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Natural resource booms and Third World development: Assessing the subsectoral impacts of the Nigerian petroleum boom on agricultural export performance

Banks, Steven Matisons, Ph.D.

The Ohio State University, 1991

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NATURAL RESOURCE BOOMS AND THIRD WORLD DEVELOPMENT:
ASSESSING THE SUBSECTORAL IMPACTS OF THE
NIGERIAN PETROLEUM BOOM ON AGRICULTURAL EXPORT PERFORMANCE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Steven M. Banks, B.S. (Honors), M.S., M.A.

The Ohio State University
1991

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Approved by
Advisor
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To the memory of my grandfather.
ACKNOWLEDGEMENTS

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VITA

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
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</tr>
</tbody>
</table>

FIELDS OF STUDY

Major Field: Geography
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>VITA</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>A. The Process of Development</td>
<td></td>
</tr>
<tr>
<td>1. The Agricultural Sector as Development</td>
<td>3</td>
</tr>
<tr>
<td>Catalyst</td>
<td></td>
</tr>
<tr>
<td>2. The Booming Sector as Development</td>
<td>4</td>
</tr>
<tr>
<td>Catalyst</td>
<td></td>
</tr>
<tr>
<td>B. The Research Framework</td>
<td>9</td>
</tr>
<tr>
<td>1. The Research Questions</td>
<td>10</td>
</tr>
<tr>
<td>2. The Research Contributions</td>
<td>11</td>
</tr>
<tr>
<td>3. The Research Approach</td>
<td>14</td>
</tr>
<tr>
<td>4. The Research Setting</td>
<td>15</td>
</tr>
<tr>
<td>a. Spatial</td>
<td>16</td>
</tr>
<tr>
<td>b. Sectoral</td>
<td>17</td>
</tr>
<tr>
<td>c. Temporal</td>
<td>17</td>
</tr>
<tr>
<td>C. The Organization of the Study</td>
<td>18</td>
</tr>
<tr>
<td>1. Introductory Material</td>
<td>18</td>
</tr>
<tr>
<td>2. The Case Study</td>
<td>19</td>
</tr>
<tr>
<td>3. Methodology</td>
<td>20</td>
</tr>
<tr>
<td>4. Analysis and Conclusions</td>
<td>21</td>
</tr>
<tr>
<td>D. Summary</td>
<td>22</td>
</tr>
<tr>
<td>II. NATURAL RESOURCE BOOMS</td>
<td>23</td>
</tr>
<tr>
<td>A. Terminology</td>
<td>23</td>
</tr>
<tr>
<td>1. Booming Sectors</td>
<td>24</td>
</tr>
<tr>
<td>2. Windfall Revenues</td>
<td>27</td>
</tr>
<tr>
<td>3. The &quot;Dutch Disease&quot;</td>
<td>28</td>
</tr>
<tr>
<td>B. Emergence of Booming Sectors</td>
<td>30</td>
</tr>
<tr>
<td>1. Resource Discoveries</td>
<td>31</td>
</tr>
</tbody>
</table>
2. Commodity Price Increase
3. Shifts in Consumer Demand

C. Classification of Booming Sectors
1. Non-mineral based Booming Sectors
2. Mineral-based Booming Sectors

D. Classification of Petroleum Economies
1. Type I Petroleum Economies
2. Type II Petroleum Economies

E. Booming Sector Impacts
1. Economic
   a. Urban-Industrial Impacts
   b. Rural-Agricultural Impacts
2. Political
3. Social
4. Geographic

F. Summary

III. REVIEW OF THE LITERATURE

A. Characteristics of the Literature
1. Historical Development of the Literature
2. Scope of the Literature
3. Geography's Contribution to the Literature

B. Theoretical Approaches in the Literature
1. Neoclassical Growth Models
   a. Representative Studies
   b. General Commentary
2. Export Instability Theories
   a. Representative Studies
   b. General Commentary
3. Theory of the Dutch Disease
   a. Representative Studies
   b. General Commentary
4. Political Economy Approaches
   a. Representative Studies
   b. General Commentary

C. Critical Analysis of the Literature
1. Theoretical Limitations
2. Methodological Limitations
3. Sectoral and Spatial Limitations
4. Contextual Limitations

