentage of total student population to national population coefficient of variation (PESCO).

Again the first variable to be incorporated into the regression analysis was the GNPCO and then the PESCO was incorporated. The two slope coefficients were both highly significant. However, the elasticity of the EDUCO with respect to GNPCO reduced drastically.

Therefore, we may conclude that the determinants of the variations in the EDUCO are the GNPCO and the PESCO. The policy makers must closely watch these two variables when determining the volume and changes in the volume of the education public recurrent expenditures.

#### 6.11. INTERNAL SECURITY PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

This model's dependent variable was the internal security public recurrent expenditure to GNP ratio coefficient of variation (INCOV). The two explanatory variables tried were the GNP per capita coefficient of variation (GNPCO) and the population growth rate coefficient of variation (POPCO). The two slope coefficients and the regression were all insignificant. The model had to be abandoned and a new one was constructed.

The new model was actually an expanded version of the previous one. A new explanatory variable was incorporated. The new explanatory variable was the unemployment rate coefficient of variation (UMPCO). However, due to insignificance of the slope coefficients and the regression, the model had to be abandoned. Various models were tried in the last chapter.

However, the established model had the INCOV as its dependent variable. The two explanatory variables were the UMPCO and the annual average crime rate coefficient of variation (ACRCO). The UMPCO was better than the ACRCO in explaining the variations in the INCOV.

The UMPCO's slope coefficient though low was significant.

At the second step the ACRCO was incorporated into the analysis. The slope coefficient was also significant. We concluded that the determinants of the variations in the INCOV are the UMPCO and the ACRCO. These two explanatory variables therefore determine the range of options open to policy makers when determining the volume of the internal security public recurrent expenditures. Therefore the variations of the UMPCO and the ACRCO must be increased. And this will increase the variation of the INCOV and thereby enlarging the range of options open to the policy makers in determining the volume of this expenditure category.

#### 6.12 RURAL DEVELOPMENT PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

This model's dependent variable was the rural development public recurrent expenditure to GNP ratio coefficient of variation (RUDCO). The explanatory variables tried were the GNP per capita coefficient of variation (GNPCO), the population growth rate coefficient of variation (POPCO) and the copper price coefficient of variation (COPCO).

The explanatory variables for the established model were the GNPCO and the COPCO. The GNPCO was better than the COPCO in explaining the variations in the RUDCO. The GNPCO has an adverse effect on the RUDCO. However, the absolute size of the elasticity is small. As the GNPCO increases the RUDCO decreases.

This implies that the range of options open to decision makers is narrowed. This is an adverse effect and more especially in Zambia where policy options are already few.

The slope coefficient of COPCO is positive. This is a booster to the RUDCO. This widens the range of options when determining the volume of rural development public recurrent expenditures. The GNPCO and the COPCO must be monitored to check deviations from the policy objectives.

We conclude that the education public recurrent expenditure to GNP ratio is difficult to alter because the EDUCO has the lowest mean. There are very few options when changing these expenditures. This expenditure category is followed by the aggregate public recurrent expenditures. The mean of the APCOV was also low. This implies that it is hard to change the expenditures as a whole. The easiest expenditures to change are the internal security public recurrent expenditures. These are followed by the health public recurrent expenditures and then the rural development public recurrent expenditures. Therefore if policy makers want to alter the levels of public recurrent expenditures they are relatively free to change firstly the internal security public recurrent expenditures. Then follow this order: (a) Health (b) rural development and (c) education public recurrent expenditures.

In general we conclude that the expansion of the aggregate public recurrent expenditure to GNP ratio and



the four functional level expenditure ratios must be in accordance with the ability of the national economy to finance these expenditures. We suggest that one way of doing this is income redistribution. The reason for this is that income redistribution lessens inequality in society. With lessened inequality the demand for social services will be easily met by realignment of the expenditure to the supply factors. And even the ratios might be stabilized easily. However, more light should be thrown in this subject by conducting more research.

APPENDIX ITHE SIMPLE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODELTHE THEIL-NAGAR FORMULA TO ESTIMATE THE  
SERIAL CORRELATION COEFFICIENT (  $\hat{\rho}$  ).

$$\hat{\rho} = \frac{N^2(1 - \frac{dw}{2}) + K^2}{N^2 - K^2}$$

Where:

$\hat{\rho}$  = Serial correlation coefficient estimate

N = Number of observations

dw = Durbin-Watson statistic

K = Number of explanatory variables plus the constant term.

Therefore for this model

$$\hat{\rho} = \frac{23^2 (1 - \frac{0.57492}{2}) + 2^2}{23^2 - 2^2}$$

$$= \frac{529 (1 - 0.28746) + 4}{529 - 4}$$

$$= \frac{529 (0.71254) + 4}{525}$$

$$= \frac{376.93366 + 4}{525}$$

$$= \frac{380.93366}{525}$$

$$= \underline{\underline{0.7255879}}$$

/.....

The estimated serial correlation coefficient was used to transform the data. For the first observation of the dependent and the explanatory variable the following formula was used.

$$Y_1^* = 1 - \hat{\xi}^2 Y_1$$

Where

$Y_1^*$  = The first observation of the dependent or explanatory variable corrected for serial correlation.

