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CONSUMER SERVICE EXPENDITURE
AND ECONOMIC DEVELOPMENT:
A CROSS-COUNTRY STUDY

by: G.C. Arnold, B.Sc.(Econ)

A Doctoral Thesis submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University of Technology

Date: February 1991

Supervisor: Professor C.R. Milner, B.A., M.A.
Department of Economics

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ABSTRACT

The influence of income levels on the demand for consumer services is examined. For twenty-six categories of services income elasticities are established. Also the influence of price and other variables, on the quantity demanded of a consumer service are investigated. The primary aim is to determine whether the relationship between income and consumer service demand is consistent across a range of countries. This enables some comments to be made on the "post-industrial society" hypothesis which suggests that the advanced economies experience a particularly high income elasticity for the consumer service sector - thus a greater proportion of resources are devoted to this area as a result of demand influences. The results of the cross-section empirical analysis, based on data derived for thirty-four countries on an internationally comparable basis, suggest that the consumer service sector as a whole exhibits a relatively low income elasticity when compared with durable goods. However this sector is a heterogeneous group and the thesis shows a wide variety of responses when a disaggregated analysis is undertaken. A number of functional forms are used for each service in ordinary least squares multiple regression, which permit a variety of hypotheses regarding the behaviour of income elasticity at different income levels to be tested. The countries used in the analysis varied greatly in their traditions, geography and so on and yet relatively consistent relationships between income and consumer service demand are shown.

(1)
Acknowledgements

The author is extremely grateful for the invaluable advice and guidance given by his supervisor, Professor C.R. Milner. His support and friendly interest was matched by many members of staff in the Department of Economics at Loughborough.
<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents Page</td>
<td>(iii)</td>
</tr>
<tr>
<td>Chapter Contents</td>
<td>(iv-vi)</td>
</tr>
<tr>
<td>List of Tables</td>
<td>(vii-xv)</td>
</tr>
<tr>
<td>List of Figures</td>
<td>(xvi-xx)</td>
</tr>
<tr>
<td>Chapter One</td>
<td>1-13</td>
</tr>
<tr>
<td>Chapter Two</td>
<td>14-29</td>
</tr>
<tr>
<td>Chapter Three</td>
<td>30-63</td>
</tr>
<tr>
<td>Chapter Four</td>
<td>64-79</td>
</tr>
<tr>
<td>Chapter Five</td>
<td>80-89</td>
</tr>
<tr>
<td>Chapter Six</td>
<td>90-111</td>
</tr>
<tr>
<td>Chapter Seven</td>
<td>112-264</td>
</tr>
<tr>
<td>Chapter Eight</td>
<td>265-311</td>
</tr>
<tr>
<td>Chapter Nine</td>
<td>312-337</td>
</tr>
<tr>
<td>Chapter Ten</td>
<td>338-345</td>
</tr>
<tr>
<td>References</td>
<td>349-352</td>
</tr>
</tbody>
</table>
# Chapter Contents

## CHAPTER ONE  INTRODUCTION

1.1 Background  
1.2 The Aims of the Research  
1.3 Elaboration of Aims  
1.4 Defining Services  
1.5 Content  

## CHAPTER TWO  THE POST-INDUSTRIAL SOCIETY DEBATE

2.1 Introduction  
2.2 Demand Factors and the Service Share of G.D.P.  
2.3 Empirical Work on the Demand for Consumer Services  
2.4 Conclusions  

## CHAPTER THREE  A REVIEW OF THE LITERATURE ON DEMAND ANALYSIS

3.1 Introduction  
3.2 Pre-War Empirical Demand Analysis  
3.3 Post-War Empirical Demand Analysis  
3.4 The Expenditure Systems Approach  
3.5 The International Comparison Project  
3.6 Conclusions  

APPENDIX: The Linear Expenditure System  

## CHAPTER FOUR  THE INTERNATIONAL COMPARISON PROJECT

4.1 Background and Purpose of the International Comparison Project  
4.2 Outline of Method  

4.3 Some Details of the International Comparison Project Method

4.4 Limitations of the International Comparison Project

4.5 Conclusions

CHAPTER FIVE  EMPIRICAL METHODOLOGY

5.1 Introduction

5.2 The Selection of Appropriate Income and Own-Price Variables

5.3 Functional Form

5.4 Additional Variables

5.5 Overall Elasticity Estimates

5.6 Limitations of the Study

5.7 Conclusions

CHAPTER SIX  INCOME AND PRICE MEASURES

6.1 Introduction

6.2 Theoretical Considerations

6.3 Method of Statistical Testing

6.4 Notes on Table 6.1

6.5 The Results

6.6 Conclusions

APPENDIX: Converting Total Consumption Expenditure Elasticity to Income Elasticity

CHAPTER SEVEN  FUNCTIONAL FORM RESULTS

7.1 Introduction

7.2 Functional Forms in Applied Demand Analysis

7.3 Results for this Study

7.4 Some Examples Drawn from the Detailed Results
CHAPTER EIGHT  ADDITIONAL VARIABLES

8.1 Introduction  265
8.2 Method  267
8.3 A Result Highlighted - Postal Communications  268
8.4 Summary Presentation of the Results  271
8.5 Conclusions  274
APPENDIX 8.1: Data Sources  276
APPENDIX 8.2: Detailed Results  284

CHAPTER NINE  AN OVERALL ELASTICITY FOR THE SERVICE SECTOR

9.1 Introduction  312
9.2 The Calculation of Overall Elasticities  313
9.3 Other Income Elasticity Evidence  322
9.4 Conclusions  330
APPENDIX 9.1: Separating the Observations into High and Low Income Groups  332

CHAPTER TEN  CONCLUSIONS AND IMPLICATIONS

10.1 Post-Industrial Society - The Role of Consumer Service Demand  338
10.2 How Consumer Service Demand Changes  341
10.3 Range of Countries  341
10.4 Disaggregates  345
10.5 Additional Variables  347
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Percent Distribution of Employment Between the Goods- and Service-Producing Sectors for the United States, Selected Years, 1959-81</td>
<td>3</td>
</tr>
<tr>
<td>1.2</td>
<td>Persons in Employment by Sector of Activity for the European Community Countries, 1987</td>
<td>4</td>
</tr>
<tr>
<td>1.3</td>
<td>International Comparisons of Output and Employment, Percentage Distributions among Agriculture, Goods and Services for Some OECD Economies</td>
<td>5</td>
</tr>
<tr>
<td>4.1</td>
<td>Purchasing Power Parities for Fresh Vegetables</td>
<td>72</td>
</tr>
<tr>
<td>6.1</td>
<td>Testing Combinations of Income and Price Measures</td>
<td>96–104</td>
</tr>
<tr>
<td>7.1</td>
<td>Functional Forms with the lowest error sum of squares, or for which the error sum of squares is not statistically different from the lowest</td>
<td>127</td>
</tr>
<tr>
<td>Table Title</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.01(a) Barbers, Beauty Shops. The Parameters, t-Values and Error</td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>Sum of Squares Given by the Five Functional Forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.01(b) Barbers, Beauty Shops. d-Statistics To Test Whether Two</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>Functions are Empirically Equivalent based on Differences in SSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.01(c) Barbers, Beauty Shops. Elasticity Estimates</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.02(a) Clothing Rental and Repair. The Parameters, t-Values and</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Error Sum of Squares Given by the Five Functional Forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.02(b) Clothing Rental and Repair. d-Statistics To Test Whether</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.02(c) Clothing Rental and Repair. Elasticity Estimates</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.03(a) Household Services. The Parameters, t-Values and Error</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>Sum of Squares Given by the Five Functional Forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.03(b) Household Services. d-Statistics To Test Whether Two</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>Functions are Empirically Equivalent based on Differences in SSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.03(c) Household Services. Elasticity Estimates</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.04(a) Electricity. The Parameters, t-Values and Error Sum of</td>
<td>152</td>
<td></td>
</tr>
<tr>
<td>Squares Given by the Five Functional Forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.04(b) Electricity. d-Statistics To Test Whether Two Functions</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>are Empirically Equivalent based on Differences in SSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 7.7.04(c) Electricity Elasticity Estimates</td>
<td>153</td>
<td></td>
</tr>
</tbody>
</table>

(viii)
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.7.05(a)</td>
<td>Local Transport. The Parameters, t-Values and Error Sum of Squares Given by the Functional Forms</td>
<td>157</td>
</tr>
<tr>
<td>7.7.05(b)</td>
<td>Local Transport. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>158</td>
</tr>
<tr>
<td>7.7.05(c)</td>
<td>Local Transport. Elasticity Estimates</td>
<td>158</td>
</tr>
<tr>
<td>7.7.06(a)</td>
<td>Bus Transport. The Parameters, t-Values and Error Sum of Squares Given by the Functional Forms</td>
<td>162</td>
</tr>
<tr>
<td>7.7.06(b)</td>
<td>Bus Transport. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>163</td>
</tr>
<tr>
<td>7.7.06(c)</td>
<td>Bus Transport. Elasticity Estimates</td>
<td>163</td>
</tr>
<tr>
<td>7.7.07(a)</td>
<td>College Teachers. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>167</td>
</tr>
<tr>
<td>7.7.07(b)</td>
<td>College Teachers. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>168</td>
</tr>
<tr>
<td>7.7.07(c)</td>
<td>College Teachers. Elasticity Estimates</td>
<td>168</td>
</tr>
<tr>
<td>7.7.08(a)</td>
<td>Parking, etc. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>172</td>
</tr>
<tr>
<td>7.7.08(b)</td>
<td>Parking, etc. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>173</td>
</tr>
<tr>
<td>7.7.08(c)</td>
<td>Parking, etc. Elasticity Estimates</td>
<td>173</td>
</tr>
<tr>
<td>Table Reference</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>TABLE 7.7.09(a)</td>
<td>Rents. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>177</td>
</tr>
<tr>
<td>TABLE 7.7.09(b)</td>
<td>d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>178</td>
</tr>
<tr>
<td>TABLE 7.7.09(c)</td>
<td>Elasticity Estimates</td>
<td>178</td>
</tr>
<tr>
<td>TABLE 7.7.10(a)</td>
<td>Teachers, First and Second Level. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>183</td>
</tr>
<tr>
<td>TABLE 7.7.10(b)</td>
<td>d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>184</td>
</tr>
<tr>
<td>TABLE 7.7.10(c)</td>
<td>Elasticity Estimates</td>
<td>184</td>
</tr>
<tr>
<td>TABLE 7.7.11(a)</td>
<td>Hospitals. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>188</td>
</tr>
<tr>
<td>TABLE 7.7.11(b)</td>
<td>d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>189</td>
</tr>
<tr>
<td>TABLE 7.7.11(c)</td>
<td>Elasticity Estimates</td>
<td>189</td>
</tr>
<tr>
<td>TABLE 7.7.12(a)</td>
<td>Nurses. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>193</td>
</tr>
<tr>
<td>TABLE 7.7.12(b)</td>
<td>d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>194</td>
</tr>
<tr>
<td>TABLE 7.7.12(c)</td>
<td>Elasticity Estimates</td>
<td>194</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>7.7.13(a)</td>
<td>Telephone and Telegraph. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>198</td>
</tr>
<tr>
<td>7.7.13(b)</td>
<td>Telephone and Telegraph. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>199</td>
</tr>
<tr>
<td>7.7.13(c)</td>
<td>Telephone and Telegraph. Elasticity Estimates</td>
<td>199</td>
</tr>
<tr>
<td>7.7.14(a)</td>
<td>Dentist's Services. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>203</td>
</tr>
<tr>
<td>7.7.14(b)</td>
<td>Dentist's Services. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>204</td>
</tr>
<tr>
<td>7.7.14(c)</td>
<td>Dentist's Services. Elasticity Estimates</td>
<td>204</td>
</tr>
<tr>
<td>7.7.15(a)</td>
<td>Physicians. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>208</td>
</tr>
<tr>
<td>7.7.15(b)</td>
<td>Physicians. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>209</td>
</tr>
<tr>
<td>7.7.15(c)</td>
<td>Physicians. Elasticity Estimates</td>
<td>209</td>
</tr>
<tr>
<td>7.7.16(a)</td>
<td>Footwear Repairs. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms</td>
<td>213</td>
</tr>
<tr>
<td>7.7.16(b)</td>
<td>Footwear Repairs. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE</td>
<td>214</td>
</tr>
<tr>
<td>7.7.16(c)</td>
<td>Footwear Repairs. Elasticity Estimates</td>
<td>214</td>
</tr>
</tbody>
</table>
TABLE 7.7.20(c) Public Entertainment.
Elasticity Estimates 234

TABLE 7.7.21(a) Postal Communication.
The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 238

TABLE 7.7.21(b) Postal Communication.
d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 239

TABLE 7.7.21(c) Postal Communication.
Elasticity Estimates 239

TABLE 7.7.22(a) Air Transport.
The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 243

TABLE 7.7.22(b) Air Transport.
d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 244

TABLE 7.7.22(c) Air Transport.
Elasticity Estimates 244

TABLE 7.7.23(a) Rail Transport.
The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 248

TABLE 7.7.23(b) Rail Transport.
d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 249

TABLE 7.7.23(c) Rail Transport.
Elasticity Estimates 249

TABLE 7.7.24(a) Hotels, Lodgings.
The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 253

TABLE 7.7.24(b) Hotels, Lodgings.
d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 254
TABLE 7.7.24(c) Hotels, Lodgings. Elasticity Estimates 254

TABLE 7.7.25(a) Restaurants, Cafes. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 258

TABLE 7.7.25(b) Restaurants, Cafes. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 259

TABLE 7.7.25(c) Restaurants, Cafes. Elasticity Estimates 259

TABLE 7.7.26(a) Domestic Services. The Parameters, t-Values and Error Sum of Squares Given by the Five Functional Forms 263

TABLE 7.7.26(b) Domestic Services. d-Statistics To Test Whether Two Functions are Empirically Equivalent based on Differences in SSE 264

TABLE 7.7.26(c) Domestic Services. Elasticity Estimates 264

TABLE 8.1 Variables other than Income and Own-Price having some Influence on Quantity Demanded 271

TABLE 8.2 Additional Variables 278

TABLE 8.3 Income Distribution 281

TABLE 9.1 Functional Forms and Total Consumption Expenditure Elasticities for each Service 314

TABLE 9.2 Final Elasticity Estimates 317

TABLE 9.3 Total Consumption Expenditure Elasticities for Services using the Functional Form with the Lowest SSE 318

TABLE 9.4 Total Consumption Expenditure Elasticities for Services using only the Double Logarithmic Functional Form 321
TABLE 9.5 Total Consumption Expenditure Elasticity Estimate for the U.K. using only the Logarithmic Reciprocal Functional Form 321

TABLE 9.6 Total Consumption Expenditure Elasticities of Major Durable Goods 323

TABLE 9.7 The Share of Services as a Proportion of G.D.P. 326

TABLE 9.8 Price Indexes for Services and Commodities, 1975 327

TABLE 9.9 Own-Price Elasticities for Services 329

APPENDIX TABLE 9.1: Results of Regressions on Each Service Using The Double Logarithmic Form. The observations are separated into two groups 334-335
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Changing Income Elasticity of Service Consumption (household expenditure, U.K. 1959-77)</td>
<td>25</td>
</tr>
<tr>
<td>7.1</td>
<td>Double Logarithmic Functional Form</td>
<td>113</td>
</tr>
<tr>
<td>7.2</td>
<td>Linear Functional Form</td>
<td>115</td>
</tr>
<tr>
<td>7.3</td>
<td>Hyperbolic Functional Form</td>
<td>116</td>
</tr>
<tr>
<td>7.4</td>
<td>Logarithmic Reciprocal Functional Form</td>
<td>117</td>
</tr>
<tr>
<td>7.5</td>
<td>Semi-Logarithmic Functional Form</td>
<td>118</td>
</tr>
<tr>
<td>7.01(a)</td>
<td>Barbers, Beauty Shops. Quantity and Total Consumption Expenditure per Capita</td>
<td>135</td>
</tr>
<tr>
<td>7.01(b)</td>
<td>Barbers, Beauty Shops. Logarithm of Quantity and Total Consumption Expenditure per Capita</td>
<td>136</td>
</tr>
<tr>
<td>7.02(a)</td>
<td>Clothing Rental and Repairs. Quantity and Total Consumption Expenditure per Capita</td>
<td>140</td>
</tr>
<tr>
<td>7.02(b)</td>
<td>Clothing Rental and Repairs. Logarithm of Quantity and Total Consumption Expenditure per Capita</td>
<td>141</td>
</tr>
<tr>
<td>7.03(a)</td>
<td>Household Services. Quantity and Total Consumption Expenditure per Capita</td>
<td>145</td>
</tr>
<tr>
<td>7.03(b)</td>
<td>Household Services. Logarithm of Quantity and Total Consumption Expenditure per Capita</td>
<td>146</td>
</tr>
<tr>
<td>7.04(a)</td>
<td>Electricity. Quantity and Total Consumption Expenditure per Capita</td>
<td>150</td>
</tr>
<tr>
<td>7.04(b)</td>
<td>Electricity. Logarithm of Quantity and Total Consumption Expenditure per Capita</td>
<td>151</td>
</tr>
<tr>
<td>7.05(a)</td>
<td>Local Transport. Quantity and Total Consumption Expenditure per Capita</td>
<td>155</td>
</tr>
</tbody>
</table>
Figure 7.7.05(b) Local Transport.
Logarithm of Quantity and Total Consumption Expenditure per Capita 156

Figure 7.7.06(a) Bus Transport.
Quantity and Total Consumption Expenditure per Capita 160

Figure 7.7.06(b) Bus Transport.
Logarithm of Quantity and Total Consumption Expenditure per Capita 161

Figure 7.7.07(a) College Teachers.
Quantity and Total Consumption Expenditure per Capita 165

Figure 7.7.07(b) College Teachers.
Logarithm of Quantity and Total Consumption Expenditure per Capita 166

Figure 7.7.08(a) Parking, etc.
Quantity and Total Consumption Expenditure per Capita 170

Figure 7.7.08(b) Parking, etc.
Logarithm of Quantity and Total Consumption Expenditure per Capita 171

Figure 7.7.09(a) Rents.
Quantity and Total Consumption Expenditure per Capita 175

Figure 7.7.09(b) Rents.
Logarithm of Quantity and Total Consumption Expenditure per Capita 176

Figure 7.7.10(a) Teachers, First and Second Level.
Quantity and Total Consumption Expenditure per Capita 181

Figure 7.7.10(b) Teachers, First and Second Level.
Logarithm of Quantity and Total Consumption Expenditure per Capita 182

Figure 7.7.11(a) Hospitals.
Quantity and Total Consumption Expenditure per Capita 186

Figure 7.7.11(b) Hospitals.
Logarithm of Quantity and Total Consumption Expenditure per Capita 187 (xvii)
Figure 7.7.18(b) Personal Transport Equipment
Repair Charges.
Logarithm of Quantity and Total Consumption Expenditure per Capita 222

Figure 7.7.19(a) Other Entertainment, Cultural
Quantity and Total Consumption Expenditure per Capita 226

Figure 7.7.19(b) Other Entertainment, Cultural
Logarithm of Quantity and Total Consumption Expenditure per Capita 227

Figure 7.7.20(a) Public Entertainment.
Quantity and Total Consumption Expenditure per Capita 231

Figure 7.7.20(b) Public Entertainment.
Logarithm of Quantity and Total Consumption Expenditure per Capita 232

Figure 7.7.21(a) Postal Communications.
Quantity and Total Consumption Expenditure per Capita 236

Figure 7.7.21(b) Postal Communications.
Logarithm of Quantity and Total Consumption Expenditure per Capita 237

Figure 7.7.22(a) Air Transport.
Quantity and Total Consumption Expenditure per Capita 241

Figure 7.7.22(b) Air Transport.
Logarithm of Quantity and Total Consumption Expenditure per Capita 242

Figure 7.7.23(a) Rail Transport.
Quantity and Total Consumption Expenditure per Capita 246

Figure 7.7.23(b) Rail Transport.
Logarithm of Quantity and Total Consumption Expenditure per Capita 247

Figure 7.7.24(a) Hotels, Lodgings.
Quantity and Total Consumption Expenditure per Capita 251

Figure 7.7.24(b) Hotels, Lodgings.
Logarithm of Quantity and Total Consumption Expenditure per Capita 252

(ixx)
Figure 7.7.25(a) Restaurants, Cafes.
Quantity and Total Consumption Expenditure per Capita 256

Figure 7.7.25(b) Restaurants, Cafes.
Logarithm of Quantity and Total Consumption Expenditure per Capita 257

Figure 7.7.26(a) Domestic Service.
Quantity and Total Consumption Expenditure per Capita 261

Figure 7.7.26(b) Domestic Service.
Logarithm of Quantity and Total Consumption Expenditure per Capita 262
CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

There has been a recurring interest among economists about the influence of economic development on demand patterns. It is important for planning purposes, for instance, that both developed and developing countries are able to estimate the pattern of expansion in final demand as income levels rise.

There has been particular interest in recent years in the services sector. It has been observed that this sector tends to assume a growing importance in terms of employment and national income in the advanced economies. This thesis examines the hypothesis that the primary reasons for this shift of resources are demand changes.

Traditionally demand studies concentrate on a few product areas in only one or two countries. This is due to the methodological and measurement problems confronting multicountry studies. Only relatively recently has it been possible to compare income and demand levels across a number of international frontiers in a reliable manner.

This thesis examines whether the relationship between income and consumer service demand is consistent across a range of countries. This permits an evaluation of the "post industrial society" hypothesis, which states that the advanced economies experience a particularly high income elasticity for the consumer service sector.
1.2 THE AIMS OF THE RESEARCH

1. To examine whether the shift towards a post-industrial society is a consequence of the demand changes resulting from economic development.
2. To investigate how the proportion of national income expended on consumer services changes with economic development.
3. To examine this expenditure-development relationship across a range of countries in order to establish its consistency across countries.
4. To examine the service sector on a disaggregated basis to see if there are consistent patterns of demand for each category with changing income levels.
5. If income measures do not give a complete explanation of the variation of consumer service demand, to establish what other factors influence the variation.

1.3 ELABORATION OF AIMS

1.3.1 The Post-Industrial Society

It has been observed that the economically advanced countries of the world have experienced a shift of employment and output in favour of the service sector.

In the years immediately following the second world war, the United States became the world's first "service economy"1 with fewer than 50 per cent of the employed population active in the primary or goods-producing sectors. By 1981 more than two thirds

---

of U.S. employment was in the service sector. This is illustrated in Table 1.1, where the goods-producing sector, by 1981, accounted for only 28 per cent of non-agricultural employment (agricultural employment accounted for less than 4% of the total by 1981, see Table 1.3).

Table 1.1

Percent Distribution Of Employment Between The Goods- and Service-Producing Sectors For The United States, Selected Years, 1959-81.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Total non-agricultural</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Goods-producing sector</td>
<td>38.3</td>
<td>34.6</td>
<td>32.4</td>
<td>29.5</td>
<td>28.0</td>
</tr>
<tr>
<td>Service-producing sector*</td>
<td>61.7</td>
<td>65.4</td>
<td>67.6</td>
<td>70.5</td>
<td>72.0</td>
</tr>
</tbody>
</table>

Notes

* Data relate to numbers of wage and salary workers in the non-agricultural economy, as determined by the Bureau of Labour Statistics Current Employment Statistics survey.

+ The service-producing sector is defined as including transportation, communication, public utilities, wholesale and retail trade, finance, insurance, real estate, other personal and business services and government.

Source: Kutscher, R.E., Mark, J.A. (1983)

The position for European Community Countries in 1987 is shown in Table 1.2. The proportion of the employed population working in the industrial sector in no case is higher than 40.1% (that for W. Germany) and is generally about one third of total employment, whereas the service sector employs on average 58.8 per cent of the total. Thus service businesses are now the dominant employer of labour throughout Western Europe and the United States.
Table 1.2

Persons in Employment by Sector of Activity for the European Community Countries, 1987

<table>
<thead>
<tr>
<th>Sector</th>
<th>EUR.12</th>
<th>EUR.10</th>
<th>Belgium</th>
<th>Denmark</th>
<th>W. Germany</th>
<th>Greece</th>
<th>Spain</th>
<th>France</th>
<th>Ireland</th>
<th>Italy</th>
<th>Lux.</th>
<th>Netherlands</th>
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</thead>
<tbody>
<tr>
<td>Agriculture</td>
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<td>6.6</td>
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</tr>
<tr>
<td>Industry</td>
<td>33.3</td>
<td>33.3</td>
<td>31.6</td>
<td>28.6</td>
<td>40.1</td>
<td>26.1</td>
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<td></td>
</tr>
<tr>
<td>Services</td>
<td>58.8</td>
<td>60.0</td>
<td>65.2</td>
<td>65.5</td>
<td>55.2</td>
<td>46.9</td>
<td></td>
<td></td>
<td></td>
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<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.2</td>
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<td>5.1</td>
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<tr>
<td>France</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32.4</td>
<td>30.6</td>
<td>28.8</td>
<td>32.2</td>
<td>31.1</td>
<td>27.1</td>
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<tr>
<td>Ireland</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>52.4</td>
<td>61.9</td>
<td>55.5</td>
<td>57.3</td>
<td>65.6</td>
<td>67.8</td>
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<tr>
<td>Italy</td>
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<td>100.0</td>
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<tr>
<td>Lux.</td>
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<tr>
<td>Portugal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.2</td>
<td>2.4</td>
<td></td>
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<tr>
<td>U.K.</td>
<td>34.1</td>
<td>32.8</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Services</td>
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<td></td>
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</tr>
</tbody>
</table>


The proportion of output devoted to the goods sector in recent years has also declined with economic growth, while that devoted to the service sector has risen. This is shown in Table 1.3.
Table 1.3

International Comparisons of Output (Y) and Employment (E), Percentage Distributions among Agriculture (A), Goods (G) and Services (S) for Some OECD Economies. *

<table>
<thead>
<tr>
<th>Year</th>
<th>A.</th>
<th>G.</th>
<th>S.</th>
<th>A.</th>
<th>G.</th>
<th>S.</th>
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<td>1890</td>
<td></td>
<td></td>
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<tr>
<td>France Y</td>
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<td>32.0</td>
<td>30.0</td>
<td>9.9</td>
<td>43.1</td>
<td>47.0</td>
</tr>
<tr>
<td>E</td>
<td>48</td>
<td>25</td>
<td>27</td>
<td>22.4</td>
<td>38.1</td>
<td>39.5</td>
</tr>
<tr>
<td>Germany Y</td>
<td>19.6</td>
<td>25.0</td>
<td>55.4</td>
<td>6.5</td>
<td>48.1</td>
<td>45.8</td>
</tr>
<tr>
<td>E</td>
<td>36</td>
<td>39</td>
<td>25</td>
<td>10.3</td>
<td>57.5</td>
<td>32.2</td>
</tr>
<tr>
<td>Japan Y</td>
<td>54.3</td>
<td>16.2</td>
<td>29.5</td>
<td>13.3</td>
<td>37.5</td>
<td>49.2</td>
</tr>
<tr>
<td>E</td>
<td>76</td>
<td>10</td>
<td>13</td>
<td>30.2</td>
<td>28.0</td>
<td>41.8</td>
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<tr>
<td>U.K. Y</td>
<td>9.7</td>
<td>36.9</td>
<td>53.5</td>
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<td>36.9</td>
<td>59.8</td>
</tr>
<tr>
<td>E</td>
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<td>4.2</td>
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<tr>
<td>U.S. Y</td>
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<td>57.3</td>
<td>3.9</td>
<td>32.3</td>
<td>63.8</td>
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<tr>
<td>E</td>
<td>42</td>
<td>28</td>
<td>30</td>
<td>8.3</td>
<td>34.6</td>
<td>57.1</td>
</tr>
<tr>
<td>1970</td>
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<tr>
<td>France Y</td>
<td>6.7</td>
<td>44.0</td>
<td>49.3</td>
<td>5.4</td>
<td>30.7</td>
<td>64.3</td>
</tr>
<tr>
<td>E</td>
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<td>47.2</td>
<td>7.9</td>
<td>33.0</td>
<td>59.1</td>
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<tr>
<td>Germany Y</td>
<td>3.8</td>
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<td>44.5</td>
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<td>61.9</td>
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<td>E</td>
<td>8.6</td>
<td>48.6</td>
<td>42.8</td>
<td>5.6</td>
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<tr>
<td>Japan Y</td>
<td>6.4</td>
<td>41.4</td>
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<tr>
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<td>3.2</td>
<td>43.2</td>
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<td>2.6</td>
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<td>U.S. Y</td>
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<td>30.9</td>
<td>65.8</td>
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<td>67.8</td>
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<tr>
<td>E</td>
<td>4.5</td>
<td>33.2</td>
<td>62.3</td>
<td>3.3</td>
<td>28.5</td>
<td>68.2</td>
</tr>
</tbody>
</table>

Note
* The data for 1890 vary in time of observation by as much as 5 years before or 1 year after column heading. Also the output data are centered averages of several years' observations whose mean time of observation is at or slightly earlier than given date. See Long-Term Economic Growth, Tables D67-69 for details. For 1960 and later, the OECD data include utilities with manufacturing, mining and construction - in the Goods column; prior to 1960, utilities are included in Services.


Table 1.3 shows that the shares of labour and output in agriculture have been diminishing greatly and that the majority of this relative decline occurred before the middle of this century. While the specific patterns of the production and output
evolution vary somewhat, the five industrial economies share three key features. First, the proportion of goods production to real gross domestic product peaked between 1960 and 1970, and has fallen to less than 40 percent for each. Second, the share of employment in goods production which also peaked between 1960 and 1970, has declined for each country from 1970 to 1984. Third, by 1984 each nation had similar output and employment shares in services production.

Thus there appears to be considerable evidence supporting the thesis that the advanced economies have moved into a "post-industrial" phase of development. That is, the dominant sector is not good-producing but service-producing.

A number of possible reasons for this shift have been advanced and a central aim of this work is to consider in detail the idea that the primary cause is the changing pattern of demand with economic development.

1.3.2 The Proportion Of National Income Spent On Consumer Services

The rising share of services described in Tables 1.1, 1.2 and 1.3 are not necessarily the result of demand factors at all, but may be due to changes occurring on the supply side. For instance, the above tables do not make a distinction between producer and consumer services. Thus a more than proportionate growth in the use of producer services such as distributors, advertisers, consultant computer programmers etc., as an input to the good-producing sector, may contribute greatly to the shifts shown in the above tables. Also the way in which statistics are collected may lead to the patterns shown. For instance, if in the
earlier periods firms classified as "goods-producing", because their final output was a good, engaged a high proportion of service workers "in-house", e.g. cleaners, designers, to aid the production of the good, then the output of the firm would all be labelled as being part of the goods sector. If then, "goods-producing" firms contracted out these kinds of services, and concentrated on their central activity of goods production, there would be an apparent or recorded shift towards producer service industry output.

The possibility that consumer services are highly income elastic, and that individuals when they gain sufficient income greatly increase their spending on these "luxuries" has been viewed, however, as a major factor in the rising importance of services.²

An analysis of consumer service income elasticity forms the core of this thesis.

1.3.3 Range Of Countries

The income elasticities are calculated using data supplied for a cross-section of thirty-four countries on an internationally comparable basis (making use of purchasing power parities, P.P.P.). These countries have a very wide range of average income per capita. Thus an examination of the expenditure-development relationship can be observed. The central issue is whether, as incomes rise, the proportion of income

devoted to consumer services rises in a consistent manner. A priori it may seem reasonable to assume that the tastes prevailing within any one country might be totally different to that in another, and thus, as economies develop a divergence would be observed in the mixture of goods and services demanded. On the whole the results show that this divergence is not very evident. The major determinants of consumer demand are income and price. Thus the high statistical significance of these variables suggests that the expenditure-development relationship is consistent across countries.

1.3.4 Disaggregation

Consumer services is a very heterogeneous group. It includes such modern and hi tech services as telecommunication, as well as ancient ones, such as domestic services. It ranges from the tangible, e.g. a haircut, to the less tangible, e.g. entertainment.

Some of these services are likely to have high income elasticities while others have low, or even negative elasticities. It seemed more appropriate to analyse this sector on a disaggregated basis and observe the differences of behaviour with respect to income and own-price effects.

This was made possible by using a data source which breaks
down the consumer service sector into twenty six separate categories. This approach highlights the unique characteristics of each service and enables greater understanding of the underlying relationships. For example, an examination is made of the most appropriate functional form for each category. This enables a variety of models regarding the behaviour of income elasticity at different levels of income to be tested. For example, the double logarithmic form assumes a constant elasticity throughout, whereas the logarithmic reciprocal assumes a decreasing income elasticity as incomes rise.

In Chapter 9 the income elasticities are brought together to give some weighted overall estimate for consumer services.

1.3.5 Other Determining Factors

Income and own-price are not likely to be the only influences on the quantity demanded of a service. Calculating elasticities when using only these two variables may lead to inaccurate results. In an attempt to establish other relevant influences and to improve the statistical significance of the income and own-price elasticities a number of other variables were tested.

For each of the twenty six services potential substitutes...
and compliments are tested along with a number of demographic variables, for instance, the proportion of the population aged under 15 years. Also, other influences thought to be relevant, such as inflation and income distribution, are examined.

1.4 DEFINING SERVICES

There is no unique definition of services. There are in general two approaches taken. The first is based on the output of the production process and emphasises the intangible nature of service products. For example Riddle* states that,

"When attributes of services are given, they typically include intangibility, labour intensity, simultaneity of production and consumption and perishability."

If the firm does not produce a physical product, it is a service industry, and if it does produce a physical product, it is a manufacturing, extractive or agricultural firm.

The problem with this approach is that limiting services to those industries with no tangible output is unnecessarily restrictive. Most professional services, for instance, have some tangible documentation in writing of the services provided. Services such as hair-cutting and shoe repair obviously produce a tangible output.

The second approach emphasises the method of production and defines services residually as being those productive activities that are neither manufacturing, mining, nor agriculture.

This residual definition is too broad. It does not describe any special characteristics of services but, rather, is a

negative classification in that it defines them by what they are not. Also, it is often difficult to distinguish between major sectors. For example, are utilities a service or manufacturing industry?.

The problem of defining services has long been noted. Stigler* in 1956 declared that,

"There exists no authoritative consensus on either the boundaries or the classification of the service industries".

In conclusion it would seem that service industries encompass an extremely heterogeneous grouping of economic sectors with different production processes, market channels and so on, and thus often have little in common other than that their principal outputs are for the most part intangible.

Taking account of the variety of opinion on defining services there seems little theoretical justification for deviating from the approach taken by the United Nations and World Bank in the International Comparison Project (I.C.P.)*. Thus, the twenty six categories of services analysed in this thesis are those which fit the definition of being "non-storable goods".7

However this thesis is not bound by the constraints imposed by this definition. There is some scope for the examination of the sensitivity of the results to the definition chosen. For instance two services (Electricity and Gross Rents) are excluded.


*For I.C.P. references see Chapter 3 Section 3.5 page 45
7I.C.P. Phase II, page 22
when calculating overall elasticity for the service sector in Chapter 9.

1.5 CONTENT

Chapter 2 examines the post-industrial society debate, with particular emphasis on the division between those who advocate primary importance of supply-side factors, and those who believe that the consumer service sector possesses a relatively high income elasticity.

Chapter 3 looks at the development of demand analysis; from the early budget studies of Ernst Engels to complete demand systems. The functional forms and range of determining variables used in empirical work are examined, and a comparison of the "ad hoc" and the systems approaches to the analysis of demand is made.

Chapter 4 describes the method used by the International Comparison Project to calculate the purchasing power parities, and thus the real quantities demanded of each service. An understanding of this data source is necessary for the full appreciation of the method and results chapters which follow.

Chapter 5 describes in detail the empirical methodology used in this study.

Chapter 6 considers the selection of an appropriate proxy for the income variable and the own-price variables. G.D.P. per capita may be subject to some relatively large fluctuations between years compared with total consumption expenditure. Which of these two is the more appropriate determining variable, for
the quantity demanded of a service, is examined from the theoretical and empirical points of view.

Chapter 7 makes use of the I.C.P. data. This provides comparable income, own-price and quantity for the twenty-six services. Using this it has been possible to establish income and own-price elasticities via ordinary least squares multiple regression. Up to seven functional forms were tested for each service. Thus each category of service had a wide variety of elasticity estimates. The functional forms with the "best fit" based on the criteria of the lowest error sum of squares was selected for further analysis.

Chapter 8 considers the relevance of variables other than own-price and income. Again ordinary least squares multiple regression is used to establish "best fit" functional forms. From this analysis some revision of the income and own-price elasticity estimates resulted, and a number of cross-price and other relationships are established.

Chapter 9 uses the individual category income elasticities to construct an average income elasticity for the consumer service sector as a whole. This overall elasticity is compared with those for durable goods.

Chapter 10 sets out the conclusions and implications of the thesis.
CHAPTER 2

THE POST-INDUSTRIAL SOCIETY DEBATE

2.1 INTRODUCTION

The developed economies tend to devote a greater proportion of Gross Domestic Product and employment to the service sector as incomes rise. A debate has taken place as to whether the cause of this shift of resources is demand related or supply related. Section Two examines the work of those who believe the shift to be a result of a high income elasticity of demand for services relative to goods. Section Three considers the evidence provided by economists who believe that the income elasticity of the consumer services sector to be relatively low. These researchers emphasise supply factors, such as the "productivity gap" and increased use of intermediate or producer services in the production of goods, as the primary factors influencing the increasing importance of services. Section Four presents the conclusions.

2.2 DEMAND FACTORS AND THE SERVICE SHARE OF G.D.P.

This debate follows in the tradition of economic analysis in trying to find consistent patterns of change as economies develop. The underlying assumption is that economies initially are dominated by primary sector output. Later manufacturing develops to be of greatest importance. This is followed by the post-industrial society in which the major employer and wealth producer eventually becomes the service sector.

The current division of economic activity into primary,
secondary and tertiary is due to the work of A.G.B. Fisher (1935 and 1939). He considered that the primary sector comprised agriculture, mining, forestry and fishing, that the secondary sector was made up of manufacturing industry and that all other activities could be grouped together in the tertiary sector. In making this division, Fisher emphasized the relationship between the distribution of employment among these three sectors and the level of development of an economy. According to Fisher economies move from the primary stage through the secondary to the tertiary stage for two reasons. On the production side, on the one hand, there is a constant increase in yield. Therefore, less labour is employed in primary and secondary sectors per unit of output. Also, labour is released for employment in the tertiary sector. On the demand side, on the other hand, there are growing preferences, as income increases for secondary and then tertiary products. Thus, the dynamism of production is ensured through innovation and technical progress, although this increase in yields is much greater in industry than in the service sector. This surplus created in the whole of the economy is channelled by the structure of demand mainly into the secondary and then into the tertiary sectors, in accordance with the observations made by Engels. That is, the expenditure elasticity for the service

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3See Chapter 3, page 30
sector is greater than unity and higher than that for goods.

This approach to shifting economic forces within society was taken up by Daniel Bell in 1974. He applied the phrase "Post-Industrial Society" to the economic phenomena of a shift of resources to the service sector.

Bell looked at the recent past and drew inferences for future political and economic change. He emphasized the economic change as being the major influence upon the socio-political trends:

"A post-industrial society is based on services"... If an industrial society is defined by the quantity of goods as marking a standard of living the post-industrial society is defined by the quality of life as measured by the services and amenities - health, education, recreation and the arts. The word "services" disguises different things, and in the transformation of industrial to post-industrial society there are several different stages.

"First, in the very development of industry there is a necessary expansion of transportation and public utilities as auxiliary services in the movement of goods and the increasing use of energy, and an increase in the non-manufacturing, but still blue collar, force".

"Second in the mass consumption of goods and the growth of population there is an increase in distribution (wholesale and

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retail) and finance, real estate and insurance, the traditional centres of white collar employment".

"Third, as national incomes rise one finds, as in the theorem of Christian Engel a German statistician of the latter half of the nineteenth century, that the proportion of money devoted to food and home begins to drop, and the marginal increments are, used first for durables (clothing, housing, automobiles) and then for luxury items, recreation and the like. Thus a third sector that of personal services begins to grow: restaurants, hotels, auto services, travel, entertainment, sports, as people's horizons expand and new wants and tastes develop".

"But here a new consciousness intervenes. The claims to the good life which society has promised becomes centered on two areas that are fundamental to that life - health and education. The elimination of disease and the increasing numbers of people who can live out a full life, plus the efforts to expand the span of life, make health services a crucial feature of modern society: and the growth of technical requirements and professional skills makes education and access to higher education, the condition of entry into the post-industrial society itself......"

"Finally the claims for more services and the inadequacy of the market in meeting peoples needs for a decent environment as well as better health and education lead to a growth of government".