D. The Justification for Alternative Approaches, and the Place of the Study in the Context of the Literature
1. Accounting for intersectoral Interactions
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methodological Justifications</td>
<td>138</td>
</tr>
<tr>
<td>Model Formulation: The Linear Case</td>
<td>139</td>
</tr>
<tr>
<td>1. Model Structure</td>
<td>139</td>
</tr>
<tr>
<td>a. Initial Model</td>
<td>140</td>
</tr>
<tr>
<td>b. Expansion Equations</td>
<td>141</td>
</tr>
<tr>
<td>c. Terminal Model</td>
<td>141</td>
</tr>
<tr>
<td>2. Model Analysis</td>
<td>142</td>
</tr>
<tr>
<td>3. Model Interpretation</td>
<td>143</td>
</tr>
<tr>
<td>a. Volume Effects</td>
<td>143</td>
</tr>
<tr>
<td>b. Growth Rate Effects</td>
<td>144</td>
</tr>
<tr>
<td>Model Formulation: The Quadratic Case</td>
<td>145</td>
</tr>
<tr>
<td>1. Model Structure</td>
<td>145</td>
</tr>
<tr>
<td>a. Initial Model</td>
<td>145</td>
</tr>
<tr>
<td>b. Expansion Equations</td>
<td>146</td>
</tr>
<tr>
<td>c. Terminal Model</td>
<td>147</td>
</tr>
<tr>
<td>2. Model Analysis</td>
<td>148</td>
</tr>
<tr>
<td>3. Model Interpretation</td>
<td>149</td>
</tr>
<tr>
<td>a. Volume Effects</td>
<td>149</td>
</tr>
<tr>
<td>b. Growth Rate Effects</td>
<td>150</td>
</tr>
<tr>
<td>Statistical Procedures</td>
<td>150</td>
</tr>
<tr>
<td>Data Sets</td>
<td>151</td>
</tr>
<tr>
<td>1. Types and Units</td>
<td>152</td>
</tr>
<tr>
<td>2. Sources</td>
<td>152</td>
</tr>
<tr>
<td>3. Categorization</td>
<td>153</td>
</tr>
<tr>
<td>4. Problems</td>
<td>154</td>
</tr>
<tr>
<td>Summary</td>
<td>155</td>
</tr>
<tr>
<td>RESULTS AND ANALYSIS</td>
<td>158</td>
</tr>
<tr>
<td>Summary of the Results</td>
<td>159</td>
</tr>
<tr>
<td>The Linear Model</td>
<td>160</td>
</tr>
<tr>
<td>1. Capital Intensive Exports</td>
<td>161</td>
</tr>
<tr>
<td>a. Model Results</td>
<td>162</td>
</tr>
<tr>
<td>b. Model Analysis</td>
<td>163</td>
</tr>
<tr>
<td>i. Growth Rate Effects</td>
<td>164</td>
</tr>
<tr>
<td>ii. Volume Effects</td>
<td>166</td>
</tr>
<tr>
<td>2. Labor Intensive Exports: Subsidized</td>
<td>167</td>
</tr>
<tr>
<td>a. Model Results</td>
<td>167</td>
</tr>
<tr>
<td>b. Model Analysis</td>
<td>168</td>
</tr>
<tr>
<td>i. Growth Rate Effects</td>
<td>169</td>
</tr>
<tr>
<td>ii. Volume Effects</td>
<td>170</td>
</tr>
<tr>
<td>3. Labor Intensive Exports: Non-subsidized</td>
<td>171</td>
</tr>
<tr>
<td>4. Non-cultivated Exports</td>
<td>172</td>
</tr>
<tr>
<td>The Quadratic Model</td>
<td>173</td>
</tr>
<tr>
<td>1. Capital Intensive Exports</td>
<td>174</td>
</tr>
<tr>
<td>a. Model Results</td>
<td>175</td>
</tr>
</tbody>
</table>
VII. CONCLUSIONS AND RESEARCH IMPLICATIONS