$\hat{\xi}$  = Serial correlation coefficient estimate

$Y_1$  = The first observation of the dependent or the explanatory variable not corrected for serial correlation.

For the observations that follow the following formula was used to correct for serial correlation,

$$Y_t^* = Y_t - \hat{\xi} Y_{t-1}$$

Where

$Y_t^*$  = The observation of the dependent or explanatory variable corrected for serial correlation.

$Y_t$  = The observation of the dependent or explanatory variable at period t not corrected for serial correlation.

$Y_{t-1}$  = The observation of the dependent or explanatory variable at period t-1 not corrected for serial correlation.

/.....

When the transformation was done, the data corrected for first order positive serial correlation was the following:

YEAR	EAGGR	GNPPER
1960	-0.96271	1.53507
1961	-0.66192	0.58959
1962	-0.72747	0.48298
1963	-0.76509	0.62659
1964	-0.51697	0.58603
1965	-0.48949	0.64983
1966	-0.65715	0.68266
1967	-0.50273	0.67503
1968	-0.59447	0.71893
1969	-0.70623	0.72843
1970	-0.65749	0.67523
1971	-0.81770	0.63073
1972	-0.83074	0.69954
1973	-0.71523	0.74815
1974	-0.72824	0.73306
1975	-0.52863	0.63597
1976	-0.81431	0.76151
1977	-0.69254	0.69605
1978	-0.78718	0.74296
1979	-0.70993	0.771847
1980	-0.65022	0.77722
1981	-0.67011	0.74861
1982	-0.80888	0.75644

Where:

E AGGR = Log (Aggregate public recurrent expenditure to GNP ratio).

GNP PER = Log (gross National Product per capita)

THE HEALTH PUBLIC RECURRENT EXPENDITURE STABILITY MODEL

THE THEIL-NAGAR FORMULA TO ESTIMATE THE  
SERIAL CORRELATION COEFFICIENT ( $\hat{\rho}$ )

$$\hat{\rho} = \frac{N^2 \left(1 - \frac{dw}{2}\right) + K^2}{N^2 - K^2}$$

The terms as defined before.

Therefore

$$\begin{aligned} \hat{\rho} &= \frac{21^2 \left(1 - \frac{0.55507}{2}\right) + 3^2}{21^2 - 3^2} \\ &= \frac{441(1 - 0.277535) + 9}{441 - 9} \\ &= \frac{441(0.722465) + 9}{432} \\ &= \frac{318.60706 + 9}{432} \\ &= \frac{327.60706}{432} \\ &= \underline{\underline{0.7583496}} \end{aligned}$$

Following the same transformation procedure as before the following data corrected for first order positive serial correlation were obtained:

/.....

YFAR	HECOV	POPCO	GNPCO
1961	-0.85628	-0.94265	-0.98769
1962	0.83541	0.33958	0.23270
1963	-0.09684	-0.22509	-0.23458
1964	-0.09924	-0.22352	-0.24115
1965	-0.01690	-0.19043	-0.21584
1966	-0.09571	-0.22564	-0.12186
1967	-0.08534	-0.23081	-0.11186
1968	-0.09819	-0.23427	-0.06617
1969	-0.09286	-0.23752	-0.05893
1970	-0.09819	-0.24095	-0.09801
1971	-0.09489	-0.24080	-0.13196
1972	-0.06562	-0.24371	-0.12685
1973	-0.09223	-0.23332	-0.10375
1974	-0.09558	-0.24628	-0.10201
1975	-0.09681	-0.25057	-0.11707
1976	-0.10249	-0.25311	-0.10621
1977	-0.10444	-0.25564	-0.11287
1978	-0.09826	-0.25608	-0.10568
1979	-0.10492	-0.25817	-0.09087
1980	-0.10848	-0.26012	-0.07964
1981	-0.10869	-0.25822	-0.08386.

Where

HECOU = log (Health public recurrent expenditure to GNP ratio  
coefficient of variation).

POPCO = log (population growth rate coefficient of variation)

GNPCO = log (Gross National Product per Capita Coefficient of  
Variation).

APPENDIX II

THE AGGREGATE PUBLIC RECURRENT EXPENDITURE MODEL  
 YOEL HAITOVSKY TEST TO CHECK FOR SEVERITY OF THE  
 MULTICOLLINEARITY PROBLEM

If

$$\frac{r_{12.3.....K}}{R_y} > 1$$

Multicollinearity is severe.

Where:

$r_{12.3.....K}$  = Partial correlation coefficient between the first and the second explanatory variables controlling or holding the rest constant.

$R_y$  = Coefficient of Multiple determination.