We can summarize Bell's argument by saying that advanced societies tend to have relatively high income elasticities for
the following services (higher than for durable goods):-

<table>
<thead>
<tr>
<th>Recreation</th>
<th>Entertainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurants</td>
<td>Sports</td>
</tr>
<tr>
<td>Hotels</td>
<td>Health</td>
</tr>
<tr>
<td>Auto Services</td>
<td>Education</td>
</tr>
<tr>
<td>Travel</td>
<td>Government Services</td>
</tr>
</tbody>
</table>

A major problem associated with both Fisher and Bell is the tendency for them to arrive at their conclusions on the basis of very limited data. They observe one or two trends, such as employment and output, for a few sectors of the economy, but neither presents enough information to draw acceptable conclusions concerning the income elasticities of the various subcategories of the economy. While they may observe increasing expenditure as a proportion of income on a service this is not sufficient to assign a high income elasticity to that service because it is also necessary to take into account the fact that expenditure will be affected by changing relative prices. Also the services sector, when looked at from the employment or output perspective has two components; services which are purchased as an input for the production of some other final product ("producer" or "intermediate" services) and those which are purchased for final consumption ("consumer services"). Fisher and Bell do not make a clear distinction between these two when describing the output or employment trends within sectors. When discussing the effect of consumer demand on the structure of national output we have to distinguish between producer and consumer service demand.
2.3 EMPIRICAL WORK ON THE DEMAND FOR CONSUMER SERVICES

Colin Clark in "The Conditions of Economic Progress" collected a large number of empirical studies, cross-sectional and time-series, which measured income elasticity. Each study was concerned with one or a small number of product groups in just one advanced country. However, the data taken as a whole does provide an insight into the effects of income growth on consumer demand. This work was a great step forward: it was based on a large collection of empirical results; it attempted to measure income elasticity, not just expenditure or employment statistics and the distinction between producer and consumer services was made. As a result of this work Clark concluded the following with regard to consumer services:

"As real income per head increases it is quite clear that the relative demand for agricultural products falls all the time and that the relative demand for manufacturers first rises and then falls in favour of services. This generalization remains; though it should be pointed out that, if we confined our analysis to consumers' services alone, we would not, in the United States and other wealthy modern communities, get quite the same result. At the prices which now have to be paid for them, these services direct to consumers are not showing a high marginal demand relative to that for other goods. If, on the other hand we include that large and increasing range of services which are now

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supplied to business we again conclude that the relative demand for services, as a whole is increasing." 7

Clark's analysis of service demand was more satisfactory in two respects; firstly, it draws a distinction between expenditure on a service and quantity of service demanded - the relative price of consumer services rises as income levels rise thus causing the proportion of consumption devoted to consumer services in volume terms to increase less than that for goods. This may, or may not, mean that the income elasticity for consumer services is less than unity, but it certainly indicates the cause of the trend towards a post-industrial service based economy may not only be consumers demand for a greater volume of services. Secondly, by separating producer services from consumer services Clark finds that advanced economies are tending towards greater service output and employment and that the cause of this is the requirement of producers for service inputs (i.e. producer services have a high elasticity with respect to national income growth).

Simon Kuznets 8 provided further evidence of the rising relative cost of consumers services in his studies of economic growth. He observed that:

"... whenever goods are labour intensive their prices are high relative to other prices in the United States and lower

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7Clark, C. (1957) ibid pp. 493.
relative to other prices in other countries; and whenever the goods are capital intensive, their prices are lower relative to other prices in the United States and higher relative to other prices in the other countries. Examples of the first group are household operation, personal care and health, recreation and entertainment (with some exceptions); education; and miscellaneous services."

Kuznet's observations support the notion that any rise in proportionate expenditure devoted to consumer services is to a large extent caused by the increasing relative price of services. However, Kuznet did not argue specifically that the service sector has a price adjusted expenditure elasticity of less than unity:

"... In terms of a uniform price structure... Only for the combined total of personal care and health, recreation, education and miscellaneous services might the shift to a more uniform price structure reduce the expenditure elasticity of demand materially although it would remain above 1".

Thus, Clark and Kuznet reasoned that the income elasticity for consumer services as a whole was less than that for manufactured goods but could conceivably be greater than unity (if this sector was taking some of the share of income previously directed at the primary sector).

More evidence of price shifts causing the share of income devoted to consumer services to decrease relative to that for

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*Kuznet, S. (1962) ibid pp. 32.
goods was provided by V.R. Fuchs. Fuchs was interested in explaining why the United States has become an economy where the majority of employment is in the service sector. He reached the conclusion that two supply factors are of greater relevance than any income elasticity effects. The "productivity gap", between services and the other two sectors, means that new technology enables the manufacturing and primary sector to increase production with less labour, whereas the service sector has enjoyed few labour saving innovations. Thus, with the passage of time, a higher proportion of the workforce is engaged in service activities. Secondly, over recent decades business has required a greater input of service operations therefore producer service demand has risen. Before considering these supply factors in detail Fuchs examines the proposition that consumer services have a high income elasticity. He concludes the following:

"Examination of cross-sectional buying patterns and of trends in output over time suggests that the growth of income and a consequent shift in demand has not been a major source of the relative growth of service employment. Measured in dollars of constant purchasing power the service sectors share of output was the same in 1965 as in 1929. Measured in current dollars, it grew only from 47 to 50 per cent. As a share of non-agricultural output in constant dollars, the service sector actually declined over the same period while in current dollars its share rose by


Fuchs, V.R. (1968) ibid pp 3.

22
less than one percentage point. The income elasticity of demand for services has been only moderately above that for the rest of the economy.... the income effect has probably been offset by a substitution effect induced by a relative rise in the price of services."

Jonathan Gershuny when writing on European economies in the 1970's and 1980's reached similar conclusions. He rejected the hypothesis that the advanced economies are entering an economic phase whereby the service sector will expand significantly because of demand factors. He did not deny that the service sector was becoming a more important employer and source of Gross Domestic Product but attributes this mainly to supply factors in a similar way to Fuchs. Gershuny carried out a more detailed analysis than previous researchers. For instance a

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19Gershuny, J. I. (1977-86)

(b) Service Employment: Trends and Prospects. EEC Science and Technology Policy Series Fast No. 5, 1982 Co-author Miles, I.D.
(d) The New Service Economy: The Transformation of Employment in Industrial Societies. pub. Frances Pinter, 1983 Co-author Miles, I.D.
distinction is drawn between marketed and non-marketed consumer services. Non-marketed consumer services are those provided by government, in the case of the United Kingdom this includes education, health and government services of various kinds. As far as this group is concerned Gershuny did consider that they account for an increasing proportion of national expenditure. Thus we have some agreement between Bell and Gershuny - both point to the increasing importance of health, education and government services.

Gershuny believed that the "service function" is the relevant dependant variable when demand patterns are considered. That is, as income rises people may well demand more "luxuries" (as Engel put it) than previously but the particular "service function" e.g. entertainment, clothes washing can be provided either by a good or a service (e.g. live show versus the purchase of a television, laundry service versus the purchase of a washing machine). According to Gershuny what has happened in recent decades is the substitution of goods for services to achieve the same service "function". Thus we have the purchase of a motor car (a good) instead of a railway journey (a service) in order to travel (the function). This switch of resources has been aided by the productivity gap. Increasing innovation and cost reduction (resulting from scale economies for example) in the goods sector has meant that the cost of the provision of a durable good has been decreasing relative to that for the corresponding service (which has tended to remain labour intensive and not subject to scale benefits). Along with this
approach goes the notion of "self-service" - the individual who purchases a durable good will have to put in some effort to obtain the desired service function, e.g. drive a car, load a washing machine. Thus we have the development of the "informal economy" i.e. people doing productive work which is not involved in a market transaction.

Gershuny concedes that in a cross sectional analysis of consumer demand consumer services will show quite a high income elasticity, but over time this relationship may change. This is shown in the following Figure:

Figure 2.1 Changing Income Elasticity of Service Consumption (household expenditure U.K. 1959-77)

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14 Taken from: Gershuny J.I., Miles I.D. (1983) (d) ibid. pp 51.
The curve AA demonstrates what happens to the budget share for services at one point in time. The society as a whole gets much richer over time but, over the same period, the prices of services rise relative to those of other commodities, with demand price elastic, ceteris paribus the whole curve appears to shift downwards. The curve BB for 1977 still shows an increasing budget share for services as incomes rise implying a high income elasticity but nevertheless, at each level of real income, households spend less on services in the later period than the earlier. In this particular case the net effect over 1959-77 was a relative decline in the consumption of marketed services. The price effect generally tended to more than offset the income effect.

Gershuny's work has provided us with more detailed insight into the shifting patterns of consumer demand. It not only draws attention to the substitution of an ever more expensive service by a durable good but shows the problems of relying upon cross-sectional data where ever changing technology (social and material) changes the relative prices over time. Also by examining the economy on a disaggregated basis (even though of limited form) he is able to identify within the service sector different reactions to changing levels of income. He thus indicates that the service sector should not be viewed as one group with similar elasticity characteristics with regard to income and price. The service sector includes such income inelastic services as bus transport and such highly elastic groups as health care.
Gershuny's work is limited to the extent that it is mainly based on U.K. data. An analysis based on information drawn from a number of countries may provide more robust results. The International Comparison Project (I.C.P.) provides such information. Phase III\(^{10}\) of the I.C.P. produced highly disaggregated demand data for thirty four countries, ranging in income levels from Malawi to the U.S.A..

(As the I.C.P. forms the main data source for this thesis the methodology of their analysis is described in detail in Chapter 4.)

2.4 CONCLUSIONS

An analysis based on employment statistics and expenditure data has led some writers (e.g. Fisher, Bell) to conclude that the rise in the relative importance of the services sector in the advanced economies is, to a large extent, a result of this sector being faced by a high income elasticity of demand. They argue that economic growth brings with it a shift of resources: firstly, from the primary to the secondary sector, and then, at high income levels; services show a higher income elasticity of demand than goods. Thus the tertiary sector becomes a faster growing area than the secondary. It is this view of the development/industrialisation process that encouraged Bell to coin the phrase the "Post-Industrial Society".

Economists such as Clark, Fuchs, Kuznets and Gershuny agree that employment resources and the proportion of expenditures has shifted in favour of the service sector with income growth. However, they ascribe supply factors as the main cause of this shift, rather than the sector possessing a particularly high income elasticity. One of these supply factors is the "productivity gap". That is, over time labour saving innovation takes place at a faster rate in the goods sector, thus leaving the service sector with an ever increasing proportion of the workforce as the economy grows. This factor also has an influence on the relative price of goods and services. Evidence has been provided (Fuchs, Gershuny, I.C.P.) which shows the tendency of the price of services to rise relative to that for goods as economic growth proceeds. This helps to explain some of the higher expenditure shares identified for the services sector.

Another important cause of the rise in service share output is the increasing fragmentation of industrial production which induces greater specialisation in the production of producer services. Thus, the sale of a good is classified as such in final consumer expenditure data, yet in its various stages of manufacture and distribution large expenditures have been made on producer services. For instance, the hi fi is classified as a good today as it was twenty years ago yet its final sale value may represent a higher proportion of producer service input than twenty years ago. The manufacturer and retailer may pay an advertising agency, computer software and hardware companies, financial service companies and shop designers. All these
services are not provided direct to the consumer and are therefore not recorded in total final consumption expenditure yet they contribute to the value of output.

What is clear from this review of the existing literature is that the service sector is very heterogeneous. It ranges from very labour intensive services such as domestic service to modern and hi-technology industries as telephones and health care.

Analysis of the demand for services as a whole may be misleading if it is not based on an investigation of the component parts.
CHAPTER 3

A REVIEW OF THE LITERATURE ON DEMAND ANALYSIS

3.1 INTRODUCTION

For over 130 years economists have been aware of a tendency for individuals and groups to behave in a relatively consistent manner with respect to the level of expenditure devoted to any one particular category of good or service when prices and incomes change. It was observed as far back as 1857\(\textsuperscript{1}\) that the proportion of household expenditures allocated to food decreases as income increases and that the proportion devoted to clothing and housing is approximately constant, while the share of "luxury" items increases. Ernst Engel came to these conclusions after an examination of about two hundred budgets of Belgium labourers.

The relationship between the quantity of a commodity purchased and the income level have, since the nineteenth century, been described as Engel curves. Many economists since Engel have been concerned with the establishment of Engel curves and other demand relationships, such as own-price and cross-price elasticities.

It is possible to identify two distinct approaches to the estimation of demand equations. The first and original approach concentrates on the demand for a particular commodity or

commodity group, paying attention to any special characteristics of the single market involved. A central issue for this approach concerns the selection of the appropriate functional form. This chapter examines the use of a number of alternative functional forms by other researchers. This approach might be viewed as the "pragmatic" or "ad hoc" approach, since the derivation of the functional form is not explicitly derived from a model of consumer behaviour.

The second approach developed since the 1950's involves the simultaneous estimation of complete systems containing demand equations for every commodity group purchased by consumers. The expenditure system approach has an explicit theoretical base. In a complete system each equation contains as explanatory variables the prices of all goods. Unrestricted estimation of such systems is clearly impractical. However, the theory of consumer behaviour produces a series of restrictions which the equations of a complete system must theoretically satisfy (e.g. adding-up criteria, homogeneity, symmetry, negativity - see Appendix for details). The imposition of these restrictions significantly reduces the number of independent price and income responses that have to be estimated.

While these theoretical restrictions make the calculation of demand systems possible they are subject to limitations. The Linear Expenditure System is examined in this chapter and the problems associated with it are explored in section four, with a fuller description given in the Appendix.

The aim of this chapter is to present an examination of the
existing literature on empirical demand analysis. The next section provides a review of the pre-war demand analysis by Schultz\textsuperscript{2} and Allen and Bowley\textsuperscript{3}. These researchers concentrated on one or two determining variables and on the simple linear or double logarithmic functional forms.

Since the war Stone\textsuperscript{4}, Prais and Houthakker\textsuperscript{5}, and Houthakker and Taylor\textsuperscript{6} have explored the use of other determining variables and a variety of functional forms. This work is described in section three. The demand systems approach is examined in section four with particular reference to the Linear Expenditure System. The expenditure analysis undertaken by the International Comparison Project is described in section five. Finally, the summary conclusions are presented in section six.

3.2 PRE-WAR EMPIRICAL DEMAND ANALYSIS

It was during the 1930's that modern econometric techniques were first systematically applied to demand analysis. Two studies are of particular significance.

Allen and Bowley in 1935 derived a series of Engel curves


relating total expenditure to the expenditure on a particular product category for a household. The main feature of their analysis is the estimation of linear Engel curves of the form:

\[ x_i = a + bE + e \quad \text{eqn. (3.1)} \]

or

\[ Q_i = a + bE + e \quad \text{eqn. (3.2)} \]

where

- \( x_i \) = expenditure on the category of good \( i \).
- \( Q_i \) = quantity of good \( i \) consumed.
- \( E \) = total expenditure.
- \( e \) = error term.

Because the data was collected from a series of different households at the same time it was considered reasonable to assume that prices would be the same for each household and therefore it was not necessary to include in the above function any price variable.

The implications of using only the linear functional form may be unsatisfactory. For instance luxury goods (where \( a < 0 \)) have an income elasticity that declines with increasing income, while the reverse is true for necessities (\( a > 0 \)) where the elasticity rises with income and tends to unity. (Chapter 7 examines the characteristics of functional forms in detail). This is intuitively unsatisfactory, one would rather expect the opposite. It is not surprising then, to discover that the explanatory power of linear Engel curves is weak (see Prais and Houthakker, Houthakker and Taylor and this study - chapters 7, 8 and 9).

The other major piece of work carried out in the 1930's was a time-series study by Henry Schultz on the demand for various agricultural products during the period 1875 - 1929. Schultz used
multiple regression models:

\[ x_{it} = a + bp_{it} + ct + e_t \quad \text{eqn. (3.3)} \]

or

\[ x_{it} = Ap_{it}^c t^{c-1} \quad \text{eqn. (3.4)} \]

where \( x_{it} \) is the per capita consumption for commodity \( i \),

\( p_{it} \) is a price index of the commodity divided by a general price index

and \( t \) measures time (\( t = 0, 1, 2, 3 \ldots \)).

Here we have a functional demand relationship expressed in terms of price. However, the total expenditure variable is not identified but is part of a time trend variable. This time trend shifts the demand curves in a systematic way and captures changing tastes, the price of other products, changes in population as well as income or total expenditure. Schultz made use of linear and double logarithmic functional forms of demand models to determine price elasticities.

The pre second world war work resulted in the presentation of a series of expenditure and price elasticities for a wide range of products. These economists confirmed the existence of consistent relationships between demand and variables such as price and income. Their work served as a foundation upon which modern empirical demand analysis is based. They made use of simple and multiple regression analysis and other econometric techniques only then being developed. Their work was constrained however by the quality of the data then available.

However the Schultz and Allen and Bowley studies were incomplete. The number of explanatory variables and the number of functional forms employed was restrictive.
A significant advance in the evolution of modern demand analysis was made with Richard Stones classic "The Measurement of Consumers Expenditure and Behaviour in the United Kingdom, 1920 – 38". In his analysis Stone includes a set of determining variables apart from own-price. He examines the effect of changes in the price of substitutes and compliments, of real income as well as a time trend.

Stone looked at U.K. consumers expenditure on non-durables during 1920-38. Whereas single equation studies generally pay scant attention to theoretical considerations Stones work is notable for its attempt to employ theory to refine the estimating equations used (for instance, homogeneity of degree zero is imposed by using real income derived as a ratio of nominal income to a general price index). In many ways this study anticipated the later expenditure system approach (see section 3.4). Stone used a double logarithmic demand function which initially, in a theoretically consistent manner, includes the prices of all commodities. For commodity i

$$\log Q_i = a + b \log E + \sum_{k=1}^{n} c \log p_k$$

where $b$ and $c$ are total expenditure and price elasticities, respectively, and there are $n$ commodities in all.

However, with only nineteen time series observations, the number of explanatory variables had to be severely restricted if estimation was to be possible. Since it is quite reasonable to treat the compensated cross-price elasticities of unrelated goods as negligible once we have allowed for income effects, it is
possible to suppress many of the price variables in equation 3.5
and rewrite it as:

\[ \log Q_0 = a + b \log (E/p) + c \log (p_r/p) + d \log (p_s/p) + f \log (p_t/p) \]

**eqn. (3.6)**

where goods \( r \) and \( s \) are close substitutes or compliments
(their number need not necessarily be restricted to two)
and \( (E/p) \) is an index of real income,
p is a general index of prices.

Equation 3.6 is Stone's basic equation for the demand for non
durable goods and this was estimated using aggregate data for the
period 1920-38. An ordinary least-squares estimation method was
used throughout.

Stone analysed in particular forty-eight different types of
food expenditures. The results were broadly in line with what one
might expect for the pre-war U.K. For example, tea was clearly a
"necessity", whereas coffee had an income elasticity in excess
of unity.

Stone's work, although a milestone in the history of demand
analysis, was limited in a number of ways. The study concentrated
on a limited range of commodities in the United Kingdom. This
restriction to a single commodity or country applied to most
demand studies in the 1950's and 1960's mainly because of data
limitation problems.

The other main problems with Stone's work were tackled in the
in the decade or so following the publication of his study. A
major criticism that may be levelled at Stone's 1954 publication
was the use of just one functional form. The double logarithmic
form has the characteristic of a constant elasticity throughout the range of income or price. This was considered by many researchers in the 1950's and '60's to be too restrictive. Many products and services were thought likely to exhibit different elasticities at different income levels. For example, the income elasticity for bus transport is likely to be reasonably high at lower and middle income ranges but low or even negative at higher incomes as personal transport is substituted (see Chapters 7, 8 & 9).

Another problem was that the determining variables were limited to own-price, income and cross-price. A time trend was used to catch all other influences. Later researchers were to include a wide variety of additional variables.

A year after the publication of Stones work another major study on this subject was published, by Houthakker, H.S. and Prais, S.J. The Analysis of Family Budgets Cambridge University Press, 1955. Prais and Houthakker tested a series of non-linear functional forms in order to obtain a better description of observed facts. They did this by making use of U.K. budget data recorded during 1937-39 and then applying each of the five functional forms. The equations which gave the closest statistical fit were judged to be the most appropriate for that particular category of good or service. The functional forms examined were as follows:

- Double Logarithmic
  \[ \ln Q_a = a + b \ln Y \]  
  eqn. (3.7)

- Logarithmic Reciprocal
  \[ \ln Q_a = a - \left( \frac{b}{Y} \right) \]  
  eqn. (3.8)

- Semi Logarithmic
  \[ Q_a = a + b \ln Y \]  
  eqn. (3.9)
Linear \[ Q_1 = a + bY \] eqn. (3.10)

Hyperbolic \[ Q_2 = a - \frac{b}{Y} \] eqn. (3.11)

where \( Y = \) Income

(A fuller description of each of these functional forms is given in Chapter 7). The functional form which fitted the budget data for the food categories was found to be the semi logarithmic form. This form makes it possible for a commodity to appear as a luxury at low income levels (high income elasticity) and as a necessity at high income levels (the elasticity gradually decreases to less than unity as income rises). For non-food commodities the double logarithmic was the dominant functional form.

This work involved a rather pragmatic approach to demand analysis based on statistical goodness of fit. While it allowed for greater accuracy when analysing data there are some doubts about the theoretical basis for using one form rather than another.

Prais and Houthakker also tackled the problem of explanatory variables being limited to own-price and total expenditure. Thus, they attempted to take account of variables such as family size and composition, regional location, social class and occupation.

This use of additional explanatory variables was taken further by Houthakker and Taylor in 1966. They estimated equations for 81 categories of consumer expenditure using annual per capita U.S. data in constant prices for the period 1929-64, omitting the war years 1942-45. Up to six explanatory variables were used for any one commodity group. The models used included
variables relating to past events, as well as current, such as, past income or quantity consumed of the commodity in the previous period. They also introduced a variable, $S_t$, referred to as a "state" variable with a different interpretation for durable and non-durable goods. For durables, $S_{t-1}$ was the beginning period stock of the relevant good. For non-durables, however $S_{t-1}$ was interpreted as a "psychological stock of habits", implying that tastes and hence purchases are influenced by previous consumption.

In all, fifty five variables were used, forty five of them being prices; with a different set of explanatory variables for each commodity group. For instance, in the 1966 study for alcohol consumption a variable stating the proportion of the population over the age of eighteen was used, but was not applied for other commodities. By tailoring each demand function to the commodity in question Houthakker and Taylor found that in nearly all instances the goodness of fit, the "plausibility" of the estimated parameter and the serial correlation of the disturbances were considered by the researchers to range from "satisfactory to excellent". In fact, fifty five of the eighty one items had coefficients of determination greater than 0.95.

Prais, Houthakker and Taylor's method of selection from among the different functional forms was based on the goodness of fit. While this tends to raise the explanatory power of the model, there are limitations which result from the use of a pragmatic approach. By allowing for more realistic changes of the income elasticity as incomes rise, Prais, Houthakker and Taylor
draw little on the theory of utility maximization as they do not satisfy the adding up criterion. That is, if all Engel curves are based on one or other of the functional forms eqn. 3.7 to 3.11 above, then the sum of expenditure on all goods and services (calculated from the individual equations) is unlikely to equal total expenditure, (derived exogeneously) i.e.

$$\sum p_i q_i \neq E$$ eqn. (3.12)

3.4 THE EXPENDITURE SYSTEMS APPROACH

This approach to the estimation of demand equations involves the estimation of a consistent system of equations covering all current expenditures made by the consumer. This enables the restrictions imposed by consumer theory to be satisfied. A set of general restrictions on a system of demand equations arise because the consumer is assumed to maximise utility subject to a budget constraint.

The budget constraint is:

$$p_1 q_1 + p_2 q_2 + p_3 q_3 + \ldots + p_n q_n = E$$ eqn. (3.13)

There are four main restrictions imposed by demand theory. The first of these is aggregation or the adding up criterion. That is, the sum of individual expenditure is equal to total expenditure.

A common restriction employed in economics is the homogeneity restrictions - a doubling of prices and income leaves the budget constraint unchanged, and therefore should have no effect on a consumers choices. Demand equations are therefore homogeneous of degree zero in prices and total expenditure.

The symmetry restriction refers to cross-substitution
effects. The total substitution effect of a unit change in $p_2$ on $q_1$ is identical to the total substitution effect of a unit change in $p_1$ on $q_2$. Finally, the negativity restriction refers to the own-substitution effect on the demand for a good of a change in its own price. The demand for a good always falls in response to a price rise which is accompanied by a compensatory payment which maintains utility constant.

In empirical work, an additional restriction is usually imposed. This is “additivity” or “want independence”, that is the marginal utility of any one good or service is independent of the quantities consumed of all other goods. The full implications of additivity are in fact very restrictive indeed. Firstly, for example, it means there can be no inferior goods. Secondly, complimentarity in the Hicksian sense is not possible. Advocates of the additivity assumption argue that it is acceptable provided goods are defined at a sufficiently high level of aggregation. For example, the marginal utility of “entertainment” is unlikely to be much affected by the quantity of “food”. The main advantage of imposing this restriction is that in empirical analysis it enables higher degrees of freedom, and thus makes possible calculations based on more limited data.

In 1954 the Linear Expenditure System (L.E.S.) was used by Stone in an attempt to improve the theoretical underpinnings of empirical demand studies. This model was not only consistent with

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7Stone, J.R.N. Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. Economic Journal 64, 1954, page 511-527
demand theory but was computable even by the modest standards of thirty years ago and could be applied to actual data. The first statement of the system appears in a paper by Klein and Rubin in 1948 and elaboration of its properties were discussed in contributions by Samuelson (1947-48) and by Geary (1949-50). In 1954 the model was restated by Stone who demonstrated a simple estimation technique and applied the model to interwar British data.

The L.E.S. is based on the specification of a utility function as given by equation 3.14

\[ U = F(q_1, q_2, \ldots, q_m) \]

\[ = A_1(q_1 - \delta_1)^{a_1} (q_2 - \delta_2)^{a_2} \ldots (q_m - \delta_m)^{a_m} \]

\[ q_i > \delta_i; \beta_i > 0 \]

where \( q_i \) refers to the quantity consumed of the \( i \)th good.

\( \delta_i \) is the minimum quantity of the \( i \)th good for the consumer's existence.

\( \beta_i \) is the marginal budget share of the \( i \)th good.

The function \( F \) is normalized by setting \( A = 1 \) and requiring the \( \beta_i \)'s to sum to unity.

The first order demand equations implied by the maximization

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of $U$ in equation 3.14 subject to the budget constraint,
\[ \sum_{i=1}^{m} p_i q_i = E \]
are:
\[ p_i q_i = \delta_i p_i + \beta_i (E - \sum_{i=1}^{m} p_i \delta_i) \]  
\[ i = 1 \]
\[ \vdots \]
\[ p_m q_m = \delta_m p_m + \beta_m (E - \sum_{i=1}^{m} p_i \delta_i) \]
where $p_i$ is the price paid for the $i$th good. $E$ is total expenditure.

Thus, expenditure on each good is a linear function of total expenditure and all prices.

For a person with a utility function like that given in equation 3.15 who is motivated by maximization of satisfaction, the demand function will have price ($\frac{\partial}{\partial p}$) and consumption ($\frac{\partial}{\partial q}$) elasticities given by equations 3.16 and 3.17
\[ \frac{\partial}{\partial p} = -1 + \frac{\delta_i (1 - \beta_i)}{q_i} \]  
\[ \frac{\partial}{\partial q} = \frac{\beta_i p_i q_i}{E} \]

Observe that the elasticities are not constant in the sense that they depend on quantities and prices as well as the parameters of the utility function.

An appealing way of interpreting equation 3.15 is to regard expenditure $p_i q_i$ on good $i$ as made up of two parts. One part, $p_i \delta_i$ is the minimum possible expenditure on good $i$ so that $\delta_i$ is to be interpreted as the "subsistence level" of consumption for good $i$. Hence, a portion of total expenditure, $\sum_{i=1}^{m} p_i \delta_i$, is committed to unavoidable subsistence purchases. The remainder of total expenditure $E - \sum_{i=1}^{m} p_i \delta_i$, is sometimes referred to as
"supernumerary expenditure" and is spent on all goods in constant proportions. Thus the second part of expenditure on good \( i \) is always some constant fraction, \( \beta_i \), of supernumerary expenditure.

Extensions of the basic model have been developed subsequently. In general they are subject to similar limitations as the L.E.S.

The problems associated with the systems approach are looked at in detail in the Appendix to this Chapter. The main points are summarised here. The major problems arise as a result of the additivity assumption. This does not permit the possibility of inferior goods, complimentary or Giffen goods. This limitation is acknowledged by demand system proponents and is judged defensible if the arguments of the utility function are taken to be broad aggregates of goods, such as, "food" and "clothing" rather than individual commodities. Thus, the systems approach is less suitable for a disaggregate analysis.

The Linear Expenditure System gives some implausible results. For instance it enforces one particular relationship known as Pigou's Law:

\[
\eta_{pi} = \phi \eta_{xi} \quad \text{eqn. (3.18)}
\]

That is, the own-price elasticity and income elasticity vary in proportion. This relationship holds in the case of the L.E.S. because of the additivity assumption.

One further result of the restrictive assumptions of the model is that as income increases all income elasticities tend to unity. This can be clearly seen as unreasonable even with the most casual observation of the real world.
The complete system approach tends to limit the opportunities for investigation of influences, other than own-price and income, on consumer demand. One may wish to consider detailed influences on the demand for a particular good. Some particular feature may not be shared by other demand equations in the subsystem: the demand for good $i$ may be a function of a number of variables that do not appear in the other demand equations. It is more appropriate, therefore, to estimate a complete system where uniform characteristics (i.e., the same functional form and the same independent variables) are required for the purpose at hand.

3.5 THE INTERNATIONAL COMPARISON PROJECT

A further advance in the field of demand analysis was made with the International Comparison Project (I.C.P.) which was undertaken by the United Nations in conjunction with the World
Bank and the University of Pennsylvania. While the aim of the Project was to be able to measure the real income of a number of countries, both in the developed and in the developing world, it also produced a large quantity of data showing the real level of consumption for 151 categories of goods and services.

The real consumption levels were calculated after taking into account the different price levels in each of the economies. The quantity of good or service consumed for the representative person in each country (34 were used in all in Phase III) was calculated and expressed as a number of international dollars worth per capita. This resource intensive project investigated price and expenditure on 151 commodity groups in each country. With the use of Purchasing Power Parities the researchers were able to compare prices and quantities consumed for each category across the sample of countries. (For a more detailed description


of I.C.P. methodology see Chapter 4).


The I.C.P. took into account all three major sectors of the economy, that is, capital formation and government spending as well as private consumption expenditure. It also undertook a cross-section analysis which allowed for varying levels of price as well as incomes. Prior to the I.C.P., budget studies concentrating on one country tended to assume that the prices for households were the same regardless of income level and thus were excluded from any regression analysis.

To calculate income and price elasticities the project members made use of a double logarithmic functional form demand equation with multiple regression.

\[
\ln Q_i = a + b\ln E + c\ln \left( \frac{P_i}{P_M} \right) \quad \text{eqn. (3.19)}
\]

where \(P_i\) is the Purchasing Power Parity for the category, \(i\), and

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\(^1\) Although the most recent International Comparison Project, Phase IV, provides information on sixty countries based on 1980 data it does not permit detailed consumer service demand analysis. The published data is for only fifty eight categories, most of which are a mixture of goods and services. Also the purchasing power parities were firstly calculated on a regional basis and only subsequently calculated across regions. Thus the results do not permit the same degree of accuracy for international comparison as the Phase III results.

Reference:
\( P_x \) is the Purchasing Power Parity for Total Consumption Expenditure.

The results, on the whole, were quite satisfactory in terms of goodness of fit and high \( t \)-values.

The I.C.P. managed to cope with some of the major problems left open at the end of the 1960's. It enabled demand analysis to be carried out internationally, and did so for a wide range of products and countries on a disaggregated basis. However their analysis made use of only two determining variables, own-price and income. These elasticities and the demand model for each commodity group may be improved by testing other functional forms and including other relevant variables. For example, the model for the demand for postal services may be improved by including a variable for the relative price of the substitute telephone services. As will be described in later chapters this thesis will test various models for the service categories using additional variables and functional forms.

3.6 CONCLUSIONS

The study of Engel curves and other demand relationships has grown in sophistication over the last 130 years. There has been a transition from simple budget studies employing one determining variable through to models involving a variety of functional forms and a number of variables. Alongside this increasingly detailed "pragmatic" approach has been the development of consumer theory and its application to empirical demand analysis leading to the "expenditure systems" approach.
With the development of regression techniques Allen and Bowley, and Schultz were able to undertake empirical demand studies in the 1930's. Allen and Bowley made use of only one determining variable, that of total expenditure. Schultz used own-price and applied a time trend variable to capture other influences. They employed either the linear or double logarithmic model. The limitation of a small number of variables and functional forms was overcome in the 1950's and 1960's when Stone, Prais and Houthakker, and Houthakker and Taylor made use of up to five different functional forms and a variety of variables. This work improved the estimates of income and own-price elasticities and identified a number of other relevant variables.

However, the studies of this period were often restricted to one country and a limited range of goods. The problems of comparing prices and incomes across international boundaries was overcome with the series of studies published under the International Comparison Project (I.C.P.) in the 1970's and 1980's. These enabled income and own-price elasticities to be calculated using thirty four countries as observations. These observations gave a wide spread of income levels, relative prices, and the quantity consumed of a good or service in each country.

The pragmatic approach generally involved the use of ordinary least squares regression. Up to five different functional forms were used and a wide range of variables tested. The selection of the most appropriate functional form and determining variables was based on goodness of fit. Unfortunately
this approach to demand analysis may not satisfy the adding-up criterion. That is, the sum of individual expenditure on goods and services as calculated through the model is highly unlikely to be equal to the actual total expenditure as given exogeneously.

The system approach developed in response to the need to establish demand relationships on the basis of the theoretical restriction of consumer theory. Under this approach the prices of all other goods and services influence the quantity consumed of one particular good or service; thus all prices should be included in the model. Unfortunately this model is likely to be impossible to estimate, because of loss of degrees of freedom, therefore a number of theoretical restrictions are applied. These include the additivity restriction which leads to the exclusion of complimentary, inferior or Giffen goods from the model. It also leads to Pigou's law and a tendency to unitary elasticities. These restrictions are considered reasonable if the model is based on large aggregates of consumer spending, such as "food" or "entertainment".

The restrictions of consumer demand theory reduce its applicability to disaggregated analysis and thus no use was made of such an approach in this study. The more pragmatic approach employed allows the estimation of elasticities on an individual service basis and permits the exploration of other relevant determining variables for each category separately.
APPENDIX 3.1 THE LINEAR EXPENDITURE SYSTEM

The Linear Expenditure System has been developed since the 1940's in order that the empirical study of consumer demand patterns may be consistent with consumer theory.

Single equation methods are not derived from formal theory of consumer behaviour in the same way. They usually break an important theoretical restriction: the adding-up criterion. That is, the total of the endogeneously determined individual expenditures on goods and services must add up to the exogeneously derived figure for total expenditure. Because this restriction is not imposed from the outset upon the explanatory equation as a whole the variables and the functional form are chosen because of the apparent better explanatory power they give in terms of error sum of squares and t-values. It will only be by coincidence that the total expenditure provided by the addition of the individual expenditures and the total derived exogeneously equal the same value.

The criticisms of the ad hoc approach are further reinforced by the ability of such an approach to give higher coefficients of determinations simply by the researcher searching through a long list of variables until the model is apparently improved. This process of "data-mining" or "torturing the data until they confess"¹ has been avoided, to some extent, in this present study by a concentration on not $R^2$ but the adjusted coefficient of determination and by only testing variables for which there are good a priori economic reasons for including.

¹The Economist May 9th 1987 pp 71.
It is argued that valid demand relationships should be based on the assumptions of utility analysis. Perhaps the first step in this direction came from the development of the Linear Expenditure System. This model was not only consistent with demand theory but was computable even by the modest standards of thirty years ago and could thus be applied to actual data. In 1954 the model was restated by Stone who demonstrated a simple estimation technique and applied the model to interwar British data. (For a description of the model see Section 3.4).

The Propositions of Utility Theory:

The first point to emphasize is that the theory is a theory of the single consumer acting without error. If his preference structure is sufficiently well behaved and if he is capable of infinitely fine adjustment of a budget spent on a large number of homogeneous goods then a few propositions about his (or her) behaviour may be deduced. These are as follows:

1. **Aggregation** (Adding-up criterion)

   The sum of his individual expenditures is equal to total expenditure. Note that total expenditure is not identified with income. The force of the total expenditure constraint is two-fold. In the first place it ensures that the form of the demand function is such that the sum of each expenditure comes to the predetermined total under all circumstances. In the second place it defines the problem so that the allocation of the budget is included while the consumption function itself is not.
(2) **Homogeneity**

The demand functions are homogeneous of degree zero in income and price: a proportional change in income and all of the prices has no effect on the quantities purchased or, a fortiori, on the budget allocation. The proposition is often referred to as the "absence of money illusion". This proposition is often used as a basis for writing demand functions in terms of real income and relative prices.

(3) **Symmetry**

The matrix of compensated price derivatives or substitution matrix must be symmetric. These derivatives are calculated after the individual has been compensated for changes in real income brought about by the price change being considered. For example, the compensated cross-price derivative between eggs and butter is measured as the number of extra eggs bought per unit increase in the price per pound of butter given that the consumer is simultaneously provided with enough extra cash to buy the original quantities at the new prices. The proposition then states that this number of eggs is equal to the number of extra pounds of butter that would have been bought had there been a similar compensated increase in the price of eggs.

(4) **Negativity**

This relates also to the substitution matrix and states that the elements should be such that the matrix as a whole should be negative semi-definite. Among other things this means that compensated price increases lead to lower demands for the goods involved, and more generally, that the same must be true for any
constant weighted bundle or index of goods.

Problems Associated With The Linear Expenditure System.

There are five main areas of problems that can be associated with the Linear Expenditure System. These are:

1. The additivity assumption is unsatisfactory.
2. The implications for price and income elasticities when the mathematical properties of the model are examined are unrealistic.
3. There are problems associated with including variables other than own-price and expenditure.
4. Aggregation over consumers in empirical work leads to a break with the utility theory which is based on the individual consumer.
5. The original purpose of the L.E.S. under the Cambridge Growth Model was rather limited and is not really relevant to the analysis of the International Comparison Project data.

The first two of these problems are closely related but here they have been separated for ease of exposition.

(1) Additivity

One of the most important restrictions on the demand systems approach (for example, the L.E.S) is that of additivity or "want independence". A consumer's preferences are said to be want independent if they can be represented by a utility function which is additive in the sense that the marginal utility of any one good is independent of the quantities consumed of all other goods.

Additivity is a somewhat extreme assumption for it can be
shown that it implies that goods cannot be inferior and neither can they be complements. Also, the prohibition of inferior goods rules out Giffin goods, a fortiori. The precluding of inferior and complementary goods is likely to be serious in dealing with all but the broadest classification of expenditures. Indeed advocates of the additivity assumption argue that it is acceptable provided goods and services are defined in a sufficiently broad manner. For example, the marginal utility for "entertainment" is unlikely to be much affected by the quantity of "clothing" consumed.

The non-acceptance of complementary or inferior goods mean that the L.E.S. can only be applied to broad categories of goods and services. This thesis is concerned with detailed disaggregation of commodities, for which the systems approach is less appropriate.

Angus Deaton, is acutely aware of the drawbacks of the additivity assumption:

"... , all goods are substitutes, or worse, if a good is inferior, it is a complement to all normal goods and a substitute to other inferior goods."

Later in Deaton's analysis of demand in post-war Britain he states that there are cases where "the model (L.E.S.) goes very wrong indeed and the most important of these should be noted again. The worst are those situations where purchases are falling due to rising relative price i.e. where a low income elasticity is accompanied by a high price elasticity, and extending this,

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where a good is inferior but normally price responsive. In the first place the model enforces inferiority and in both it will give perverse price elasticities contrary to even the most obvious evidence to the contrary. It is probably the number of these cases rather than the more commonly emphasized factors such as the absence of cross-price effects, which in the last analysis limits the applicability of the L.E.S. or of additive models in general".  

(2) The Implications for Income and Price Elasticities of the L.E.S.'s Mathematical Properties

The Linear Expenditure System enforces one particular relationship known as Pigou's Law:

\[ \eta_{p} = \eta_{i} \]

That is, the own-price elasticity and income elasticity vary in proportion. Deaton\(^4\) says that the quantity \( \phi \) tends to be somewhere between -4 and -1. This relationship holds in the case of the L.E.S. because of the additivity assumption (for a mathematical explanation consult Deaton 1974\(^6\)).

In the real world there is no reason to expect that this relationship should hold for all groups of goods and services. Thus, we have more evidence that the additive demand systems fail to reflect the true demand relationships. So we must question whether the assumptions of utility theory have over-

\(^3\)Deaton, A.S. (1975) ibid pp 154.
\(^4\)Deaton, A.S. (1975) ibid pp 18.
simplified the real world. Deaton is very doubtful about the chances of Pigou's Law holding in the real world "This is a very restrictive relationship. It is also so little supported by casual empirical observation that it would be surprising if it were universally valid".

"It might be added that although it may seem obvious that the imposition of a strong relationship between price and income elasticities would tend to distort the measurement of both, this has not at all been emphasized in the literature. This failing seems primarily due to a less than full realization of the implications of the models used and of the extent to which assumption was being allowed to dominated over the evidence under analysis".

..."the major contradictions found between Pigou's Law and the evidence... must give rise to serious doubts about the whole methodology of demand analysis using additive models. This is not because the rejection of additivity is itself new but because the prior implausibility of the proportionality relation much enhances the force of the rejection. For if additivity is regarded as a convenient way of dealing with cross-price responses the finding that the assumption is false can be taken to mean that there exists more interaction between commodities than has been explicitly modelled.... In view of Pigou's Law... it is the own-price responses which additivity is distorting and it is the income and own-price elasticities which are the very

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†Deaton, A.S. (1975) pp 76
stuff of the modelling and analysis of demand behaviour".*

The additivity assumption has shown itself to be an unrealistic simplification of the real world first of all with respect to complements, inferior goods and Giffen goods and it has the unfortunate property when applied in the L.E.S. of imposing income and price elasticities that are directly related for a good or service. To this list can be added one further unrealistic result of the restrictive assumptions of this model: as income increases all income elasticities tend to unity (the mathematical explanation for this is given on page 28 of Deaton*).

In the real world some goods, at low income levels, are highly income elastic, they become less so as they become more commonplace and eventually their consumption approaches saturation or even falls off, giving zero or even negative elasticities. It is more reasonable to expect the demand for, say, potatoes to follow this pattern rather than the income elasticity approaching unity with high levels of income as the theory would suggest.

The characteristics of the L.E.S. may be more appropriate at high levels of aggregation. However it is difficult to accept that the category "food", say, can be said to tend toward an income elasticity of unity whatever the rise in income.