A. Review of the Study
   1. Purpose
   2. Methodology
   3. Analysis
   4. Results

B. Research Conclusions
   1. On Model Structure and the Expansion Method
      a. The Linear Expansion Model
      b. The Quadratic Expansion Model
   2. On Contextual Variation in the Models
      a. Growth Rate Effects and Volume Effects, and Agricultural Export Performance
      b. The Effects of Oil Sector Dynamics on Agricultural Export Performance
      c. The Effects of Time on Agricultural Export Performance
   3. On the Agricultural Export Sector under Booming Sector Conditions
      a. Disaggregation of the Agricultural Export Sector
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>b.</td>
<td>Mode of Production and Capital Dependency</td>
<td>237</td>
</tr>
<tr>
<td>c.</td>
<td>Agricultural Export Contributions to Foreign Exchange</td>
<td>238</td>
</tr>
<tr>
<td>4.</td>
<td>Incorporation of Nigerian Historical Realities</td>
<td>238</td>
</tr>
<tr>
<td>a.</td>
<td>Internal Consumption: The Domestic Market</td>
<td>239</td>
</tr>
<tr>
<td>b.</td>
<td>Environmental Influences: The Impacts of Drought</td>
<td>240</td>
</tr>
<tr>
<td>c.</td>
<td>Tree Crop Production and Time Lags</td>
<td>241</td>
</tr>
<tr>
<td>C.</td>
<td>Implications for Nigerian Agricultural Development</td>
<td>243</td>
</tr>
<tr>
<td>1.</td>
<td>Domestic Agriculture</td>
<td>244</td>
</tr>
<tr>
<td>2.</td>
<td>Export Agriculture</td>
<td>245</td>
</tr>
<tr>
<td>D.</td>
<td>Implications for Further Research</td>
<td>246</td>
</tr>
<tr>
<td>1.</td>
<td>Demand Side Analysis</td>
<td>247</td>
</tr>
<tr>
<td>2.</td>
<td>Issues of Scale and Spatial Resolution</td>
<td>248</td>
</tr>
<tr>
<td>a.</td>
<td>Intranational Scale</td>
<td>249</td>
</tr>
<tr>
<td>b.</td>
<td>International Scale</td>
<td>249</td>
</tr>
<tr>
<td>3.</td>
<td>Non-petroleum Commodity Booms</td>
<td>250</td>
</tr>
<tr>
<td>4.</td>
<td>Incorporating Temporal Parameters and Time Lags</td>
<td>250</td>
</tr>
<tr>
<td>5.</td>
<td>Membership in Producer Associations</td>
<td>251</td>
</tr>
<tr>
<td>E.</td>
<td>Contributions of the Study</td>
<td>251</td>
</tr>
<tr>
<td>1.</td>
<td>Implications for Relevant Literatures</td>
<td>252</td>
</tr>
<tr>
<td>2.</td>
<td>The Expansion Method and Booming Sector Research</td>
<td>253</td>
</tr>
<tr>
<td>3.</td>
<td>Geography and Booming Sector Research</td>
<td>254</td>
</tr>
<tr>
<td>F.</td>
<td>Summary</td>
<td>255</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
<td>257</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td></td>
<td>258</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Summary of Statistical Significances in the Linear Expansion Terminal Model</td>
<td>161</td>
</tr>
<tr>
<td>2. Linear Expansion Model Parameter Estimates: Capital Intensive Agricultural Exports</td>
<td>192</td>
</tr>
<tr>
<td>3. Linear Expansion Model Parameter Estimates: Subsidized Labor Intensive Agricultural Exports</td>
<td>192</td>
</tr>
<tr>
<td>4. Linear Expansion Model Parameter Estimates: Non-subsidized Labor Intensive Agricultural Exports</td>
<td>193</td>
</tr>
<tr>
<td>5. Linear Expansion Model Parameter Estimates: Non-cultivated Agricultural Exports</td>
<td>193</td>
</tr>
<tr>
<td>6. Linear Expansion Model: Growth Rates of Groundnut Oil Exports</td>
<td>194</td>
</tr>
<tr>
<td>7. Linear Expansion Model: Growth Rates of Oilseed Cake Exports</td>
<td>197</td>
</tr>
<tr>
<td>8. Linear Expansion Model: Growth Rates of Sawn Wood Exports</td>
<td>200</td>
</tr>
<tr>
<td>9. Linear Expansion Model: Growth Rates of Cocoa Exports</td>
<td>203</td>
</tr>
<tr>
<td>10. Linear Expansion Model: Growth Rates of Groundnut Exports</td>
<td>206</td>
</tr>
<tr>
<td>11. Summary of Statistical Significances in the Quadratic Expansion Terminal Model</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>Quadratic Expansion Model Parameter Estimates: Non-subsidized Labor Intensive Agricultural Exports</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>15.</td>
<td>Quadratic Expansion Model Parameter Estimates: Non-cultivated Agricultural Exports</td>
</tr>
<tr>
<td>16.</td>
<td>Quadratic Expansion Model: Growth Rates of Oilseed Cake Exports</td>
</tr>
<tr>
<td>17.</td>
<td>Quadratic Expansion Model: Growth Rates of Sawn Wood Exports</td>
</tr>
<tr>
<td>18.</td>
<td>Quadratic Expansion Model: Growth Rates of Cocoa Exports</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The Agricultural Sector in the Development Process</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>The Booming Sector in the Development Process</td>
<td>7</td>
</tr>
<tr>
<td>3.</td>
<td>Diagrammatic Representation of the Research Questions Addressed</td>
<td>12</td>
</tr>
<tr>
<td>4.</td>
<td>The Emergence of Booming Sectors: Case Studies from the Literature</td>
<td>32</td>
</tr>
<tr>
<td>5.</td>
<td>The Impacts of Booming Sectors on Developing Economies</td>
<td>42</td>
</tr>
<tr>
<td>6.</td>
<td>Disciplinary Origins and Major Theoretical Approaches in the Literature to the Study of Booming Sectors</td>
<td>66</td>
</tr>
<tr>
<td>7.</td>
<td>Booming Sector Theory: An Overview of Theoretical Approaches in the Literature</td>
<td>99</td>
</tr>
<tr>
<td>8.</td>
<td>The Political Map of Africa</td>
<td>101</td>
</tr>
<tr>
<td>9.</td>
<td>The Agricultural Production Zones of Nigeria</td>
<td>107</td>
</tr>
<tr>
<td>10.</td>
<td>Production Characteristics of Nigerian Export Agriculture</td>
<td>113</td>
</tr>
<tr>
<td>11.</td>
<td>The Life Cycle of the Nigerian Petroleum Industry</td>
<td>116</td>
</tr>
</tbody>
</table>
17. Groundnut Oil Exports: Volume Effects in the Linear Model 195
18. Groundnut Oil Exports: Growth Rate Effects in the Linear Model 196
19. Oilseed Cake Exports: Volume Effects in the Linear Model 198
20. Oilseed Cake Exports: Growth Rate Effects in the Linear Model 199
21. Sawn Wood Exports: Volume Effects in the Linear Model 201
22. Sawn Wood Exports: Growth Rate Effects in the Linear Model 202
23. Cocoa Exports: Volume Effects in the Linear Model 204
24. Cocoa Oil Exports: Growth Rate Effects in the Linear Model 205
25. Groundnut Exports: Volume Effects in the Linear Model 207
26. Groundnut Exports: Growth Rate Effects in the Linear Model 208
27. Oilseed Cake Exports: Volume Effects in the Quadratic Model 212
28. Oilseed Cake Exports: Growth Rate Effects in the Quadratic Model 213
29. Sawn Wood Exports: Volume Effects in the Quadratic Model 215
30. Sawn Wood Exports: Growth Rate Effects in the Quadratic Model 216
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Cocoa Exports: Volume Effects in the Quadratic Model</td>
<td>218</td>
</tr>
<tr>
<td>32</td>
<td>Cocoa Exports: Growth Rate Effects in the Quadratic Model</td>
<td>219</td>
</tr>
<tr>
<td>33</td>
<td>Summary of Contextual Variations for the Linear Model</td>
<td>220</td>
</tr>
<tr>
<td>34</td>
<td>Summary of Contextual Variations for the Quadratic Model</td>
<td>221</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