Partial Correlation Coefficients (controlling for LGNP & LPOP)

LURBAN 0.1784

with DF = 19

DUMMY SIG = 0.220

$$\frac{r_{\text{LURBAN, DUMMY . LGNP, LPOP}}}{R_{\text{TAGGR, LGNP, LPOP, LURBAN, DUMMY}}} = \frac{0.1784}{0.91833} = 0.1942656$$

$0.1942656 < 1 \implies$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LGNP & LURBAN)

LPOP 0.1302

With DF = 19

DUMMY SIG = 0.287

$$\frac{r_{\text{LPOP, DUMMY, LGNP \& LURBAN}}}{R_{\text{FAGGR, LGNP, LPOP, LURBAN, DUMMY}}} = \frac{0.1302}{0.91833} = 0.141779$$

$0.141779 < 1 \implies$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LPOP & LURBAN)

LGNP 0.2039

With DF = 19

DUMMY SIG = 0.188

$$\frac{r_{\text{LGNP, DUMMY, LPOP, LURBAN}}}{R_{\text{FAGGR, LGNP, DUMMY, LPOP, LURBAN}}} = \frac{0.2039}{0.91833} = 0.2220334$$

$0.2220334 < 1 \implies$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LGNP & DUMMY)

LPOP -0.0130

With DF = 19

LURBAN SIG = 0.478

$$\frac{r_{\text{LPOP, LURBAN, LGNP \& DUMMY}}}{R_{\text{FAGGR, LGNP, DUMMY, LPOP, LURBAN}}} = \frac{-0.0130}{0.91833} = -0.0141561$$

$-0.0141561 < 1 \implies$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LPOP, DUMMY)

LGNP 0.9041

With DF = 19

LURBAN SIG = 0.001

$$\frac{r_{\text{LGNP, LURBAN, LPOP, DUMMY}}}{R_{\text{FAGGR, LGNP, LURBAN, LPOP, DUMMY}}} = \frac{0.9041}{0.91833} = 0.9845044$$

$0.9845044 < 1 \implies$  Multicollinearity is not severe.



THE EDUCATION PUBLIC RECURRENT EXPENDITURE MODEL  
 YOEL HAITOVSKY TEST TO CHECK FOR THE SEVERITY OF  
 THE MULTICOLLINEARITY PROBLEM

If

$$\frac{r_{12.3....K}}{R_y} > 1$$

Multicollinearity is severe

Where:

$r_{12.3....K}$  = partial correlation coefficient between the first and  
 the second explanatory variables controlling or holding  
 the others constant.

$R_y$  = Coefficient of multiple determination.

Partial correlation coefficient (controlling for LPESPO

LGNP 0.0628

With DF = 20

LLAECG SIG = 0.591

$$\frac{r_{LGNP, LLAECG, LPESPO}}{R_{FAGGR, LGNP, LLAECG, LPESPO}} = \frac{0.0628}{0.93871} = 0.0669003$$

0.0669003 < 1  $\Longrightarrow$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LLAECG

LPESPO 0.8711

With DF = 20

LGNP SIG= 0.001

$$\frac{r_{\text{LPESPO, LGNP} \cdot \text{LLAECG}}}{R_{\text{EAGGR, LGNP, LLAECG, LPESPO}}} = \frac{0.8711}{0.93871} = 0.9279756$$

0.9279756 < 1  $\implies$  Multicollinearity is not severe.

Partial correlation coefficient (controlling for LGNP)

LPESPO 0.1244

With DF = 20

LLAECG SIG = 0.291

$$\frac{r_{\text{LPESPO, LLAECG} \cdot \text{LGNP}}}{R_{\text{EAGGR, LPESPO, LLAECG, LGNP}}} = \frac{0.1244}{0.93871} = 0.1325222$$

0.1325222 < 1  $\implies$  Multicollinearity is not severe.

THE HEALTH PUBLIC RECURRENT EXPENDITURE MODEL  
 YOEL HAITOVSKY TEST TO CHECK FOR THE SEVERITY  
 OF THE MULTICOLLINEARITY PROBLEM.

If

$$\frac{r_{12,3,\dots,K}}{R_y} > 1$$

Multicollinearity is severe.

Where:

$R_y$  = Coefficient of Multiple determination.

$r_{12,3,\dots,K}$  = Partial Correlation Coefficient between the first and  
the second explanatory variable holding others constant.

Partial correlation coefficient (controlling for LGNP)

LPCP 0.0136

With DE = 20

Lurban Sig = 0.476

$$\frac{r_{LPOP, Lurban, LGNP}}{R_{HPEX, LGNP, LURBAN, LPOP}} = \frac{0.0136}{0.92040} = 0.0147761$$

$0.0147761 < 1 \implies$  Multicollinearity is not severe.

Partial Correlation Coefficient (controlling for LPOP)

$r_{Lurban, LGNP, LPOP}$  LGNP 0.9762

$R_{HPEX, LURBAN, LGNP, LPOP}$  With DF = 20

LURBAN SIG = 0.001

$$= \frac{0.976}{0.92040} = 1.0606258$$

/.....

$1.0606258 > 1 \implies$  Multicollinearity is severe

Partial Correlation Coefficient (controlling for Lurban)

LPOP 0.0829

With DF = 20

LGNP SIG = 0.357

$$\frac{r_{LPOP, LGNP \cdot LURBAN}}{r_{HPEX \cdot LGNP, LPOP, LURBAN}} = \frac{0.0829}{0.92040} = 0.0900695$$

$0.0900695 < 1 \implies$  Multicollinearity is not severe.

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