(3)Additional Variables

A major problem in obtaining estimates of income elasticities and price elasticities with cross sectional data is

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**Deaton, A.S. (1975) p. 28.
that the expenditure on any good will vary from individual to individual for reasons other than variations in income and prices. These "nuisance" variables range from average age of consumer to whether the individual lives in a densely populated area. While aggregate values of such variables will change only slowly over time and hence can be ignored in time series studies it is clear that considerable variation is to be expected over a cross section such as the International Comparison Project (I.C.P.) data. If these variables are ignored there is a danger of serious specification error. The ad hoc model approach is far more suited to the introduction of a handful of additional variables than the L.E.S. One reason for this is that the L.E.S. requires that each additional variable must apply to each of the commodities consumed. The ad hoc approach allows the introduction of a variable to one commodity and a completely different variable to another. For example, the demand for children's clothes is related to the proportion of the population under fifteen years old thus it is appropriate to introduce this variable when looking at this particular category. However this variable is probably not relevant when one is interested in assessing the demand for many other commodities e.g. petrol.

(4) The Transfer Of Utility Theory Propositions from the Individual Consumer and the Specific Commodity to Groups of Consumers and Commodities.

Utility theory is concerned with the world of the individual consumer, yet data is normally collected on groups of individuals and on commodities in a highly aggregated way.
Aggregation over commodities is a problem of index number theory: how is it possible to define composite commodities and price indices which behave in all respects identically to the individual commodities of the original statement? This particular problem can generally be overcome.

However, aggregation over consumers causes problems. In outline the problem is as follows: even if every single consumer in the economy behaves according to the theory, there is no guarantee that their aggregate behaviour will likewise conform. This is partly because changes in aggregate income will in general involve changes in the distribution of income (and even when this is not so, differences in utility functions between consumers can cause apparent inconsistencies in aggregate behaviour). This is one of the areas where pure theory is of little use when related to the real world. Perfect aggregation over consumers requires highly implausible restrictions. In order that all consumers taken together or alternatively the average consumer should behave as the single consumer of the theory, it is necessary that all consumers' Engel curves be parallel straight lines. Thus, under all circumstances increases in income must be spent in fixed proportions on each of the goods and these fixed proportions are not only constant for each individual but are also the same for all individuals. A consequence of this is that every consumer buys all of the goods. At best this could only hold for broad categories of goods, and even so, it requires a quite unreasonable degree of uniformity between individuals.

The I.C.P. data involves a very broad range of income levels
and income distribution patterns, therefore the aggregation problem is very real here. It may, to some extent, be alleviated in the pragmatic approach by including a variable for income distribution in each of the models. This is more difficult with the L.E.S.. Deaton criticises those that ignore this problem caused by incomplete theory: "Most empirical analysis based on the theory of demand has simply ignored this problem. Fundamentally such a procedure may or may not be useful quite independently of the validity of its assumptions, but there is certainly no justification for the often repeated contention that such models are "theoretically superior" to alternative demand equations derived on a more casual basis."

(5) The Limited Ambition of the Linear Expenditure System (as used by R. Stone and A. Deaton et. al.)

The Linear Expenditure System was developed to a large extent by the contributors to the Cambridge Growth Project. This project looked at all facets of the economy, only one of which was consumption.

The L.E.S. was used to analyse private consumption expenditure. It did not take income per capita as its starting point nor did it allow for investment, and government expenditure. Taking this narrow outlook when analysing demand can have important consequences. For instance, if the propensity to invest changes with rising income then the demand pattern for consumer goods and services is likely to be alterable by a variable other than income.

During the twentieth century governments have increasingly
taken responsibility for the provision of a number of goods and services which previously would have been provided for by consumers purchases. For example, health and education. The result of this tendency is that consumer expenditure accounts for less of total final expenditure. Just because the source of funds for these services has shifted it does not mean that the consumption per capita has changed. However, because in most studies, the L.E.S. looks only at consumer expenditure it fails to take account of the consumer services provided by government.

Thus, the systems approach can be criticized for its narrowness, concentrating on only one part of the economy.

Concluding Remarks

This appendix has highlighted the problems associated with the Linear Expenditure System in application to the data of the International Comparison Project.

The L.E.S. is inappropriate to this study for two overarching reasons. Firstly, the theory is incomplete and therefore cannot justly claim theoretical superiority over the more casual approach. Secondly, the model is less suitable for handling data on the level of disaggregation that this thesis is based upon and is unable to take account of a number of relevant variables other than price and income.

With regard to the theoretical implausibility one can mention the unrealistic assumption of additivity with its consequences on inferior goods, complimentary goods, Giffin goods, Pigou's law and the tendency of elasticities to unity. These consequences are very serious. Attempts have been made to
avoid some of the unacceptable effects by analysing demand on the basis of large aggregates of commodities e.g. "food", "clothing", "entertainment", as the aggregate group is unlikely to be a complement or to behave in an inferior way with regard to another group. This may be reasonable with sufficiently high aggregation but the problems of Pigou's Law and the tendency of elasticities to unity still reduces the usefulness of the utility theory based models.

Another problem associated with the L.E.S. claim to be based on appropriate theory is that utility theory is based upon the individual consumer and so when data is analysed on the basis of groups of consumers unrealistic assumptions have to be made concerning such matters as income distribution. This restriction does not have to be imposed so rigidly for the ad hoc models as income distribution may be introduced as an explanatory variable.

A final point concerning the theoretical superiority is that the L.E.S. looks at only one sector of the economy (consumption). This may lead to an incomplete analysis.

The L.E.S. is less useful in the analysis of the data made available by the I.C.P.. Firstly, the theoretical problems mean disaggregated analysis is not possible. Secondly, the L.E.S. does not allow the addition of commodity specific variables such as age, whereas the ad hoc approach permits a variety of variables to be applied.

The systems approach to the study of demand patterns on a disaggregated basis is subject to both theoretical and practical limitations.
CHAPTER 4
THE INTERNATIONAL COMPARISON PROJECT

The International Comparison Project (I.C.P.) is the primary data source used in this thesis. A description of the I.C.P.'s methodology is given in this Chapter. This is set out in the following manner:

Section 4.1 gives an introduction the background and purpose of the I.C.P.

Section 4.2 describes the basic methodology chosen by the I.C.P.

Section 4.3 provides some details on the construction of the data.

Section 4.4 considers some of the limitations of the study.

4.1 BACKGROUND AND PURPOSE OF THE INTERNATIONAL COMPARISON PROJECT

The United Nations International Comparison Project represents a cooperative effort, under the aegis of the United Nations Statistical Office and with the support of the World Bank and many governments, to establish a reliable system of comparisons of real product and purchasing power.

The lack of comparable data on levels of output and income in different countries has been an important gap in the statistical systems describing the world economy. Until the I.C.P. was initiated, the usual practice was to convert the output or incomes of the various countries to United States dollars, or some other common currency, through the use of
official exchange rates. Although exchange rates have long served as a yardstick in international comparisons they do not reflect the relative purchasing powers of different currencies. Phase I of I.C.P. found, for example, that the same basket of goods bought in Italy at Italian prices cost 25 per cent less than it did when purchased in the United States.

The problem with exchange rate conversions become more pronounced with floating rates. Changes in rates within one year can be dramatic.

Reasonably accurate comparisons of intercountry differences in income and purchasing power of currencies are required for a wide variety of purposes. They are particularly useful in any effort to understand the process of economic growth and development; an aspect of which is the demand for consumer services.

The comparisons of real product per capita and of purchasing power are not only for G.D.P. as a whole but also for the three main components of G.D.P. - namely, consumption, capital formation, and government. In addition, estimates are provided for a more detailed breakdown of expenditure on G.D.P.

The Phase I report - A system of International Comparisons of Gross Product and Purchasing Power¹ set out the methodology


This thesis makes use of the data provided by the third phase of the I.C.P.

4.2 OUTLINE OF METHOD

The basic methodological approach of the I.C.P. is to obtain quantity comparisons by means of price and expenditure comparisons. Expenditure (E), prices (P) and quantities (Q) are linked together in the familiar identity

$$E = P \cdot Q$$  \hspace{1cm} eqn. (4.1)

It follows that for any pair of countries, j and k, with respect to commodity i,

$$\left(\frac{E_{ij}}{E_{ik}}\right) = \left(\frac{P_{ij}}{P_{ik}}\right) \cdot \left(\frac{Q_{ij}}{Q_{ik}}\right)$$

so

$$\left(\frac{Q_{ij}}{Q_{ik}}\right) = \left(\frac{E_{ij}}{E_{ik}}\right) \div \left(\frac{P_{ij}}{P_{ik}}\right)$$  \hspace{1cm} eqn. (4.2)

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Thus the quantity ratio can be estimated either directly or indirectly through the ratio of \((E_{s,t}/E_{w,t})\) to \((P_{s,t}/P_{w,t})\).

Direct quantity comparisons - that is, direct estimates of \((Q_{s,t}/Q_{w,t})\) are difficult to make for many kinds of goods or services. The I.C.P. category women's clothing, for example, is so heterogeneous that quantity data for each type and quality are difficult to obtain. Also the quantity ratios \((Q_{s,t}/Q_{w,t})\) for individual types and qualities can be expected to exhibit wide dispersion relative to the corresponding price ratios.

Hence primary reliance has been placed on indirect estimates of the quantity ratio. This is achieved by the calculation of direct price ratios and dividing these into the expenditure ratios (as in eqn. 4.2). The expenditure for the various detailed categories were available from national accounts data or could be otherwise derived.

The tasks involved in the I.C.P. methodology are:

(i) Dividing G.D.P. into categories for which expenditure data and price comparisons can be obtained.

(ii) Selecting and pricing a sample of specifications for each expenditure category.

(iii) Aggregating the price relatives at the category level.

*In a few categories however quantity data lend themselves more readily to international comparisons than to price data. These are categories for which the quantity data are available on a comprehensive basis and in which the contents are relatively homogeneous, at least as far as can be measured for purposes of international comparison. These conditions are met in the service sectors for which national accounting conventionally measures output by the quantity of inputs, as in education and health.
(iv) Aggregating the categories to form price and quantity indexes for G.D.P. and its subaggregates.

A description of each of these stages in the I.C.P. analysis is given in the next section.

4.3 SOME DETAILS OF THE I.C.P. METHOD

4.3.1 Dividing G.D.P. Into Categories

Final expenditures on G.D.P. are subdivided into 151 detailed categories, following closely the United Nations System of National Accounts® (S.N.A.). It was necessary however to flesh out and make more specific the commodity classifications suggested in the S.N.A. The classification employed in the I.C.P. is mainly a functional one: household consumption, capital formation, and government consumption are differentiated and then subdivided.

For some kinds of final expenditure - medical care, education and the like - regardless of the varying degrees to which they are paid for by households or governments, the I.C.P. assigned each general type wholly to "consumption" or to "government" in a uniform manner from country to country. Expenditures for health, education, recreation and housing have been assigned to I.C.P. "consumption".

Services providing physical, social, and national security - those activities which are found rather consistently to be carried on by public authorities and financed by tax revenues -

have been allocated to I.C.P. "government".

Each participating country was asked to allocate its expenditures on G.D.P. to the detailed categories of the I.C.P. classification system.

4.3.2 Selecting And Pricing A Sample Of Specifications For Each Expenditure Category

The next step is to make price comparisons for each detailed category. This phase of the work has the greatest influence on the quality of the income comparisons.

Prices for each of the other thirty three "partner" countries were compared with the prices for United States for most of the 151 detailed categories. In each case the comparisons were made for from one to a dozen representative items in common use.

The sample of specifications for each category must be representative of price formation influences in each country, and the items actually priced in the different countries must be equivalent in quality.

To insure such equivalence the I.C.P. arranged international exchanges of samples, on-the-spot inspection of goods in shops by visiting price experts, plus the advice of merchants, manufacturers and engineers. Once the specifications were established, the country's statistical authorities provided the national average price for each.

In Phase III the thirty four participating countries each priced an average of nearly 400 consumer goods, 38 construction specifications, and nearly 100 producer durable goods.
The price comparison for each item yields the purchasing power parity (P.P.P.) for the item within a category. That is, a price ratio indicating the number of units of the country's currency that are required to buy what can be bought in the United States with one U.S. dollar.

4.3.3 Aggregating The Price Relatives At Category Level

A major problem was encountered when the item prices were averaged in order to calculate the P.P.P. for the category as a whole. Countries vary widely in their consumption habits at the item level. This variety made it impossible to price a standard list of specifications in all countries and still retain the principle that only representative items be compared. For instance in the category "Fresh Vegetables" a representative price would not be found for yellow squash in the U.K. as this vegetable is rarely consumed in this country.

Thus, for most detailed categories few, if any countries reported prices for the full list of items. Methods were devised for deriving transitive, base country invariant, index numbers from incomplete sets of prices for the detailed categories.

The question was how to treat \( p_{ij} \)'s in a way that took systematic account of the absence of price entries for particular items in particular countries. The I.C.P. procedure is a generalized bridge country technique called the country product dummy (C.P.D.) method.
The data input will be a collection of entries in the price tableau $P$. The entries will be a matrix with $i$ rows and $j$ columns, where $i$ represents the number of items and $j$ represents the number of countries. The entries in the matrix are the prices of the items in each country, expressed in the currency of that country.

<table>
<thead>
<tr>
<th>Item (i)</th>
<th>Country (j)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 ... n</td>
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<tr>
<td>1</td>
<td>$p_{11}$ $p_{12}$ ... $p_{1n}$</td>
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<tr>
<td>2</td>
<td>$p_{21}$ $p_{22}$ ... $p_{2n}$</td>
</tr>
<tr>
<td>P</td>
<td>$p_{i1}$ $p_{i2}$ ... $p_{in}$</td>
</tr>
<tr>
<td>A</td>
<td>$p_{a1}$ $p_{a2}$ ... $p_{an}$</td>
</tr>
</tbody>
</table>

where $p_{ij}$ is the price of the $i$th commodity in the $j$th country and is expressed in the units of the $j$th country's national currency.

To overcome the problem of missing entries in the tableau $P$, the C.P.D. method relies upon a linear regression equation in which the dependent variable is the natural logarithm of price. The independent variables consist of two sets of dummy variables, one relating to the various countries (excluding the base, or numeraire, country) and the other to the various items. The regression coefficient of the dummy variable for each country is then interpreted as the logarithm of the purchasing power parity of that country's currency relative to that of the numeraire country for the category.

An intuitive understanding of the nature of the C.P.D. method may be conveyed by pointing out that if there are no missing observations in the tableau of item prices, the P.P.P. produced by the C.P.D. method for each country is simply the geometric mean of the purchasing power parities of the individual items.
Table 4.1 Purchasing Power Parities For Fresh Vegetables

Prices Per Kilogram Of Fresh Vegetables In 10 Countries In 1970

<table>
<thead>
<tr>
<th>Country</th>
<th>Artichokes (Peso)</th>
<th>Beets (Franc)</th>
<th>Brussel sprouts (D. Mark)</th>
<th>Cabbage (Florint)</th>
<th>Cauliflower (Lira)</th>
<th>Carrots (Yen)</th>
<th>Celery, pas (Shilling)</th>
<th>Cucumbers (Pound)</th>
<th>Eggplant (Dollar)</th>
<th>Coefficient B</th>
<th>Antilog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
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<tr>
<td>Colombia</td>
<td>2.75</td>
<td>3.26</td>
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<td>France (West)</td>
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<tr>
<td>U. K.</td>
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<tr>
<td>U. S.</td>
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</tr>
</tbody>
</table>

1. Artichokes 2.75 3.26
2. Beets 3.90 2.35 1.69
3. Brussel sprouts 1.41 .98 .55
4. Cabbage 5.33 1.90 1.13
5. Cauliflower 2.10 .93 .88
6. Carrots 4.49 .47
7. Celery, pas 4.82 2.32 2.32 8.7
8. Cucumbers 4.71 3.23 2.27 9.3
9. Eggplant 7.90 5.60
10. Escarole 17.4 2.62 2.32 8.7
11. Green peppers 1.27 .56
12. Kunde greens 5.59 1.18 .86
13. Lettuce 1.82 .98
14. Mushrooms 4.82 3.23 2.27 9.3
15. Onions, yellow 5.91 1.18 .86
16. Radishes 1.27 .56
17. Red cabbage 4.71
18. Spinach 5.79 2.55 1.85 6.7
19. Tomatoes 2.29
20. Yellow squash 1.96

Coefficient B, 1.96

Antilog 7.11

*This entry represents a correction of the corresponding figure in Kravis et al. (1975, p. 59).

Taken from I.C.P. Phase I 1975 p.59 & p.60.
The example of fresh vegetables is given in Table 4.1 to illustrate the C.P.D. method.

Let \( p_{ic} \) be the price of item \( i \) in country \( c \), expressed in that country's currency. The C.P.D. method describes the natural log of \( p_{ic} \) as the sum of an item effect \( A_i \) and a country effect \( B_c \). If there are no missing price data and if this relation is estimated by least squares, the estimate of \( B_c \) is the mean over all items of log \( p_{ic} \), and hence the antilog of this estimate of \( B_c \) equals the geometric mean of \( p_{ic} \) over \( i = 1 \ldots 20 \).

However, there are numerous missing prices, indicated by, ..., in Table 4.1. The approach followed by the I.C.P. in such a case is a weighted form of least squares, the weight of each country being selected so as to correct for the large number of items with missing price data in that country.

The \( B_c \)'s of the 10 countries which were covered by the first phase of the I.C.P. and their antilogs are shown in the last two lines of Table 4.1. These antilogs are estimated purchasing power parities of fresh vegetables.

The P.P.P.'s directly obtained from the C.P.D. method are used to derive (indirect) quantity ratios - that is, by division of the P.P.P.'s into the expenditure ratios (see equation 4.2).

4.3.4 Aggregation

The P.P.P.'s and the quantity ratios for the detailed categories were aggregated to derive price and quantity comparisons for thirty six summary categories of G.D.P. (such as "Clothing" and "Education"), the three main components of G.D.P. (consumption, capital formation, and government), and G.D.P.
itself.

The basic I.C.P. method of aggregating the price and quantity indexes for the detailed categories involves the use of a set of average international prices to provide a common measuring rod for the evaluation of each country's quantities. The international prices have been estimated using a procedure by R.C. Geary8 and amplified by S.H. Khamis7.

The price inputs to this process are the detailed category P.P.P.'s and the detailed category quantities, which are obtained from the expenditure provided by the countries.

Since country P.P.P.'s for each category are denominated in their own currency units per unit of the numeraire country's currency, they cannot be combined directly to obtain average world prices. To make the country P.P.P. commensurate, each country's category P.P.P.'s are divided by the country P.P.P. for G.D.P. as a whole. Then the international price for a category is simply the quantity-weighted average of the category P.P.P.'s expressed relative to the country's overall P.P.P.'s.


The category quantities for the countries when valued by the international prices can be aggregated to get G.D.P. or some sub-aggregate.

The problem with the above logical sequence is that the calculation of the international price is possible only if the P.P.P. for G.D.P. as a whole for a country is known.

Similarly, it is necessary to know the international price for each good or service to be able to compute for each country the average (weighted) deviation of its prices from the international prices and thereby obtain the corresponding purchasing power, denoted P.P.P. for the countries G.D.P. as a whole.

That is to say, using the prices and quantities for all countries and all goods and services, $p_{it}$ and $q_{it}$, one can obtain the $\pi_i$'s (international price for a category) if all the P.F.P. are known; and the P.P.P. can be obtained if all the $\pi_i$'s are known.

Geary and Khamis suggested the use of a system of homogeneous linear equations that would make it possible to find the $\pi_i$'s and P.P.P. simultaneously.

G.D.P. can then be found for each country in either of two ways: either (1) by valuing the category quantities at the calculated international prices (the $\pi_i$'s) and aggregating across all 151 categories or, (2) by deflating each country's G.D.P. expressed in domestic currency units by its calculated purchasing power parity (P.P.P.). The two procedures give the same amount.

The Geary-Khamis equation system is as follows:
\[ \pi_i = \sum_{j=1}^{n} \left( \frac{P_{i,j}}{\text{PPP}_j} \right) \times \left( \frac{q_{i,j}}{\text{PPP}_j} \right) \]  
\text{eqn. (4.3)}

\[ \text{PPP}_j = \frac{\sum_{i=1}^{m} P_{i,j} q_{i,j}}{\sum_{i=1}^{m} q_{i,j}} \]  
\text{eqn. (4.4)}

where \( n \) is the number of countries
\( m \) is the number of detailed categories.
\( P_{i,j} \) is the Purchasing Power Parity for category \( i \) and country \( j \)

Equation 4.3 says that the international price of the \( i \)th category is the quantity weighted average of the purchasing-power-adjusted prices of the \( i \)th category in the \( n \) countries.

Equation 4.4 says that the purchasing power of a country's currency is equal to the ratio of the cost of its total bill of goods at national prices to the cost at international prices.

It should be added that an international dollar has the same purchasing power over the U.S. G.D.P. as a whole as a U.S. dollar, but its purchasing power over individual categories is different, because it is determined by the structure of international prices. The quantity relationships among the countries would be the same if some other country was taken as the numeraire country, even though the results would be described in terms of "international pounds", "international marks", or whatever.

\*Without any adjustment of the quantity weights, the international prices and therefore the estimates of per capita G.D.P.s would depend fortuitously on which countries fell within the I.C.P. set. If the I.C.P. countries were unrepresentative of all the countries in the world this would affect the I.C.P. results. Therefore weights were used that in effect allowed each I.C.P. country to affect the calculation of international prices in a way that reflected the prevalence of countries worldwide with its economic structure.
4.4 LIMITATIONS OF THE INTERNATIONAL COMPARISON PROJECT

The international comparisons reported involve many problems concerning the availability and quality of data and concerning concepts and methods applied.

It must be pointed out that on the statistical side, the estimates are based upon a necessarily limited set of observations, and thus sampling errors must be reckoned with. Furthermore despite extensive efforts to avoid them, some incomparabilities remain with regard to expenditures, prices, quantities and even population sizes gathered from different countries.

With respect to the magnitude of errors arising from the expenditure data we have no basis for quantitative assessment. Incomparabilities undoubtedly affect the classification of expenditures into the detailed categories. The quality of the data varies from one country to another, and fitting the country expenditure data into the I.C.P. classification system sometimes required approximations for certain detailed categories. Also, incorrect aggregate G.D.P. totals in national currency will affect the calculation of relative G.D.P.'s in international dollars.

Great care was taken to ensure that the item prices were accurate both when they were collected originally in the various countries and during the processing of them by the I.C.P.. But even if all the individual item prices were exactly correct, the fact that they are regarded as sample observations means that the category P.P.P.s based upon them will be subject to error.
It is possible that a "mis-specification of the proper aggregation procedures" occurred by selecting the Geary-Khamis multilateral method. As a way of testing the extent of this potential error in both phases I and III Kravis et al compare the G.D.P.s resulting from the Geary-Khamis method with a number of alternatives. The resulting estimates of G.D.P. showed only small differences which led Kravis et al to conclude:

"the uncertainty associated with the choice of aggregation methods is probably small".

What is particularly striking from this testing is that, although the estimates for G.D.P. do vary, these variations are very small compared with the results given by official exchange-rate based calculations.

A further drawback of the I.C.P. work as a data source for this thesis is that the most recent international comparable income, quantity and price information relates to the year 1975 i.e. the third phase of the I.C.P. published in 1982.

The projects authors freely admit to the possible errors and problems associated with an analysis of this kind. They are an almost inevitable consequence of an empirical undertaking of this scale.

Nevertheless the I.C.P. estimates provide a rich and improved data set on cross-country expenditure patterns.

4.5 CONCLUSIONS

The International Comparison Project Phase III is an
extremely valuable data source for this thesis.

It has long been known that cross-country comparisons of output and its subaggregates on the basis of exchange rates is fraught with difficulties. The I.C.P. make use of purchasing power parities to provide comparable estimates of real income and total consumption expenditure for a broad range of countries with greatly differing income levels. It also provides information on the relative prices for, and quantity demanded of, 151 detailed subaggregates of G.D.P.

Thus for the twenty six categories of services examined in this thesis the I.C.P. provides the basic input data required to calculate income and own-price elasticites.

This data source provides us with the unusual ability to undertake a cross-sectional analysis of demand, while being able to observe the effects of both income and own-price varying on the quantity demanded of a service.
CHAPTER 5

EMPIRICAL METHODOLOGY

5.1 INTRODUCTION

The empirical method of analysis used in this thesis, along with the results of each stage, are presented in detail in the following four chapters. Here an overview of the stages of the method employed is given.

There are four stages of the analysis. Firstly, it is necessary to select appropriate variables determining the quantity demanded of a service to be tested. The I.C.P. data provide both G.D.P. per capita and total consumption per capita. These two alternative "income" measures are examined, along with their respective alternative price variables, in Chapter 6.

Secondly, if income and own-price are the primary determining variables it is necessary to establish the nature of the relationship with quantity demanded for a service. For instance, does elasticity remain constant or become larger or smaller as incomes rise? This is examined with the use of ordinary least squares regression employing a number of functional forms in Chapter 7.

Thirdly, income and own-price are unlikely to be the only source of variation in demand. Multiple regression permits the testing of a number of possible influences simultaneously. Many additional variables are analysed and the results are presented in Chapter 8.

Finally, after the analysis of the first three phases is completed on a disaggregated basis the information is brought
together to provide evidence on the income elasticity for the consumer service sector as a whole and thus aid the post-industrial society debate. This is shown in Chapter 9.

5.2 THE SELECTION OF APPROPRIATE INCOME AND OWN-PRICE VARIABLES

This problem is tackled from both a theoretical standpoint and by empirical testing of the I.C.P. data.

The theory of "permanent income"¹ and the "life-cycle hypothesis"² suggest that the level of demand for goods and services is not determined by the, possibly, transitory effects of fluctuating levels of G.D.P. from one year to another, but rather, is determined by the perceived long term income of households. This is likely to be some weighted average of past, present and future income, and may only be marginally affected by changes to this year's G.D.P.. Total consumption expenditure is more closely related to permanent income than G.D.P. and is therefore likely to be a more appropriate proxy.

Not only is it possible to use alternative income measures; associated with them are two alternative relative price estimates. The price of a particular category of service may be expressed relative to the price of all items of expenditure in the economy (i.e. the purchasing power parity for G.D.P.), including the price of government services and gross capital formation. Alternatively the price of a category may be expressed


relative to the price of total consumption expenditure items only (i.e. the purchasing power parity for total consumption expenditure).

Thus there are two income measures and two relative price measures and therefore four alternative combinations of these. On a priori grounds, consumption expenditure is preferable to G.D.P. However a series of statistical tests are made to see which income and price measures fitted the data provided by the I.C.P. best. For each of the twenty six services ordinary least squares multiple regressions are carried out using each of the combinations of income and own-price. This was undertaken for five functional forms. Thus a total of 520 regressions were calculated.

The empirical evidence did not encourage the rejection of the argument in favour of consumption expenditure. From this stage of the analysis the theoretical arguments in favour of total consumption expenditure lead to its being selected as the basis on which subsequent income and own-price analysis is conducted.

5.3 FUNCTIONAL FORM

The second stage concerns the precise relationship between the determining variables, income and own-price, and the dependent variable, quantity demanded of a service.

The relationships tested permit a wide range of behaviour. For instance, the double logarithmic form assumes constant elasticity, whereas the logarithmic reciprocal assumes decreasing
elasticity as incomes rise.

For most of the services five functional forms were used. However two categories, "Bus transport" and "Local transport" show a tendency for the income elasticity to be positive initially and then to become negative with higher levels of income. The basic five functional forms were not able to efficiently take this kind of relationship into account. The fit of the regression line in each case is very poor. Thus for these two categories use is made of two quadratic functional forms which give good statistical fits to the data.

For most of the services ambiguous elasticity estimates for the two primary variables are given initially. This is because at a 95% confidence level, even though one functional form may show the "best fit" by its lowest error sum of squares, other functional forms often have error sum of squares not statistically significantly different. Therefore given the sample error inherent in the I.C.P. data it is not always possible to state categorically that one functional form, and thus one elasticity estimate is the most appropriate. The consequences of this ambiguity on the income elasticity estimates for particular categories of services are shown in the appendix to Chapter 7.

5.4 ADDITIONAL VARIABLES

In an attempt to improve the statistical significance of the income and own-price elasticities as well as to establish other relevant variables a number of additional influences on demand are examined in Chapter 8.

Demographic factors may be thought to have a particular
effect on the demand for certain services. For instance the demand for medical care may be influenced by the proportion of the population in old age.

Thus for each of the 26 services four demographic variables are examined via ordinary least squares multiple regression. These are:

(i) Proportion of the population less than fifteen years old.
(ii) Proportion of the population between 15 and 65.
(iii) Proportion of the population older than 65.
(iv) The density of the population - the number of individuals per square kilometre of habitable land surface.

Inflation may also influence the quantity demanded of a service and this is the fifth additional variable tested. The sixth is income distribution but this is hampered by the absence of any suitable data for about one third of the 34 countries in the I.C.P.

Of course the most obvious additional influence on demand, that of cross price effects is also tested. For each category between one and nine possible substitutes or compliments are examined.

Thus for each of the twenty six services ordinary least squares multiple regressions are carried out, firstly with income and own-price as determining variable and then with each of the additional variables in turn, and finally with the additional variables in a variety of combinations. Between seven and fifteen
additional influences are considered for each category.

The results demonstrating an improvement in the income and own-price elasticity estimates and a satisfactory t-value for the additional variable are presented in the appendix to Chapter 8.

The estimates of income elasticities for individual services were then used in the following Chapter to estimate an overall elasticity for services.

5.5 OVERALL ELASTICITY ESTIMATES

Even though the addition of variables in Chapter 8 improved the estimates of income elasticities for the individual services in most cases there were still two or more functional forms of similar statistical significance, giving alternative income elasticities, when the 95% confidence level is used. With a lower level of confidence (such as 80%) it was possible however to establish only one or two elasticity estimates for each category. This was more manageable when calculating an overall elasticity for consumer services.

Chapter 9 shows the calculation of the weighted average elasticities of the service categories.

A number of overall income elasticities for consumer services are provided. For each of the "G5" countries (U.K., France, W.Germany, Japan and U.S.A.) estimates are first based on the inclusion of all 26 services and then two services are excluded (Rents and Electricity) to give estimates based on an alternative view of what constitutes consumer services.

An overall income elasticity is also calculated on the
assumption that one functional form is used for all services. The double logarithmic form was applied. This tends to give higher elasticities at high income levels than the other forms and therefore may perhaps be considered to give the upper limit for the income elasticity estimate.

The resulting overall elasticities are compared with the income elasticities, as provided by the I.C.P., for the durable goods sector. This permitted some judgement to be made on the post industrial society argument that consumer services have particularly high income elasticities.

5.6 LIMITATIONS OF THE STUDY

This statistical investigation of the relationship between economic growth and the level of demand for consumer services is limited by the specific time period relating to the basic data and the specific countries. As such, there is a danger of making generalizations based on specific experiences. The I.C.P. data relates to the year 1975 and to a sample of thirty four countries. Even though this sample contains a wide variety of countries it is still unlikely to be perfectly representative of the world as a whole. Also since 1975 a number of influences on demand may have changed. For instance, at any one time the demand for a particular service depends to some extent on the alternatives then available. The particular mix of goods and services on offer varies from year to year due to, say, innovation. Thus, the introduction of new products since 1975 may affect the demand for consumer services.

Reliance on empirical observation necessitates confidence in
the validity and accuracy of the observed variables. The basic data source, the I.C.P., involves many problems concerning the availability and quality of data. Such problems are inevitable in any international comparison, especially one on such a vast scale, as the activities of many different national accounting bodies have to be coordinated. With respect to the magnitude of the errors arising from expenditure or price data we have no basis for quantitative assessment. All that can be said is that great care was taken over the collection of the data and a great deal of resources were allocated to the study by The World Bank and the United Nations. As Thiel\textsuperscript{3} said about the I.C.P. "as far as the construction of the basic data is concerned, their work is better than what anyone before has performed. In Trumanesque terms, they did their 'damnedest'".

There are some theoretical problems associated with the analysis. For example the adding-up criterion may be violated, that is total consumption expenditure ($E$) derived exogeneously is unlikely to be equal to the total of the expenditures on the various categories ($\Sigma p_q$) derived endogeneously from the individual ad hoc equations i.e.

$$\Sigma p_q \neq E \quad \text{eqn. (10.1)}$$

Also the demand for any good or service is influenced by the price of every good or service. Simply testing for some substitutes and compliments may mean that significant influences

are omitted. However to introduce numerous determining variables would use up degrees of freedom.

These two theoretical problems are solvable in principle by the use of a complete systems approach. However, as was explained in Chapter 3 this approach has its own problems and on balance the ad hoc approach adopted was preferred for the purposes of this study.

Limitations have been imposed by the selection of only a few functional forms and a limited number of variables. It may well be the case that greater insight can be gained by the testing of an ever widening range of these. However practical considerations do not permit the infinite testing that is theoretically desirable. In many cases the data is simply not available. For instance, a variable concerning the proportion of the population living in an urban environment may influence the demand for certain services. Suitable data is not available on this variable for the sample of countries in this study. Even some of the variables used may not have been adequately tested because of problems of data availability. This was certainly the case for income distribution, which may have proved to be a significant factor if accurate data for all 34 countries had been available.

5.7 CONCLUSIONS

The empirical method of this thesis follows a step-by-step approach. The establishment of an appropriate income and price variables is followed by an analysis of demand using only income and own price as determining variables. The analysis is then
broadened and deepened with the addition of a wide variety of other influences on consumer demand. Finally, conclusions are drawn on the consumer service sector as a whole by drawing together the individual elasticities.

While this approach does have drawbacks, such as reliability of data, these have to be seen in the context of the scale of the task at hand and must not be viewed out of all proportion.
CHAPTER 6

INCOME AND PRICE MEASURES

6.1 INTRODUCTION

The International Comparison Project (I.C.P.) has generated information on both the level of real G.D.P. per capita and the total consumption per capita for thirty four countries. Total consumption is defined by I.C.P. as G.D.P. minus gross capital formation and government expenditure. The I.C.P. reports only elasticities using the total consumption expenditure figure as a proxy for income. Thus, the I.C.P. does not, in a strict sense, report income elasticities but total consumption expenditure elasticities. This Chapter compares estimated demand equations using total consumption per capita and the actual income per capita as income variables. The evaluation of the appropriateness of the alternative income measures is based on the statistical significance of the resulting elasticity estimates, and on theoretical considerations.

Similarly the relative price variable used by the I.C.P. is not the price of the category relative to the price level throughout that economy as a whole, but rather, the price relative to the price level for just the consumption component of the economy. This study compares the results of using these alternative price variables.

The structure of the Chapter is as follows:

The theoretical arguments for using a particular proxy for income and relative price are examined in Section 6.2. This is followed, in Section 6.3 by a consideration of the empirical
robustness of the alternative income and price measures. Table 6.1 presents the results of testing the combinations of income and price variables in ordinary least squares regressions. This is shown in Section 6.4 accompanied by a few notes to explain the method and results. Section 6.5 discusses the results. The conclusions and implications are presented in Section 6.6.

6.2 THEORETICAL CONSIDERATIONS

6.2.1 The Income Variable

Income elasticity is the responsiveness of the demand for a good or service to changes in the buyer's income. This definition fails to identify the time period involved, over which the change in the buyer's income takes place. The problem is that a buyer may not determine his spending pattern on the basis of this month's or this year's income but takes into account past spending patterns as well as expected future income. For instance, someone who has been accustomed to spending £1,000 a month, having an income of £1,200, will not necessarily change his habits should his income in this month drop to £500. Even if monthly income is consistently only £900 he may feel safe spending £1,000 because there is an expectation of higher future income sufficient to pay off any debts incurred today. Thus the determining factor may not be this month's or even this year's income, but some weighted combination of all previous years income, present income and expected future income.

The I.C.P. provide the income figure for a single year, i.e. 1975. They do not allow for the lifetime income pattern for
each country. It may be that a country has a particularly low income per capita in 1975, but the level of expenditure remains high because income in 1975 is only one element of the expected lifetime income. Prais and Houthakker\(^1\) put this issue in the following way:

"....both the income of the household and its needs change over time, and the income received in a particular period may be a very poor indicator of its standard of life. The time determinants of the expenditure pattern of a household in a dynamic situation are a complicated function of past, present, and expected incomes, and though this function can analytically be formulated in a precise way it is of little help here. The success of an empirical analysis must depend on the choice of some simple, readily obtainable measure which substantially represents the facts. The use of total expenditure as the determining variable in the Engel Curve can be justified on the assumption that while total expenditure may depend in a complicated way on income expectations and the like, the distribution of expenditures among the various commodities depends only on the level of total expenditure."

(We may, for our purpose, equate Prais and Houthakker's total expenditure with the I.C.P.'s total consumption expenditure.)

Thus, perhaps the most suitable measure for an "income" elasticity would be some expected "permanent" income. This is difficult to obtain, especially on a consistent cross country basis. The second-best measure would be total consumption expenditure followed by the actual income in a given year. The latter ranks third because consumption is a more accurate proxy for "permanent" income due to the fact that consumption expenditure is likely to be less volatile than income. The use of

total consumption expenditure is widely supported, e.g. Philips\textsuperscript{2} and Thomas\textsuperscript{3}. It has also been widely used in applied demand analysis, for example, Stone\textsuperscript{4}, Prais and Houthakker\textsuperscript{1}, Houthakker and Taylor\textsuperscript{5}.

6.2.2 The Price Variable

The question of which price measure to use is a choice between price relative to all prices in the economy or prices relative to just total consumption. The I.C.C. chose to use the latter measure. This is presumably because the consumer mainly takes into account the relative prices of goods and services which he encounters day-to-day when deciding expenditure allocations. The price of government supplied goods and services, such as defence, will not usually affect the demand for consumption items. That is, defence and consumer goods and services are unlikely to be considered close substitutes or compliments. The same logic may be applied, to the investment sector of the economy, especially if most of that investment is funded by the government. This is, perhaps, less convincing because, for instance, the price of investment in housing may be said to have an influence on the demand for goods and services in


the consumption category.

In the absence of a clear theoretical argument the determination of the appropriate relative prices is ultimately an empirical issue.

In the next two sections the I.C.P. data is used to test the appropriateness of the alternative income and price measures based on statistical fit. An agnostic approach is taken initially. Testing is for all possible combinations of the two income measures and the two price measures.

6.3 METHOD OF STATISTICAL TESTING

The price and income measures are therefore:

Income

(i) Total Consumption Expenditure (\(E\))
That is, G.D.P. minus gross capital formation minus government expenditure (expressed in per capita terms) as defined in the I.C.P.

(ii) G.D.P. (\(Y^*\))
Total gross domestic product per capita.

Price

(i) \(P_x/P_m\).
The price of the service expressed relative to the price for total consumption.

(ii) \(P_x/P_y\)
The price of the category expressed relative to the price for G.D.P.
Where $P_i$ is the Purchasing Power Parity (P.P.P.) for category $i$.

$P_m$ is the P.P.P. for total consumption.

$P_Y$ is the P.P.P. for total G.D.P.

There are four possible combinations of income and price measures that can be used in the model:

\[ Q_i = f(\text{Income}, \frac{P_i}{P_m}) \]

They are:

\[ Q_i = f(E, \frac{P_i}{P_m}) \quad \text{eqn. (6.1)} \]
\[ Q_i = f(Y^*, \frac{P_i}{P_Y}) \quad \text{eqn. (6.2)} \]
\[ Q_i = f(E, \frac{P_i}{P_Y}) \quad \text{eqn. (6.3)} \]
\[ Q_i = f(Y^*, \frac{P_i}{P_m}) \quad \text{eqn. (6.4)} \]

As can be seen from Table 6.1 this study examines five alternative functional forms for each of the equations (6.1 - 6.4) above. The five functional forms are:

(i) Double Logarithmic
(ii) Linear
(iii) Semi-Logarithmic
(iv) Hyperbolic
(v) Logarithmic Reciprocal

(The characteristics of these functional forms are considered in Chapter 7).