I. Introduction.

This study provides an analysis of the manner in which various subsectors of an economy interact during the process of economic development, and the implications that such interactions have for the international trade sector. More specifically, the study seeks to empirically assess the extent to which a natural resource "boom" affects the performance of the agricultural trade sector, the traditional source of foreign exchange revenues for most less developed countries (LDCs). To this extent, the Nigerian oil boom experience is used as a test case.

While developed more fully in the following chapter, booming sectors can be loosely defined here as initially latent or dormant subsectors of an economy which, due to an endogenous or exogenous stimulation, some time later emerge to dominate the economy, particularly as a source of foreign exchange revenues. Typically, booming sectors come into existence over a relatively short period of time, sometimes in less than a year and usually in no more than five, and are induced by either: a) the discovery and exploitation of a previously unknown natural resource; b) a rapid increase in the price of the commodity on global markets; or c) a dramatic shift in consumer demand towards the product supplied by the booming sector.
As these booming sectors reach maturity and the massive foreign exchange revenues or "windfalls" accrue, these sectors begin to impact the broader macroeconomy by dwarfing the contributions made by traditional sectors, particularly agriculture; ultimately, the economic contributions of these traditional agricultural "engines of growth" to such things as tax revenues, foreign exchange earnings, and employment, may be rendered insignificant vis-a-vis those of the booming sector.

Among the many examples of booming sectors which have received attention in the literature are: coffee booms in Central America (Struckmeyer 1977) and the Ivory Coast (Priovolos 1981); tea and cocoa in selected Asian and African economies (Davis 1983); natural gas in the Netherlands (Corden and Neary 1982); gold in Australia (Bordo 1975; Gregory 1976); bauxite in the Caribbean (Thomas 1982); tin in Malaysia (Thornburn 1981); copper in Chile (Lasaga 1981; and more recently, cocaine in Colombia (Kamas 1986).

Obviously, the booming sector which has had the most profound and lasting impact on many LDC economies is petroleum. Indeed, interest in petroleum as a booming sector not only spawned an entire research literature on its own, but created a new vocabulary in its wake by infusing such terms as the "Dutch Disease", petrodollars, petronaira, the "petrolization" of an economy, deagriculturalization, and "black gold" into the literature. The terms are defined terms in the following chapter.

Excluding the Middle Eastern petroleum producers, which alone have received the bulk of the research attention, other important oil-boom case studies among Third World countries have been those of: Algeria (Conway 1988; Conway and Gelb 1988); Ecuador (Commander and Peek 1986; Marshall-Silva 1988); Egypt (Martin and Van Wijnbergen 1986); Indonesia (Warr 1986, 1989; Glassburner 1988); Libya (Allan and McLachlan 1976); Mexico (Carrada-Bravo 1982); Nigeria (Taylor, et. al., 1986; Richards
1987; Watts 1987; Aluko and Ijere 1965; Angaye 1985; Bienen 1988); Trinidad and Tobago (Auty and Gelb 1986); and Venezuela (Bourguignon 1988). This list of studies is, however, by no means exhaustive.

As suggested, in the context of economic booms, this study addresses the case of the Nigerian petroleum boom of the 1960s, and the impacts that petroleum exports have had upon the performance of Nigeria's traditional source of foreign exchange revenue, agricultural commodity exports, between 1960 and 1980.

A. The Process of Development.

Economies are dynamic entities which change through time and space, and whose rate and direction of growth are influenced by a myriad of endogenous and exogenous social, political, economic, cultural, historical, and other factors. Since the "creation" of the Third World in the 1960s, one of the fundamental concerns has been on the identification of the critical variables necessary to induce the process of "development." Although no consensus exists as to what development actually is, or what the goals of development should be, it is generally taken that development, in its broadest sense and however defined, is a "good" thing. Often used in conjunction with terms such as modernization, progress, advancement and growth, the implicit assumption is that "more" development is to be preferred to "less" of it.

Just as the definition and goals of development are elusive, so too is its measurement, and as a result we often resort to identifying the occurrence of development on the basis of a set of common patterns or trends which appear time after time as countries move from the state of being relatively "underdeveloped" to the state of being relatively "developed". Among the most important indicators that the process of development is actually occurring, is a fundamental change in the relative importance of various
subsectors of the economy, i.e., the process of structural economic transformation. What this transformation entails is the reallocation of, among other things, the country's income generating capacity, labor force, and international trade orientation from one economic subsector to another; in the context of the LDCs, this usually implies a shift from the primary to the secondary sector. Assuming that it is indeed one of the goals of development to replace the "backward" agrarian-based society with the "modern" urban-industrial-based economy, the concern becomes how to achieve such a structural transformation as quickly and efficiently as possible.