The I.J.P. provides for up to thirty four countries, the quantity demanded of a service as well as two income measures and two price measures. Thus, twenty regressions were carried out for each of the twenty six service categories. (For each category the four possible combinations of income and price variables were
Table 6.1(a)  
Testing Combinations of Income and Price Measures

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Observations</th>
<th>Price Measure</th>
<th>Income Measure</th>
<th>Elasticity Parameters</th>
<th>Double Log Functional Form Parameters (t-values)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>E P_x/P_y</td>
<td>E P_x/P_y</td>
<td>Y P_x/P_y</td>
</tr>
<tr>
<td>College</td>
<td>34</td>
<td>Price Variable</td>
<td>-0.23(1.72)</td>
<td>-0.23(1.74)</td>
<td>-0.29(2.22)</td>
</tr>
<tr>
<td>Teachers</td>
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<td>1.01(9.25)</td>
<td>0.98(9.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constant</td>
<td>-5.40(6.43)</td>
<td>-5.40(6.44)</td>
<td>-5.62(6.64)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SSE</td>
<td></td>
<td>7.87</td>
<td>7.71</td>
</tr>
<tr>
<td>Teachers</td>
<td>34</td>
<td>Price Variable</td>
<td>-0.05(0.62)</td>
<td>-0.05(0.62)</td>
<td>-0.07(0.76)</td>
</tr>
<tr>
<td>1st &amp; 2nd</td>
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<td>Income Variable</td>
<td>0.38(4.58)</td>
<td>0.38(4.57)</td>
<td>0.37(4.49)</td>
</tr>
<tr>
<td>Level</td>
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<td>Constant</td>
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<tr>
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<td></td>
<td>SSE</td>
<td></td>
<td>1.27</td>
<td>1.33</td>
</tr>
<tr>
<td>Household</td>
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<td>-1.67(4.3)</td>
<td>-1.64(4.26)</td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td>Income Variable</td>
<td>1.33(7.2)</td>
<td>1.35(7.22)</td>
<td>1.27(7.11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constant</td>
<td>7.95(5.77)</td>
<td>8.13(5.81)</td>
<td>8.06(5.79)</td>
</tr>
<tr>
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<td></td>
<td>SSE</td>
<td></td>
<td>18.9</td>
<td>19.2</td>
</tr>
<tr>
<td>Domestic</td>
<td>29</td>
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<td>-1.06(2.45)</td>
<td>-1.15(2.98)</td>
<td>-0.99(2.43)</td>
</tr>
<tr>
<td>I.C.P.</td>
<td></td>
<td>Income Variable</td>
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<td>0.57(1.35)</td>
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<tr>
<td>Services</td>
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<td>Constant</td>
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<td>-5.41(1.62)</td>
<td>-3.76(1.07)</td>
</tr>
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<td>SSE</td>
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<td>50.7</td>
<td>54.3</td>
</tr>
<tr>
<td>Restaurants,</td>
<td>34</td>
<td>Price Variable</td>
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<td>0.34(0.63)</td>
</tr>
<tr>
<td>Cafés</td>
<td></td>
<td>Income Variable</td>
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<td>1.86(9.81)</td>
<td>1.81(10.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constant</td>
<td>-10.03(6.99)</td>
<td>-9.90(7.04)</td>
<td>-10.21(7.29)</td>
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<tr>
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<td>23.8</td>
<td>22.5</td>
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<tr>
<td>Hotels,</td>
<td>30</td>
<td>Price Variable</td>
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<td>-1.29(2.89)</td>
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<tr>
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<td>1.23(5.31)</td>
</tr>
<tr>
<td>Lodgings</td>
<td>This Study</td>
<td>Constant</td>
<td>-8.54(5.01)</td>
<td>-8.42(5.19)</td>
<td>-7.78(4.6)</td>
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<tr>
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<td>33</td>
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<td>24.7</td>
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<tr>
<td>Local</td>
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<td>-1.41(4.87)</td>
<td>-1.31(4.48)</td>
</tr>
<tr>
<td>Transport</td>
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<td>1.01(5.03)</td>
<td>0.69(4.52)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constant</td>
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<td>-5.84(3.75)</td>
<td>-5.26(3.3)</td>
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<tr>
<td></td>
<td></td>
<td>SSE</td>
<td></td>
<td>23.4</td>
<td>25.3</td>
</tr>
<tr>
<td>Rail</td>
<td>33</td>
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<td>-0.66(1.96)</td>
<td>-0.69(2.03)</td>
</tr>
<tr>
<td>I.C.P.</td>
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<td>Income Variable</td>
<td>1.28(4.42)</td>
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<td>1.25(4.79)</td>
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<td>Transport</td>
<td>This Study</td>
<td>Constant</td>
<td>-9.06(4.0)</td>
<td>-9.00(4.07)</td>
<td>-9.44(4.32)</td>
</tr>
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<td>34</td>
<td>SSE</td>
<td></td>
<td>50.1</td>
<td>47.9</td>
</tr>
<tr>
<td>Bus</td>
<td>33</td>
<td>Price Variable</td>
<td>-0.41(1.03)</td>
<td>-0.37(0.98)</td>
<td>-0.45(1.18)</td>
</tr>
<tr>
<td>I.C.P.</td>
<td></td>
<td>Income Variable</td>
<td>0.004(0.02)</td>
<td>0.04(0.16)</td>
<td>0.03(0.12)</td>
</tr>
<tr>
<td>Transport</td>
<td>This Study</td>
<td>Constant</td>
<td>1.35(0.66)</td>
<td>1.03(0.51)</td>
<td>1.13(0.55)</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>SSE</td>
<td></td>
<td>29.2</td>
<td>29.8</td>
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<tr>
<td>CATEGORY</td>
<td>No. of</td>
<td>FUNCTIONAL FORM</td>
<td>I.C.P. Elasticity Calculations</td>
<td>Double Log Functional Form Parameters (t-values)</td>
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<td>----------</td>
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<td>-----------------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>INCOME MEASURE</td>
<td>PRICE MEASURE</td>
<td>E</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P.i/Pm</td>
<td>p.i/Pv</td>
</tr>
<tr>
<td>Air, I.C.P. 32</td>
<td>Transport This Study 34</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Barber, I.C.P. 34</td>
<td>Beauty This Study 33</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Gross 34</td>
<td>Rents</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Indoor I.C.P. 33</td>
<td>Repair, This Study 33</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Electricity 34</td>
<td>Physicians Services 34</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Dentists I.C.P. 34</td>
<td>Services This Study 33</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
</tr>
<tr>
<td>Nurses 34</td>
<td>Hospitals 34</td>
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<td>Income Variable</td>
<td>Constant</td>
<td>SSE</td>
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Table 6.1(a) cont'd
Table 6.1(a) cont'd

<table>
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<tr>
<th>CATEGORY</th>
<th>No. of Observations</th>
<th>PRICE MEASURE</th>
<th>INCOME MEASURE</th>
<th>Elasticity Parameters (t-values)</th>
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</thead>
<tbody>
<tr>
<td>Postal Communication</td>
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<td>Price Variable</td>
<td>Income Variable</td>
<td>$E_{P_{t}/P_{m}}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.68(1.77)</td>
<td>1.33(7.82)</td>
<td>-9.11(7.25)</td>
</tr>
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<td>Telephone, Telegraph</td>
<td>34</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-1.07(8.58)</td>
</tr>
<tr>
<td>Public Entertainment</td>
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<td>Price Variable</td>
<td>Income Variable</td>
<td>-1.09(2.81)</td>
</tr>
<tr>
<td>Other Recreation, Cultural</td>
<td>34</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-0.87(2.44)</td>
</tr>
<tr>
<td>Auto I.C.P.</td>
<td>33</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-1.41(2.91)</td>
</tr>
<tr>
<td>Repair This Study Charges</td>
<td>33</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-0.22(0.30)</td>
</tr>
<tr>
<td>Parking, I.C.P.</td>
<td>32</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-0.34(0.54)</td>
</tr>
<tr>
<td>Repairs This Study</td>
<td>32</td>
<td>Price Variable</td>
<td>Income Variable</td>
<td>-1.46(2.59)</td>
</tr>
<tr>
<td>(Figures in parenthesis for price, income and constant variable are the t-values)</td>
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## Testing Combinations of Income and Price Measures

<table>
<thead>
<tr>
<th>FUNCTIONAL FORM</th>
<th>Linear F. F., Parameters (t-values)</th>
<th>Semi Logarithmic F. F., Parameters (t-values)</th>
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<tr>
<td>INCOME MEASURE</td>
<td>E, Y</td>
<td>E, Y</td>
</tr>
<tr>
<td>PRICE MEASURE</td>
<td>P(_x)/P(_x)</td>
<td>P(_x)/P(_x)</td>
</tr>
<tr>
<td>CATEGORY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### College P. V.
-2.40(0.9) -3.85(1.3) -2.63(-91) -3.54(1.3) -0.72(0.34) -1.10(0.52) -0.65(0.31) -1.19(0.55)

### Teachers P. V.
-15.14(1.2) -17.7(1.21) -16.65(1.2) -15.84(1.12) -4.91(1.09) -5.18(1.06) -5.29(1.18) -4.85(0.98)

### 1st & 2nd Level P. V.
50.11(12.1) 51.14(12.1) 50.13(12.1) 51.12(12) -104(2.9) -105(2.7) -106(3) -103(2.6)

### Household P. V.
-6.83(2.37) -7.14(2.56) -6.59(2.3) -7.41(2.64) -7.18(2.3) -6.95(2.18) -6.75(2.11) -7.45(2.3)

### Services P. V.
-17.49(1.9) -15.2(1.49) -17.71(1.8) -15.22(1.6) -12.69(3.1) -11.88(2.8) -12.8(3.1) -11.81(2.83)

### Domestic P. V.
-17.49(1.9) -15.2(1.49) -17.71(1.8) -15.22(1.6) -12.69(3.1) -11.88(2.8) -12.8(3.1) -11.81(2.83)

### Restaurants P. V.
-16.10(0.74) -19.50(0.84) -18.26(0.8) -17.23(0.75) -3.45(0.12) -2.79(0.09) -4.63(0.15) -1.78(0.06)

### Cafés P. V.
0.05(6.91) 0.03(6.24) 0.05(6.86) 0.03(6.29) 8.37(2.86) 6.82(2.41) 7.88(2.7) 6.55(2.67)

### Hotels, Lodgings P. V.
-30.77(1.6) -38.4(1.8) -34.18(1.7) -34.9(1.8) -29.35(1.9) -32.95(2.2) -30.54(2.0) -31.77(2.1)

### Local Transport P. V.
-26.7(3.33) -26.8(3.18) -27.9(3.22) -25.6(3.18) -17.9(4.25) -18.7(3.95) -17.3(4.14) -17.25(4)

### Rail Transport P. V.
-2.22(0.68) -2.50(0.7) -2.51(0.68) -2.21(0.69) -4.12(1.29) -4.17(1.28) -3.98(1.21) -4.31(1.36)

### Bus Transport P. V.
-5.95(0.82) -7.29(0.94) -6.87(0.88) -6.34(0.89) -2.67(0.94) -2.98(1.04) -2.93(1.01) -2.74(0.98)

---

**SSE** values are also provided for each category.
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>FUNCTIONAL FORM</th>
<th>Linear F. F., Parameters (t-values)</th>
<th>Semi Logarithmic F. F., Parameters (t-values)</th>
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</thead>
<tbody>
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<td>Air P. V.</td>
<td>-3.64(3.15)</td>
<td>-3.63(3.91)</td>
<td>-3.44(2.87)</td>
</tr>
<tr>
<td>Transport P. V.</td>
<td>0.002(3.4)</td>
<td>0.0011(3)</td>
<td>0.0019(3.4)</td>
</tr>
<tr>
<td>C.</td>
<td>4.78(3.46)</td>
<td>5.06(3.55)</td>
<td>4.83(3.49)</td>
</tr>
<tr>
<td>SSE</td>
<td>69</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Barber, P. V.</td>
<td>-3.56(0.82)</td>
<td>-3.58(0.88)</td>
<td>-3.53(0.87)</td>
</tr>
<tr>
<td>Beauty, P. V.</td>
<td>0.006(6)</td>
<td>0.004(6.2)</td>
<td>0.004(6.2)</td>
</tr>
<tr>
<td>C.</td>
<td>2.56(0.79)</td>
<td>2.71(0.86)</td>
<td>2.53(0.79)</td>
</tr>
<tr>
<td>SSE</td>
<td>25.2</td>
<td>24.5</td>
<td>25.1</td>
</tr>
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(Figures in parenthesis for price, income and constant variable are the 't'-values)
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Note: The table shows the testing combinations of income and price measures for different categories, with functional forms ranging from Hyperbolic F. F. to Log. Reciprocal F. F., along with their respective parameters and t-values.
### Table 6.1(c) Cont’d

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(Figures in parentheses for price, income and constant variable are the 't'-values)
used with each of the five functional forms).

The parameters and t-values relating to these regressions are shown in Table 6.1.

6.4 NOTES ON TABLE 6.1

There are specific points relating to Table 6.1 which need explaining:

6.4.1 Number Of Observations

The I.C.P. uses for some categories a different number of observations (countries) to this study. In some cases the I.C.P. uses less than thirty four observations in their regression analysis. There is no explanation as to why some countries were left out, or, indeed, which were excluded. The result is that this study cannot exactly replicate the same sample.

6.4.2 Differences With I.C.P. Results

The I.C.P. used income and price variables based on total consumption to compute consumption expenditure elasticities and own price elasticities. The results of this analysis are shown in the first column of Table B.1. This study followed the I.C.P. and made use of E and P_i/P_m; the results are shown in the

*In many cases the quantity consumed of a particular service in a particular country has been put at zero. This does not cause too many problems when linear functional forms are used in the analysis. However, when the logarithm of quantity is taken for an observation (as in the case of Double Log. and Log. Reciprocal) the computer programme is unable to compute and so excludes the observation completely from the multiple regression calculation. This results in some services being analysed on the basis of fewer observations than the I.C.P. analysis. Even so, the lowest sample size in this study is 31.
adjacent column.

As can be seen most of the results are identical, which is to be expected as the raw data is much the same. The small differences can be explained by the variations in observations and small "rounding" differences.

6.4.3 Error Sum Of Squares

A first indicator of the relative fit is the error sum of squares (SSE). This is shown for all 520 regressions. The reasons for preferring this statistic rather than the coefficient of determination is explained in Chapter 7. The important point is that one is able, with SSE, to apply a conversion factor so as to make regression equations with the alternative dependent variables Q(quantity) and Ln.Q comparable. All the SSE shown in Table 6.1 have been adjusted, where necessary, to facilitate this comparison.

6.5 THE RESULTS

Table 6.1 shows that the parameters, t values and SSE's are very similar (for a particular functional form) regardless of which combination of income and price measures are used. Given the sampling error inherent in this kind of work the differences which do exist may be due to the particular sample chosen. To see if this is the case a test was carried out on the SSE result for the category "Telephone, Telegraph". This was chosen because it shows the greatest difference between SSE for alternative income and price measures in the Table.

A non-parametric test was applied to see whether the difference between these error sum of squares are significant.
The test is based on a statistic defined as:

\[ d = \frac{T}{2} \log \left( \frac{SSE_H}{SSE_L} \right) \]  \hspace{1cm} \text{eqn. (6.5)}

where \( SSE_L \) is the lowest error sum of squares for the category and functional form.

\( SSE_H \) is the highest error sum of squares for the same category and functional form but with a different combination of income and price measures.

\( T \) is the number of observations.

(for a derivation of this test statistic, see Rao and Miller\textsuperscript{*}).

This test makes use of the differences between the error sum of squares for the double log. functional form.

The \( d \)-statistic follows the chi-squared distribution with one degree of freedom. The critical value for the 95\% confidence level is 3.841. The computed statistic in this case is 2.71, less than the critical value, hence we accept the null hypothesis that these two functions are empirically equivalent with 95\% confidence.

As this particular category shows the largest difference in \( SSE \), when the income and price variables are changed, the implication is that it is not possible to say that the changing of income and price variables for the other categories has a significant effect on the goodness of fit to the sample data. In other words, we are unable to say, on statistical grounds, whether one particular combination of income and price measures

\textsuperscript{*Rao, P., Miller, R. \textit{Applied Econometrics}. Wadsworth, 1971 Chapter 4.}
is the most appropriate.

6.6 CONCLUSIONS

The G.D.P. per capita for a country may fluctuate greatly from one year to the next. Theoretical considerations suggest that consumption depends on some combination of past, present and future incomes. Total consumption expenditure per capita is a better proxy for this "permanent income" than G.D.P. per capita. It tends to be less volatile, as it is determined by a weighted average of the income from a number of years. Thus, Section two explains the theoretical superiority of total consumption expenditure compared with G.D.P. as a determinant of consumption of a service.

An examination of the data, using a variety of combinations of income and price measures, showed that it was not possible to establish one proxy as more suitable in terms of goodness of fit. At the 95% confidence level income and price measures based on G.D.P. fit the data equally well as those based on total consumption expenditure.

Thus the empirical results do not provide a clear rejection of the theoretical superiority of total consumption expenditure compared with G.D.P. However, for the majority of categories (24 out of 26), even allowing for a statistical confidence level of 80%, it is not possible using the I.C.P. III data to empirically establish one set of income and price measures as more suitable than another. In the two cases where a better fit is achieved ("Electricity" and "Telephone, Telegraph") the lowest SSE is for the regression using total consumption expenditure for income and price.

*If, for the category "Telephone and Telegraph", the level of confidence for the test is reduced to 80% it is possible to say that the SSE's are significantly different. Thus for this category the proxies total consumption expenditure (E) and prices based on E give a significantly better fit than the proxies based on G.D.P.. However, for the majority of categories (24 out of 26), even allowing for a statistical confidence level of 80%, it is not possible using the I.C.P. III data to empirically establish one set of income and price measures as more suitable than another. In the two cases where a better fit is achieved ("Electricity" and "Telephone, Telegraph") the lowest SSE is for the regression using total consumption expenditure for income and price.
of any of the income and own-price measures.

In order to reduce the analysis to a reasonably manageable size and understandable framework the Chapters which follow do not attempt regressions based on G.D.P. income and price measures but use only total consumption expenditure, without any great loss of fundamental understanding of the underlying relationships. This is justified by the above conclusion that in the majority of cases empirical analysis showed no preference for using G.D.P., and by the theoretical acceptability of consumption as a proxy for "permanent income".
APPENDIX 6.1 Converting Total Consumption Expenditure Elasticity To Income Elasticity

It is possible to calculate an income elasticity from a total consumption expenditure elasticity if one first establishes the elasticity of total consumption expenditure with respect to income.

The elasticity of an item with respect to income is the product of its elasticity with respect to total consumption expenditure and the elasticity of total consumption expenditure with respect to income. This may be shown as follows: in which, \( Y^* \) denotes income, \( E \) denotes total consumption expenditure and \( Q_i \) denotes expenditure on a given category \( i \).

\[
\hat{h}_{x'} = \left( \frac{Y}{Q_i} \right) \left( \frac{dQ_i}{dY^*} \right) \\
= \left[ \left( \frac{E}{Q_i} \right) \left( \frac{dQ_i}{dE} \right) \right] \left[ \left( \frac{Y^*}{E} \right) \left( \frac{dE}{dY^*} \right) \right] \\
= h_{x E} \cdot h_{x Y} 
\]

where \( h_{x E} \) = Consumption expenditure elasticity \\
\( h_{x Y} \) = Elasticity of total consumption expenditure with respect to income.

All the elasticities given in the following Chapters are total consumption expenditure elasticities or price elasticities based on prices expressed relative to total consumption prices.

So, for an estimate of income elasticities to be calculated the total consumption expenditure elasticity should be multiplied by the elasticity of total consumption expenditure with respect to income. This has been calculated for the I.C.P. data from the following equation:
\[ \ln E = a + b \ln Y + c \ln \left( \frac{P_x}{P_Y} \right) + \epsilon \quad \text{eqn. (6.8)} \]

The parameter, \( b \), is an estimate of the elasticity of total consumption expenditure with respect to income, \( \eta_{xy} \). The I.C.P. data give the following result:

\[ \ln E = -0.043 + 0.957 \ln Y + 0.2 \ln \left( \frac{P_x}{P_Y} \right) \quad \text{eqn. (6.9)} \]
\[ (0.27) \quad (45) \quad (0.59) \]

(Figures in brackets - t values) \[ R^2 = 0.985 \]

Thus, the elasticity of total consumption expenditure with respect to income is 0.957.
CHAPTER 7

RESULTS FOR ALTERNATIVE FUNCTIONAL FORMS

7.1 INTRODUCTION

Traditional consumer theory suggests that the demand of a utility-maximising consumer for any commodity depends on the price of the commodity itself, the price of other goods (substitutes and complements) and his income. Thus:

\[ q_i = q_i(p_1, p_2, \ldots, p_n, Y) \quad \text{eqn. (7.1)} \]

where \( q_i \) and \( p_i \) are the quantity demanded and the price of the \( i \)th commodity, there are \( n \) commodities in all, and \( Y = \sum_{i=1}^{n} p_i q_i \) is total expenditure.

Unfortunately consumer theory is not unambiguous about the precise functional form of the above equation, and for this reason empirical versions of the equation are typically of an ad hoc nature. The International Comparison Project Phase III (I.C.P. III) reports results of applying the double logarithmic functional form. This has the algebraic form:

\[ \ln q_i = a + b \ln Y + c \ln p_i \quad \text{eqn. (7.2)} \]

This form represents the following relationship between income and quantity demanded.
Figure 7.1 Double Logarithmic Functional Form

By using this form one is testing a very specific relationship between income and the quantity demanded of a particular category. The relationship is one of constant elasticity throughout the range of income. So, whether income is 500 international dollars per capita or 5000, a certain specific percentage rise in income will lead to a constant percentage rise in quantity demanded. As an hypothesis of consumption behaviour this functional form may have much in its favour, but it is conceivable that income elasticity of demand may vary with the income level. For instance, it is possible that income elasticity may be extremely high at low income levels but at higher income levels becomes zero. Alternatively it may tend to unity at high income levels. For some services the income elasticity may be positive up to a middle income level and then become negative. All these possibilities, and many others, may exist but Kravis et. al. (the I.C.P.) report results which only apply the double logarithmic functional form.

This chapter shows the results of testing up to six other possible functional forms. The chapter is organized as follows:

Section 7.2 identifies functional forms used in other applied consumption analysis and summarizes the specific
characteristics of each form.

Section 7.3 explains the method of analysis and the method of presentation of the detailed results. These results are for twenty six services and have therefore not been set out in detail in the body of this chapter, but are given in the Appendix.

Section 7.4 provides an examination of a few of the categories from the Appendix and looks at them in more detail, in order to highlight particular methodological problems and special characteristics of some categories.

Section 7.5 summarizes the functional form information derived from the detailed category analysis. This gives an overview of the applicability of the alternative functional forms, and demonstrates the possible limitations of using a common functional form for all categories.

Section 7.6 discusses the influence of heteroscedasticity on the results.

Section 7.7 summarizes the results and implications of this stage of the analysis.

7.2 FUNCTIONAL FORMS IN APPLIED DEMAND ANALYSIS

When a relationship is expected to exist between a number of variables the simplest assumption that can be made about its form is that it is linear. This form has proved particularly popular with demand analysts since the time of Allen and Bowley and

---

This assumed relationship is shown in Figure 7.2.

Figure 7.2 Linear Functional Form

This form implies a constant marginal propensity to consume a particular service given by $b$, but an elasticity which is not constant. If the term, $a$, is positive then elasticity increases throughout the income range. However even at high income levels it merely tends to unity. If the intercept is zero then the elasticity is constant throughout the income range. Unlike the double logarithmic form, the elasticity can only take on the value of one. If the constant term is negative, then again the elasticity tends to unity (but this time from elasticities that are higher than unity). Note also, in this third case, that there is a level of income below which there is zero consumption.

This linear functional form, as recognised by Prais and


115
Prais and Houthakker, does not have the characteristic of "satiety". That is, there is not a level of income at which the elasticity falls to zero, rather the quantity consumed increases continuously with income. The "satiety" characteristic may be important in the case of necessities, where the percentage increase in the demand for necessities can be expected to gradually decrease for each percentage increase in income. Thus, as incomes rise, some commodities should command a smaller share of an individual's budget. This model seems potentially appropriate for a number of commodities and so a functional form which possesses this property merits consideration.

One such form that exhibits the "satiety" criterion is the hyperbolic functional form. This also has what Prais and Houthakker thought, a priori, a realistic characteristic for some commodities: there is an income level below which none of the commodity is demanded. The hyperbolic functional form can be expressed as follows:

\[ q_i = a + b(1/Y) + c(1/p_i) \quad \text{eqn. (7.4)} \]

Figure 7.3 Hyperbolic Functional Form

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A priori one may reasonably expect to observe some commodities possessing the pattern of elasticities described by equation (7.4). Some goods and services are regarded as luxuries at low income levels and therefore are not consumed by the poor at all. When an income level is reached where people are able to purchase these products there may be a very large change in quantity demanded for a given change in income levels (i.e. a high income elasticity). Then at high income the commodity may be perceived as a necessity and have an elasticity of less than one, perhaps eventually reaching zero.

Another functional form which possesses the "satiety" property is the logarithmic reciprocal:

$$\ln q_x = a + b(1/Y) + c(1/p_x)$$  \hspace{1cm} \text{eqn. (7.5)}

Figure 7.4 Logarithmic Reciprocal Functional Form

This model differs from that of the hyperbolic because even at very low income levels some of the commodity is demanded. However, as incomes rise the two models are similar in that the elasticity of demand is high at low income levels and then gradually reduces to zero. This form was used by Prais and
Houthakker in the 1950's to examine pre-war budget data.

Prais and Houthakker thought the four forms already mentioned (double logarithmic, linear, hyperbolic and logarithmic reciprocal) as being reasonable a priori models for explaining consumer demand with changing income. They also made use of a fifth form, which proved to be of great value, especially in the examination of various categories of food. This is the semi-logarithmic functional form:

\[ q_i = a + b \ln Y + c \ln p_i \]  

\text{eqn. (7.6)}

Figure 7.5 Semi-Logarithmic Functional Form

This form possesses the following qualities: it gives zero demand at low income levels, but after a critical level of income the commodity shows a high level of elasticity, which then gradually decreases. However the elasticity does not reach zero. That is, it does not have an asymptote, unlike the hyperbolic and logarithmic reciprocal forms. However, as Prais says, "the degree of curvature for realistic values of the parameters is so large as to make it almost indistinguishable from an asymptotic form".

*Prais, S.J. (1953) Ibid.
7.3 RESULTS FOR THIS STUDY

This study examines for each of the first five functional forms (equations (7.2) - (7.6)) mentioned above, all twenty six services. This has been done on the basis of income and price measures using total consumption expenditure per capita and has been carried out via ordinary least squares multiple regression.

The results of these regressions are presented for each service individually in the Appendix to this chapter. Prais and Houthakker⁷ expressed the problem of selecting suitable functional forms in the following way:

"A priori it is difficult to express any preference as to which of the above hypotheses is the most reasonable. The linear hypothesis implies that the income elasticity for all goods tends to unity as income increases, and thus may be thought unreasonable. Again there is some ground for not favouring the first two forms (double logarithmic and logarithmic reciprocal) since they pass through the origin and thus do not give an initial income. Further they lead to difficulties in the treatment of households that have no expenditure on the commodity. ... These reasons are not, however, sufficient to reject these forms since (the double logarithmic form) for example, provides the simplest means of testing the hypothesis that the income elasticity is constant."

7.3.1 Some Explanatory Notes On The Results

The results for each category are presented without detailed commentary in the Appendix. However, in order to highlight particular features a discussion of four categories of services is presented in Section 7.4. The first category, Electricity, illustrates the case of a service which is relatively easy to analyse in terms of appropriate functional form (the double logarithmic form clearly gives the best fit to the data). It is less obvious which functional form is most suitable for the

⁷Prais, S.J. and Houthakker, H.S., 1971 ibid page 87
case of Household Services. For Bus Transport and Local transport it was necessary to make use of a quadratic functional form.

Before these categories are examined it is necessary to explain the method of analysis and the way in which the detailed results are presented. This will enable a better understanding of the Figures and Tables presented in the Appendix.

7.3.2 On The Regression Results

The first table for each category in the Appendix shows the results of O.L.S. multiple regression analysis using each of the five functional forms. The parameters given for each variable are shown along with the t-values. The last column presents the error sum of squares (SSE), some of which have to be adjusted in order to compare a SSE from a regression with quantity (Q) as the dependent variable with one using the logarithm of quantity (LnQ) as the dependent variable. In order to make the SSE comparable, the SSE's given in the cases of the linear, semi-logarithmic and hyperbolic forms (i.e. those with Q as the dependent variable) had to be multiplied by the square of the inverse of the geometric mean of Q. This procedure is described by Rao and Miller*.

Adjusted SSE's were used to judge relative goodness of fit (a significantly lower SSE indicated a better fit).

Another indicator of the goodness of fit is the coefficient of determination (R²). This was rejected as unsuitable because it was not possible to compare an R² for an equation with Q as the dependent variable.

---

dependent variable with an $R^2$ using $\ln Q$ as the dependent variable (as in the case of double logarithmic and logarithmic reciprocal). An adjustment technique for the $R^2$ was investigated. Cassidy suggests using the estimated equation in which $\ln Q$ is the dependent variable to generate the regression line values for all, $n$, observations on $\ln Q$ and then take the antilog of each of these observations, which become the fitted $Q$ of the equation. These values are put into the $R^2$ formula. Cassidy suggests that this $R^2$ is now directly comparable to the one computed for the equation in which $Q$ was the dependent variable.

However, the $R^2$ formula assumes that the regression line passes through the mean of $Q$. In the equations in this study where $\ln Q$ is the dependent variable the regression will pass through the mean of $\ln Q$ and not of $Q$. The antilog of the mean of $\ln Q$ is not the same as the mean of $Q$. Thus, if $Q$ and $\bar{Q}$ are the actual (non logged) values of the dependent variable and its mean, whilst $\bar{Q}$ is the antilogged value of the $\ln Q$ then:

$$\frac{\Sigma (Q - \bar{Q})^2}{\Sigma (\bar{Q} - \bar{Q})^2 + \Sigma (\bar{Q} - Q)^2}$$

eqn. (7.3)

7.3.3 On Testing For Differences In Statistical Fit

A lower SSE is the main criteria for judging superiority of fit to the data. However the low SSE may simply be due to the particular sample taken (34 countries out of the world total). This study makes use of a non-parametric test to see whether the differences between the error sum of squares in the five functional forms are significant. The test is based on a

statistic defined as:

\[ d = T/2 \log (SSE_k / SSE) \]  

where \( SSE_k \) is the lowest error sum of squares of the functional forms tested.

\( SSE \) is the error sum of squares of one of the functional forms.

\( T \) is the number of observations.

The \( d \)-statistic follows a chi-squared distribution with one degree of freedom. When the \( d \)-statistic exceeds the critical value of 3.841 (i.e. that for 95% confidence) we may reject the null hypothesis that these two functions are empirically equivalent with 95% confidence. Rao and Miller explain this technique more fully. The second table for each category in the Appendix displays the results of this analysis. In each case the functional form with the lowest SSE is chosen as the denominator and the \( d \)-statistic is shown in the first column. The third column presents the conclusion on whether or not the hypothesis of statistical equivalence can be accepted.

7.3.4 On The Elasticity Estimates

In order to illustrate the effect of using one functional form rather than another, the third table for each category presents the results of elasticity calculations making use of each functional form having the lowest SSE or which cannot be said to be statistically different from the lowest.

For the income elasticities the income levels chosen were firstly, a simple average of total consumption expenditure per capita of all 34 countries (i.e. $2019), and then half of this.
income level, and finally double the average level.

As can be seen, for those categories with more than one possible relevant functional form the elasticity estimates are often very different. Take the case of Postal Communications (page 239); at an income level of $4023 the double logarithmic form gives a total consumption expenditure elasticity of 1.50, whereas the statistically equivalent logarithmic reciprocal form gives an elasticity of only 0.28.

A similar wide dispersion of elasticity estimates is also found for own-price elasticities. Here, the average price used was the average relative price for the service, which varied from category to category.

7.4 SOME EXAMPLES DRAWN FROM THE DETAILED RESULTS

This section takes a few of the categories from the Appendix and looks at them in more detail in order to highlight special characteristics.

7.4.1 An Example Of An Unambiguous Functional Form

Consider the evidence for Electricity (pages 149-153). The graphs (Figures 7.7.04(a) and 7.7.04(b)) suggest that both linear and double logarithmic forms give good fits to the data. Multiple regression shows the double logarithmic form gives the largest t-values and the smallest error sum of squares (Electricity Table 7.7.04(a) - page 152). The parameter for the income variable is twenty two times the standard error. Thus, the 95% confidence interval for total consumption expenditure elasticity is 1.50 - 1.80, based on the double logarithmic functional form.
7.4.2 An Example Of An Ambiguous Functional Form

Turning to the case of Household Services (pages 144-145), Figures 7.7.03(a) and 7.7.03(b) show a very wide scatter of plot points, and there is no obvious relationship between quantity and total consumption - except a vague impression that it is positive. Table 7.7.03(a) (page 147) gives little clue as to which functional form gives the best fit. The error sum of squares are all contained within a narrow range, and all but one of the t-values are significant at the 95% confidence level. Table 7.7.03(b) leads to the dropping of the hyperbolic functional form because its SSE is significantly different from that for the double logarithmic regression. The hyperbolic form has the feature of a high elasticity at low income levels, decreasing to eventually become zero at high income levels.

Because only one functional form has been judged inferior to the others the analysis continues on the basis of the remaining four forms. The elasticity calculations are shown in the third table (figure 7.7.03(c)). The very wide range of income elasticities is particularly noteworthy, especially at high income levels (1.35 for double logarithmic, 0.25 for logarithmic reciprocal). This divergence illustrates the benefit of finding the functional form which most accurately describes this category. This may be improved with the addition of variables other than own-price and income. This is considered in Chapter 3.

7.4.3 Additional Functional Forms

The graphs (Figures 7.7.05(a), 7.7.05(b) & 7.7.06(a),
7.7.06(b) on pages 155, 156, 160, 161) for the categories Local Transport and Bus Transport suggest that the most suitable functional form may be one that permits a positive elasticity up to a certain level of income and then shows a negative elasticity. None of the original five functional forms allow for this possibility. The functional form which gives this inverted U-shaped relationship is the quadratic. Two versions of the quadratic function were tested:

**Linear Quadratic**

\[ q_i = a + bY + cp_i + dY^2 \]  

**Logarithmic Quadratic**

\[ \text{Ln}q_i = a + b\text{Ln}Y + c\text{Ln}p_i + d(\text{Ln}Y)^2 \]

It can be seen from Bus Transport Table 7.7.06(a) (page 162) and Local Transport Table 7.7.05(a) (page 157) that the logarithmic quadratic gives the lowest error sum of squares and in the case of Bus Transport the highest t-values for the income variable.

7.5 **SUMMARY PRESENTATION OF THE FUNCTIONAL FORM RESULTS**

The major question that this Section examines is whether it is correct to assume that one functional form offers the optimal statistical fit for the relationship between income, price and quantity for all twenty six service categories. The I.C.P. chose to use the double logarithmic form which implies for all services that the income and price elasticities remain constant regardless of the income and price level. This form cannot be shown, in all cases, to be superior. This is demonstrated in Table 7.1. For each category, the functional forms which have either the lowest (adjusted) SSE, or an SSE which is not statistically
significantly different from the lowest SSE, are shown by a star(*)). At this stage in the analysis it may not be possible to support a specific functional form on empirical grounds. Thus, for Uniteach (College and University Teachers) the sample data is such as to permit the possibility that the logarithmic reciprocal form gives as good a fit as the double logarithmic. However, the analysis of the data has shown that the linear, hyperbolic and semi logarithmic forms give significantly poorer fits to the data and are thus less suitable for the analysis of the demand for Uniteach than the double logarithmic and logarithmic reciprocal.
Table 7.1 Functional Forms With The Lowest Error Sum Of Squares Or For Which The Error Sum Of Squares Is Not Statistically Different From The Lowest

<table>
<thead>
<tr>
<th>Category</th>
<th>Functional Form</th>
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<tbody>
<tr>
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<td>D.L.</td>
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<td>eqn7.2</td>
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<tr>
<td>1 Uniteach</td>
<td>*</td>
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<td>2 Teachers</td>
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<td>3 House. Ser.</td>
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<td>4 Dom. Ser.</td>
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<td>5 Restaur.</td>
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<td>6 Hotels</td>
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<td>7 Loc. Trans.</td>
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<td>8 Rail Trans.</td>
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<td>9 Bus Trans.</td>
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<tr>
<td>10 Air Trans.</td>
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<td>11 Barbers</td>
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<td>12 Rents</td>
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<td>13 Indoor Rep.</td>
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<td>14 Electric.</td>
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<td>15 Doctors</td>
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<td>16 Dentists</td>
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<td>17 Nurses</td>
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<td>18 Hospital</td>
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<td>19 Postal</td>
<td></td>
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<tr>
<td>20 Telephone</td>
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<td>21 Pub. Ent.</td>
<td></td>
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<td>22 Rec. &amp; Cult.</td>
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<td>23 Auto Rep.</td>
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<td>24 Banking</td>
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<td>26 Cloth R&amp;F</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>23</td>
</tr>
</tbody>
</table>

D.L. = Double Logarithmic Form  
LIN = Linear Form  
S.L. = Semi-Logarithmic Form  
H. = Hyperbolic Form  
L.R. = Logarithmic Reciprocal Form  
LogQ = Quadratic Form using the linear expression of the variables  
LogQ = Quadratic Form using the logarithm of all variables
It is clear from the Table that there is not one "best fit" form in all cases. Indeed, the functional form which turns out to be the best fit in more cases than any other, the double logarithmic, gives (with 95% confidence) a poorer fit to the data than other forms in three services - Teachers, Local Transport and Bus Transport. In these three cases, by making use of the double logarithmic we obtain very different elasticity estimates from those given by the other functional forms.

In only five cases (Electricity, Doctors services, Nurses, Hospitals and Telephone) does a clear preference for one functional form emerge. In these cases we can be more confident that the income and price elasticities are constant throughout. For the other twenty one categories it is impossible at this stage to express a preference between two or more forms. In two cases (Teachers and Household Services) four entirely different hypotheses concerning income and price effects on quantity consumed are seen to be statistically supportable.

The overall "popularity" of each of the forms is also given in Table 7.1. The double logarithmic form is the one regarded as fitting the data best in most cases (23 out of 26) closely followed by the logarithmic reciprocal (19 out of 26). The poor showing of the other forms is, at first glance, quite a surprise. Houthakker and Prais\(^\text{11}\) thought the hyperbolic and semi-logarithmic forms were particularly suitable before they examined the budget data they had before them. The feature of a minimum income level being reached before any of the service/good was

\(^{11}\)Prais, S.J. and Houthakker, H.S. (1971) ibid
demanded was seen as reasonable.

The I.C.P. data show this possibility occurring in only two categories (Teachers and Household Services). An explanation may lie in the type of data used here. The I.C.P. data is average per capita quantities, incomes and prices, so that in an economy with some rich people even luxuries will be demanded whether the average income level is I$200 or I$2000. Thus, a functional form which shows consumption even at very low incomes (e.g. double logarithmic, logarithmic reciprocal) is likely to be more appropriate. In Prais and Houthakkers study the data was for individual households, and so they may reasonably expect that some commodities would not be demanded at all by those on low incomes. (In fact, they came to the conclusion that the best form for the non-food categories was the double logarithmic).

Given that only five of the categories show an unambiguous relationship between income, price and quantity demanded we have a situation, where twenty one categories have two or more possible descriptions of behaviour. This has important implications for the measurement of elasticities. Income elasticities vary widely according to the functional form being used, thus, for each of twenty one services, at this stage, there is a potentially wide range of income elasticity estimates.

7.6 HETEROSCEDASTICITY

To test for the possibility of non-constant variability of the error terms the Goldfeld-Quant test was carried out on each of the service categories. For each service the test was used for
the double logarithmic functional forms (using as independent
variables own-price and total consumption expenditure). The first
fourteen observations in ascending order of income, were compared
with the final fourteen. The middle six observations were
excluded. The error sum of squares of each group of observations
were in many cases statistically similar. For the majority of
services (fourteen) heteroscedasticity is not found. This test is
based on a 95% confidence F-test with eleven degrees of freedom.
If a 99% confidence level is used it is possible to reject the
possibility of heteroscedasticity in all cases but nine.

It is important to note that the presence of
heteroscedasticity does not affect the parameter values and thus
the estimated elasticities remain the same. The priority of
interest for this thesis is in the income elasticities.

Although there are some biased standard errors the test for
the most appropriate functional form is based on a ratio of error
sum of squares. This ratio is unlikely to be affected greatly by
Heteroscedasticity. If both forms have low scatter (variance) at
high income and high scatter at low incomes both SSE's are
inefficient to the same degree.

Experimentation was undertaken to correct for
heteroscedasticity and thereby obtain less biased and more
efficient standard errors. Thus for the category Gross Rents
"White's heteroscedasticity - consistent estimates of the
variance - covariance matrix of the O.L.S. estimators" was

1985, pp 108
applied. Before Whites correction the standard error for the income variable when the double logarithmic functional form is used is 0.0333. The corrected figure is 0.0705, thus the standard error is reduced and the t-value increased. In the case of the price variable the standard error is made larger as a result of correction - going from 0.147 to 0.1617.

7.7 CONCLUSIONS

This Chapter has described and demonstrated the use of a wide range of functional forms. The major conclusion from this work is that it may not be reasonable to rely always on one functional form to express demand relationships for every service category. We have made use of seven different forms to establish relationships.

With the functional forms selected as most suitable on the basis of lowest SSE we are left with the problem of selecting a unique income elasticity estimate for most services. The analysis is based on selecting functional forms with the lowest SSE (and those that are not significantly different from the lowest). This often gives ambiguous elasticity estimates. An attempt is made in Chapter 8 to reduce this ambiguity and to examine the robustness of the results thus far. This is to be done by examining the implications for overall "goodness of fit" of adding explanatory variables to the analysis.

In the forthcoming analysis only those functional forms judged to be the "best fit" in this Chapter will be used. The computational cost outweighs the benefit of continuing to analysis.
each service on the basis of seven functional forms, especially as this Chapter has shown the poor quality of fit when some forms are used. Leaving aside these functional forms will enable us to retain a sufficiently simple framework for comparison.
APPENDIX. DETAILS OF THE RESULTS FOR EACH CATEGORY
Description Of The Category

The I.C.P. describe this category as consisting of "Services of Barbers and Beauty Shops, baths and the like". It does not include goods for personal care such as hair dryers.
Figure 7.7.01(a) Barbers, Beauty Shops.
Quantity and Total Consumption Expenditure per Capita

T.C.E. (I$)

Quantity per Capita (I$)

0 1000 2000 3000 4000 5000
0 10 20 30 40 50
Figure 7.7.01(b) Barbers, Beauty Shops.
Logarithm of Quantity and Total Consumption Expenditure per Capita
Table 7.7.01(a) Barbers, Beauty Shops. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.89</td>
<td>1.43</td>
<td>-9.05</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>(3.82)</td>
<td>(10.4)</td>
<td>(8.3)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-3.35</td>
<td>0.00558</td>
<td>2.56</td>
<td>25.2</td>
</tr>
<tr>
<td></td>
<td>(0.82)</td>
<td>(6.03)</td>
<td>(0.79)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-1.03</td>
<td>8.75</td>
<td>-53.1</td>
<td>26.5</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(5.65)</td>
<td>(4.5)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>-0.222</td>
<td>-5708</td>
<td>18.5</td>
<td>34.1</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(4.03)</td>
<td>(6.6)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.264</td>
<td>-1346.2</td>
<td>2.695</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td>(3.11)</td>
<td>(11.1)</td>
<td>(14.11)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.01(b) Barbers, Beauty Shops. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE.