1. The Agricultural Sector as Development Catalyst

For the bulk of the world less developed countries (LDCs), the catalyst for structural economic transformation from an agricultural to an industrial base, as well as for sustained economic development over the long run, lies, somewhat paradoxically, in the agricultural sector itself. Indeed, the critical role of agriculture in transforming LDCs into Newly Industrializing countries (NICs) and ultimately, more developed countries (MDCs) has been the focus of a great deal of research. The success of many of today's rapidly industrializing LDCs and NICs can be traced to agriculture as noted in the cases of Argentina, Brazil, India, Indonesia, Mexico, Malaysia, Thailand, and Venezuela. A diagrammatic representation of the agricultural sector's role in the development process is given in Figure 1 on the following page.

The contributions of agriculture to the development process are many, and have been studied exhaustively. See, for example, Schultz (1964), Mellor (1966), Hayami and Ruttan (1971), Todaro (1981), Eicher and Staatz (1984), Ghatak and Ingersent (1984), and Stevens and Jabara (1988). Among the most important contributions of the agricultural sector are direct and indirect employment, providing surplus labor for industrialization, a
source of food and raw materials, a source of investment and savings, a tax base for revenue generation, and providing foreign exchange revenues via the exports of agricultural commodities.

The exact role that the agricultural sector plays as the catalyst for industrialization will depend in part on the economic policies an LDC government puts into place, ranging from autarky at one extreme to free trade on the other, and with a gambit of options such as import substitution industrialization (ISI) in between. Yet regardless of the policy choices that are ultimately made, the agricultural sector in general, and the agricultural export sector in particular should provide a stable source of foreign exchange revenue over an extended period of time, which can gradually be diverted away from the primary sector and towards investment in industrial activity. However, the process by which industrialization is induced using agricultural trade as a catalyst is a time consuming one, and as such we can expect that for the majority of LDCs the process of development characterized
by structural economic transformation and membership in the "elite" club of NICs, can only occur over the medium and long runs. Industrial evolution through agricultural commodity exports, not industrial revolution is the appropriate rite of passage.

2. The Booming Sector as Development Catalyst.

The process of gradual structural economic transformation induced by catalyst of agriculture was thought to apply to all LDCs except those whose agricultural resources were so poor in quantity or quality that development itself would be an impossible goal to achieve. At the same time it became clear that for a very small subset of "lucky" or more "fortunate" LDCs, the path to sustained development and structural economic transformation would lie not in the agricultural sector, but in other more lucrative but currently latent or dormant sectors of the economy. A natural resource commodity boom, not agriculture, would provide the catalyst for development. The role of booming sectors in the LDC development process is given in Figure 2 on the following page.

Although any mineral was coveted, the most envied of these resources sectors was crude petroleum, and for those LDCs with vast, unexploited reserves of oil, it appeared that the path to urban-industrial transformation would be both inexpensive and swift. In

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* A dormant or latent sector of an economy can be thought of in either physical or economic terms. In the case of the former it refers to any subsector in which a given commodity is thought to exist, but has not, as of yet, been discovered. In the sense of the latter it refers to any subsector in which a given commodity is known to exist, but has not, due to low global prices for the commodity, been economically exploited so as to garner windfall revenues.

** It should be noted that resource booms are not limited to the natural resource sector in general, and the mineral subsector in particular. Although they occur less frequently, it is entirely possible that an agricultural commodity can undergo a boom. Such has been the case, for example, with coffee, cocoa, tea, and bananas at various periods. Thus natural resources and agricultural exports are not mutually
reference to this, Amuzegar (1982, p. 814) states that the capital-short and aspiring Third World planners have kept telling themselves (and each other) that if they only had this black gold, the magical *elan vital* for their economic takeoff would be close at hand.

This prospect of breaking the economic shackles and stigma associated with being a primary commodity exporter by becoming an industrial powerhouse virtually overnight, led to a massive reallocation of investment resources in many LDCs away from agriculture and a reliance upon agricultural exports to investment in the capital equip-
ment and technology necessary to discover, extract, refine, and export vast untapped off-
shore and on-shore oil reserves.

Petroleum, then, was the new catalyst for industrial development, and within a
very short period of time most LDCs with petroleum-boom potential had neglected their
agricultural sectors to concentrate all efforts on petroleum-induced development. Among
the countries in which strong pre-oil boom agricultural bases were quickly eroded as
petroleum discoveries were made were Ecuador, Gabon, Indonesia, Mexico, Nigeria,
Trinidad and Tobago, and Venezuela.

Yet many of the "lucky" oil-rich LDCs of the 1950s and 1960s are now the
relatively "unlucky" oil-rich LDCs of 1990s. Vast petroleum reserves are no longer seen as
the catalyst for development, nor the panacea for development constraints. As Gelb (1981,
p. 27) states somewhat cynically that "oil exporters are nations which have oil sufficient
to create problems, but not enough to solve them." Indeed Van Wijnbergen (1984), Katapu
(1985), and others have suggested that after all of the costs and benefits of booming sectors
are accounted for, the oil-boom based LDCs have done no better in terms of achieving
development, than have their non-oil dependent LDC counterparts.