The other forms are tested against the log. reciprocal SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE Formula</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>((\frac{34}{2})\log(10.1/8.9)) = 0.93</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Linear</td>
<td>((\frac{34}{2})\log(25.2/8.9)) = 7.68</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>((\frac{34}{2})\log(26.5/8.9)) = 8.06</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>((\frac{34}{2})\log(34.1/8.9)) = 9.9</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 7.7.01(c) Barbers, Beauty Shops. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.43</td>
<td>1.43</td>
<td>1.43</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.33</td>
<td>0.666</td>
<td>0.331</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.314)</th>
<th>Average Price (0.629)</th>
<th>Double Average Price (1.26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.891</td>
<td>-0.891</td>
<td>-0.891</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.839</td>
<td>-0.42</td>
<td>-0.21</td>
</tr>
</tbody>
</table>
7.7.02 CLOTHING RENTAL, REPAIR

Description Of The Category

The I.C.P. include under this category "Rental of clothing, repairs to clothing other than footwear". Services such as cleaning, dyeing and laundering of clothing are included under "Household Services" and not in this category.
Figure 7.7.02(a) Clothing Rental, Repairs, Quantity and Total Consumption Expenditure per Capita
Figure 7.7.02(b) Clothing Rental, Repairs. Logarithm of Quantity and Total Consumption Expenditure per Capita
Table 7.7.02(a) Clothing Rental & Repair. The Parameters, t-values And Error Sum of Squares Given By The Five Functional Forms.

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.07</td>
<td>0.767</td>
<td>-5.85</td>
<td>34.5</td>
</tr>
<tr>
<td></td>
<td>(1.94)</td>
<td>(2.04)</td>
<td>(1.94)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-6.4</td>
<td>0.00141</td>
<td>3.97</td>
<td>242</td>
</tr>
<tr>
<td></td>
<td>(1.85)</td>
<td>(1.56)</td>
<td>(2.56)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-4.06</td>
<td>1.78</td>
<td>-12.5</td>
<td>236</td>
</tr>
<tr>
<td></td>
<td>(1.96)</td>
<td>(1.35)</td>
<td>(1.18)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.56</td>
<td>-1049</td>
<td>0.694</td>
<td>239</td>
</tr>
<tr>
<td></td>
<td>(1.82)</td>
<td>(1.08)</td>
<td>(0.42)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.406</td>
<td>-556</td>
<td>0.081</td>
<td>34.9</td>
</tr>
<tr>
<td></td>
<td>(1.78)</td>
<td>(1.81)</td>
<td>(0.19)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.02(b) Clothing Rental & Repair. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE.

The other forms are tested against the double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(32/2)log(242/34.5) = 13.5</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(32/2)log(236/34.5) = 13.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(32/2)log(239/34.5) = 13.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(32/2)log(34.9/34.5) = 0.08</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.02(c) Clothing Rental & Repair. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>0.767</td>
<td>0.767</td>
<td>0.767</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.55</td>
<td>0.28</td>
<td>0.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.32)</th>
<th>Average Price (0.64)</th>
<th>Double Average Price (1.28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.07</td>
<td>-1.07</td>
<td>-1.07</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.29</td>
<td>-0.633</td>
<td>-0.317</td>
</tr>
</tbody>
</table>
7.7.03 HOUSEHOLD SERVICES

Description Of The Category

Household services other than domestic - includes cleaning, dyeing and laundering; hire of furniture, furnishings and household equipment, including payments by subtenants for the use of furniture and the like; service charges for insurance of household property against fire, theft and other eventualities; payments for services such as chimney cleaning, window cleaning, snow removal, exterminating, disinfecting and fumigating and the like; also all repair of furniture, furnishings and household equipment.  

(I.C.P. page 63)
Figure 7.7.03(a). Household Services.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.03(b). Household Services.
Logarithm of Quantity and Total Consumption Expenditure per Capita

Logarithm of Quantity per Capita (1$)
Table 7.7.03(a) Household Services. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms.

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log.</td>
<td>-1.67</td>
<td>1.35</td>
<td>-8.13</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>(4.3)</td>
<td>(7.22)</td>
<td>(5.81)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-6.83</td>
<td>0.00552</td>
<td>7.13</td>
<td>24.7</td>
</tr>
<tr>
<td></td>
<td>(2.37)</td>
<td>(6.16)</td>
<td>(2.44)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-7.18</td>
<td>8.84</td>
<td>-53.9</td>
<td>26.8</td>
</tr>
<tr>
<td></td>
<td>(2.23)</td>
<td>(5.67)</td>
<td>(4.64)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.85</td>
<td>-5969</td>
<td>14.9</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>(0.64)</td>
<td>(3.7)</td>
<td>(4.38)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.851</td>
<td>-1003</td>
<td>1.88</td>
<td>28.2</td>
</tr>
<tr>
<td></td>
<td>(2.38)</td>
<td>(5.01)</td>
<td>(4.44)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.03(b) Household Services. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE.

The other forms are tested against the double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE Value</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2) \log(24.7/18.9) = 1.98</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Semi-Log</td>
<td>(34/2) \log(26.4/18.9) = 2.47</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2) \log(37.5/18.9) = 5.05</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(34/2) \log(28.2/18.9) = 2.95</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.03(c) Household Services. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.35</td>
<td>1.35</td>
<td>1.35</td>
</tr>
<tr>
<td>Linear Form</td>
<td>0.44</td>
<td>0.61</td>
<td>0.76</td>
</tr>
<tr>
<td>Semi-Log. Form</td>
<td>1.23</td>
<td>0.66</td>
<td>0.45</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.99</td>
<td>0.50</td>
<td>0.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.5)</th>
<th>Average Price (0.99)</th>
<th>Double Average Price (1.98)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.67</td>
<td>-1.67</td>
<td>-1.67</td>
</tr>
<tr>
<td>Linear Form</td>
<td>-0.92</td>
<td>-18.35</td>
<td>-</td>
</tr>
<tr>
<td>Semi-Log. Form</td>
<td>Not Computable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.7</td>
<td>-0.86</td>
<td>-0.43</td>
</tr>
</tbody>
</table>
7.7.04 ELECTRICITY

Description Of The Category - Simply "Electricity".
Figure 7.7.04(a). Electricity.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.04(b). Electricity. Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.04(a) Electricity. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms.

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.85</td>
<td>1.653</td>
<td>-9.4</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(6.92)</td>
<td>(22)</td>
<td>(16.7)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-2.18</td>
<td>0.01644</td>
<td>-4.79</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(11.53)</td>
<td>(0.91)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-6.07</td>
<td>22.99</td>
<td>-141.6</td>
<td>46.9</td>
</tr>
<tr>
<td></td>
<td>(1.18)</td>
<td>(7.34)</td>
<td>(6.03)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>3.43</td>
<td>-17012</td>
<td>38.06</td>
<td>82.5</td>
</tr>
<tr>
<td></td>
<td>(0.61)</td>
<td>(4.5)</td>
<td>(5.54)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.442</td>
<td>-1539.6</td>
<td>3.56</td>
<td>11.9</td>
</tr>
<tr>
<td></td>
<td>(2.46)</td>
<td>(12.8)</td>
<td>(16.3)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
### Table 7.7.04(b) Electricity. \( d \) Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE.

The other forms are tested against the double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>((34/2)\log(\text{SSE}))</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>13.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>18.6</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>22.7</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>8.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

### Table 7.7.04(c) Electricity. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average</th>
<th>Average</th>
<th>Double Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (I$1010)</td>
<td>1.65</td>
<td>1.65</td>
<td>1.65</td>
</tr>
<tr>
<td>Income (I$2019)</td>
<td>1.65</td>
<td>1.65</td>
<td>1.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average</th>
<th>Average</th>
<th>Double Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (0.8)</td>
<td>-0.85</td>
<td>-0.85</td>
<td>-0.85</td>
</tr>
<tr>
<td>Price (1.59)</td>
<td>-0.85</td>
<td>-0.85</td>
<td>-0.85</td>
</tr>
</tbody>
</table>

153
7.7.05 LOCAL TRANSPORT

Description Of The Category

Fares on trains, buses and cabs; includes local and long distance water transport, moving and storage of household goods, service charges for special transport accident insurance.
Figure 7.7.05(a). Local Transport.
Quantity and Total Consumption Expenditure.

T.C.E. (I$)

Quantity per Capita (I$)
Figure 7.7.05(b). Local Transport. Logarithm of Quantity and Total Consumption Expenditure.
Table 7.7.05(a) Local Transport. The Parameters, t-Values And Error Sum of Squares Given By The Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.41</td>
<td>1.01</td>
<td>-5.84</td>
<td>23.4</td>
</tr>
<tr>
<td></td>
<td>(4.87)</td>
<td>(5.03)</td>
<td>(3.75)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-26.7</td>
<td>0.00346</td>
<td>28.39</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>(3.33)</td>
<td>(1.59)</td>
<td>(5.34)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-17.97</td>
<td>8.37</td>
<td>-53.8</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>(4.25)</td>
<td>(2.86)</td>
<td>(2.37)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>6.61</td>
<td>-7577</td>
<td>11.05</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>(3.73)</td>
<td>(3.01)</td>
<td>(2.48)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.48</td>
<td>-987</td>
<td>2.28</td>
<td>19.45</td>
</tr>
<tr>
<td></td>
<td>(4.33)</td>
<td>(6.17)</td>
<td>(8.2)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)

Alternative Functional Forms

<table>
<thead>
<tr>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>SSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Quad.</td>
<td>-27.6</td>
<td>0.0277</td>
<td>-0.00000532</td>
</tr>
<tr>
<td>q=a+bY+cY²+dY²</td>
<td>(4.34)</td>
<td>(4.79)</td>
<td>(4.39)</td>
</tr>
<tr>
<td>Log. Quad</td>
<td>-0.946</td>
<td>14.93</td>
<td>-0.989</td>
</tr>
<tr>
<td>lnq=a+blnY+</td>
<td>(4.01)</td>
<td>(5.39)</td>
<td>(5.03)</td>
</tr>
<tr>
<td>c1np+d(lnY)²</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.05(b) Local Transport. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>(34/2)log(23.4/12.69) = 4.52</td>
<td>3.841</td>
</tr>
<tr>
<td>Linear</td>
<td>(34/2)log(54/12.69) = 10.7</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(45/12.69) = 9.3</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(45/12.69) = 9.3</td>
<td>3.841</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>(34/2)log(19.45/12.69) = 3.15</td>
<td>3.841</td>
</tr>
<tr>
<td>Lin. Quad.</td>
<td>(34/2)log(32.92/12.69) = 7.04</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.05(c) Local Transport. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log. Quad. Form</td>
<td>1.25</td>
<td>-0.12</td>
<td>-1.49</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.96</td>
<td>0.48</td>
<td>0.24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.34)</th>
<th>Average Price (0.67)</th>
<th>Double Average Price (1.34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log. Quad. Form</td>
<td>-0.95</td>
<td>-0.95</td>
<td>-0.95</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.41</td>
<td>-0.7</td>
<td>-0.357</td>
</tr>
</tbody>
</table>
7.7.06 BUS TRANSPORT

Description Of The Category

Long distance bus transport - fares on transport; fees for transporting personal transportation equipment, for baggage transfer; storage and excess charges; tips to porters; service charges for baggage.
Figure 7.7.06(a)  Bus Transport.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.06(b) Bus Transport
Logarithm of Quantity and
Total Consumption Expenditure per Capita

Logarithm of Quantity per Capita (l$)

Log. of T.C.E. (l$)
Table 7.7.06(a) Bus Transport. The Parameters, t-Values And Error Sum of Squares Given By The Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.37</td>
<td>0.11</td>
<td>1.35</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>(0.98)</td>
<td>(0.04)</td>
<td>(0.66)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-5.95</td>
<td>-0.00077</td>
<td>12.89</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>(0.82)</td>
<td>(0.7)</td>
<td>(4.55)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-2.67</td>
<td>0.434</td>
<td>2.97</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>(0.94)</td>
<td>(0.24)</td>
<td>(0.19)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>0.62</td>
<td>-1461</td>
<td>8.26</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>(0.85)</td>
<td>(0.95)</td>
<td>(3.27)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.1055</td>
<td>-174</td>
<td>1.63</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>(1.07)</td>
<td>(0.84)</td>
<td>(4.81)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)

<table>
<thead>
<tr>
<th>Alternative Functional Forms</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>SSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Quad.</td>
<td>-10.692</td>
<td>0.00834</td>
<td>-0.00000192</td>
<td>7.481</td>
</tr>
<tr>
<td>q=a+bY+cp+dY^2</td>
<td>(1.55)</td>
<td>(2.27)</td>
<td>(2.59)</td>
<td>(2.24)</td>
</tr>
<tr>
<td>Log. Quad</td>
<td>-0.17</td>
<td>11.834</td>
<td>-0.837</td>
<td>-39.6</td>
</tr>
<tr>
<td>lnq=a+blnY+clnp+d(lnY)^2</td>
<td>(0.52)</td>
<td>(3.6)</td>
<td>(3.6)</td>
<td>(3.44)</td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.06(b) Bus Transport. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against log. quad. SSE

Critical Chi Value for 95% YES or NO Confidence

All non-quadratic forms give insignificant t-values

Linear Quad.\((34/2)\log(33.75/20.37) = 3.73\) 3.841 YES

Table 7.7.06(c) Bus Transport. Elasticity Estimates.

<table>
<thead>
<tr>
<th></th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Quadratic Form</td>
<td>0.4</td>
<td>0.08</td>
<td>-2.79</td>
</tr>
<tr>
<td>Log. Quadratic Form</td>
<td>0.25</td>
<td>-0.9</td>
<td>-2.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Half Average Price (0.2)</th>
<th>Average Price (0.4)</th>
<th>Double Average Price (0.8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Quadratic Form</td>
<td>-0.4</td>
<td>-1.33</td>
<td>-</td>
</tr>
<tr>
<td>Log. Quadratic Form</td>
<td>-0.17</td>
<td>-0.17</td>
<td>-0.17</td>
</tr>
</tbody>
</table>
7.7.07 COLLEGE TEACHERS (Uniteach)

Description Of The Category

"Compensation of employees (total expenditure for personnel, whether paid by governments or institutions or directly by households)" of "Teachers for colleges and universities". For the purposes of the I.C.P. this level of education was defined as that requiring more than twelve years of previous education to gain entry.

For this category the I.C.P. used direct quantity comparisons. These were calculated as follows:
Stage (1) The total quantity of teachers per capita expressed relative to that for the United States was obtained.
Stage (2) The total number of students per capita expressed relative to that for the United States was obtained.
Stage (3) The geometric mean of the results of stages (1) and (2) were calculated. This was the quantity ratio used.

The indirect PPPs were obtained by dividing the expenditure ratios by the quantity ratios.
Figure 7.7.07(a). College Teachers. Quantity and Total Consumption Expenditure.
Figure 7.7.07(b) College Teachers. Logarithm of Quantity and Total Consumption Expenditure.
<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.23</td>
<td>1.01</td>
<td>-5.4</td>
<td>7.87</td>
</tr>
<tr>
<td></td>
<td>(1.74)</td>
<td>(9.3)</td>
<td>(6.4)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-2.4</td>
<td>0.00603</td>
<td>2.09</td>
<td>19.9</td>
</tr>
<tr>
<td></td>
<td>(0.9)</td>
<td>(6.11)</td>
<td>(0.81)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-0.72</td>
<td>8.66</td>
<td>-51.4</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>(0.34)</td>
<td>(5.01)</td>
<td>(3.88)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>-0.26</td>
<td>-6588</td>
<td>19.6</td>
<td>29.6</td>
</tr>
<tr>
<td></td>
<td>(0.33)</td>
<td>(3.82)</td>
<td>(6.87)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.035</td>
<td>-891.9</td>
<td>2.95</td>
<td>8.84</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
<td>(8.56)</td>
<td>(17.06)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>$(34/2)\log(19.9/7.87) = 6.8$</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>$(34/2)\log(24/7.87) = 8.2$</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>$(34/2)\log(29.6/7.87) = 9.8$</td>
<td>3.841</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>$(34/2)\log(8.84/7.87) = 0.86$</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.07(c) College Teachers. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income ($1010)</th>
<th>Average Income ($2019)</th>
<th>Double Average Income ($4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.88</td>
<td>0.44</td>
<td>0.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.31)</th>
<th>Average Price (0.62)</th>
<th>Double Average Price (1.24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.23</td>
<td>-0.23</td>
<td>-0.23</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.112</td>
<td>-0.056</td>
<td>-0.03</td>
</tr>
</tbody>
</table>
7.7.08 PARKING, e.t.c.

Description Of The Category

Other expenditures on personal transport equipment. Parking and garaging; bridge, tunnel, ferry and road tolls; driving lessons; hire of personal transport equipment; service charges on insurance of personal transport equipment.
Figure 7.7.08(a). Parking etc.
Quantity and Total Consumption Expenditure per Capita.

T.C.E. ($) vs. Quantity per Capita ($).
Figure 7.7.08(b). Parking etc.
Logarithm of Quantity and
Total Consumption Expenditure per Capita.
Table 7.7.08(a) Parking, e. t. c. The parameters, t-Values and Error Sum of Squares Given By The Five Functional Forms.

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.62</td>
<td>1.70</td>
<td>-11.3</td>
<td>53.2</td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(5.18)</td>
<td>(4.59)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-2.77</td>
<td>0.0074</td>
<td>-1.28</td>
<td>61.3</td>
</tr>
<tr>
<td></td>
<td>(1.27)</td>
<td>(9.55)</td>
<td>(0.38)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-2.83</td>
<td>10.49</td>
<td>-66.29</td>
<td>106.6</td>
</tr>
<tr>
<td></td>
<td>(1.00)</td>
<td>(6.56)</td>
<td>(5.62)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.52</td>
<td>-7573</td>
<td>16.05</td>
<td>174.4</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(4.06)</td>
<td>(4.22)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.32</td>
<td>-1244</td>
<td>2.04</td>
<td>77.9</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
<td>(3.34)</td>
<td>(3.07)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.08(b) Parking, e.t.c. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>$\sqrt{(31/2)\log(61.3/53.2)} = 0.95$</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>$\sqrt{(31/2)\log(106.6/53.2)} = 4.68$</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>$\sqrt{(31/2)\log(174.4/53.2)} = 8$</td>
<td>2.841</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>$\sqrt{(31/2)\log(77.9/53.2)} = 2.57$</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.08(c) Parking, e.t.c. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income ($I$1010$)</th>
<th>Average Income ($I$2019$)</th>
<th>Double Average Income ($I$4038$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Linear Form</td>
<td>1.2</td>
<td>1.09</td>
<td>1.04</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.23</td>
<td>0.62</td>
<td>0.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.55)</th>
<th>Average Price (1.1)</th>
<th>Double Average Price (2.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.62</td>
<td>-0.62</td>
<td>-0.62</td>
</tr>
<tr>
<td>Linear Form</td>
<td>Not Computable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.58</td>
<td>-0.29</td>
<td>-0.15</td>
</tr>
</tbody>
</table>

173
7.7.09 RENTS

Description Of The Category

All gross rent in respect of dwellings, actual and imputed in the case of owner-occupied houses, including ground rents and taxes on the property. In general, house rent will be space rent, covering heating and plumbing facilities, lighting fixtures, fixed stoves, wash basins, and similar equipment that customarily is installed in the house before selling or letting. Also included are payments for garbage and sewage disposal. Rents paid for rooms in boarding houses, but not in hotels, are included. Rents of secondary dwellings such as summer cottages, mountain chalets and the like, are also included. (I.C.P. page 62)

All rent subsidies extended by governments to households have been added to gross rents. (I.C.P. page 34)
Figure 7.7.09(a). Rents.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.09(b). Rents, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.09 (a) Rents. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.712 (4.86)</td>
<td>1.366 (15.3)</td>
<td>-5.58 (8.57)</td>
<td>5.2</td>
</tr>
<tr>
<td>Linear</td>
<td>-29.17 (1.49)</td>
<td>0.1122 (16.04)</td>
<td>-20.49 (0.73)</td>
<td>8.2</td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-23.33 (0.76)</td>
<td>160.9 (8.61)</td>
<td>-1006 (7.37)</td>
<td>24.3</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>12.8 (0.46)</td>
<td>-117958 (4.91)</td>
<td>272 (5.27)</td>
<td>49.3</td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.334 (2.19)</td>
<td>-1227 (9.3)</td>
<td>5.26 (18.53)</td>
<td>14</td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.09(b) Rents. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>$(34/2)\log(8.2/5.2) = 3.36$</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>$(34/2)\log(24.3/5.2) = 11.4$</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>$(34/2)\log(49.6/5.2) = 16.7$</td>
<td>3.841</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>$(34/2)\log(14/5.2) = 7.3$</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.09(c) Rents. Elasticity Estimates

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.37</td>
<td>1.37</td>
<td>1.37</td>
</tr>
<tr>
<td>Linear Form</td>
<td>1.22</td>
<td>1.10</td>
<td>1.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.47)</th>
<th>Average Price (0.93)</th>
<th>Double Average Price (1.86)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.71</td>
<td>-0.71</td>
<td>-0.71</td>
</tr>
<tr>
<td>Linear Form</td>
<td>Not Computable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.7.10 TEACHERS, FIRST AND SECOND LEVEL

Description Of The Category

Compensation of employees for teaching in primary and secondary schools. (Total expenditure for personnel, whether paid by governments or institutions or directly by households).

The three educational levels were approximated in the following way (see page 68 I.C.P.):
1) First level, 7 - 9 years of completed education or less.
2) Third level, more than twelve years of completed education.
3) Second level, years of completed education above the first level and under the third level.

A quantity comparison was undertaken and the PPP's derived from this. The quantity comparisons were based on the number of standardized persons engaged in providing the services. A "standard" teacher is one that has completed two years of college or university. (I.C.P. page 132)

The quantity comparisons were carried out in four stages:
(I.C.P. pages 154 -162)
1) Raw quantities were adjusted to represent the number of "standard" teachers.
2) A "productivity" correction factor is applied - this takes account of the better quality of teaching in higher income countries.
3) Data was collected on the number of pupils per capita. This was used as a measure of quantity output.
4) The direct quantity ratios are given by the geometric mean of the adjusted quantity ratio for "standard" teachers, and the pupil output ratio. That is:

\[ \text{Final quantity} = \sqrt{\text{stage 2 quantity} \times \text{stage 3 quantity}} \]

The indirect PPP's were obtained by dividing the expenditure ratios by the quantity ratios.
Figure 7.7.10(a). Teachers, First and Second Level. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.10(b). Teachers, First and Second Level. Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.10(a) Teachers, First and Second Level. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.054</td>
<td>0.378</td>
<td>1.37</td>
<td>1.27</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(4.57)</td>
<td>(1.95)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-15.14</td>
<td>0.0131</td>
<td>50.1</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>(1.16)</td>
<td>(4.57)</td>
<td>(12.1)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-4.91</td>
<td>22.99</td>
<td>-104</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>(1.09)</td>
<td>(5.37)</td>
<td>(2.86)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>-0.333</td>
<td>-16628</td>
<td>87.92</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(4.59)</td>
<td>(32.14)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>-0.0124</td>
<td>-284</td>
<td>4.54</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>(0.89)</td>
<td>(4.56)</td>
<td>(98.6)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.10(b) Teachers, First and Second Level. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against the hyperbolic SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>(34/2)log(1.27/0.7) = 4.4</td>
<td>3.841</td>
</tr>
<tr>
<td>Linear</td>
<td>(34/2)log(1.15/0.7) = 3.67</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(0.74/0.7) = 0.41</td>
<td>3.841</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(34/2)log(0.91/0.7) = 1.94</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.10(c) Teachers, First and Second Level. Elasticity Estimates

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Form</td>
<td>0.21</td>
<td>0.35</td>
<td>0.51</td>
</tr>
<tr>
<td>Semi-Log. Form</td>
<td>0.42</td>
<td>0.32</td>
<td>0.26</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.28</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Hyperbolic Form</td>
<td>0.23</td>
<td>0.10</td>
<td>0.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.19)</th>
<th>Average Price (0.38)</th>
<th>Double Average Price (0.76)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Form</td>
<td>-0.061</td>
<td>-0.13</td>
<td>-0.3</td>
</tr>
<tr>
<td>Semi-Log. Form</td>
<td>Cannot calculate(negative quantities given)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.066</td>
<td>0.033</td>
<td>0.016</td>
</tr>
<tr>
<td>Hyperbolic Form</td>
<td>0.02</td>
<td>0.01</td>
<td>0.005</td>
</tr>
</tbody>
</table>

184
7.7.11 HOSPITALS

Description Of The Category

Current expenditures of hospitals, laboratories, clinics, and medical offices, not elsewhere classified (including expenditure related to physical facilities and personnel other than medical and related practitioners). It was difficult for some countries to separate expenditure on nurses and hospitals. (I.C.P. page 141)

Quantity comparisons were based on direct comparisons of the number of bed-days, but in a few cases where bed-days were not available, the number of beds were used. Thus, the quantity ratios were calculated before the PPP's, the latter being derived from a division of the expenditure ratio by the quantity ratio.

The first stage in the calculation of relative quantities was to count the number of bed-days (or beds) per capita. This figure was then adjusted to make allowance for the greater effectiveness of hospitals in the wealthier countries due to two factors:

a) Greater availability of capital equipment.

b) Better "quality" of hospital facilities e.g. more efficient clinics and laboratories.
Figure 7.7.11(a). Hospitals.

Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.11(b). Hospitals.
Logarithm of Quantity and Total Consumption Expenditure per Capita.

Logarithm of Quantity per Capita (1$)

Log. of T.C.E. (1$)

187
<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.41</td>
<td>1.48</td>
<td>-8.06</td>
<td>12.3</td>
</tr>
<tr>
<td></td>
<td>(3.27)</td>
<td>(11.06)</td>
<td>(7.92)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-19.89</td>
<td>0.0281</td>
<td>2.03</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>(2.22)</td>
<td>(9.89)</td>
<td>(0.25)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-12.03</td>
<td>45.3</td>
<td>-295.9</td>
<td>25.6</td>
</tr>
<tr>
<td></td>
<td>(2.64)</td>
<td>(9.23)</td>
<td>(7.93)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.54</td>
<td>-33394</td>
<td>73.52</td>
<td>50.1</td>
</tr>
<tr>
<td></td>
<td>(1.61)</td>
<td>(5.3)</td>
<td>(8.3)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.037</td>
<td>-1149.2</td>
<td>4.14</td>
<td>26.5</td>
</tr>
<tr>
<td></td>
<td>(1.36)</td>
<td>(6.36)</td>
<td>(16.3)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.11(b) Hospitals. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(22.2/12.3) = 4.36</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(25.6/12.3) = 5.4</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(50.1/12.3) = 10.4</td>
<td>3.841</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>(34/2)log(26.5/12.3) = 5.67</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.11(c) Hospitals. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.48</td>
<td>1.48</td>
<td>1.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.24)</th>
<th>Average Price (0.48)</th>
<th>Double Average Price (0.96)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.41</td>
<td>-0.41</td>
<td>-0.41</td>
</tr>
</tbody>
</table>
7.7.12 NURSES

Description Of The Category

Services of nurses and related professional and semiprofessional personnel (compensation of employed persons and net income of independent practitioners for services performed, both in and out of the hospital) nurses, physiotherapists, technicians, midwives, and so forth.

It is difficult, for some countries to separate expenditure on nurses and hospitals. (I.C.P. page 141)

Quantity comparisons were based on direct comparisons of the number of nurses per capita. (Thus the quantity ratios were calculated before PPP's, the latter being derived from a division of the expenditure ratio by the quantity ratio).

To obtain the relative quantity of nurses per capita, the first stage was to count the number of nurses per capita. This figure was then adjusted to make allowance for the greater effectiveness of nurses in wealthier countries due to two factors:

a) Greater availability of capital equipment.

b) Better "quality" of nurses i.e. more skilled.
Figure 7.7.12(a). Nurse's Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.12(b). Nurse's Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.12(a) Nurses. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.269</td>
<td>1.4995</td>
<td>-8.58</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(13.79)</td>
<td>(10.9)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-7.07</td>
<td>0.01648</td>
<td>-0.555</td>
<td>36.7</td>
</tr>
<tr>
<td></td>
<td>(1.35)</td>
<td>(7.96)</td>
<td>(0.09)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-7.62</td>
<td>23.2</td>
<td>-148</td>
<td>38.9</td>
</tr>
<tr>
<td></td>
<td>(2.79)</td>
<td>(6.81)</td>
<td>(6.01)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>0.676</td>
<td>-17042</td>
<td>40.16</td>
<td>52.2</td>
</tr>
<tr>
<td></td>
<td>(3.66)</td>
<td>(4.78)</td>
<td>(8.31)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.0141</td>
<td>-1328.2</td>
<td>3.8</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td>(9.65)</td>
<td>(20.35)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.12(b) Nurses. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 7.7.12(c) Nurses. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Double Log. Form</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.32)</th>
<th>Average Price (0.63)</th>
<th>Double Average Price (1.26)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Double Log. Form</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.27</td>
<td>-0.27</td>
<td>-0.27</td>
</tr>
</tbody>
</table>
7.7.13 TELEPHONE AND TELEGRAPH

Description Of The Category

As in title only.
Figure 7.7.13(a). Telephone and Telegraph. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.13(b). Telephone and Telegraph, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.13(a) Telephone and Telegraph. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.07</td>
<td>1.86</td>
<td>-12.05</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>(8.42)</td>
<td>(19.58)</td>
<td>(17.19)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-8.39</td>
<td>0.0077</td>
<td>6.85</td>
<td>136.8</td>
</tr>
<tr>
<td></td>
<td>(3.49)</td>
<td>(6.2)</td>
<td>(1.66)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-7.54</td>
<td>10.3</td>
<td>-63.19</td>
<td>186</td>
</tr>
<tr>
<td></td>
<td>(2.46)</td>
<td>(4.49)</td>
<td>(3.25)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>4.05</td>
<td>-7431</td>
<td>14.05</td>
<td>242</td>
</tr>
<tr>
<td></td>
<td>(1.66)</td>
<td>(3.06)</td>
<td>(3.25)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.504</td>
<td>-1676.5</td>
<td>2.49</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>(3.77)</td>
<td>(12.57)</td>
<td>(10.5)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.13(b) Telephone and Telegraph: d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE.

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(136.8/6.3) = 22.7</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(186/6.3) = 25</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(242/6.3) = 27</td>
<td>3.841</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>(34/2)log(14.5/6.3) = 6.15</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.13(c) Telephone and Telegraph: Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.86</td>
<td>1.86</td>
<td>1.86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.64)</th>
<th>Average Price (1.28)</th>
<th>Double Average Price (2.56)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.07</td>
<td>-1.07</td>
<td>-1.07</td>
</tr>
</tbody>
</table>
7.7.14 DENTIST'S SERVICES

Description Of The Category

Services of dentists - compensation of employed persons and net income of independent practitioners for services performed, both in and out of the hospital.

Quantity comparisons were based on direct comparisons of the number of dentists per capita. (Thus quantity ratios were calculated before PPP's, the latter being derived from a division of the expenditure ratios by the quantity ratios).

To obtain the relative quantity of dentists per capita the first stage was to count the number of dentists per capita. This figure was then adjusted to make allowances for the greater effectiveness of dentists in wealthier countries due to two factors:

a) Greater availability of capital equipment.

b) Better "quality" of dentists i.e. more skilled.
Figure 7.7.14(a). Dentist's Services.  
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.14(b). Dentist's Services. Logarithm of Quantity and Total Consumption Expenditure per Capita.
<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.34</td>
<td>2.21</td>
<td>-15.4</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td>(3.36)</td>
<td>(14.7)</td>
<td>(13.6)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-1.33</td>
<td>0.00611</td>
<td>-2.06</td>
<td>56.7</td>
</tr>
<tr>
<td></td>
<td>(1.89)</td>
<td>(9.5)</td>
<td>(1.22)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-2.5</td>
<td>9.4</td>
<td>-62.1</td>
<td>74.9</td>
</tr>
<tr>
<td></td>
<td>(2.96)</td>
<td>(8.07)</td>
<td>(7.12)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>0.32</td>
<td>-7414</td>
<td>14.7</td>
<td>142.6</td>
</tr>
<tr>
<td></td>
<td>(1.34)</td>
<td>(4.63)</td>
<td>(7.43)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.0666</td>
<td>-2407</td>
<td>3.01</td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td>(2.66)</td>
<td>(12.2)</td>
<td>(14.96)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.14(b) Dentist's Services. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(33/2)log(56.7/13.2) = 10.4</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(33/2)log(74.9/13.2) = 12.4</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(33/2)log(142.6/13.2) = 17</td>
<td>3.841</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(33/2)log(17.2/13.2) = 1.9</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.14(c) Dentist's Services. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4039)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>2.21</td>
<td>2.21</td>
<td>2.21</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>2.38</td>
<td>1.19</td>
<td>0.59</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.38)</th>
<th>Average Price (0.76)</th>
<th>Double Average Price (1.52)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.34</td>
<td>-0.34</td>
<td>-0.34</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.175</td>
<td>-0.09</td>
<td>-0.044</td>
</tr>
</tbody>
</table>
Description Of The Category

Services of physicians: compensation of employed persons and net income of independent practitioners for services performed, both in and out of hospital.

Quantity comparisons were based on direct comparisons of the number of physicians per capita. (Thus quantity ratios were calculated before PPP's, the latter being derived from a division of the expenditure ratio by the quantity ratio).

In obtaining the relative quantity of physicians per capita the first stage was to count the number of physicians per capita. This figure was then adjusted to make allowance for the greater effectiveness of physicians in wealthier countries due to two factors:

a) Greater availability of capital equipment.

b) Better "quality" of physicians, i.e. more skilled.
Figure 7.7.15(a). Physicians. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.15(b). Physicians. Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.15(a) Physicians. The Parameters, t-Values And Error
Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.45</td>
<td>1.67</td>
<td>-9.67</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>(4.9)</td>
<td>(18.64)</td>
<td>(14.62)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-6.31</td>
<td>0.0215</td>
<td>-1.99</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>(1.62)</td>
<td>(12.55)</td>
<td>(0.4)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-6.4</td>
<td>33.14</td>
<td>-211</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>(2.02)</td>
<td>(10.68)</td>
<td>(9.18)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.74</td>
<td>-25341</td>
<td>55.89</td>
<td>42.6</td>
</tr>
<tr>
<td></td>
<td>(1.31)</td>
<td>(5.91)</td>
<td>(8.04)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.11</td>
<td>-1510</td>
<td>4</td>
<td>10.9</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(13.13)</td>
<td>(21.5)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.15(b) Physicians. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(14/5.6) = 6.8</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(19/5.6) = 9</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(42.6/5.6) = 15</td>
<td>3.841</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>(34/2)log(10.9/5.6) = 4.9</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.15(c) Physicians. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.3)</th>
<th>Average Price (0.6)</th>
<th>Double Average Price (1.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.45</td>
<td>-0.45</td>
<td>-0.45</td>
</tr>
</tbody>
</table>
7.7.16 FOOTWEAR REPAIRS

Description Of The Category

Repairs to footwear (including shoe cleaning). Includes rubber, sports shoes (other than boots and shoes with ice or roller skates attached, gaiters, spats, leggings, puttees).
Figure 7.7.16(a). Footwear Repairs.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.16(b). Footwear Repairs.
Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.16(a) Footwear Repairs. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.73</td>
<td>0.90</td>
<td>-6.57</td>
<td>23.2</td>
</tr>
<tr>
<td></td>
<td>(1.31)</td>
<td>(4.35)</td>
<td>(4.28)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-1.29</td>
<td>0.00063</td>
<td>1.89</td>
<td>84.9</td>
</tr>
<tr>
<td></td>
<td>(1.14)</td>
<td>(2.39)</td>
<td>(1.43)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-0.88</td>
<td>1.07</td>
<td>-6.02</td>
<td>84.5</td>
</tr>
<tr>
<td></td>
<td>(0.76)</td>
<td>(2.56)</td>
<td>(1.96)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>0.44</td>
<td>-896</td>
<td>2.25</td>
<td>89.9</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(2.26)</td>
<td>(1.74)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.32</td>
<td>-902.9</td>
<td>0.605</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>(0.66)</td>
<td>(4.5)</td>
<td>(0.96)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.16(b). Footwear Repairs. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>(32/2)log(84.9/23.2) = 9</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td></td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td></td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td></td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log.Recip.</td>
<td>(32/2)log(23.8/23.2) = 0.18</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.16(c) Footwear Repairs. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.9</td>
<td>0.45</td>
<td>0.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.48)</th>
<th>Average Price (0.96)</th>
<th>Double Average Price (1.92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.73</td>
<td>-0.73</td>
<td>-0.73</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.66</td>
<td>-0.33</td>
<td>-0.17</td>
</tr>
</tbody>
</table>
7.7.17 INDOOR REPAIR, UPKEEP

Description Of The Category

Expenditures of occupants of dwelling units on indoor repair and upkeep (indoor painting, wallpaper, decorating and the like).
Figure 7.7.17(a). Indoor Repairs, Upkeep. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.17(b). Indoor Repairs, Upkeep, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.17(a) Indoor Repair, Upkeep. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.02</td>
<td>1.64</td>
<td>-9.41</td>
<td>19.4</td>
</tr>
<tr>
<td></td>
<td>(3.23)</td>
<td>(9.36)</td>
<td>(7.29)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-1.21</td>
<td>0.0136</td>
<td>-3.24</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(4.84)</td>
<td>(0.37)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>4.26</td>
<td>19.13</td>
<td>-118.8</td>
<td>123.4</td>
</tr>
<tr>
<td></td>
<td>(0.48)</td>
<td>(3.92)</td>
<td>(3.31)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>-12.54</td>
<td>-14211</td>
<td>46.7</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>(1.09)</td>
<td>(2.99)</td>
<td>(4.12)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.45</td>
<td>-1447</td>
<td>3.33</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>(1.03)</td>
<td>(8)</td>
<td>(7.73)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.17(b) Indoor Repair, Upkeep. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>(33/2)log(110/19.4)</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>12.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>13.3</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>14.3</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>1.82</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.17(c) Indoor Repair, Upkeep. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.64</td>
<td>1.64</td>
<td>1.64</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.44</td>
<td>0.72</td>
<td>0.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.7)</th>
<th>Average Price (1.4)</th>
<th>Double Average Price (2.8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.02</td>
<td>-1.02</td>
<td>-1.02</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.64</td>
<td>-0.32</td>
<td>-0.16</td>
</tr>
</tbody>
</table>
Description Of The Category

As in title.
Figure 7.7.18(a). Personal Transport Equipment Repair Charges. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.18(b). Personal Transport Equipment Repair Charges. Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.18(a) Personal Transport Equipment Repair Charges: The Parameters, \( t \)-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.37</td>
<td>1.64</td>
<td>-10.4</td>
<td>33.8</td>
</tr>
<tr>
<td></td>
<td>(4.3)</td>
<td>(6.13)</td>
<td>(5.33)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-5.97</td>
<td>0.0232</td>
<td>-10.37</td>
<td>556</td>
</tr>
<tr>
<td></td>
<td>(1.19)</td>
<td>(6.04)</td>
<td>(0.84)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-25.5</td>
<td>22.7</td>
<td>-140.5</td>
<td>637</td>
</tr>
<tr>
<td></td>
<td>(3.03)</td>
<td>(3.23)</td>
<td>(2.74)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>35.06</td>
<td>-7311</td>
<td>-12.47</td>
<td>591</td>
</tr>
<tr>
<td></td>
<td>(5.41)</td>
<td>(1.21)</td>
<td>(0.92)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>1.45</td>
<td>-1054</td>
<td>0.76</td>
<td>55.1</td>
</tr>
<tr>
<td></td>
<td>(4.46)</td>
<td>(3.5)</td>
<td>(1.11)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are \( t \)-values)
Table 7.7.18(b) Personal Transport Equipment Repair Charges.  
**Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE**

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear ((33/2)\log(556/33.8) = 20)</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log. ((33/2)\log(637/33.8) = 21)</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic ((33/2)\log(591/33.8) = 21)</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip. ((33/2)\log(55.1/33.8) = 3.5)</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.18(c) Personal Transport Equipment Repair Charges.  
**Elasticity Estimates.**

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.64</td>
<td>1.64</td>
<td>1.64</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.04</td>
<td>0.52</td>
<td>0.26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.57)</th>
<th>Average Price (1.14)</th>
<th>Double Average Price (2.28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.37</td>
<td>-1.37</td>
<td>-1.37</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-2.55</td>
<td>-1.27</td>
<td>-0.64</td>
</tr>
</tbody>
</table>

224
7.7.19 OTHER ENTERTAINMENT, CULTURAL (REC. & CULT)

Description Of The Category

Other entertainment (not included in "Public Entertainment"), religious, recreational and cultural services. Expenditure on private entertainment such as hiring musicians, clowns and the like for private parties; bridge, dancing, and sports lessons; gambling; portrait and other services such as film developing and print processing furnished by photographs; hire of radio and television sets, airplanes, boats, horses and other recreational equipment; veterinary and other services for pets; radio and television licenses where government broadcasting stations exist; religious activities.