In reference to the Venezuelan case, which could easily be generalized to other
LDC oil exporters, Rovard (1984, p. 123) notes that

although Venezuela's situation may be regarded as very
special owing to the presence of oil, it must be understood
that natural resources by themselves do not constitute a
guarantee of development.

With soft oil markets and low oil prices of the middle and late 1980s, the ne-
glected agricultural sectors have, by and large, stagnated, and in many cases are no longer
capable of providing food for domestic markets or foreign exchange earnings from their
sale in export markets. In the most critical cases of over-petrolization of an economy, those
of Indonesia and Nigeria, food security statuses have changed from being net food exporters prior to the oil boom, to net food importers after the oil boom. While the effects of the oil boom will be discussed in greater detail in the following chapters, Amuzegar (1982, p. 815) captures much of the sentiment concerning the condition of oil-exporting LDCs by stating that

many oil exporters now seem to think, and some even publicly admit, that the "oil bonanza" has not been a clear or unmitigated blessing for them. A disenchanted statesman among OPEC insiders goes as far as to say that history may show that the oil-exporting countries "have gained the least, or lost the most, from the discovery and development of their (petroleum) resources."

In similar fashion, Roemer (1983, p. 235-36) adds that

it has become clear that a relatively long period of buoyant (petroleum) export revenues (are) not enough to stimulate the kinds of structural change in the rest of the economy that might sustain growth after the export boom.

It is to the Nigerian development experience, and the impact of its own petroleum boom upon the agricultural export sector that we now turn our attention.

B. The Research Framework.

This section provides an outline of the general research framework of the study. A series of specific research questions are proposed, and the goals of the study in relation to expected contributions to relevant literatures in geography and allied disciplines are outlined. The conceptual and methodological approach of the study is given, including a justification for the use of the expansion methodology as the primary tool for investigation. Finally, the spatial, sectoral, and temporal boundaries of the study are outlined.
1. The Research Questions.

Research into the effects of resource booms on other subsectors of an economy is of relatively recent nature, extending back no more than twenty years. While significant accomplishments have been made in this time, there is remains a great deal about booming sectors which we do not yet know. However, in that twenty year period, there already appears to be an overabundance of macroeconomic, historical studies on the emergence and development of booming resource sectors and their socio-economic impacts. Among the LDC petroleum-boom case studies are: Mexico (Falk 1987, Millor 1982, Carrada-Bravo 1982); Nigeria (Onoh 1983, Pearson 1970, Schatz 1969); and Venezuela (Salazar-Castiillo 1976, Randall 1987).

While the framework of this study remains macroeconomic in nature, it seeks to make contributions at the level of inter-sectoral interactions in the Nigerian foreign trade sector. Specifically, the study seeks to answer the following six related research questions:

a) assuming that a fundamental relationship between the booming petroleum sector and the agricultural sector can be established, in what way can the expansion method provide an appropriate conceptual and methodological framework for the analysis of these interactions?

b) assuming that a useful set of equations to model the petroleum-agricultural interactions in the context of the expansion method can be proposed, what is the empirical nature of the effect of the exports of petroleum on the exports of agricultural commodities?

c) assuming that statistically significant interactions between oil and agricultural exports can be identified, can the impacts of petroleum exports be disaggregated? Specifically, can we isolate the differential impacts of: a) the
volume of petroleum exports, and b) the growth rate of petroleum exports, on the growth rate of agricultural commodity exports, over time?

d) assuming that statistically significant interactions can be identified, can the impacts of petroleum exports on the growth rate of agricultural exports be sectorally disaggregated by each agricultural commodity's mode of production? That is, does petroleum have different effects upon capital intensive, labor intensive, and non-cultivated agricultural commodity exports?

e) assuming that statistically significant interactions between the petroleum and agricultural export sectors exist, what happens to the parameters in the model as contextual variations are introduced? Specifically, how do the growth rates of agricultural exports change as the temporal context is allowed to vary?

f) In addition to these specific research questions, the study has sought at the more general level, to: a) contribute to the rapidly expanding literature on booming sectors; b) to introduce the expansion method into the literatures related to booming sectors, as it appears the methodology has application for a wide range of booming sector related research issues; and c) to highlight the contribution that the discipline of geography can make to the study of booming sectors.

These justification of these research questions, and more specific proposals of the questions are given in the chapters which follow. A diagrammatic representation of the research questions in given in Figure 3 on the following page.

2. The Research Contributions.

The motivation for undertaking this research results from what appear to be three major deficiencies in the current research agenda in the field of booming sectors: first, the bulk of the research on the subject has been limited to the field of economics; geographers,
Windfall foreign exchange revenue

Natural Resource Sector

Resource boom → Increase in oil exports

Domestic Subsector

Analyze the effects of changes in the volume and the growth rate of Nigerian oil exports on:

Agricultural Sector

Subsidized

Non-subsidized

Capital Intensive

Labor Intensive

Export Subsector

Non-cultivated

the growth rates of sectorally disaggregated agricultural exports, over time.