On page 36 of the I.C.F. is stated "In some countries radio and television is provided in whole or in part by government. In other countries it is provided by direct listener charges, and in others almost entirely of business cost through advertising. Since no adjustments have been attempted for this in the entertainment category, quantity comparisons may be misleading."
Figure 7.7.19(a). Other Entertainment, Cultural. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.19(b). Other Entertainment, Cultural, Logarithm of Quantity and Total Consumption Expenditure per Capita.
<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.88</td>
<td>1.097</td>
<td>-5.5</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>(2.46)</td>
<td>(6.69)</td>
<td>(4.54)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-9.53</td>
<td>0.01073</td>
<td>10.3</td>
<td>53.8</td>
</tr>
<tr>
<td></td>
<td>(1.38)</td>
<td>(4.77)</td>
<td>(1.17)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-15.4</td>
<td>17.74</td>
<td>-109</td>
<td>54.5</td>
</tr>
<tr>
<td></td>
<td>(1.88)</td>
<td>(4.77)</td>
<td>(3.95)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>9.12</td>
<td>-13327</td>
<td>24.48</td>
<td>69.4</td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
<td>(3.4)</td>
<td>(2.75)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.69</td>
<td>-904</td>
<td>2.66</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>(1.94)</td>
<td>(5.13)</td>
<td>(6.65)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.19(b) Other Entertainment, Cultural elasticity statistics to test whether two functions are empirically equivalent based on differences in SSE.

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>(34/2) log(53.8/17.5)</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>8.3</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>8.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>10.2</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>2.1</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.19(c) Other Entertainment, Cultural Elasticity Estimates.

<table>
<thead>
<tr>
<th></th>
<th>Income</th>
<th>Average Income</th>
<th>Double Average Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Half Average</td>
<td>Average</td>
<td>Double Average</td>
</tr>
<tr>
<td></td>
<td>Income (I$1010)</td>
<td>Income (I$2019)</td>
<td>Income (I$4038)</td>
</tr>
<tr>
<td>Double Log. Form</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.9</td>
<td>0.45</td>
<td>0.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Half Average</td>
</tr>
<tr>
<td></td>
<td>Price (0.53)</td>
</tr>
<tr>
<td>Double Log. Form</td>
<td>-0.88</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.3</td>
</tr>
</tbody>
</table>
7.7.20 PUBLIC ENTERTAINMENT

Description Of The Category

Public entertainment (excluding hotels, restaurants, and cafés). Private and public expenditure on places of public amusement and recreation, including theatres, cinemas, sports, museums, art galleries, historical monuments, botanical and zoological gardens, parks, ski facilities, and the like.
Figure 7.7.20(a). Public Entertainment. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.20(b). Public Entertainment, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.20(a) Public Entertainment. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.096</td>
<td>1.314</td>
<td>-8.3</td>
<td>27.2</td>
</tr>
<tr>
<td></td>
<td>(2.88)</td>
<td>(6.57)</td>
<td>(5.35)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-30</td>
<td>0.00536</td>
<td>23.2</td>
<td>170.6</td>
</tr>
<tr>
<td></td>
<td>(2.23)</td>
<td>(1.99)</td>
<td>(2.59)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-20.8</td>
<td>11.85</td>
<td>-83.95</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>(2.74)</td>
<td>(2.97)</td>
<td>(2.72)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>9.7</td>
<td>-11215</td>
<td>6.72</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>(2.67)</td>
<td>(3.09)</td>
<td>(0.75)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.48</td>
<td>-1229.3</td>
<td>2.23</td>
<td>26.1</td>
</tr>
<tr>
<td></td>
<td>(2.65)</td>
<td>(6.84)</td>
<td>(5.06)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.20(b) Public Entertainment. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against the log. reciprocal SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log (34/2)log(27.2/26.1) = 0.3</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Linear (34/2)log(170.6/26/1) = 13.9</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log. (34/2)log(147/26.1) = 12.8</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic (34/2)log(145/26.1) = 12.7</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 7.7.20(c) Public Entertainment. Elasticity Estimates.

<table>
<thead>
<tr>
<th></th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.314</td>
<td>1.314</td>
<td>1.314</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.217</td>
<td>0.608</td>
<td>0.304</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Half Average Price (0.27)</th>
<th>Average Price (0.54)</th>
<th>Double Average Price (1.08)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.096</td>
<td>-1.096</td>
<td>-1.096</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.76</td>
<td>-0.88</td>
<td>-0.44</td>
</tr>
</tbody>
</table>
7.7.21 POSTAL COMMUNICATION

Description Of The Category

Simply stated as "Postal Communication" in the I.C.P.
Figure 7.7.21(a). Postal Communications. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.21(b). Postal Communications.
Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.21(a) Postal Communication. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.67</td>
<td>1.38</td>
<td>-9.46</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>(1.69)</td>
<td>(7.8)</td>
<td>(7.3)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-1.25</td>
<td>0.00276</td>
<td>-0.009</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(5.41)</td>
<td>(0)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-1.36</td>
<td>3.85</td>
<td>-23.9</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>(0.67)</td>
<td>(4.3)</td>
<td>(3.6)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.57</td>
<td>-2670</td>
<td>5.06</td>
<td>193</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(2.85)</td>
<td>(1.86)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.66</td>
<td>-1136</td>
<td>0.998</td>
<td>29.9</td>
</tr>
<tr>
<td></td>
<td>(1.49)</td>
<td>(5.85)</td>
<td>(1.76)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.21(b) Postal Communication. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(125/21.1) = 13.1</td>
<td>3.841</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(153/21.1) = 14.6</td>
<td>3.841</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(193/21.1) = 16.3</td>
<td>3.841</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(34/2)log(29.9/21.1) = 2.57</td>
<td>3.841</td>
</tr>
</tbody>
</table>

Table 7.7.21(c) Postal Communication. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.38</td>
<td>1.38</td>
<td>1.38</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.13</td>
<td>0.56</td>
<td>0.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.53)</th>
<th>Average Price (1.06)</th>
<th>Double Average Price (2.12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.67</td>
<td>-0.67</td>
<td>-0.67</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.24</td>
<td>-0.62</td>
<td>-0.31</td>
</tr>
</tbody>
</table>
7.7.22 AIR TRANSPORT

Description Of The Category

Air transport: - fares on transport, fees for transporting personal transportation equipment, for baggage transfer; storage and excess charges; tips to porters; service charges for baggage.
Figure 7.7.22(a). Air Transport.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.22(b). Air Transport. Logarithm of Quantity and Total Consumption Expenditure per Capita.
<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.934 (1.4)</td>
<td>1.20 (5.45)</td>
<td>-7.89 (4.86)</td>
<td>30.4</td>
</tr>
<tr>
<td>Linear</td>
<td>-3.65 (3.15)</td>
<td>0.00196 (3.39)</td>
<td>4.77 (3.46)</td>
<td>69</td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-2.97 (2.61)</td>
<td>2.59 (3.07)</td>
<td>-14.5 (2.34)</td>
<td>72</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.68 (1.94)</td>
<td>-1955 (2.56)</td>
<td>4.28 (3.03)</td>
<td>77</td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.49 (2.27)</td>
<td>-1028 (5.35)</td>
<td>1.26 (3.55)</td>
<td>30.3</td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.22(b) Air Transport. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE Calculation</th>
<th>Critical Chi Value</th>
<th>95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>$(34/2) \log(30.4/30.3) = 0.02$</td>
<td>3.841</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>$(34/2) \log(69/30.3) = 6.09$</td>
<td>3.841</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>$(34/2) \log(72/30.3) = 6.39$</td>
<td>3.841</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>$(34/2) \log(77/30.3) = 6.89$</td>
<td>3.841</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.7.22(c) Air Transport. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income (I$1010)</th>
<th>Half Average Income</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.02</td>
<td>0.51</td>
<td>0.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price (0.58)</th>
<th>Half Average Price</th>
<th>Average Price (1.15)</th>
<th>Double Average Price (2.30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.934</td>
<td>-0.934</td>
<td>-0.934</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.86</td>
<td>-0.43</td>
<td>-0.215</td>
</tr>
</tbody>
</table>
7.7.23 RAIL TRANSPORT

Description Of The Category

Long distance rail transport: fees for transporting personal transportation equipment, for baggage transfer; storage and excess charges; tips to porters; service charges for baggage.
Figure 7.7.23(a). Rail Transport.
Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.23(b). Rail Transport, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.23(a) Rail Transport. The Parameters, \( t \)-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-0.66 (1.96)</td>
<td>1.27 (4.5)</td>
<td>-9</td>
<td>50.1</td>
</tr>
<tr>
<td>Linear</td>
<td>-2.22 (0.68)</td>
<td>0.0032 (1.97)</td>
<td>1.81</td>
<td>674</td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-4.12 (1.29)</td>
<td>6.34 (2.38)</td>
<td>-43.6</td>
<td>644</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.11 (0.95)</td>
<td>-5038 (1.92)</td>
<td>8.11</td>
<td>685</td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.246 (2)</td>
<td>-1163 (4.21)</td>
<td>1.217</td>
<td>52.9</td>
</tr>
</tbody>
</table>

(figures in brackets are \( t \)-values)
Table 7.7.23(b) Rail Transport. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>Formula</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(674/50.1) = 19.2</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(644/50.1) = 18.9</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(685/50.1) = 19.3</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(34/2)log(52.9/50.1) = 0.4</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.23(c) Rail Transport. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.27</td>
<td>1.27</td>
<td>1.27</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.15</td>
<td>0.58</td>
<td>0.29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.24)</th>
<th>Average Price (0.49)</th>
<th>Double Average Price (0.98)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-0.66</td>
<td>-0.66</td>
<td>-0.66</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-1.02</td>
<td>-0.51</td>
<td>-0.25</td>
</tr>
</tbody>
</table>
7.7.24 HOTELS, LODGINGS

Description Of The Category

The I.C.P. just state: "Hotels and similar lodging places".
Figure 7.7.24(a). Hotels, lodgings. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.24(b). Hotels, lodgings, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.24(a) Hotels, Lodgings. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.09 (2.45)</td>
<td>1.40 (6.01)</td>
<td>-8.42 (5.19)</td>
<td>22.9</td>
</tr>
<tr>
<td>Linear</td>
<td>-30.77 (1.58)</td>
<td>0.00905 (1.39)</td>
<td>30.2</td>
<td>314</td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-29.35 (1.92)</td>
<td>13.8 (1.79)</td>
<td>-87.1 (1.62)</td>
<td>293</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>24.9 (2.63)</td>
<td>-9539 (1.42)</td>
<td>-5.46 (0.27)</td>
<td>289</td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.867 (3.32)</td>
<td>-1272 (6.65)</td>
<td>2.04 (3.73)</td>
<td>21</td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.24(b) Hotels, Lodgings. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against the log. reciprocal SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE Formula</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>((33/2)\log(22.9/21)) = 0.62</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Linear</td>
<td>((33/2)\log(314/21)) = 19.4</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>((33/2)\log(293/21)) = 18.9</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>((33/2)\log(289/21)) = 18.8</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 7.7.24(c) Hotels, Lodgings. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.26</td>
<td>0.63</td>
<td>0.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.37)</th>
<th>Average Price (0.73)</th>
<th>Double Average Price (1.46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.09</td>
<td>-1.09</td>
<td>-1.09</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-2.34</td>
<td>-1.18</td>
<td>-0.6</td>
</tr>
</tbody>
</table>
7.7.25 RESTAURANTS, CAFÉS

Description Of The Category

No further detail is given beyond "expenditures in restaurants and cafés".
Figure 7.7.25(a). Restaurants, Cafes. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.25(b). Restaurants, Cafes, Logarithm of Quantity and Total Consumption Expenditure per Capita.
Table 7.7.25(a) Restaurants, Cafés. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>0.32</td>
<td>1.86</td>
<td>-9.9</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>(0.76)</td>
<td>(9.81)</td>
<td>(7.04)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-16.1</td>
<td>0.0543</td>
<td>5.87</td>
<td>51.9</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(6.91)</td>
<td>(0.17)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-3.45</td>
<td>84.05</td>
<td>-519</td>
<td>61.5</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(6.25)</td>
<td>(5.21)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>-4.01</td>
<td>-64425</td>
<td>162</td>
<td>88.5</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(4.45)</td>
<td>(4.35)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>-0.93</td>
<td>-1714</td>
<td>6.35</td>
<td>20.5</td>
</tr>
<tr>
<td></td>
<td>(2.83)</td>
<td>(10.82)</td>
<td>(15.6)</td>
<td></td>
</tr>
</tbody>
</table>

(figures in brackets are t-values)
Table 7.7.25(b) Restaurants, Cafés. d Statistics To Test Whether Two Functions Are Empirically Equivalent Based On Differences In SSE

The other forms are tested against the log. reciprocal SSE

<table>
<thead>
<tr>
<th>Function</th>
<th>Formula</th>
<th>Critical Chi Value for 95% Confidence</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>( \frac{34}{2} \log(23.8/20.5) = 1 )</td>
<td>3.841</td>
<td>YES</td>
</tr>
<tr>
<td>Linear</td>
<td>( \frac{34}{2} \log(51.9/20.5) = 6.86 )</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>( \frac{34}{2} \log(61.5/20.5) = 8.11 )</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>( \frac{34}{2} \log(88.5/20.5) = 10.8 )</td>
<td>3.841</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 7.7.25(c) Restaurants, Cafés. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>1.86</td>
<td>1.86</td>
<td>1.86</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.70</td>
<td>0.85</td>
<td>0.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.56)</th>
<th>Average Price (1.12)</th>
<th>Double Average Price (2.24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>1.67</td>
<td>0.83</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Note: positive price elasticites
7.7.26 DOMESTIC SERVICES

Description Of The Category

"Domestic services (total compensation, including payments in kind to domestic servants, cleaners and the like; includes payments in cash and in kind to babysitters, chauffeurs, gardeners, governesses, tutors and the like)".

(I.C.P. page 62)
Figure 7.7.26(a). Domestic Services. Quantity and Total Consumption Expenditure per Capita.
Figure 7.7.26(b). Domestic Services, Logarithm of Quantity and Total Consumption Expenditure per Capita.
### Table 7.7.26(a) Domestic Services. The Parameters, t-Values And Error Sum of Squares Given By The Five Functional Forms.

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>Price Variable</th>
<th>Income Variable</th>
<th>Constant</th>
<th>Error Sum of Squares (SSE) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log</td>
<td>-1.15</td>
<td>0.81</td>
<td>-5.4</td>
<td>50.7</td>
</tr>
<tr>
<td></td>
<td>(2.98)</td>
<td>(1.95)</td>
<td>(1.62)</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>-17.5</td>
<td>0.00243</td>
<td>15.6</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>(1.85)</td>
<td>(0.86)</td>
<td>(3.29)</td>
<td></td>
</tr>
<tr>
<td>Semi-Log</td>
<td>-12.7</td>
<td>9.2</td>
<td>-68.1</td>
<td>230</td>
</tr>
<tr>
<td></td>
<td>(3.13)</td>
<td>(2.1)</td>
<td>(1.94)</td>
<td></td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>1.83</td>
<td>-4276</td>
<td>7.89</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td>(2.27)</td>
<td>(1.26)</td>
<td>(2.12)</td>
<td></td>
</tr>
<tr>
<td>Log. Reciprocal</td>
<td>0.169</td>
<td>-275.6</td>
<td>1.23</td>
<td>56.1</td>
</tr>
<tr>
<td></td>
<td>(2.23)</td>
<td>(0.86)</td>
<td>(3.5)</td>
<td></td>
</tr>
</tbody>
</table>

*figures in brackets are t-values*
The other forms are tested against double log. SSE

<table>
<thead>
<tr>
<th>Form</th>
<th>SSE</th>
<th>Critical Chi Value for 95%</th>
<th>Equivalent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>(34/2)log(270/50.7) = 12.3</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-Log.</td>
<td>(34/2)log(230/50.7) = 11.2</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Hyperbolic</td>
<td>(34/2)log(261/50.7) = 12.1</td>
<td>3.841</td>
<td>NO</td>
</tr>
<tr>
<td>Log. Recip.</td>
<td>(34/2)log(56.1/50.7) = 0.75</td>
<td>3.841</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 7.7.26(c) Domestic Services. Elasticity Estimates.

<table>
<thead>
<tr>
<th>Income</th>
<th>Half Average Income (I$1010)</th>
<th>Average Income (I$2019)</th>
<th>Double Average Income (I$4038)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>0.28</td>
<td>0.14</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Half Average Price (0.29)</th>
<th>Average Price (0.57)</th>
<th>Double Average Price (1.14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Log. Form</td>
<td>-1.15</td>
<td>-1.15</td>
<td>-1.15</td>
</tr>
<tr>
<td>Log. Reciprocal Form</td>
<td>-0.58</td>
<td>-0.29</td>
<td>-0.15</td>
</tr>
</tbody>
</table>
CHAPTER 8

ADDITIONAL VARIABLES

8.1 INTRODUCTION

The objectives of this Chapter are twofold: Firstly, to identify and describe the influence of a number of variables on the quantity of each service demanded. Secondly, through the addition of these variables to improve the significance of the own-price and income elasticity estimates so as to obtain less ambiguous elasticity estimates than those given in Chapter Seven.

The most obvious additional type of variable to test is a cross-price variable. Thus, for each of the services a number of possible substitutes and compliments were tested. For instance, in the case of Electricity nine cross-price influences were examined including "Gas" and "Other fuels" (coal e.t.c.).

Because the International Comparison Project (I.C.P.) data is presented on the basis of average per capita quantity and total consumption expenditure, it seemed reasonable to suppose that two countries with identical per capita incomes and relative price may show differing demand for a service because the age structure of the population differed. For instance, the demand for Teachers is likely to be affected by the proportion of the population below the age of fifteen. Thus, for each of the services, three age structures were tested; the proportion below fifteen, that between fifteen and sixty-five and finally, that over sixty-five.

Countries which have a large population in a small land area may show a different pattern of demand than a country with a
similar population in a large area. For instance, the demand for barbers and hairdressers may be less if people have to travel great distances to obtain this service. Thus, the density of the population may have an influence on the per capita quantity of a service demanded. This was tested.

Inflation may also affect the relative demand for goods and services. It may lead to distorted market signals through its uneven effects throughout the economy. Inflation was tested as a possible determining variable.

The way in which the average income is distributed may be thought to influence the pattern of demand. For instance, two economies may be identical in all respects except that one has a more equitable income distribution. This may result in a different demand level of, for example "Air Transport". Those people in the equitable society may exhibit very little demand for air travel because very few individual incomes are high. Whereas the few wealthy people in the society of uneven income levels may allocate significant amounts of income to air fares. Thus the per capita demand for "Air Transport" will be much higher in the second country. An income distribution measure was tested for each of the services.

For each service between seven and fifteen additional variables were examined. That is, between one and nine cross-price elasticities plus three population age structure variables, as well as density, inflation and income distribution.

The Chapter is organized as follows:
Section 8.2 explains the method used for the analysis carried out
in this Chapter.

Section 8.3 highlights one of the results (that for Postal Communications) to illustrate the nature of the analysis. Section 8.4 gives a summary presentation of the results, set out in detail in the Appendix 8.2 to the Chapter. This shows the extent to which the additional variables proved to be relevant. Section 8.5 presents the conclusions.

8.2 METHOD

Chapter Seven gave, for each service, the functional forms which fitted the data best based on the criteria of lowest error sum of squares (S.S.E). In many cases two or more functional forms fit the data equally well if allowance is made for the error inherent in sampling. That is, the SSE's were not statistically significantly different.

For this analysis the best fit functional forms from Chapter Seven were used. As the other functional forms had proved to be less appropriate, at this first stage, it seemed reasonable to leave them out of further analysis on the grounds of computational cost, and it allowed a relatively simple framework for further analysis. (For a few services some non-best fit forms were tested to see if these could be made "best fit" by the addition of other variables. However, the results showed that little was to be gained by examining all the functional forms again).

Ordinary least squares (O.L.S.) multiple regression was used. For each service own-price and total consumption
expenditure were always included as determining variables. To these variables possible substitutes and compliments were added and tested one at a time, and then in various combinations. Then, each of the other additional variable, were added and tested in turn and in a variety of combinations.

These other variables are:

(i) Percentage of population under 15 years.
(ii) Percentage of population aged 15 - 65 years.
(iii) Percentage of population over 65 years.
(iv) Density of population.
(v) Inflation rate (average per annum rate of price increases 1970 -1976).
(vi) Income distribution (Gini coefficients).

8.3 A RESULT HIGHLIGHTED - POSTAL COMMUNICATIONS

The results for all twenty six services are presented in the second Appendix to the Chapter. However, to understand the stages of analysis a closer examination of one of these categories is undertaken here.

Postal Communication
(see page 306)

This is an example of a category where the addition of a cross-price variable results in the establishment of a statistically supportable relationship between the quantity of a service demanded and the price of another service. It also shows how the estimates for own-price and income coefficients can be improved.

A total of seven additional variable were tested for postal
services. One of these was "telephone, telegraph", and the other six were the four demographic variables, plus inflation and income distribution.

The "Stage 1 Results" section show the functional forms judged to give the best fit to the data in Chapter Seven. In this case the double logarithmic and the logarithmic reciprocal gave the lowest SSE when only two variables, own-price and total consumption expenditure are used as determining variables.

The double logarithmic form gives a slightly better fit than the logarithmic reciprocal (SSE of 21.1 rather than 29.3 and a t-value for the income variable of 7.8 rather than 5.9). However the SSE are sufficiently close that with 95% confidence we can reject the hypothesis that the fits are significantly different.

Thus, both of these functional forms go forward to the next stage of analysis. Here each of the seven additional variables are included in an ordinary least squares regression. Firstly, one variable is added at a time so that fourteen regressions with three determining variables were undertaken. Then various combinations of variables were tested.

The "Stage 2 Results" only show the equations which exhibit an improvement on the "Stage 1 Results". This was judged on the basis of the following criteria: Improved t-values for the income and own-price variables plus a t-value for the additional variable greater than one.

In the case of "Postal Communications" six of the seven additional variables did not improve the estimates. However, an improvement was observed in the case of "telephone, telegraph".
Here we have evidence of a substitute. A positive cross-price elasticity of 0.44 for the double logarithmic form and 0.69 for the logarithmic reciprocal appears to confirm what may be an a priori belief. The t-value for the substitute, telephone and telegraph in the case of logarithmic reciprocal, 2.70, indicates that the parameter is statistically significant.

The adjusted coefficients of determination for both functional forms are improved with the addition of this substitute.

The own-price elasticity t-value rises from 1.7 in the case of the double logarithmic form to 2.1, and from 1.5 to 1.95 in the case of logarithmic reciprocal. Thus the own-price elasticity estimates become statistically significant at the 90% confidence level.

The total consumption expenditure elasticity estimates are improved. The t-value for the double logarithmic form rises from 7.8 to 8.1, with the elasticity changing slightly from 1.38 to 1.37. In the case of logarithmic reciprocal the t-value increases.

Thus, for this category we have established a cross-price elasticity and improved the statistical significance of the own-price and income elasticities for each of the two functional forms.

Unfortunately it is still not possible to declare one functional form, and thus one total consumption expenditure elasticity, statistically superior to another. This is because the new SSE's of 18.7 and 24 are not significantly different at
the 95% confidence level. (This was established by applying Equation 7.9, on page 122 to the two SSEs).

8.4 SUMMARY PRESENTATION OF THE RESULTS

Table 8.1

Variables Other Than Income and Own-Price Having Some Influence On Quantity Demanded

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Additional Variables Tested</th>
<th>Additional Variables, Elasticity (t-values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbers</td>
<td>7</td>
<td>Density +0.35(4), Inflation +0.26(2.39)</td>
</tr>
<tr>
<td>Clothing R&amp;R</td>
<td>11</td>
<td>$P_{MC} +2.4(2.8)$, $P_{MD} -1.92(2.7)$</td>
</tr>
<tr>
<td>Electricity</td>
<td>15</td>
<td>$P_{OF} +0.14(1.45)$, Inflation +0.23(3.2)</td>
</tr>
<tr>
<td>Household Service</td>
<td>11</td>
<td>Inflation -0.48(2.9)</td>
</tr>
<tr>
<td>Local Transport</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Bus Transport</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>College Teachers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Parking</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Rents</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Telephone</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Dentists</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Physicians</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Footwear Repairs</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Indoor Repairs</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Auto Repairs</td>
<td>11</td>
<td>Density -0.25(1.25), Inflation +0.29(1.13), $P_{F} +0.62(1.5)$</td>
</tr>
<tr>
<td>Rec. &amp; Culture</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Public Ent.</td>
<td>12</td>
<td>Density -0.27(1.77)</td>
</tr>
<tr>
<td>Postal Comm.</td>
<td>7</td>
<td>$P_{T} +0.44(1.94)$</td>
</tr>
<tr>
<td>Air Transport</td>
<td>10</td>
<td>Inflation +0.33(1.5)</td>
</tr>
<tr>
<td>Rail Transport</td>
<td>10</td>
<td>Inflation -0.47(1.5)</td>
</tr>
<tr>
<td>Hotels</td>
<td>9</td>
<td>Inflation +0.37(1.97)</td>
</tr>
<tr>
<td>Restaurants</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Domestic Service</td>
<td>11</td>
<td>$P_{CA} +0.83(1.6)$</td>
</tr>
</tbody>
</table>

For definition of notation see Appendix 1.

Key:

$P_{MC}$ = The purchasing power parity for "Men's clothing".

$P_{MD}$ = The purchasing power parity for "Boy's and Girl's clothing".

$P_{OF}$ = The purchasing power parity for "Other fuels".

$P_{MD}$ = The purchasing power parity for "Residential construction".

$P_{F}$ = The purchasing power parity for "Parking, tolls etc".

$P_{T}$ = The purchasing power parity for "Telephones, telegraph".

$P_{CA}$ = The purchasing power parity for "Cleaning appliances".
Table 8.1 shows those additional variables which displayed evidence of having an influence upon the quantity demanded of a service. These results are based on the additional variable having a t-value greater than one and the own-price and income t-values not being made smaller.

The empty spaces in the table indicate that no additional variable appeared to have a significant influence. Perhaps the most striking feature of the table is the small number of relevant additional variables. Considering that dozens of variables were tested it might have been expected that more than twelve services would show a relationship.

Explanations may lie in the nature of the data. In the case of income distribution the lack of data for a third of the countries reduced the number of observations and thus increased the SSEs and decreased the t-values from the multiple regressions. Thus any influence that this variable might have shown was swamped by the effect of losing degrees of freedom.

There are remarkably few cross-price elasticities - only six out of twenty six categories displayed a cross-price relationship. A possible reason for this may be that the categories used for cross-prices were not specific enough. Even though the I.C.P. divide G.D.P. into 151 categories of goods and services this may not be detailed enough to enable us to find and describe cross-price effects. For instance, the demand for "Barbers, beauty shops" may be influenced by the price of hair dryers, permanent wave sets etc., but not by the price of tooth and toilet brushes. All these goods are included in the potential
cross-price category "Toilet articles". The cross-price tested in
this study included the price of irrelevant articles such as
toilet brushes as well as the more appropriate goods.

The age structure of the population did not show any
significant influence in any category. For many categories (e.g.
electricity) we might have expected this result, but there are
some categories which one would expect to be greatly influenced
by, say, the proportion of the population below fifteen years.
For instance, the demand for "teachers". Perhaps in this case
other elements in the socio-political mix of a nation play a part
in obscuring the importance of age structure for influencing the
proportion of G.D.P. spent on education. This area of spending is
usually seen as a merit good and thus susceptible to a variety of
political influences.

Population density appears a relevant variable in the case
of three services. It seems highly significant (t-value 4) in the
case of "Barbers, beauty shops", and also the parameter value fits
the a priori assumption by having a positive sign. Thus, as
density increases, i.e. people have to travel shorter distances,
the demand for this service rises.

In the case of "Auto repairs" and "Public entertainment" the
negative value for the density parameter is less easy to explain
and may require further study to establish the relationships and
influences here.

Inflation features in seven categories. In five cases the
parameter has a positive value indicating that if inflation
averages at a higher annual rate the demand for the service
rises. In the case of two categories (Household service and Rail Transport) high inflation leads to less consumption. The theoretical explanations for the inflation results appear complex. Perhaps these categories are susceptible to the distortionary effects of general inflation on the demand for specific services. It may be that relative prices tend to change for particular services when the general inflation rate is high thus increasing or decreasing demand. For example, if governments have a tendency to keep the price of electricity low compared with other energy sources in times of high inflation then this category would receive a boost to demand.

8.5 CONCLUSIONS

Variables other than own-price and total consumption expenditure have been established as influencing demand for some service categories. Also, the statistical significance of the primary determining variables (own-price and income) have been increased.

However, for the majority of services no additional variables were shown to be sufficiently significant. For those where some significance was established the variables were often not significant at the 95% confidence level (i.e. they had a t-value greater than one but not as high as two). In the case of age structure and income distribution variables no relationships were established in any of the twenty six services.

The striking feature of the results is the dominant influence of the total consumption expenditure variable (with
t-values into double figures) and to a lesser extent, the own-price variable. This factor combined with the potential multicollinearity problems resulting from the introduction of additional variables may have reduced the ability of this analysis to draw out cross-price and other influences from the data available.

Some, but limited, revision of the income and own-price estimates, has been achieved by the introduction of additional variables. A criterion for accepting an additional variable was that the t-values of the primary variables was improved. However the improvement, as can be seen from the second Appendix, in most cases was very small. Generally the t-value for the total consumption expenditure variable was improved by less than 10%. The increase was unusually high at 56% in the case of "Clothing rental and repair" (see page 286). Even for this category the SSEs for the two functional forms, double logarithmic and logarithmic reciprocal are very similar and cannot be said to be significantly different at the 95% confidence level even after the two additional variables are included. Thus the extension of the analysis does not permit significant resolution of the ambiguities about the appropriate functional form. As a result there remains a range of possible income elasticity estimates for particular categories of services.
APPENDIX 8.1

DATA SOURCES

Substitutes And Compliments

The data source for cross-price elasticity variables was the I.C.P. Stage III. This is because the data was in a comparable form to the quantity, own-price and income variables. The price used for each cross-price variable was the purchasing power parity for the potential substitute or compliment divided by the purchasing power parity for total consumption expenditure, i.e. price relative to the consumption category within an economy.

An attempt was made, in the selection of the potential substitutes and compliments to test any good or service price which might be thought to have a measurable influence on the quantity of the service category we are primarily interested in. For the case of "Long-distance Bus Transport" (page 291) the following relative prices were tested:

(i) Rail Transport.
(ii) Air Transport.
(iii) Personal Transport Equipment (cars, motor cycles etc.)
(iv) Personal Transport Operation Costs (petrol, repairs etc.)

Any problems or limitations associated with this I.C.P. Stage III data source are discussed in Chapter Four.

Age Structure Of The Population

The data source for the age structure variable is the United
Demographic data of this kind is not made available each year, especially in the poorer countries of the world. Therefore, the data used by the United Nations is a compilation of the most recent and reliable census figures.

The data used by the Yearbook is not always of the highest quality and accuracy. One reason for this is that in some countries the census years are much earlier than 1975. This can be seen in Table 8.2 where the first column gives the census dates. Other reasons for errors in the age data are described in the introduction to the Demographic Yearbook. These problems are partially alleviated by the presentation and use of the data on the basis of three broad categories of age.

**Density**

The density data shown in Table 8.2 was taken from the United Nations Demographic Yearbook 1975. Density is defined as the number of persons in the 1975 total population per square kilometre of habitable surface area.

The density values are very rough indexes, in as much as they do not take account of the dispersions or concentration of population within countries or areas. For instance, the U.S.A. appears to be a sparsely populated country yet has high concentrations of population in some areas. The degree of concentration of population in certain regions of a country may

---

be a more relevant variable when examining the influence of population distribution on the demand for services.

Table 8.2

<table>
<thead>
<tr>
<th></th>
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<td>44</td>
<td>52</td>
<td>4</td>
<td>43</td>
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<td>2. Kenya ('69)</td>
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<td>48</td>
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<td>23</td>
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<td>3. India ('74)</td>
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<td>182</td>
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<td>6. Zambia ('75)</td>
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<td>7</td>
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<td>0.56</td>
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<td>345</td>
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<td>37</td>
<td>6.5</td>
<td>0.52</td>
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<tr>
<td>11. Columbia ('73)</td>
<td>44</td>
<td>53</td>
<td>3</td>
<td>22</td>
<td>18.9</td>
<td>0.52</td>
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<tr>
<td>12. Jamaica ('70)</td>
<td>46</td>
<td>48</td>
<td>6</td>
<td>185</td>
<td>13.1</td>
<td>0.52</td>
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<td>49</td>
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<td>12.7</td>
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<td>83</td>
<td>17.9</td>
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<td>17</td>
<td>65.3</td>
<td>0.449</td>
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<td>20. Ireland ('75)</td>
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<td>58</td>
<td>11</td>
<td>44</td>
<td>14.0</td>
<td>0.32</td>
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<tr>
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<td>62</td>
<td>10</td>
<td>70</td>
<td>13.0</td>
<td>0.403</td>
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<td>25. U.K. ('75)</td>
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<td>229</td>
<td>13.6</td>
<td>0.327</td>
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<tr>
<td>26. Japan ('75)</td>
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<td>68</td>
<td>8</td>
<td>298</td>
<td>11.1</td>
<td>0.407</td>
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<td></td>
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<tr>
<td>27. Austria ('75)</td>
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<td>90</td>
<td>7.3</td>
<td>0.37</td>
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<tr>
<td>28. Netherlands ('75)</td>
<td>25</td>
<td>64</td>
<td>11</td>
<td>334</td>
<td>8.7</td>
<td>0.37</td>
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<td>29. Belgium ('74)</td>
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<td>63</td>
<td>14</td>
<td>321</td>
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<tr>
<td>30. France ('72)</td>
<td>24</td>
<td>62</td>
<td>14</td>
<td>97</td>
<td>8.9</td>
<td>0.403</td>
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<tr>
<td>31. Luxembourg ('74)</td>
<td>20</td>
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<td>13</td>
<td>138</td>
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<td>0.3</td>
<td></td>
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<tr>
<td>32. Denmark ('73)</td>
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<td>13</td>
<td>117</td>
<td>9.2</td>
<td>0.3</td>
<td></td>
<td></td>
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<tr>
<td>33. Germany ('75)</td>
<td>21</td>
<td>65</td>
<td>14</td>
<td>249</td>
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<td>0.378</td>
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<tr>
<td>34. U.S.A. ('76)</td>
<td>24</td>
<td>65</td>
<td>11</td>
<td>23</td>
<td>6.6</td>
<td>0.397</td>
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</table>
One potential measure of concentration could be that based on the proportion of the population living in an urban area. The United Nations do present such data but unfortunately this is not suitable for this work because "urban" has been defined differently in each country. So, in Albania a population greater than 400 is defined as urban, whereas in Austria 5,000 is the limit.

Thus "Density" although crude and suffering from many drawbacks is a better measure of population concentration than urban/rural proportions for this study.

Inflation

The data source for the inflation statistics is The World in Figures2. (The ultimate data source for these figures are the International Financial Statistics3 where data is presented on a monthly, quarterly and annual basis).

It seemed reasonable to assume that the pattern of demand for any one year is likely to be affected by the "usual" or "normal" rate of inflation that people had begun to expect rather than the inflation rate for a particular year, 1975. Hence, an average for six years is taken. If the inflation rate went to unusually high levels in 1975 the population may not adjust their spending pattern within the same year. It may take time for

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3The International Monetary Fund, International Financial Statistics.
people to become aware of the need to change spending habits to the new inflationary times. Thus previous years inflationary experiences may influence this years pattern of demand.

Income Distribution

Theory suggests that the demand for a service is likely to be affected by the extent of income inequality. In a society with a low per capita income but with large inequalities of income there may be a high demand for, say, "Restaurants". A country with a similar average income level which was evenly distributed may have very little demand for "Restaurants".

A great many problems were encountered in the search for suitable data for this variable. For many of the countries in this study income distribution data were simply not available. For the others the data has been collected in a variety of ways by an assortment of researchers, thus the data is very often not entirely comparable. Two studies (J. Lecaillon et. al. and International Labour Office) attempted to bring together the various pieces of income distribution evidence in a reasonably reliable and comparable way. These two studies form the basis for the construction of Table 8.3.

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### Table 8.3

**Income Distribution**

<table>
<thead>
<tr>
<th>Country</th>
<th>J. Lecaillon et al.</th>
<th>International Labour Office</th>
<th>GINI Coeffs used in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GINI</td>
<td>YEAR</td>
<td>TYPE</td>
</tr>
<tr>
<td>1. Malawi</td>
<td>0.452</td>
<td>1969</td>
<td>In</td>
</tr>
<tr>
<td>2. Kenya</td>
<td>0.604</td>
<td>1969</td>
<td>Ec</td>
</tr>
<tr>
<td>3. India</td>
<td>0.428</td>
<td>1964/5</td>
<td>H</td>
</tr>
<tr>
<td>4. Pakistan</td>
<td>0.375</td>
<td>1973</td>
<td>H</td>
</tr>
<tr>
<td>5. Sri Lanka</td>
<td>0.618</td>
<td>1970</td>
<td>In</td>
</tr>
<tr>
<td>6. Zambia</td>
<td>0.504</td>
<td>1969</td>
<td>H</td>
</tr>
<tr>
<td>7. Thailand</td>
<td>0.49</td>
<td>1971</td>
<td>H</td>
</tr>
<tr>
<td>8. Philippines</td>
<td>0.351</td>
<td>1970</td>
<td>H</td>
</tr>
<tr>
<td>9. S. Korea</td>
<td>0.52</td>
<td>1970</td>
<td>H</td>
</tr>
<tr>
<td>10. Malaysia</td>
<td>0.52</td>
<td>1974</td>
<td>H</td>
</tr>
<tr>
<td>11. Columbia</td>
<td>0.50</td>
<td>1970</td>
<td>H</td>
</tr>
<tr>
<td>12. Jamaica</td>
<td>0.567</td>
<td>1969</td>
<td>H</td>
</tr>
<tr>
<td>13. Syria</td>
<td>0.33</td>
<td>1978</td>
<td>H</td>
</tr>
<tr>
<td>14. Brazil</td>
<td>0.561</td>
<td>1971</td>
<td>H</td>
</tr>
<tr>
<td>15. Romania</td>
<td>0.449</td>
<td>1967</td>
<td>H</td>
</tr>
<tr>
<td>16. Mexico</td>
<td>0.37</td>
<td>1973</td>
<td>H</td>
</tr>
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<td>17. Yugoslavia</td>
<td>0.344</td>
<td>1973</td>
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<td>18. Iran</td>
<td>0.407</td>
<td>1971</td>
<td>H</td>
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<tr>
<td>19. Uruguay</td>
<td>0.32</td>
<td>1973</td>
<td>H</td>
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<td>0.416</td>
<td>1970</td>
<td>H</td>
</tr>
<tr>
<td>21. Hungary</td>
<td>0.396</td>
<td>1973</td>
<td>H</td>
</tr>
<tr>
<td>22. Poland</td>
<td>0.404</td>
<td>1972</td>
<td>H</td>
</tr>
</tbody>
</table>

**KEY:**
- **H**: Household Data
- **In**: Individual Data
- **Ec**: Economically Active Person
Gini coefficients have generally been collected on the basis of income distribution between households. Table 8.3 presents the coefficients as measured by households where possible. When household data is not available an alternative is presented. The household data takes precedence in this study because of the even greater scarcity of the other two types of income distribution measures. (Those based on Individuals and Economically Active Persons).

The final Gini coefficients used in this study are drawn from the measures given by Lecaillon et. al. and I.L.O. and are calculated on the basis of the following rules:

(i) If, for a country there is only one Gini coefficient measured using households then this is to be used.

(ii) If there are two measures based on households then a simple average is taken.