Arrows trace the interactions between booming and non-booming sectors.

Shadowed boxes outline the research concerns addressed in the study.

Figure 3

Diagrammatic Representation of the Research Questions Addressed
with rare exceptions (e.g., Watts 1987, 1988; Auty 1980, 1986a, 1986b) have made few direct contributions to this extremely important area of study.

Second, the literature on booming sectors is characterized by conceptual and ideological extremes, such as the highly theoretical normative studies such as those by Auty and Gelb (1986), and Van Wijnbergen (1982) on the one hand, and the highly descriptive positivistic studies characteristic of Watts (1987, 1988), Onimode (1982), and Andrae and Beckman (1985). Further, except for a small number of input-output studies (Kuyvenhoven 1978, Priovolos 1981, Schreiner and Skoglund 1985) and various econometric models (Lasaga 1981, Priovolos 1981, Carrada-Bravo 1982) there have been few "real world" empirical analyses of the intersectoral effects of booming sectors using specific case studies.

And finally, although there have been a number of studies which have attempted to assess the effects of booming sectors under alternative economic scenarios, these studies have concerned themselves solely with the effects of booming sector price variations on a small set of macroeconomic variables such as inflation, absorptive capacity, investment etc. (e.g., Bruce 1972, El Serafi 1981, Van Long 1983, Bulter and Purvis 1983). None have attempted to investigate the parametric drift of the models as other, non-price contextual variations are introduced.

As a result of these important deficiencies in the current approaches in the literature on booming sectors, the contributions that this study expects to make are as follows:

a) through the use of the expansion method, to establish an alternative conceptual framework in which natural resource booms and booming sectors can be hypothesized and investigated.

b) to add to the literature on booming sectors by just by offering an alternative conceptual and methodological approach to the concept, but by attempting to
integrate some of the diverse approaches in the literature on booming sectors under a single "umbrella".

to broaden the contributions to the study of booming sectors by the discipline of geography, which to the present time have not only been limited and in quantity, but also dominated by certain narrowly defined methodological approaches and ideological biases.

3. The Research Approach.

The research approach adopted in the study is a statistical analysis of Nigerian international trade data. An empirical portrait of the effects of Nigeria's petroleum exports on the exports of its more traditional agricultural commodity exports is sought. A time series from the beginning of the Nigerian petroleum boom in 1960 until the 1980, for when the most recent international trade data are available, is used.

The analysis is conducted in the framework outlined by the expansion method (Casetti 1972), which provides an empirical means for assessing the manner in which the parameters of a model "drift", or change, as the contexts in which the model is applied changes. Specifics on the conceptual and methodological formulation of the expansion method, and the appropriateness of the expansion method for studying booming sectors is given in Chapter V.

Of particular concern in this study is the manner in which Nigeria's exports of agricultural commodities are stimulated and/or stagnated by the petroleum sector. The expansion model which is developed will allow for the simultaneous isolation of the individual effects of the volume of oil exports on the one hand, and the growth rate in oil exports, on the other, upon the growth rate of agricultural exports. Then, we introduce the notion of contextual variations into the model by varying the values associated with the
volume and growth rates of petroleum exports, and analyzing their impacts upon the agri-cultural trade sector.

4. The Research Setting.

Nigeria was chosen as a case study primarily on account of the author's personal interests in African economic development in general, and West African development in particular. Within the African context, Nigeria provides perhaps the best opportunity for the "testing" of various theories and hypotheses related to development. This results primarily for Nigeria's anomalous status in Sub-Saharan Africa. With the arguable exception of South Africa, Nigeria is Africa's economic and military powerhouse. The country's population of over 100 million makes it the most populous nation among those south of the Sahara; it has an exceptionally well developed urban system; it is highly industrialized by African standards; it has a large and productive labor force; and its varied agricultural resources are among the best on the continent; and finally, Nigeria has vast reserves of crude petroleum.

Yet despite all of its potential wealth and power Nigeria remains very much a "typical" less developed country: per capita income levels remain low, and have actually declined in real terms since the oil boom of the 1960s; the standard of living, as measured by the Physical Quality of Life Index (PQLI) has not increased perceptibly since independence; there is significant unemployment and underemployment in the economy; agricultural and industrial productivity levels remain low; the country has accumulated the largest external debt in Sub-Saharan Africa.

Not surprisingly, scapegoats for Nigeria's lack of economic development are not difficult to find: a devastating civil war following independence from Britain; continued political instability and repeated returns to military rule; rapid rural to urban migration;
governmental policy bias against agriculture and the rural sector; declining world market prices for agricultural commodities; and perhaps most calamitous, an extremely soft world market at the present time for Nigeria's primary export, petroleum.

In summary, the extent to which such potential for development and yet such persistent lack of development can be reconciled, makes Nigeria an exceptionally interesting case. This is particularly true as it relates to the allocation of resources between a stable, long-run contributor to development, the agricultural sector, and the unstable, short-term contributor, the petroleum sector.

a. Spatial.