As can be seen from the table there are eleven countries for which no Gini coefficient of sufficient quality has been established. This reduces the number of observations by approximately one third when ordinary least squares multiple regression is carried out.
APPENDIX 8.2

DETAILED RESULTS

Key

\[ E \] = Total Consumption Expenditure per capita

\[ Q_i \] = Quantity of service i consumed per capita

\[ P_i \] = Purchasing power parity of service, i

\[ P_E \] = Purchasing power parity of Total Consumption Expenditure per capita

\[ D \] = Density of population

\[ I \] = Inflation

\[ P_{MC} \] = The purchasing power parity for "Men's clothing"

\[ P_{BG} \] = The purchasing power parity for "Boy's and Girl's clothing"

\[ P_{OF} \] = The purchasing power parity for "Other fuels"

\[ P_{RC} \] = The purchasing power parity for "Residential construction"

\[ P_T \] = The purchasing power parity for "Parking, tolls, etc."

\[ P_T\] = The purchasing power parity for "Telephones, telegraph"

\[ P_{CA} \] = The purchasing power parity for "Cleaning appliances"

All figures in brackets are t-values.
Barber And Beauty Shops

Cross-Price Elasticities Tested:

1) Toilet articles

Stage 1 Results

Double Logarithmic

\[
\ln Q_a = -9.05 - 0.89 \ln (P_a/P_m) + 1.43 \ln E + 0.256 \ln D + 0.277 \ln I
\]

\[
\text{SSE} = 10.1 \quad (8.1)
\]

\[
\bar{R}^2 = 0.768
\]

Logarithmic Reciprocal

\[
\ln Q_a = 2.70 + 0.264 \ln (P_a/P_m) - 1346(1/E) + 0.35 \ln D + 0.26 \ln I
\]

\[
\text{SSE} = 8.9 \quad (8.2)
\]

\[
\bar{R}^2 = 0.785
\]

Stage 2 Results

Double Logarithmic

\[
\ln Q_a = -10.3 - 0.812 \ln (P_a/P_m) + 1.37 \ln E + 0.256 \ln D + 0.277 \ln I
\]

\[
\text{SSE} = 7.77 \quad (8.3)
\]

\[
\bar{R}^2 = 0.809
\]

Logarithmic Reciprocal

\[
\ln Q_a = 0.598 + 0.226 \ln (P_a/P_m) - 1281(1/E) + 0.35 \ln D + 0.26 \ln I
\]

\[
\text{SSE} = 5.4 \quad (8.4)
\]

\[
\bar{R}^2 = 0.866
\]
Clothing Rental And Repair

Cross-Price Elasticities Tested:
1) Clothing materials
2) Men's clothing
3) Women's clothing
4) Boy's and girl's clothing
5) Haberdashery, millinery

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -5.85 - 1.07 \ln (P_2/P_1) + 0.767 \ln E \]
\[ (1.94) \quad (1.94) \quad (2.04) \]
SSE 34.5 (8.5)
\[ R^2 = 0.077 \]

Logarithmic Reciprocal

\[ \ln Q_1 = 0.081 + 0.406 (P_2/P_3) - 556(1/E) \]
\[ (0.19) \quad (1.78) \quad (1.81) \]
SSE 34.9 (8.6)
\[ R^2 = 0.066 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_1 = -7.45 - 1.15 \ln (P_4/P_3) + 1.02 \ln E + 1.86 \ln (P_6/P_3) - 1.72 \ln (P_8/P_3) \]
\[ (2.34) \quad (2.11) \quad (2.63) \quad (2.33) \quad (2.42) \]
SSE 26.5 (8.7)
\[ R^2 = 0.24 \]

Logarithmic Reciprocal

\[ \ln Q_1 = 0.60 + 0.46 (P_2/P_3) - 989(1/E) + 2.37 \ln (P_6/P_3) - 1.92 \ln (P_8/P_3) \]
\[ (1.15) \quad (2.04) \quad (3.03) \quad (2.83) \quad (2.71) \]
SSE 24.8 (8.8)
\[ R^2 = 0.288 \]

\[ P_{21} = \text{The purchasing power parity for "Men's clothing"} \]
\[ P_{83} = \text{The purchasing power parity for "Boy's and girl's clothing"} \]
Electricity

Cross-Price Elasticities Tested

1) Gas
2) Liquid fuels
3) Other fuels, ice
4) Refrigerators, freezers
5) Washing appliances
6) Cooking appliances
7) Heating appliances
8) Cleaning appliances
9) Other household appliances

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -9.35 - 0.85 \ln \left( \frac{P_1}{P_m} \right) + 1.65 \ln E \]

\[ (16.7) \quad (6.9) \quad (22) \]

SSE 3.78 \quad (8.9)

\[ R^2 = 0.949 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_1 = -9.88 - 0.89 \ln \left( \frac{P_1}{P_m} \right) + 1.655 \ln E + 0.144 \ln \left( \frac{P_{0r}}{P_m} \right) + 0.227 \ln I \]

\[ (19.25) \quad (8.33) \quad (25.8) \quad (1.45) \quad (3.20) \]

SSE 2.6 \quad (8.10)

\[ R^2 = 0.963 \]
Household Services

Cross-Price Elasticities Tested

1) Washing appliances
2) Cleaning appliances
3) Nondurable household goods
4) Domestic service
5) Furniture, fixtures

Stage 1 Results

Double Logarithmic

\[ \ln Q_4 = -8.13 - 1.67 \ln \left( \frac{P_4}{P_m} \right) + 1.35 \ln E \]
\[ (5.81) \quad (4.3) \quad (7.22) \]

\[ R^2 = 0.607 \]

Linear

\[ Q_4 = 7.13 - 6.83 \left( \frac{P_4}{P_m} \right) + 0.00552E \]
\[ (2.44) \quad (2.37) \quad (6.18) \]

\[ R^2 = 0.521 \]

Semi-Logarithmic

\[ Q_4 = -53.9 - 7.18 \ln \left( \frac{P_4}{P_m} \right) + 8.84 \ln E \]
\[ (4.64) \quad (2.23) \quad (5.67) \]

\[ R^2 = 0.48 \]

Logarithmic Reciprocal

\[ \ln Q_4 = 1.88 + 0.85 \left( \frac{P_m}{P_4} \right) - 1002 \left( \frac{1}{E} \right) \]
\[ (4.44) \quad (2.38) \quad (5.0) \]

\[ R^2 = 0.414 \]
Stage 2 Results

**Double Logarithmic**

\[
\ln Q_a = -6.75 - 1.59 \ln \left( \frac{P_a}{P_m} \right) + 1.31 \ln E - 0.48 \ln I \quad \text{SSE 14.8}
\]

\[\begin{array}{l}
(5.02) \\
(4.56) \\
(7.77) \\
(2.88)
\end{array}\]

\[\bar{R}^2 = 0.682 \quad (8.15)\]

**Linear**

\[
Q_a = 8.14 - 5.39 \left( \frac{P_a}{P_m} \right) + 0.00525 E - 0.1581 \quad \text{SSE 23}
\]

\[\begin{array}{l}
(2.77) \\
(1.8) \\
(5.85) \\
(1.48)
\end{array}\]

\[\bar{R}^2 = 0.539 \quad (8.16)\]

\[
Q_a = 11.3 - 6.24 \left( \frac{P_a}{P_m} \right) + 0.00536 E - 1.94 \ln I \quad \text{SSE 23.3}
\]

\[\begin{array}{l}
(2.64) \\
(2.17) \\
(5.99) \\
(1.32)
\end{array}\]

\[\bar{R}^2 = 0.532 \quad (8.17)\]

**Semi-Logarithmic**

\[
Q_a = -48.6 - 5.55 \ln \left( \frac{P_a}{P_m} \right) + 8.5 \ln E - 0.2261 \quad \text{SSE 23.1}
\]

\[\begin{array}{l}
(4.32) \\
(1.77) \\
(5.75) \\
(2.19)
\end{array}\]

\[\bar{R}^2 = 0.537 \quad (8.18)\]

\[
Q_a = -46.8 - 6.8 \ln \left( \frac{P_a}{P_m} \right) + 8.64 \ln E - 2.47 \ln I \quad \text{SSE 24.6}
\]

\[\begin{array}{l}
(3.87) \\
(2.16) \\
(5.67) \\
(1.65)
\end{array}\]

\[\bar{R}^2 = 0.508 \quad (8.19)\]

**Logarithmic Reciprocal**

\[
\ln Q_a = 3.16 + 0.868 \left( \frac{P_m}{P_a} \right) - 997 \left( \frac{1}{E} \right) - 0.58 \ln I \quad \text{SSE 22.2}
\]

\[\begin{array}{l}
(5.37) \\
(2.70) \\
(5.52) \\
(2.86)
\end{array}\]

\[\bar{R}^2 = 0.524 \quad (8.20)\]
Local Transport

Cross-Price Elasticities Tested

1) (Personal) Transport equipment - summary category
2) (Personal) Transport operation costs - summary category

Stage 1 Results

Logarithmic Quadratic

\[ \ln Q_4 = -54 - 0.946 \ln \left( \frac{P_4}{P_3} \right) + 14.9 \ln E - 0.89 (\ln E)^2 \]

SSE 12.7

\( \bar{R}^2 = 0.718 \)

Logarithmic Reciprocal

\[ \ln Q_4 = 2.28 + 0.48 \left( \frac{P_4}{P_3} \right) - 967 \left( \frac{1}{E} \right) \]

SSE 19.45

\( \bar{R}^2 = 0.581 \)

Stage 2 Results

No improvement on stage 1 results found.
Bus Transport

Cross-Price Elasticities Tested

1) Rail transport
2) Air transport
3) (Personal) Transport equipment - summary category
4) (Personal) Transport operation cost - summary category

Stage 1 Results

Linear Quadratic

\[ Q_1 = 7.48 - 10.7 \left( \frac{P_1}{P_2} \right) + 0.0083E - 0.00000192E^2 \]

\[ (2.24) \quad (1.55) \quad (2.27) \quad (2.59) \]

\[ \text{SSE} \quad 33.75 \]

\[ R^2 \quad 0.168 \]

(8.23)

Logarithmic Quadratic

\[ \ln Q_1 = -39.6 - 0.17 \ln \left( \frac{P_1}{P_2} \right) + 11.8 \ln E - 0.837 (\ln E)^2 \]

\[ (3.44) \quad (0.52) \quad (3.8) \quad (3.6) \]

\[ \text{SSE} \quad 20.4 \]

\[ R^2 \quad 0.263 \]

(8.24)

Stage 2 Results

No improvement on stage 1 results found.
College Teachers (UniTeach)

Cross-Price Elasticities Tested

1) Books, papers, magazines
2) Stationery
3) Educational books, supplies

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -5.4 - 0.23 \ln \left( \frac{P_s}{P_m} \right) + 1.01 \ln E \]

\[
\begin{align*}
\text{SSE} & = 7.9 \quad (8.25) \\
\text{R}^2 & = 0.718
\end{align*}
\]

Logarithmic Reciprocal

\[ \ln Q_2 = 2.95 + 0.035 \left( \frac{P_m}{P_s} \right) - 892 \left( \frac{1}{E} \right) \]

\[
\begin{align*}
\text{SSE} & = 8.84 \quad (8.26) \\
\text{R}^2 & = 0.684
\end{align*}
\]

Stage 2 Results

No improvement on stage 1 results found.
Cross-Price Elasticities Tested

1) Purchased transport - summary category
2) (Personal) Transport equipment - summary category
3) Tyres, tubes, accessories
4) Automobile repairs
5) Gasoline, oil, grease

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -11.3 - 0.62 \ln(P_a/P_w) + 1.70 \ln E \]
\[ (4.59) \quad (1.17) \quad (5.18) \]
\[ \text{SSE} = 53.2 \quad (8.27) \]
\[ R^2 = 0.485 \]

Linear

\[ Q_1 = -1.28 - 2.77(P_a/P_w) + 0.0074E \]
\[ (0.38) \quad (1.27) \quad (9.55) \]
\[ \text{SSE} = 61.3 \quad (8.28) \]
\[ R^2 = 0.761 \]

Logarithmic Reciprocal

\[ \ln Q_1 = 2.04 + 0.32(P_w/P_a) - 1244(1/E) \]
\[ (3.07) \quad (0.73) \quad (3.34) \]
\[ \text{SSE} = 77.9 \quad (8.29) \]
\[ R^2 = 0.244 \]

Stage 2 Results

No improvement on stage 1 results found.
Rents

Cross-Price Elasticities Tested

1) Indoor repair and upkeep

2) Residential construction - summary category

Stage 1 Results

Double Logarithmic

\[ \ln Q_a = -5.58 - 0.712 \ln (P_a/P_s) + 1.37 \ln E \]
\[ \text{SSE } 5.21 \quad (8.30) \]
\[ (8.57) \quad (4.86) \]
\[ R^2 = 0.906 \]

Linear

\[ Q_a = -20.5 - 29.2 \frac{P_a}{P_s} + 0.112 E \]
\[ \text{SSE } 8.2 \quad (8.31) \]
\[ (0.73) \quad (1.49) \]
\[ R^2 = 0.904 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_a = -5.64 - 0.728 \ln (P_a/P_s) + 1.38 \ln E - 0.28 \ln \left( \frac{P_m}{P_s} \right) \]
\[ \text{SSE } 4.99 \quad (8.32) \]
\[ (8.68) \quad (4.97) \]
\[ R^2 = 0.907 \]

Linear

\[ Q_a = -19.6 - 29.2 \frac{P_a}{P_s} + 0.113 E - 15.9 \ln \left( \frac{P_m}{P_s} \right) \]
\[ \text{SSE } 8.12 \quad (8.33) \]
\[ (0.69) \quad (1.47) \]
\[ R^2 = 0.901 \]

\[ P_m = \text{The purchasing power parity for Residential construction} \]
Teachers, First And Second Level

Cross-Price Elasticities Tested

1) Books, papers, magazines
2) Stationery
3) Educational books, supplies

Stage 1 Results

Linear

\[ Q_t = 50.1 - 15.14 \left( \frac{P_t}{P_m} \right) + 0.013E \]

\[ (12.1) \quad (1.16) \quad (4.57) \]

SSE 1.15 (8.34)

\[ R^2 = 0.523 \]

Semi-Logarithmic

\[ Q_t = -104 - 4.91 \ln \left( \frac{P_t}{P_m} \right) + 23.0 \ln E \]

\[ (2.86) \quad (1.09) \quad (5.37) \]

SSE 0.74 (8.35)

\[ R^2 = 0.692 \]

Hyperbolic

\[ Q_t = 87.8 - 0.33 \left( \frac{P_m}{P_t} \right) - 16628 \left( \frac{1}{E} \right) \]

\[ (32.1) \quad (0.41) \quad (4.66) \]

SSE 0.7 (8.36)

\[ R^2 = 0.708 \]

Logarithmic Reciprocal

\[ \ln Q_t = 4.54 - 0.0124 \left( \frac{P_m}{P_t} \right) - 284 \left( \frac{1}{E} \right) \]

\[ (98.6) \quad (0.89) \quad (4.66) \]

SSE 0.91 (8.37)

\[ R^2 = 0.747 \]

Stage 2 Results

No improvement on stage 1 results found.
Cross-Price Elasticities Tested

1) Drugs, medical preparations
2) Medical supplies
3) Therapeutic equipment
4) Physicians' services

Stage 1 Results

Double Logarithmic

\[ \ln Q = -8.06 - 0.406 \ln \left( \frac{P_1}{P_2} \right) + 1.48 \ln E \]

\[ \text{SSE} = 12.3 \quad (8.38) \]

\[ \text{R}^2 = 0.788 \]

Stage 2 Results

No improvement on stage 1 results found.
Nurses' Services

Cross-Price Elasticities Tested

1) Drugs, medical preparations
2) Medical supplies
3) Therapeutic equipment
4) Physicians' services

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -8.58 - 0.27 \ln(P_A/P_M) + 1.5 \ln E \]

\[ \begin{align*}
\text{SSE} & = 7.77 (8.39) \\
\bar{R}^2 & = 0.877
\end{align*} \]

Stage 2 Results

No improvement on stage 1 results found.
Cross-Price Elasticities Tested

1) Postal communication

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -12.05 - 1.07 \ln \left( \frac{P_1}{P_2} \right) + 1.86 \ln E \]

\[
\begin{array}{cccc}
 & (17.2) & (8.4) & (19.6) \\
SSE & 6.35 & (8.40) & \\
\bar{R}^2 & 0.933
\end{array}
\]

Stage 2 Results

No improvement on stage 1 results found.
Dentists' Services

Cross-Price Elasticities Tested

1) Physicians' services
2) Medical supplies
3) Therapeutic equipment
4) Hospitals

Stage 1 Results

**Double Logarithmic**

\[
LnQ_a = -15.4 - 0.34 \ln(P_a/P_x) + 2.21 \ln E
\]

\[
(13.6) \quad (3.36) \quad (14.7)
\]

\[\text{SSE} \quad 13.2 \quad (8.41)\]

\[r^2 = 0.872\]

**Logarithmic Reciprocal**

\[
LnQ_a = 3.01 + 0.067 \ln(P_a/P_x) - 2407(1/E)
\]

\[
(15.0) \quad (2.66) \quad (12.2)
\]

\[\text{SSE} \quad 17.2 \quad (8.42)\]

\[r^2 = 0.833\]

Stage 2 Results

No improvement on stage 1 results found.
Physicians (Doctors)

Cross-Price Elasticities Tested

1) Drugs, medical preparations
2) Medical supplies
3) Therapeutic equipment
4) Nurses' services
5) Hospitals

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -9.67 - 0.45 \ln (P_a / P_x) + 1.67 \ln E \]
\( (14.6) \quad (4.9) \quad (18.6) \)

SSE 5.6 \( (8.43) \)
\( R^2 \) 0.92

Stage 2 Results

No improvement on stage 1 results found.
Footwear Repairs

Cross-Price Elasticities Tested

1) Men's footwear
2) Women's footwear
3) Children's footwear

Stage 1 Results

Double Logarithmic:

\[ \ln Q = -6.57 - 0.73 \ln \left( \frac{P}{P_m} \right) + 0.90 \ln E \]

\( (4.28) \quad (1.31) \quad (4.35) \)

\( \bar{R}^2 = 0.438 \)

Logarithmic Reciprocal:

\[ \ln Q = 0.605 + 0.32 \left( \frac{P_m}{P} \right) - 903 \left( \frac{1}{E} \right) \]

\( (0.96) \quad (0.66) \quad (4.5) \)

\( \bar{R}^2 = 0.422 \)

Stage 2 Results:

No improvement on stage 1 results found.
Indoor Repair, Upkeep

Cross-Price Elasticities Tested

1) Gross rents
2) Household textiles, e.t.c.
3) Nondurable household goods
4) Domestic service
5) Household service

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -9.41 - 1.02\ln(P_1/P_2) + 1.64\ln E \]

\( t = 7.29 \quad (3.23) \quad (9.36) \)

\[\bar{R}^2 = 0.737\]

Logarithmic Reciprocal

\[ \ln Q_2 = 3.33 + 0.45(P_1/P_2) - 1447(1/E) \]

\( t = 7.73 \quad (1.03) \quad (8.0) \)

\[\bar{R}^2 = 0.661\]

Stage 2 Results

No improvement on stage 1 results found.
Personal Transport Equipment Repair Charges (Auto Repair)

Cross-Price Elasticities Tested

1) (Personal) Transport Equipment - summary category
2) Purchased transport - summary category
3) Tyres, tubes, accessories
4) Gasoline, oil, grease
5) Parking, tolls, e.t.c.

Stage 1 Results

Double Logarithmic

\[ \ln Q = -10.4 - 1.37 \ln (P / P_0) + 1.64 \ln E \]

\[ \text{SSE 33.8 (8.48)} \]

\[ R^2 = 0.788 \]

Logarithmic Reciprocal

\[ \ln Q = 0.76 + 1.45 (P / P_0) - 1054(1/E) \]

\[ \text{SSE 55.1 (8.49)} \]

\[ R^2 = 0.654 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q = -10.5 - 1.60 \ln (P / P_0) + 1.71 \ln E+0.62 \ln (P / P_0)-0.25 \ln D+0.29 \ln I \]

\[ \text{SSE 28.6 (8.50)} \]

\[ R^2 = 0.801 \]

Logarithmic Reciprocal

\[ \ln Q = 1.33+1.62 (P / P_0)-1109(1/E)+0.48 \ln (P / P_0)-0.25 \ln D+0.14 \ln I \]

\[ \text{SSE 51.8 (8.51)} \]

\[ R^2 = 0.639 \]

\[ P_0 = \text{Purchasing power parity for parking, tolls e.t.c.} \]
Other Entertainment, Cultural

Cross-Price Elasticities Tested

1) Radio, television, phonographs
2) Durable recreational equipment
3) Other recreational equipment
4) Public entertainment
5) Books, papers, magazines
6) Restaurants, cafés

Stage 1 Results

Double Logarithmic

\[ \ln Q_a = -5.5 - 0.88 \ln \left( \frac{P_a}{P_m} \right) + 1.10 \ln E \]
\[ (4.54) \quad (2.46) \quad (6.69) \]
\[ \text{SSE} = 17.6 \quad (8.52) \]
\[ \bar{R}^2 = 0.567 \]

Logarithmic Reciprocal

\[ \ln Q_a = 2.66 + 0.69 \left( \frac{P_m}{P_a} \right) - 904 \left( \frac{1}{E} \right) \]
\[ (6.65) \quad (1.94) \quad (5.13) \]
\[ \text{SSE} = 23.3 \quad (8.53) \]
\[ \bar{R}^2 = 0.425 \]

Stage 2 Results

No improvement on stage 1 results found.
Public Entertainment

Cross-Price Elasticities Tested

1) Radios, television, phonographs
2) Durable recreational equipment
3) Other recreational equipment
4) Other recreation, culture
5) Books, papers, magazines
6) Restaurants, cafés

Stage 1 Results

Double Logarithmic

\[ \ln Q_a = -8.28 - 1.10 \ln (P_a/P_m) + 1.31 \ln E \]
\[ \begin{array}{ccc}
(5.4) & (2.9) & (6.6)
\end{array} \]
\[ \text{SSE} = 27.2 \quad (8.54) \]
\[ R^2 = 0.572 \]

Logarithmic Reciprocal

\[ \ln Q_a = 2.23 + 0.48 (P_m/P_a) - 12.29 (1/E) \]
\[ \begin{array}{ccc}
(5.1) & (2.7) & (6.8)
\end{array} \]
\[ \text{SSE} = 26.1 \quad (8.55) \]
\[ R^2 = 0.59 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_a = -7.73 - 1.10 \ln (P_a/P_m) + 1.42 \ln E - 0.30 \ln D \]
\[ \begin{array}{ccc}
(5.1) & (3.0) & (7.1) & (1.93)
\end{array} \]
\[ \text{SSE} = 24.2 \quad (8.56) \]
\[ R^2 = 0.607 \]

Logarithmic Reciprocal

\[ \ln Q_a = 3.46 + 0.49 (P_m/P_a) - 13.03 (1/E) - 0.27 \ln D \]
\[ \begin{array}{ccc}
(4.27) & (2.83) & (7.29) & (1.77)
\end{array} \]
\[ \text{SSE} = 23.6 \quad (8.57) \]
\[ R^2 = 0.617 \]
Postal Communication

Cross-Price Elasticities Tested

1) Telephone, telegraph

Stage 1 Results

Double Logarithmic

\[
\ln Q_t = -9.46 - 0.67 \ln (P_t/P_M) + 1.38 \ln E \\
(7.3) \quad (1.7) \quad (7.8)
\]

SSE 21.1 \quad (8.58)
\[ \bar{R}^2 \quad 0.679 \]

Logarithmic Reciprocal

\[
\ln Q_t = 1.0 + 0.66 (P_M/P_t) - 11.36 (1/E) \\
(1.8) \quad (1.5) \quad (5.9)
\]

SSE 29.9 \quad (8.59)
\[ \bar{R}^2 \quad 0.546 \]

Stage 2 Results

Double Logarithmic

\[
\ln Q_t = -9.45 - 0.82 \ln (P_t/P_M) + 1.37 \ln E + 0.44 \ln (P_T/P_M) \\
(7.8) \quad (2.1) \quad (8.1) \quad (1.94)
\]

SSE 18.7 \quad (8.60)
\[ \bar{R}^2 \quad 0.706 \]

Logarithmic Reciprocal

\[
\ln Q_t = 0.863 + 0.79 (P_M/P_t) - 12.07 (1/E) + 0.69 \ln (P_T/P_M) \\
(1.7) \quad (1.95) \quad (6.7) \quad (2.70)
\]

SSE 24.0 \quad (8.61)
\[ \bar{R}^2 \quad 0.622 \]

\( P_T \) = The purchasing power parity for telephones, telegraph
Air Transport

Cross-Price Elasticities Tested

1) (Personal) Transport equipment - summary category
2) (Personal) Transport operational costs - summary category
3) Rail transport
4) Bus transport

Stage 1 Results

Double Logarithmic

\[ \ln Q_a = -7.89 - 0.93 \ln (P_a / P_m) + 1.20 \ln E \quad \text{SSE 30.4} \quad (8.62) \]
\[ \begin{array}{c}
(4.9) \\
(3.1) \\
(5.5)
\end{array} \]
\[ \bar{R}^2 = 0.474 \]

Logarithmic Reciprocal

\[ \ln Q_a = 1.26 + 0.49 (P_m / P_a) - 1029 (1/E) \quad \text{SSE 30.3} \quad (8.63) \]
\[ \begin{array}{c}
(3.6) \\
(2.27) \\
(5.4)
\end{array} \]
\[ \bar{R}^2 = 0.477 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_a = -8.77 - 0.94 \ln (P_a / P_m) + 1.21 \ln E + 0.33 \ln I \quad \text{SSE 28.4} \quad (8.64) \]
\[ \begin{array}{c}
(5.2) \\
(3.2) \\
(5.6) \\
(1.5)
\end{array} \]
\[ \bar{R}^2 = 0.493 \]

Logarithmic Reciprocal

\[ \ln Q_a = 0.695 + 0.48 (P_m / P_a) - 1032 (1/E) + 0.26 \ln I \quad \text{SSE 29.0} \quad (8.65) \]
\[ \begin{array}{c}
(1.1) \\
(2.2) \\
(5.4) \\
(1.13)
\end{array} \]
\[ \bar{R}^2 = 0.481 \]
Rail Transport

Cross-Price Elasticities Tested

1) (Personal) Transport equipment - summary category
2) (Personal) Transport operational costs - summary category
3) Air transport
4) Bus transport

Stage 1 Results

Double Logarithmic

\[ \ln Q_a = -9.0 - 0.66 \ln \left( \frac{P_a}{P_x} \right) + 1.27 \ln E \]
\[ (4.07) \quad (1.96) \quad (4.5) \]
\[ \text{SSE} = 50.1 \quad (8.66) \]
\[ R^2 = 0.36 \]

Logarithmic Reciprocal

\[ \ln Q_a = 1.22 + 0.25 \left( \frac{P_a}{P_x} \right) - 1.63 \left( \frac{1}{E} \right) \]
\[ (2.66) \quad (2.0) \quad (4.2) \]
\[ \text{SSE} = 52.9 \quad (8.67) \]
\[ R^2 = 0.325 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_a = -8.36 - 0.86 \ln \left( \frac{P_a}{P_x} \right) + 1.30 \ln E - 0.47 \ln I \]
\[ (3.8) \quad (2.4) \quad (4.7) \quad (1.5) \]
\[ \text{SSE} = 46.6 \quad (8.68) \]
\[ R^2 = 0.385 \]

Logarithmic Reciprocal

\[ \ln Q_a = 2.2 + 0.324 \left( \frac{P_a}{P_x} \right) - 1.223 \left( \frac{1}{E} \right) - 0.53 \ln I \]
\[ (2.95) \quad (2.5) \quad (4.5) \quad (1.65) \]
\[ \text{SSE} = 48.5 \quad (8.69) \]
\[ R^2 = 0.365 \]
Hotels, Lodgings

Cross-Price Elasticities Tested

1) Gross rents
2) Recreation - summary category
3) Food, beverages and tobacco - summary category

Stage 1 Results

Double Logarithmic

\[ \ln Q' = -8.42 - 1.09 \ln (P_x / P_\gamma) + 1.4 \ln E \]
\[ (5.2) \quad (2.45) \quad (6.0) \]
SSE 22.9 \hspace{1cm} (8.70)

\[ R^2 = 0.73 \]

Logarithmic Reciprocal

\[ \ln Q' = 2.0 + 0.87 (P_x / P_\gamma) - 1272 (1/E) \]
\[ (3.7) \quad (3.3) \quad (6.6) \]
SSE 21 \hspace{1cm} (8.71)

\[ R^2 = 0.752 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q' = -9.35 - 1.09 \ln (P_x / P_\gamma) + 1.4 \ln E + 0.39 \ln I \]
\[ (5.77) \quad (2.6) \quad (6.3) \quad (1.98) \]
SSE 20.1 \hspace{1cm} (8.72)

\[ R^2 = 0.754 \]

Logarithmic Reciprocal

\[ \ln Q' = 1.14 + 0.9 (P_x / P_\gamma) - 1258 (1/E) + 0.37 \ln I \]
\[ (1.6) \quad (3.6) \quad (6.9) \quad (1.97) \]
SSE 18.5 \hspace{1cm} (8.73)

\[ R^2 = 0.773 \]
Restaurants, Cafés

Cross-Price Elasticities Tested

1) Food, beverages and tobacco – summary category
2) Recreation – summary category
3) Food – summary category

Stage 1 Results

Double Logarithmic

\[ \ln Q_s = -9.9 + 0.32 \ln \left( \frac{P_s}{P_m} \right) + 1.86 \ln E \]
\[ (7.0) \ (0.76) \ (9.8) \]
SSE 23.8 \ (8.74)
\[ R^2 = 0.747 \]

Logarithmic Reciprocal

\[ \ln Q_s = 6.35 - 0.93 \left( \frac{P_s}{P_a} \right) - 1714 \left( \frac{1}{E} \right) \]
\[ (15.6) \ (2.8) \ (10.8) \]
SSE 20.5 \ (8.75)
\[ R^2 = 0.782 \]

Stage 2 Results

No improvement on stage 1 results found.
Domestic Service

Cross-Price Elasticities Tested

1) Household services
2) Furniture and appliance - summary category
3) Nondurable household goods
4) Cleaning appliances
5) Cooking appliances

Stage 1 Results

Double Logarithmic

\[ \ln Q_1 = -5.4 - 1.15 \ln \left( \frac{P_s}{P_m} \right) + 0.81 \ln E \]
\[ \text{SSE} = 50.7 \]
\[ (1.62) (3) (1.95) 12 \]
\[ R^2 = 0.178 \]

Logarithmic Reciprocal

\[ \ln Q_1 = 1.23 + 0.169 \left( \frac{P_m}{P_s} \right) - 276 \left( \frac{1}{E} \right) \]
\[ \text{SSE} = 56.1 \]
\[ (3.5) (2.2) (0.86) \]
\[ R^2 = 0.09 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_1 = -9.5 - 1.46 \ln \left( \frac{P_s}{P_m} \right) + 1.23 \ln E + 0.83 \ln \left( \frac{P_{oa}}{P_m} \right) \]
\[ \text{SSE} = 42.2 \]
\[ (2.2) (3.3) (2.4) (1.6) \]
\[ R^2 = 0.218 \]

Logarithmic Reciprocal

\[ \ln Q_1 = 0.52 + 0.35 \left( \frac{P_m}{P_s} \right) - 519 \left( \frac{1}{E} \right) + 0.5 \ln \left( \frac{P_{oa}}{P_m} \right) \]
\[ \text{SSE} = 45.3 \]
\[ (0.91) (2.8) (1.3) (1.0) \]
\[ R^2 = 0.16 \]

\( P_{oa} \) = The purchase power parity for cleaning appliances
Domestic Service

Cross-Price Elasticities Tested

1) Household services
2) Furniture and appliance - summary category
3) Nondurable household goods
4) Cleaning appliances
5) Cooking appliances

Stage 1 Results

Double Logarithmic

\[ \ln Q_s = -5.4 - 1.15 \ln \left( \frac{P_s}{P_m} \right) + 0.81 \ln E \]
\[ \text{SSE} 50.7 \hspace{2cm} (8.76) \]
\[ (1.62) \hspace{2cm} (1.95) \]
\[ R^2 = 0.178 \]

Logarithmic Reciprocal

\[ \ln Q_s = 1.23 + 0.169 \left( \frac{P_m}{P_s} \right) - 276 \left( \frac{1}{E} \right) \]
\[ \text{SSE} 56.1 \hspace{2cm} (8.77) \]
\[ (3.5) \hspace{2cm} (2.2) \hspace{2cm} (0.86) \]
\[ R^2 = 0.09 \]

Stage 2 Results

Double Logarithmic

\[ \ln Q_s = -9.5 - 1.46 \ln \left( \frac{P_s}{P_m} \right) + 1.23 \ln E + 0.83 \ln \left( \frac{P_{CA}}{P_m} \right) \]
\[ \text{SSE} 42.2 \hspace{2cm} (8.78) \]
\[ (2.2) \hspace{2cm} (3.3) \hspace{2cm} (2.4) \hspace{2cm} (1.6) \]
\[ R^2 = 0.218 \]

Logarithmic Reciprocal

\[ \ln Q_s = 0.52 + 0.35 \left( \frac{P_m}{P_s} \right) - 519 \left( \frac{1}{E} \right) + 0.5 \ln \left( \frac{P_{CA}}{P_m} \right) \]
\[ \text{SSE} 45.3 \hspace{2cm} (8.79) \]
\[ (0.91) \hspace{2cm} (2.8) \hspace{2cm} (1.3) \hspace{2cm} (1.0) \]
\[ R^2 = 0.16 \]

\[ P_{CA} = \text{The purchase power parity for cleaning appliances} \]

311
CHAPTER 9

AN OVERALL ELASTICITY FOR THE SERVICE SECTOR

9.1 INTRODUCTION

The purpose of this Chapter is to construct an overall income elasticity for the service sector. This will allow comment to be made on the expected changes in consumer demand for services associated with economic development. This is to be undertaken by weighting the income elasticity for each service by the share of total service expenditure for a country, and thus, attain a weighted average income elasticity of the twenty six consumer services.

The overall elasticity estimates are compared with durable goods income elasticities. This will permit comment to be made about the thesis that the demand for manufactures eventually rises at a lower rate than that for services i.e. that consumer services take a greater budget share in advanced economies.

The International Comparison Project: Stage III (I.C.P. III) observed that the real budget share of services is constant at about one third of total GDP as income rose. This can only occur if the income elasticity for services is greater than one given that the price of services tend to rise relative to goods as incomes increase. This piece of evidence provides a cross-check on the income elasticities calculated in the first part of the Chapter.
The Chapter is organized as follows:

In Section 9.2 overall elasticities are calculated for the consumer service sector. Section 9.3 contains some additional evidence on income elasticity, firstly, for the durable goods sector and, then, for the service sector making use of the price evidence provided by the International Comparison Project. Section 9.4 presents the conclusions. Finally the Appendix considers the merits of separating high and low income countries in an attempt to obtain better fits to the data.

9.2 THE CALCULATION OF OVERALL ELASTICITIES

At the end of the last Chapter a problem was left open: for many services it was impossible at the 95% confidence level to declare that one functional form gave a superior fit to the data on the basis of lowest SSE.

The problem can be seen in Table 9.1, where, in the first column, are shown those functional forms which give the best fit at 95% confidence. (These are taken from the second Appendix to Chapter 8 and thus the equations on which they are based include any relevant additional variables). Column 1 demonstrates the problem of not being able to select unambiguous elasticity estimates. For instance in the case of "Teachers" there are four possible estimates of total consumption expenditure elasticity at the consumption level of I$3174 (that of the U.K.). If the linear functional form is used the elasticity turns out to be 0.45, if the semi-logarithmic form is used 0.28 is obtained, the logarithmic reciprocal gives a value of 0.09 and the hyperbolic 0.06.
Table 9.1 Functional Forms And Total Consumption Expenditure Elasticities For Each Service

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Consumption Expenditure Elasticities (E=I$3174)</th>
<th>95% Confidence</th>
<th>90% Confidence</th>
<th>80% Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
</tr>
<tr>
<td>Barbers</td>
<td>DL 1.37, LR 0.4</td>
<td>DL 1.37, LR 0.4</td>
<td>LR 0.4</td>
<td></td>
</tr>
<tr>
<td>Cloth R&amp;R</td>
<td>DL 1.02, LR 0.31</td>
<td>DL 1.02, LR 0.31</td>
<td>DL 1.02, LR 0.31</td>
<td></td>
</tr>
<tr>
<td>Electric</td>
<td>DL 1.655</td>
<td>DL 1.655</td>
<td>DL 1.655</td>
<td></td>
</tr>
<tr>
<td>HouseSer.</td>
<td>DL 1.31, L 0.67, LR 0.31</td>
<td>DL 1.31</td>
<td>DL 1.31</td>
<td></td>
</tr>
<tr>
<td>LocTrans.</td>
<td>LQ -1.02, LR 0.3</td>
<td>LQ -1.02</td>
<td>LQ -1.02</td>
<td></td>
</tr>
<tr>
<td>BusTrans.</td>
<td>LQ -1.67, LinQ -0.81</td>
<td>LQ -1.67</td>
<td>LQ -1.67</td>
<td></td>
</tr>
<tr>
<td>UniTeach.</td>
<td>DL 1.01, LR 0.28</td>
<td>DL 1.01, LR 0.28</td>
<td>DL 1.01, LR 0.28</td>
<td></td>
</tr>
<tr>
<td>Parking</td>
<td>DL 1.7, L 1.06, LR 0.4</td>
<td>DL 1.7, L 1.06</td>
<td>DL 1.7, L 1.06</td>
<td></td>
</tr>
<tr>
<td>Rents</td>
<td>DL 1.38, L 1.06</td>
<td>DL 1.38</td>
<td>DL 1.38</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>L 0.45, SL 0.28</td>
<td>SL 0.28, H 0.06, LR 0.09</td>
<td>SL 0.28, H 0.06</td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td>DL 1.48</td>
<td>DL 1.48</td>
<td>DL 1.48</td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>DL 1.5</td>
<td>DL 1.5</td>
<td>DL 1.5</td>
<td></td>
</tr>
<tr>
<td>Telephone</td>
<td>DL 1.86</td>
<td>DL 1.86</td>
<td>DL 1.86</td>
<td></td>
</tr>
<tr>
<td>Dentists</td>
<td>DL 2.21, LR 0.76</td>
<td>DL 2.21, LR 0.76</td>
<td>DL 2.21</td>
<td></td>
</tr>
<tr>
<td>Doctors</td>
<td>DL 1.67</td>
<td>DL 1.67</td>
<td>DL 1.67</td>
<td></td>
</tr>
<tr>
<td>FootRep.</td>
<td>DL 0.9, LR 0.28</td>
<td>DL 0.9, LR 0.28</td>
<td>DL 0.9, LR 0.28</td>
<td></td>
</tr>
<tr>
<td>IndoorRep.</td>
<td>DL 1.64, LR 0.46</td>
<td>DL 1.64, LR 0.46</td>
<td>DL 1.64</td>
<td></td>
</tr>
<tr>
<td>AutoRep.</td>
<td>DL 1.71</td>
<td>DL 1.71</td>
<td>DL 1.71</td>
<td></td>
</tr>
<tr>
<td>Rec&amp;Cult.</td>
<td>DL 1.1, LR 0.28</td>
<td>DL 1.1, LR 0.28</td>
<td>DL 1.1</td>
<td></td>
</tr>
<tr>
<td>PublicEnt.</td>
<td>DL 1.42, LR 0.41</td>
<td>DL 1.42, LR 0.41</td>
<td>DL 1.42, LR 0.41</td>
<td></td>
</tr>
<tr>
<td>Postal</td>
<td>DL 1.37, LR 0.38</td>
<td>DL 1.37, LR 0.38</td>
<td>DL 1.37</td>
<td></td>
</tr>
<tr>
<td>AirTrans.</td>
<td>DL 1.21, LR 0.33</td>
<td>DL 1.21, LR 0.33</td>
<td>DL 1.21, LR 0.33</td>
<td></td>
</tr>
<tr>
<td>RailTrans.</td>
<td>DL 1.3, LR 0.39</td>
<td>DL 1.3, LR 0.39</td>
<td>DL 1.3, LR 0.39</td>
<td></td>
</tr>
<tr>
<td>Hotels</td>
<td>DL 1.4, LR 0.4</td>
<td>DL 1.4, LR 0.4</td>
<td>DL 1.4, LR 0.4</td>
<td></td>
</tr>
<tr>
<td>Restaurants</td>
<td>DL 1.86, LR 0.54</td>
<td>DL 1.86, LR 0.54</td>
<td>DL 1.86, LR 0.54</td>
<td></td>
</tr>
<tr>
<td>Dom.Ser.</td>
<td>DL 1.23, LR 0.16</td>
<td>DL 1.23, LR 0.16</td>
<td>DL 1.23, LR 0.16</td>
<td></td>
</tr>
</tbody>
</table>

Key:

DL Double Logarithmic functional form
LR Logarithmic Reciprocal functional form
L Linear functional form
SL Semi-Logarithmic functional form
H Hyperbolic functional form
LQ Logarithmic Quadratic
LinQ Linear Quadratic
It would be difficult to arrive at overall elasticities for "Services" with this wide variety of possible elasticities for individual categories. A way of reducing the number of possible estimates is to reduce the confidence level. At a 90% confidence level the difference between the SSE's only has to produce a d-statistic greater than 2.706 (based on equation 7.9 page 122) to be judged statistically different.

The results of basing the selection of functional forms on the 90% confidence level are shown in Column 2. In the case of "Teachers" only three functional forms are now judged to have good fits. The SSE's for the linear form at 1.15 was significantly greater than that for the Hyperbolic (the lowest SSE) at 0.7. When these two SSE's are put into equation 7.9 the d-statistic is 3.66 which is larger than the critical value of 2.706, thus we reject the hypothesis that these two SSE's are statistically similar.

Even with one functional form rejected as inferior there are still three possible forms for "Teachers" and more than one form for a great many other categories. If the 80% confidence level is used then the majority of services (15) show only one best fit functional form and the remainder display only two. This is a more manageable range of elasticity estimates because now it is possible to take the highest elasticity estimate given by Column 3 and combine it with the weight for the category to calculate the "high" weighted average total consumption expenditure elasticity. Then the lowest elasticity estimate can be taken for each of the twenty six services, and, used with appropriate
weights, to obtain the "low" elasticity estimate for the service sector. Of course, where only one elasticity estimate is shown for a category in Column 3, that estimate is used for both the "high" and "low" estimates of overall elasticity.

The data used in such a calculation is shown in Table 9.2 for the U.K. level of total consumption. For each of the services one or two elasticities are given, these are drawn from Table 9.1. In the case of double logarithmic the elasticity estimate does not vary with consumption level, but for the other functional forms it is important to state the total consumption level (in this case I$3174) and calculate the income elasticity for that level. The weights used are those given by the I.C.P. III for the expenditure per capita on each of the service categories in 1975 measured in International dollars (I$). Thus, the average U.K. citizen in 1975 spent I$61.1 on Electricity out of a total consumption expenditure of I$3174.

For the U.K. a weighted average of the elasticities presented in Table 9.2 is calculated and the results are presented in Table 9.3. The total consumption expenditure elasticity estimate based on using the lowest individual elasticities is shown as 1.07 or 0.93. The "high" estimate is either 1.41 or 1.40.
<table>
<thead>
<tr>
<th>Category</th>
<th>Functional Form and Elasticity</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbers</td>
<td>Log. Rec. 0.4</td>
<td>13.2</td>
</tr>
<tr>
<td>Clothing R &amp; R</td>
<td>Double Log. 1.02 Log. Rec. 0.31</td>
<td>1.2</td>
</tr>
<tr>
<td>Electricity</td>
<td>Double Log. 1.655</td>
<td>61.1</td>
</tr>
<tr>
<td>Household Ser.</td>
<td>Double Log. 1.31</td>
<td>20.7</td>
</tr>
<tr>
<td>Local Trans.</td>
<td>Log. Quad. -1.02</td>
<td>23.6</td>
</tr>
<tr>
<td>Bus Trans.</td>
<td>Log. Quad. -1.67</td>
<td>3.3</td>
</tr>
<tr>
<td>Uniteach</td>
<td>Double Log. 1.01 Log. Rec. 0.28</td>
<td>9.5</td>
</tr>
<tr>
<td>Parking</td>
<td>Double Log. 1.70 Linear 1.06</td>
<td>21.9</td>
</tr>
<tr>
<td>Gross Rents</td>
<td>Double Log. 1.38</td>
<td>317.5</td>
</tr>
<tr>
<td>Teachers</td>
<td>Semi-Log. 0.28 Hyperbolic 0.06</td>
<td>87.2</td>
</tr>
<tr>
<td>Hospital</td>
<td>Double Log. 1.48</td>
<td>93.6</td>
</tr>
<tr>
<td>Nurses</td>
<td>Double Log. 1.50</td>
<td>101.5</td>
</tr>
<tr>
<td>Telephone</td>
<td>Double Log. 1.86</td>
<td>19.3</td>
</tr>
<tr>
<td>Dentists</td>
<td>Double Log. 2.21</td>
<td>16.4</td>
</tr>
<tr>
<td>Doctors</td>
<td>Double Log. 1.67</td>
<td>63.4</td>
</tr>
<tr>
<td>Footwear Rep.</td>
<td>Double Log. 0.90 Log. Rec. 0.28</td>
<td>2.6</td>
</tr>
<tr>
<td>Indoor Rep.</td>
<td>Double Log. 1.64</td>
<td>43.6</td>
</tr>
<tr>
<td>Auto Rep.</td>
<td>Double Log. 1.71</td>
<td>46.5</td>
</tr>
<tr>
<td>Rec. &amp; Culture</td>
<td>Double Log. 1.10</td>
<td>62.5</td>
</tr>
<tr>
<td>Public Ent.</td>
<td>Double Log. 1.42 Log. Rec. 0.41</td>
<td>19.0</td>
</tr>
<tr>
<td>Postal</td>
<td>Double Log. 1.37</td>
<td>9.6</td>
</tr>
<tr>
<td>Air Trans.</td>
<td>Double Log. 1.21 Log. Rec. 0.33</td>
<td>8.3</td>
</tr>
<tr>
<td>Rail Trans.</td>
<td>Double Log. 1.30 Log. Rec. 0.39</td>
<td>2.3</td>
</tr>
<tr>
<td>Hotels</td>
<td>Double Log. 1.40 Log. Rec. 0.40</td>
<td>60.5</td>
</tr>
<tr>
<td>Restaurants</td>
<td>Double Log. 1.86 Log. Rec. 0.54</td>
<td>248.5</td>
</tr>
<tr>
<td>Domestic Ser.</td>
<td>Double Log. 1.23 Log. Rec. 0.16</td>
<td>5.0</td>
</tr>
<tr>
<td>Consumption Level (I$)</td>
<td>Japan</td>
<td>U.K.</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>All 26 Low Categories Estimate</td>
<td>2925</td>
<td>3174</td>
</tr>
<tr>
<td>Low Estimate</td>
<td>1.04</td>
<td>1.07</td>
</tr>
<tr>
<td>High Estimate</td>
<td>1.29</td>
<td>1.41</td>
</tr>
<tr>
<td>Excluding Rents and Electricity Low (24 High Categories) Estimate</td>
<td>0.91</td>
<td>0.93</td>
</tr>
<tr>
<td>Low Estimate</td>
<td>1.25</td>
<td>1.40</td>
</tr>
</tbody>
</table>
Two estimates have been given because it seemed possible that the categories "Gross Rents" and "Electricity" would distort the overall elasticities because of their large weightings, and, more importantly, many people would not automatically identify these two categories as "true" services even though they do fit the I.C.P. III definition of being "non-storable goods". Thus, to prevent an over-estimate of the income elasticity for the "normal" services the elasticity is calculated without "Electricity" and "Gross Rents".

As well as estimates for the U.K. those for the other "G.5" countries are given. For each different consumption level new elasticities had to be calculated and combined with the unique weights for each country.

The results show that even if the highest possible estimate is selected for individual categories the average for the service sector as a whole is only 1.45 for the United States and merely 1.41 for the U.K., France and West Germany. For Japan the "high" estimate is only 1.29. If the lowest individual elasticity estimates are used then the overall elasticity is close to one and in some cases less than one. For the U.K. if only 24 categories are used the estimate may be as low as 0.93.

The I.C.P. III calculated elasticities for each of the consumption categories on the basis of the double logarithmic functional form. They did not examine the possibility of a better fit using other forms nor of applying additional variables. Following in this tradition Table 9.4 presents the results of

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1International Comparison Project Stage III ibid page 22
simply using for each service the double logarithmic form to calculate a weighted overall total consumption expenditure elasticity for services. The individual elasticities used are those given after the addition of other variables and will thus be different from an overall elasticity calculated from the original I.C.P. III elasticities.

Even using the assumption of one functional form being suitable and that form being the double logarithmic which generally provides the highest elasticity estimates at high income levels (relative to other functional forms) the largest elasticity estimate is only 1.50.

It was noted in Chapter 7 that alongside the double logarithmic functional form the logarithmic reciprocal was the most widely applicable. Table 7.1 (page 127) shows that the logarithmic reciprocal gave one of the best fits in the case of nineteen services. Thus, it may have been possible to conclude at that stage that an overall elasticity may be calculated by using the logarithmic reciprocal form for each of the categories and then obtaining a weighted average. Such a calculation is shown in Table 9.5 for the case of the U.K.
### Table 9.4 Total Consumption Expenditure Elasticities For Services Using Only The Double Logarithmic Functional Form

<table>
<thead>
<tr>
<th>Consumption Level (I$)</th>
<th>Japan</th>
<th>U.K.</th>
<th>France</th>
<th>W.Germany</th>
<th>U.S.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 26 Categories of Service</td>
<td>2925</td>
<td>3174</td>
<td>3746</td>
<td>3743</td>
<td>4984</td>
</tr>
<tr>
<td>Excluding Rents and Electricity (24 Categories of Services)</td>
<td>1.38</td>
<td>1.46</td>
<td>1.46</td>
<td>1.44</td>
<td>1.47</td>
</tr>
</tbody>
</table>

### Table 9.5 Total Consumption Expenditure Elasticity Estimate For The U.K. Using Only The Logarithmic Reciprocal Functional Form (I$3174)

| All 26 Categories of Service | 0.40 |
| Excluding Rent and Electricity (24 Categories) | 0.40 |
This shows an elasticity markedly less than one at 0.40 suggesting an income inelastic group of categories. Although this figure is interesting it should be borne in mind that when an 80% confidence level for the difference in SSE is used (as in Table 9.1) only ten services show logarithmic reciprocal to be a relevant functional form, whereas double logarithmic is relevant in twenty two cases. Thus, it would seem inappropriate to apply the logarithmic reciprocal form to all twenty six services. Also Table 7.1 was drawn up before the addition of other variables.

This section has shown the probable overall total consumption expenditure elasticity for the service sector to be at most 1.50, and, possibly to be less than 1.

9.3 OTHER INCOME ELASTICITY EVIDENCE

9.3.1 Durable Goods

A fundamental aspect of the post-industrial society argument is the belief that advanced economies show a higher income elasticity for services than for manufactured goods. Table 9.6 shows the total consumption expenditure elasticity estimates for the major durable consumer products. These are taken from the I.C.P. III elasticity calculations. Thus they are based on the use of the double logarithmic functional form and with total consumption expenditure and own-price as determining variables.
<table>
<thead>
<tr>
<th>Category</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furniture, fixtures</td>
<td>1.70 (0.22)</td>
</tr>
<tr>
<td>Floor coverings</td>
<td>2.30 (0.27)</td>
</tr>
<tr>
<td>Household textiles, etc.</td>
<td>1.58 (0.18)</td>
</tr>
<tr>
<td>Refrigerators, freezers</td>
<td>1.45 (0.26)</td>
</tr>
<tr>
<td>Washing appliances</td>
<td>2.41 (0.55)</td>
</tr>
<tr>
<td>Cooking appliances</td>
<td>1.96 (0.43)</td>
</tr>
<tr>
<td>Heating appliances</td>
<td>2.12 (0.24)</td>
</tr>
<tr>
<td>Cleaning appliances</td>
<td>1.91 (0.25)</td>
</tr>
<tr>
<td>Other household appliances</td>
<td>0.36 (0.40)</td>
</tr>
<tr>
<td>Personal cars</td>
<td>2.07 (0.36)</td>
</tr>
<tr>
<td>Other personal transport</td>
<td>1.37 (0.27)</td>
</tr>
<tr>
<td>Radio, T.V., phonograph</td>
<td>1.34 (0.33)</td>
</tr>
<tr>
<td>Major durable recreation equipment</td>
<td>1.51 (0.34)</td>
</tr>
<tr>
<td>Other recreation equipment</td>
<td>2.71 (0.27)</td>
</tr>
</tbody>
</table>

Taken from United Nations International Comparison Project Phase III pages 361 - 363

The numbers in parenthesis are coefficient standard errors.
The overall impression is one of remarkably high elasticities, especially when compared with that for services. Only four out of the fourteen durable goods shows an elasticity less than 1.50 (the highest estimate established for services as a whole in the previous section). The average elasticity is considerably more than 1.50.

The standard errors show the estimates to be highly significant (except in the case of "Other household appliances") therefore the double logarithmic form provides a reasonably good description of the data.

Thus we have an indication that the total consumption expenditure elasticity for durable consumer goods is higher than that for services.

9.3.2 Price Evidence

There is evidence to show that when incomes rise the real quantity (price adjusted) of the service sector remains constant as a proportion of G.D.P. In other words real budget share is static. There is also evidence that rising incomes lead to the price of the service sector rising relative to the goods sector. Assuming a negative own-price elasticity for the service sector this would lead to a decreasing budget share, ceteris paribus. The fact that this sector has a constant budget share suggests that there is an offsetting influence. That is, consumer services have an income elasticity greater than one.

In this section evidence is drawn from the I.C.P. III and from this thesis to show the above statements to be evident in the data.
In dealing with this matter we have to be aware of the distinction between expressing the proportion of G.D.P. spent on services in terms of expenditure rather than in real quantity terms. If it is true that the price of services tends to rise with income then expenditure on services as a proportion of G.D.P. would rise even if the real quantity (as a proportion) remained the same. This is indeed what happens with economic development - as can be seen in Table 9.7. The data for this table is taken from I.C.P. III. It shows that when expenditure in national currency terms is used to express the expenditure on services as a proportion of G.D.P. then that proportion rises from 22.2% for the group of low income countries to 43.9% for the U.S.A.. However when we express the proportion of services in real terms (volume terms) then the percentage of G.D.P. remains in a very narrow range (30.3% - 33.8%) and does not show any tendency to rise.

The reason for this fundamental difference is that the price of services rises relative to that for goods with income growth. This can be seen in Table 9.8 where the price of services in Group I is a fifth of that for the U.S.A.. The price of commodities is also less for the poor countries compared with the U.S.A. but the difference is only a factor of about one half. Thus it can be observed that the price of services rises with economic development relative to that for commodities.
<table>
<thead>
<tr>
<th>Country Groups</th>
<th>Share of Services in G.D.P., 1975 expressed in real terms International Prices</th>
<th>G.D.P. share of Services when expressed in National Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>33.8</td>
<td>22.2</td>
</tr>
<tr>
<td>(Malawi - Philippines)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group II</td>
<td>31.7</td>
<td>28.4</td>
</tr>
<tr>
<td>(S. Korea - Brazil)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group III</td>
<td>31.8</td>
<td>27.3</td>
</tr>
<tr>
<td>(Romania - Ireland)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group IV</td>
<td>30.3</td>
<td>25.6</td>
</tr>
<tr>
<td>(Hungary - Spain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group V</td>
<td>31.2</td>
<td>36.8</td>
</tr>
<tr>
<td>(U.K. - W. Germany)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group VI</td>
<td>32.3</td>
<td>43.9</td>
</tr>
<tr>
<td>(U.S.A.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Taken from: The International Comparison Project: Stage III Table 6.10 Page 194
### Table 9.8 Price Indexes For Services And Commodities, 1975
(U.S.A. = 100)

<table>
<thead>
<tr>
<th>Country Groups (ascending order of income)</th>
<th>Services</th>
<th>Commodities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>20.7</td>
<td>57.2</td>
</tr>
<tr>
<td>Group II</td>
<td>34.1</td>
<td>65.9</td>
</tr>
<tr>
<td>Group III</td>
<td>41.2</td>
<td>83.1</td>
</tr>
<tr>
<td>Group IV</td>
<td>46.3</td>
<td>94.0</td>
</tr>
<tr>
<td>Group V</td>
<td>94.6</td>
<td>119.0</td>
</tr>
<tr>
<td>Group VI</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Taken from: International Comparison Project Stage III
Table 6.12 Page 196
In Chapters 7 and 8 price elasticities were provided for each category alongside the income elasticities. Table 9.9 shows some of these own-price elasticities. The figures shown are taken from the double logarithmic functional form equations after the addition of other variables (as in the Appendix to Chapter 8). As can be seen the elasticities vary greatly (there is even a positive own-price elasticity, that for "Restaurants" of +0.32). The t-values, in the main, show the own-price parameters to be statistically significant.

A calculation was made to obtain the weighted average own-price elasticity for the service sector (based on U.K. expenditure weights). This turned out to be -0.52. Crude though this estimate may be it does provide evidence of a negative own-price elasticity for services.

The fact that the price of services rises relative to goods combined with a negative own-price elasticity should result in a decrease in the real quantity of services as a proportion of G.D.P. when incomes rose if the income elasticity had a value of one. Because there is evidence that the proportion remains constant the conclusion drawn is that the income elasticity is greater than one.
Table 9.9  Own-Price Elasticities for Services

<table>
<thead>
<tr>
<th>Category</th>
<th>Own-Price Elasticity (t-value)</th>
<th>U.K. Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbers</td>
<td>-0.81 (3.69)</td>
<td>13.2</td>
</tr>
<tr>
<td>Clothing R&amp;R</td>
<td>-1.15 (2.11)</td>
<td>1.2</td>
</tr>
<tr>
<td>Electricity</td>
<td>-0.89 (8.33)</td>
<td>61.1</td>
</tr>
<tr>
<td>Household Services</td>
<td>-1.59 (4.56)</td>
<td>20.7</td>
</tr>
<tr>
<td>Local Transport</td>
<td>-0.95 (4.01)</td>
<td>23.6</td>
</tr>
<tr>
<td>Bus Transport</td>
<td>-0.17 (0.52)</td>
<td>3.3</td>
</tr>
<tr>
<td>UniTeachers</td>
<td>-0.23 (1.74)</td>
<td>9.5</td>
</tr>
<tr>
<td>Parking</td>
<td>-0.62 (1.17)</td>
<td>21.9</td>
</tr>
<tr>
<td>Rents</td>
<td>-0.73 (4.97)</td>
<td>317.5</td>
</tr>
<tr>
<td>Teachers</td>
<td>-0.05 (0.62)</td>
<td>87.2</td>
</tr>
<tr>
<td>Hospital</td>
<td>-0.41 (3.27)</td>
<td>93.6</td>
</tr>
<tr>
<td>Nurses</td>
<td>-0.27 (3.08)</td>
<td>101.5</td>
</tr>
<tr>
<td>Telephone</td>
<td>-1.07 (8.4)</td>
<td>19.3</td>
</tr>
<tr>
<td>Dentists</td>
<td>-0.34 (3.36)</td>
<td>16.4</td>
</tr>
<tr>
<td>Doctors</td>
<td>-0.45 (4.9)</td>
<td>63.4</td>
</tr>
<tr>
<td>Footwear Repairs</td>
<td>-0.73 (1.31)</td>
<td>2.6</td>
</tr>
<tr>
<td>Indoor Repairs</td>
<td>-1.02 (3.23)</td>
<td>43.6</td>
</tr>
<tr>
<td>Auto Repairs</td>
<td>-1.60 (4.88)</td>
<td>46.5</td>
</tr>
<tr>
<td>Rec.&amp; Culture</td>
<td>-0.88 (2.46)</td>
<td>62.5</td>
</tr>
<tr>
<td>Pub. Entertainment</td>
<td>-1.10 (3.0)</td>
<td>19.0</td>
</tr>
<tr>
<td>Postal</td>
<td>-0.82 (2.1)</td>
<td>9.6</td>
</tr>
<tr>
<td>Air Transport</td>
<td>-0.94 (3.2)</td>
<td>8.3</td>
</tr>
<tr>
<td>Rail Transport</td>
<td>-0.86 (2.4)</td>
<td>2.3</td>
</tr>
<tr>
<td>Hotels</td>
<td>-1.09 (2.6)</td>
<td>60.5</td>
</tr>
<tr>
<td>Restaurants</td>
<td>+0.32 (0.76)</td>
<td>248.5</td>
</tr>
<tr>
<td>Domestic Services</td>
<td>-1.46 (3.3)</td>
<td>5.0</td>
</tr>
</tbody>
</table>
9.4 CONCLUSIONS

This study calculated individual elasticities for each of the twenty-six services. These were then combined to obtain weighted averages. A "low" weighted average for the G5 countries showed an income elasticity of only 0.91 (that for Japan). One of the "high" estimates was 1.45 (the U.S.A.).

Even when the functional form which tended to give the highest income elasticities (that of the double logarithmic) was applied the weighted average was, at most, 1.50.

These estimates indicate that the service sector is not one of very high income elasticity resulting in the sector taking a rapidly rising share of household expenditure when income rises.

However, the service sector is a very heterogeneous group. Some categories have high elasticities for the income variable e.g. Telephones, 1.86, whereas others possess negative income elasticities e.g. Bus Transport, -1.67.

A comparison with the durable goods sector shows the service sector to have a relatively modest income elasticity (even for its "high" estimate). The vast majority of durable goods have an income elasticity higher than 1.50. This appears to provide some support to Gershuny's idea (see Chapter 2) of an increase in the demand for a "luxury" service "function" being provided via a durable good rather than a service. For instance, in the advanced economies the service function, clean clothes, often involves a great deal of additional expenditure on goods (e.g. a washing machine, with an income elasticity of 2.41) and a decrease in expenditure on a service (e.g. laundry services).
Although this thesis has presented its own estimates of income elasticities another direction of approach was also examined. Evidence was provided to show that the rising relative price of the service sector did not result in a loss of share of G.D.P. with economic development. This led to the conclusion (based on price and budget share evidence alone) that the service sector has an income elasticity greater than one.

An important feature of this Chapter is that the estimates of overall elasticities are in a relatively narrow range. Thus for a number of industrial countries we had estimates, none of which was greater than 1.44 and none of which was less than 1.04 (when all twenty six services are included).

A relative low income elasticity (compared with durable goods) combined with a tendency for the price of services to rise with income growth is likely to produce a sector which does not take a significantly greater share of G.D.P. in real terms i.e. volume of services. It may, however, permit expenditure (as a share of G.D.P. expenditure) in national currency terms to increase if the price elasticity is between 0 and -1, as is indicated by this research.
APPENDIX 9.1

Separating The Observations Into High And Low Income Groups

It can be observed in many of the graphs in the Appendix to Chapter 7 that the relationship between T.C.E. and Quantity is different for the high income countries than for the low income nations. Take the case of "Teachers" (Figures 7.7.10(a), 7.7.10(b) pages 181,182) where a distinct change in relationship appears to occur at about I$1500 per capita income. Up to that point there is a strong positive relationship. Beyond I$1500 the quantity rises slowly, if at all.

It also seemed theoretically plausible that the demand relationship for a service could change at certain income levels. For instance, if a service is a "luxury" a certain critical level of income may be required before it was demanded in large quantities. This change in relationship may be allowed for by some functional forms used earlier, but perhaps a better alternative is to separate the high and low income countries.

Thus, rather than using a variety of functional forms involving all 34 observations, the first 17 observations could be taken (the lowest income countries, Malawi to Yugoslavia) and a double logarithmic regression could be carried out on these. Then follow this by analysis of the final seventeen countries (Iran to U.S.A.) on the same basis.

To split the countries into high and low income groups at

\[ PowerPoint Slides \]

the 17th country, that of Yugoslavia, (total consumption per capita $1692) is, admittedly, arbitrary. However there does not appear to be a consistent point of income at which the demand pattern changes for all, or most, of the 26 services. Thus, any alternative point of separation would be equally arbitrary or based on a rather thin theoretical justification. The decision to split at the seventeenth country at least has the virtue of providing two reasonably large sample sizes on which to carry out regressions.

Appendix Table 9.1 shows the results of such an analysis. For comparison the first four columns show the double logarithmic parameter values when all 34 observations are used. In each case only two determining variables are used; income and own-price. These parameters and t-values are the same as those found in the Appendix to Chapter 7. In the second four columns the results for the low income countries are presented, and in the third those for the high income countries.

In most cases the t-values and adjusted coefficients of determination are not improved by splitting the data in this way. This may be due largely to the the loss of degrees of freedom when the observations are reduced from 34 to 17. For instance in the case of "Teachers" the best fit remains that given by using all thirty four observations even though a glance at the graph suggests a significantly different relationship for high and low income countries. Two other factors should be borne in mind when viewing these results; firstly, the graphs do not allow for the influence of price unlike the multiple regression. Secondly,
### Appendix Table 9.1 Results Of Regressions On Each Service Using The Double Logarithmic Form. The Observations are separated into two groups. (Initially All 34 Observations Are Used, Then The First 17 Only And Lastly The Second 17 Observations).

<table>
<thead>
<tr>
<th>Service</th>
<th>All Observations</th>
<th>17 Low Income Countries</th>
<th>17 High Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price Variable Parameter</td>
<td>Income Constant (SSE)</td>
<td>Variable Parameter</td>
</tr>
<tr>
<td>Dentists</td>
<td>-0.34 (3.36)</td>
<td>2.21 (14.7)</td>
<td>0.87 (13.6)</td>
</tr>
<tr>
<td>Doctors</td>
<td>-0.45 (4.90)</td>
<td>1.67 (18.64)</td>
<td>0.92 (14.6)</td>
</tr>
<tr>
<td>Foot.Rep.</td>
<td>-0.73 (1.31)</td>
<td>0.90 (4.35)</td>
<td>0.44 (4.28)</td>
</tr>
<tr>
<td>Indoor Rep.</td>
<td>-1.02 (3.23)</td>
<td>1.64 (9.36)</td>
<td>0.74 (7.29)</td>
</tr>
<tr>
<td>Auto Rep.</td>
<td>-1.37 (4.30)</td>
<td>1.64 (6.13)</td>
<td>0.78 (5.33)</td>
</tr>
<tr>
<td>Rec.&amp; Cult.</td>
<td>-0.88 (2.48)</td>
<td>1.10 (6.69)</td>
<td>0.57 (4.54)</td>
</tr>
<tr>
<td>Public Ent.</td>
<td>-1.10 (2.88)</td>
<td>1.31 (6.57)</td>
<td>0.57 (27.2)</td>
</tr>
<tr>
<td>Postal</td>
<td>-0.67 (1.69)</td>
<td>1.38 (7.79)</td>
<td>0.68 (7.26)</td>
</tr>
<tr>
<td>Air Trans.</td>
<td>-0.93 (3.14)</td>
<td>1.20 (5.45)</td>
<td>0.47 (4.86)</td>
</tr>
<tr>
<td>Rail Trans.</td>
<td>-0.66 (1.96)</td>
<td>1.27 (5.00)</td>
<td>0.36 (4.07)</td>
</tr>
<tr>
<td>Hotels</td>
<td>-1.09 (2.45)</td>
<td>1.40 (6.00)</td>
<td>0.73 (5.19)</td>
</tr>
<tr>
<td>Restaurants</td>
<td>0.32 (0.78)</td>
<td>9.81 (9.81)</td>
<td>0.75 (7.04)</td>
</tr>
<tr>
<td>Dom. Ser.</td>
<td>-1.15 (2.98)</td>
<td>0.81 (1.95)</td>
<td>0.18 (1.62)</td>
</tr>
</tbody>
</table>

Notes:
1) In all cases only own-price and consumption are taken as explanatory variables.
2) Figures in brackets - t-values
Appendix Table 9.1 Results Of Regressions On Each Service Using The Double Logarithmic Form. The Observations are separated into two groups (Initially All 34 Observations Are Used, Then The First 17 Only And Lastly The Second 17 Observations)

<table>
<thead>
<tr>
<th>Service</th>
<th>All Observations</th>
<th>17 Low Income Countries</th>
<th>17 High Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price Variable</td>
<td>Income Constant Parameter</td>
<td>Parameter (SSE) t-value</td>
</tr>
<tr>
<td></td>
<td>Income Variable</td>
<td>Parameter (SSE) t-value</td>
<td>(SSE) t-value</td>
</tr>
<tr>
<td></td>
<td>Parameter</td>
<td>Parameter (SSE) t-value</td>
<td>(SSE) t-value</td>
</tr>
<tr>
<td></td>
<td>Price Variable</td>
<td>Income Constant Parameter</td>
<td>Parameter (SSE) t-value</td>
</tr>
<tr>
<td></td>
<td>Income Variable</td>
<td>Parameter (SSE) t-value</td>
<td>(SSE) t-value</td>
</tr>
<tr>
<td></td>
<td>Parameter</td>
<td>Parameter (SSE) t-value</td>
<td>(SSE) t-value</td>
</tr>
<tr>
<td>Barber's</td>
<td>-0.89</td>
<td>1.43</td>
<td>-9.05</td>
</tr>
<tr>
<td></td>
<td>(3.82)</td>
<td>(10.37)</td>
<td>(8.33)</td>
</tr>
<tr>
<td>Cloth.R&amp;R</td>
<td>-1.07</td>
<td>0.77</td>
<td>-5.85</td>
</tr>
<tr>
<td></td>
<td>(1.94)</td>
<td>(2.04)</td>
<td>(1.94)</td>
</tr>
<tr>
<td>Electric</td>
<td>-0.85</td>
<td>1.65</td>
<td>-9.35</td>
</tr>
<tr>
<td></td>
<td>(6.92)</td>
<td>(22.2)</td>
<td>(16.7)</td>
</tr>
<tr>
<td>House.Serv.</td>
<td>-1.67</td>
<td>1.35</td>
<td>-8.13</td>
</tr>
<tr>
<td></td>
<td>(4.3)</td>
<td>(7.22)</td>
<td>(5.81)</td>
</tr>
<tr>
<td>Loc.Trans.</td>
<td>-1.41</td>
<td>1.01</td>
<td>-5.84</td>
</tr>
<tr>
<td></td>
<td>(4.87)</td>
<td>(5.03)</td>
<td>(3.75)</td>
</tr>
<tr>
<td>Bus Trans.</td>
<td>-0.37</td>
<td>0.01</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>(0.93)</td>
<td>(0.04)</td>
<td>(0.66)</td>
</tr>
<tr>
<td>Uni.Teach.</td>
<td>-0.23</td>
<td>1.01</td>
<td>-5.40</td>
</tr>
<tr>
<td></td>
<td>(1.74)</td>
<td>(9.25)</td>
<td>(6.44)</td>
</tr>
<tr>
<td>Parking</td>
<td>-0.62</td>
<td>1.70</td>
<td>-11.3</td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(5.19)</td>
<td>(4.6)</td>
</tr>
<tr>
<td>Gross Rents</td>
<td>-0.71</td>
<td>1.37</td>
<td>-5.58</td>
</tr>
<tr>
<td></td>
<td>(4.86)</td>
<td>(15.3)</td>
<td>(8.57)</td>
</tr>
<tr>
<td>Teachers</td>
<td>-0.05</td>
<td>0.38</td>
<td>1.37</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(4.57)</td>
<td>(1.95)</td>
</tr>
<tr>
<td>Hospital</td>
<td>-0.41</td>
<td>1.48</td>
<td>-8.06</td>
</tr>
<tr>
<td></td>
<td>(3.27)</td>
<td>(11.06)</td>
<td>(7.92)</td>
</tr>
<tr>
<td>Nurses</td>
<td>-0.27</td>
<td>1.50</td>
<td>-8.58</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(13.8)</td>
<td>(7.19)</td>
</tr>
<tr>
<td>Telephone</td>
<td>-1.07</td>
<td>1.86</td>
<td>-12.0</td>
</tr>
<tr>
<td></td>
<td>(8.42)</td>
<td>(19.6)</td>
<td>(17.2)</td>
</tr>
</tbody>
</table>

Notes:
1) In all cases only own-price and consumption expenditure are taken as explanatory variables.
2) Figures in brackets - t-values or SSE.
functional forms other than double logarithmic do allow for different elasticities at higher income levels.

In a few cases an improvement can be observed. "Clothing, rental and repair" shows higher adjusted coefficients of determination (rising from 0.077 to 0.25 and 0.21) and, for the high income group an improved t-value for the income parameter rising from 2.04 to 2.22. However, the significance of the price parameter is worsened (down to a t-value of 0.34 from 1.94) and the income elasticity for the low income countries becomes statistically insignificant (t-value 1.12).

"Local Transport" and "Bus Transport" show some improvement which is only to be expected. The first column shows the results of trying to fit a constant elasticity functional form to categories which clearly have the properties of a positive income elasticity up to a certain income level and then a negative one at high incomes. Once the data is separated the negative income elasticity for the high income countries becomes apparent: -0.88 for "Local Transport" and -1.64 for "Bus Transport". However, the negative elasticity for "Local Transport" has a t-value of only 1.30 and is therefore not statistically significant. The t-value for "Bus Transport" is only just significant at 2.02. This does not compare favourably with the significance of the logarithmic quadratic regression (see pages 157 and 162), where the income parameter t-values for "Local Transport" are greater than 5 and for "Bus Transport" more than 3.

The category "Parking" shows a dramatic improvement in
goodness of fit for the high income countries but a very poor fit for the low income countries. For the wealthy nations the coefficient of determination rises to 70% compared with 49%, and the t-value for the income variable to 6.12 rather than 5.18. While this is an impressive result the t-value given for the income variable when the linear functional form is used for all 34 observations is higher at 9.55.

The only other category to show an improvement in statistical significance for the income parameter and a higher $R^2$ is "Hotels". There is a very slight increase in these measures for the low income countries, but the values become very small for the high income nations regression.

Separating the data into high and low income groups has not provided better fitting multiple regression equations than those shown in Chapters 7, 8 and 9. In a few cases there is some evidence of an improvement compared with the double logarithmic functional form applied to all 34 observations. However, in these cases another functional form (using all 34 observations) fits the data better than double logarithmic applied to just the high or low income countries.
CHAPTER 10

CONCLUSIONS AND IMPLICATIONS

10.1 POST-INDUSTRIAL SOCIETY - THE ROLE OF CONSUMER SERVICE DEMAND

The increasing relative importance of the service sector in the economically advanced countries led commentators to suggest that this sector had a particularly high income elasticity. They concluded that as individuals became more affluent a higher proportion of their income was spent on consumer services. That is, consumer services are luxuries.

An alternative view is expressed by other researchers. They see the increase in employment and share of output for this sector being a consequence of supply side effects. For instance, the rising productivity of labour in the manufacturing sector relative to services and the growth of producer services. This thesis examines the demand for consumer services using data from the International Comparison Project. It does this, firstly on a disaggregated basis and then by drawing together the various individual service elasticities to establish an overall income elasticity for the consumer service sector.

When all twenty six services are included in the weighted average the income elasticity is between 1.04 and 1.44 for a number of developed economies. This is shown to be a relatively low income elasticity when compared with durable goods.

This thesis thus provides some evidence which is in direct contradiction to Bell's view of economic growth; there does not

1See Chapter 2 of this thesis
appear to be a point of economic development at which the demand for consumer services rises at a faster rate than that for durable goods.

Not only does the service sector have a relatively low income elasticity when compared with durable manufactured goods it also exhibits a rising relative price when economies develop. This tendency was commented upon by a number of researchers including Clark, Fuchs and Gershuny\(^2\). More up to date empirical evidence of the rising price of services with income growth was provided by the International Comparison Project Phase III.

This phenomenon leads to the possibility that the consumer service sector may be observed to take an increasing share of G.D.P. when measured in expenditure terms even though in real or volume terms the share of G.D.P. is not rising at all. This would be due to the per unit price of a service being higher in advanced economies compared with a lower income per capita economy.

This leads to the possibility of some researchers concentrating on the current expenditure share of G.D.P. for consumer services and reaching the conclusion that the sector is of increasing importance; while at the same time other researchers may examine the relationships in terms of income and own-price elasticities and come to the conclusion that this sector possesses a comparatively low income elasticity and thus low budget share increase with income growth in volume terms. Not only does the rising relative price influence the expenditure

\(^2\)See Chapter 2
share it also results in a lower volume of services than might otherwise occur. (A rising price will lead to a lower volume if the own-price elasticity is negative, ceteris paribus). Both the relatively low income elasticity and the downward demand effect of a rising relative price suggest that as economies develop consumer services, when taken as a whole, is unlikely to be sector which will lead to the dramatic shifts in the economy and society, in terms of employment and output, suggested by the hypothesis of the "post-industrial society".

It is interesting to note that if the definition of a service can be greatly broadened beyond simply a "non-storable good" to anything which provides a "service function", such as a washing machine providing the "service function" of cleaning clothes, then the "service industry" may possess a high income

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"An interesting aside is that the relative price of services may to a large extent be dependent on productivity in manufacturing, for instance, the cost of air travel will be influenced by the productivity in the aircraft construction industry. Also it was observed in Chapter 3 that over time the relative price of services rises. This caused the income elasticity for services to appear to be at a lower value on a time series study compared with a budget study examination of spending behaviour. Thus the observed effect of the substitution of a durable good providing a "service function" for a direct "service industry" is likely to be greater over time, (as the durable good becomes relatively cheaper) than at one point in time. Thus we have an example of a price movement influencing a long run income elasticity. While this phenomenon is interesting it was not investigated by this thesis due to data limitations; in particular the reliance on a cross sectional international data source, the I.C.P.. Also the observation of the substitution of a durable good "service function" for a market bought "service" is likely to vary between nations due to the fact that what is a substitute for a service in one country may not be in another."
elasticity. This is because, as we have observed, there is a tendency when incomes increase for the demand for ("service" providing) durable goods to rise quite sharply. If one were to accept the broad definition of the "service function" being the crucial dependent variable, whether provided via the use of a durable good or through the purchase of a consumer service, then one would indeed observe a post-industrial shift in consumer service demand. However Bell and other post-industrial writers are not referring to the "service function" when they describe the shift of output and employment. They are referring to industrial sectors identifiable by the nature of their product at the point of sale. Thus a washing machine is a good at its point of sale even though it may later provide a "service function", whereas a train journey is a service at its point of sale.

10.2 HOW CONSUMER SERVICE DEMAND CHANGES

Another essential element in the examination of consumer service demand for this thesis is the behaviour of the income elasticity for the individual categories at different income levels.

Earlier studies tended to make use of only one functional form to describe how the income elasticity changed at higher income levels. This was generally the double logarithmic form, which assumes a constant elasticity throughout the income range, or alternatively, the linear functional form which implies that elasticities tend to unity at high income levels.

The International Comparison Project followed in this tradition by making use of only the double logarithmic form.
Chapter seven has shown the restrictiveness of this approach for the purposes of this thesis.

While there may be some a priori grounds for accepting one functional form as theoretically superior, for example the income elasticity in the hyperbolic case is \((-b/qY)\) and this is more general than the log reciprocal case \((-b/Y)\), chapter Seven has illustrated the problems of accepting one functional form and thereby rejecting all other possibilities prior to undertaking the analysis.

Up to six other functional forms were used to examine the expenditure-development relationship. In only six categories of consumer services was it shown unambiguously that the double logarithmic form describes the data best (at the 95% confidence level - see Table 9.1). Thus for twenty services at least one other functional form gave as good a fit to the data as the double logarithmic (given the statistical error inherent in sampling). In fact, in three cases the double logarithmic gave a distinctly poor fit.

Thus consumer services exhibit a wide variety of behaviour with regard to their income elasticities. For some, elasticity does remain constant throughout the range of income levels, however for many, elasticity increases or decreases and may even be negative. One of the major advantages of undertaking a study of this kind on an individual service category basis is that the heterogeneous nature of the sector is highlighted. For instance, the category "Electricity" demonstrates a constant income
elasticity of about 1.65 for a wide range of income (95% confidence interval 1.50 - 1.80). However the category "Long distance bus transport" shows a positive elasticity when income rises from a low level, but at higher incomes the elasticity becomes negative.

The implication of this point for empirical work is that, a priori assumptions concerning the nature of the income-expenditure relationship such as constant elasticity may be too restrictive. An examination of alternatives may be required.

10.3 RANGE OF COUNTRIES

Traditionally empirical demand research tends to concentrate on a limited range of goods or services in just one or two countries. There are a number of difficulties in comparing demand across international frontiers - especially in terms of data comparability.

The release of the International Comparison Project, Phase III data enabled elasticities to be calculated for 151 relatively detailed categories of expenditure in thirty four countries for one year, 1975. Using this data this thesis has examined in detail the demand influences on twenty six categories of consumer services.

A priori it seemed possible that these thirty four nations may exhibit such diverse taste differences in their consumption habits that common determinants would be difficult to establish. For instance the consumption of fish in Japan is likely to be determined by its unique historical, geographical and cultural background.
Even though the countries used in this study varied greatly in their traditions and so on, as income levels rose from one country to another in the I.C.P. sample the expenditure in each category of service changed in a relatively consistent manner. On the whole the income and own-price elasticity estimates have high statistical significance. It would appear that the categories examined are sufficiently broadly based so as not to demonstrate large taste variations within the sample of countries.

It is important for planning purposes that both developed and developing countries be able to anticipate the patterns of expansion in final demand as income levels rise. For instance, government expenditure allocation decisions are likely to be influenced by the anticipated rise in demand for certain services. Rising affluence may lead to an expectation of rapidly improving health services for example. Also, infrastructure development needs to keep pace with the growth in particular areas of the economy - prime examples here might be the growth in air traffic or the rising demand for telecommunications. If these government budgetary pressures can be anticipated then the planning process can encourage the continued growth in the economy. Business too would benefit from being able to anticipate likely future demand. Entrepreneurs and managers are constantly searching for growth areas to expand into while being on the look out for evidence of declining demand in existing markets. Knowledge of income elasticities and other influences on demand may be a potent competitive weapon in a fast changing market place.
Also knowledge of income elasticities of the various services may have implications for trade policy. Even though the overall income elasticity shown by this thesis is relatively low many of the services are unlikely to be traded internationally on any great scale, for instance medicine, footwear repairs and rail transport. Those services which may be traded internationally such as telecommunications, electricity, hotels and restaurants do tend to possess relatively high income elasticities. Being informed of the relatively high elasticities in these sectors may cause developing country policy makers and trade negotiators to be more reluctant to remove trade barriers for fear of destroying the indigenous suppliers through the actions of western multinationals attracted by quickly growing markets.

By examining a number of countries this thesis has widened the applicability of the elasticity results. The conclusions drawn are not limited to one country or one region of the world, therefore the information provided may be of greater use to government or business planners.

*The information gleaned from this analysis may be improved if it did not rely upon a proxy for permanent income, (total consumption expenditure) which does not necessarily accurately reflect a weighted average of past, present and expected income but is merely the better of the two available proxies. It may even be commented that permanent income itself is not necessarily the appropriate scaling variable in some of the demand curves. Possibly some services respond more to short term income changes. This is an area suitable for further research.*
10.4 DISAGGREGATION

Analysing consumer service demand as one complete aggregate would fail to show some important relationships for the individual categories. This is an enormously diverse sector and some important insights have been gained from the disaggregated approach taken. The heterogeneity is evident in the great variety of income and own-price elasticity responses. A greater depth of knowledge is gained by not lumping together modern high technology services as telecommunications with ancient and labour intensive ones such as domestic services. In addition to the highly individual income and own-price effects each service has unique relationships with other variables. For instance substitutes and compliments have been identified by the analysis of the detailed data. Also factors such as density of the population, age structure, inflation, as well as income distribution have been examined for their influence on each of the twenty-six services.

Within this heterogeneous group some categories do fit the "post-industrial society" model. That is they exhibit a relatively high income elasticity, as in the case of the medical service categories. Whereas others such as footwear repairs or local transport have a tendency to account for a smaller proportion of household budgets as incomes rise. This diversity has great significance for the employment structures of economies experiencing growth. Labour is likely to be gradually shifted within the economic sub sector of consumer services. Some services will require greater levels of labour input as the
economy grows whereas others will shed workers.

These important movements in the labour markets (and output markets) would not be perceptible if the analysis were undertaken on an unified basis. An examination of this sub-sector of total final expenditure is best carried out in a relatively disaggregated manner if the subleties of the demand relationships and the diversity of behaviour is to be fully appreciated.

10.5 ADDITIONAL VARIABLES

Income and own-price are not the only influences on the demand for consumer services. Demographic variables, cross-price variables as well as income distribution and inflation were tested for each of the consumer services.

As a result of this analysis a number of significant variables, other than income and own-price, were established. For instance the demand for postal services is influenced by the price of telecommunications.

The inclusion of the additional variables not only provided further insight into the demand for the individual consumer services it also permitted improved statistical significance of the own-price and income variables.

The search for additional variables is, of course, susceptible to continual improvement. If suitable data can be found a number of other variables may be discovered to be relevant to the demand for particular services. One possible influence may be Veblen-type effects – a service may possess a high income elasticity in developing countries because of its "snob-value". This may be reflected in an altered income elasticity
profile. The problem here would be the identification of motives for purchase — is the service bought for snobbish reasons or merely the satisfaction of other needs?

The problem of the lack of comparable cross-country data for establishment of variables other than income and own-price was amply illustrated with the income distribution analysis undertaken in chapter Seven. If adequate data could be found for a suitable proportion of the sample of countries then it would seem highly likely that income distribution would be shown to be a major influence on demand.

A combination of additional variables could be a further development. For instance, inflation, a determining variable in its own right, may alter the distribution of income by favouring the rich and not the poor thus having a secondary effect.

These issues and many others could be examined to further progress the work undertaken in this thesis.

However the analysis of the additional variables studied in this work has provided information on the elements which determine the demand for consumer services. The implication derived from the work so far is that for a more complete analysis of consumer behaviour it is advisable that cross-price and other influences can be considered.
REFERENCES


The Economist, May 9th 1987.


The International Monetary Fund, International Financial Statistics.