The level of spatial resolution at which the study is conducted is the national scale. Specifically, the study concentrates on an analysis of the Nigerian macroeconomic experience. This is not to imply that the effects of booming sectors are not felt as strongly at other levels of spatial resolution, e.g., international, and particularly the regional and local levels. For example, at the regional scale, the effects of Nigeria's petroleum boom on stimulating migration from rural to urban regions, and from agricultural areas to petroleum producing areas have yet to be investigated in any great detail.

The motivation for choosing the national level of spatial resolution was essentially twofold: a) first, it is important to establish how booming sectors and agricultural sectors interact at the national level before analyses at the broader or finer levels can be conducted. The national level is, if you will, the benchmark from which studies at various other levels must necessarily emerge. And, b) the national scale is the only level from which accurate data for secondary level investigation emerge.
b. Sectoral.

The economic sectors of the Nigerian economy which are concern is this study are the petroleum sector, which will be also be referred to as the booming sector, and the agricultural sector. Although there are various ways in which the petroleum sector can be subdivided, we will take this sector to include only those activities which are responsible for the extraction and export of crude petroleum. As such, refined petroleum and petrochemicals are not considered. Thus, the booming petroleum sector is captured by the Standard International Classification (SIC) code of 331.

The agricultural sector can be subdivided into two general categories: export agriculture, and domestic agriculture. The former provides agricultural commodities for sale on global markets, while the latter provides agricultural commodities for sale on domestic, i.e., Nigerian markets. As the study is strictly a supply-side, i.e., export study, we will concern ourselves only with the export agriculture subsector.

We can take the export subsector and subdivide it further, on the basis of the mode of production. If we do so, we can classify all Nigerian agricultural export commodities on the basis of four modes of production: a) capital intensive production; b) government subsidized labor intensive production; c) non-subsidized labor intensive production; and d) non-cultivated or tree crop agricultural export commodities which are require very few capital and labor inputs except during harvesting.

c. Temporal.

The time period chosen for the analysis was a function of both the availability and reliability of the agricultural and petroleum export statistics. In addition, it was also a function of the period in which the petroleum sector in the Nigerian economy began to boom. As a consequence of these considerations, the year 1960 was taken as the initial
time period, and the year 1980 was chosen as the terminal period. The initial time period corresponds with the first year in which Nigerian petroleum exports were of consequence to the Nigerian economy in terms of foreign exchange earnings; for practical purposes, the year 1960 marks the turning point in the fundamental base of the Nigerian economy away from an agricultural base and towards increased reliance upon the petroleum sector. The year 1980 was chosen as the terminal year since this is the latest year for which reputable agricultural and petroleum international trade data are available.

C. The Organization of the Study.

The study is organized into seven chapters and various appendices. Each chapter begins with a general introduction of the role and scope of the chapter, and concludes with a summary of the analysis of the subject matter covered in the chapter.

1. Introductory Material.

Chapter I provides a general introduction to the development process, including what the characteristics and catalysts for development. The research context, research questions, and expected contributions of the research to geography and allied disciplines is given. The motivation for choosing Nigeria as the case study in which to investigate booming-sector and agricultural-sector interactions in the framework of international trade is given, and the choice of time period, methodological approach, and level of spatial resolution of the analysis is justified.

Chapter II concerns itself with an overview and analysis of the impacts of booming sectors on the economic, social, and political fabric of the countries in which they occur. Emphasis is placed on the economic effects, which are further subdivided into urban economic impacts and rural economic impacts. Examples of a variety of economic booms
and a range of country studies are drawn upon. A review of the terminology associated with the literature on booming sectors is also given.

Chapter III reviews the literature on booming sectors, and the various paradigmatic constructs which have developed since the 1960s to assess the impacts of such sectors. The disciplinary contributions of economics, geography, and political science to the development of the four major approaches to the literature are identified and discussed. These are the: a) neoclassical growth models; b) trade instability theories; c) linkage analysis; and d) political economy approaches. Both theoretical and applied aspects of the literature are reviewed. This chapter ends with a summary of the major directions in booming sector literature, the role of geographical analysis in contributing to the literature, and the inherent weaknesses in the current literature which calls for a new approach to the investigation and analysis of the impacts of booming sectors on various inter- and intra-sectoral economic interactions.

2. The Case Study.

Chapter IV provides a brief overview of the Nigerian setting. Basic data on the economic and demographic structure of the Nigerian state are given. Data are also introduced from the pre- and post-petroleum boom eras to illustrate the impacts of oil on the Nigerian macroeconomy, and the decline of Nigerian agriculture. An outline of the Nigerian agricultural sector and the role of agriculture in the Nigerian economy is then given, including the major ecological zones, agricultural regions, and crops grown. The agricultural sector is then subdivided into capital intensive, labor intensive, and non-cultivated subsectors, and the crops and cropping characteristics associated with each mode of production are reviewed.
3. The Methodology.

Chapter V introduces the expansion method as an alternative means of conceptualizing the notion of, and empirically investigating the impacts of booming sectors. This is discussed in light of the inherent weakness highlighted in Chapter III. The expansion method is discussed at both paradigmatic and methodological levels, with particular emphasis given to the usefulness of the expansion method in introducing contextual variation into models, and the investigating the extent to which the parameters of models "drift" as the contexts in which they are applied changes. The notions of initial model, expansion equations, and terminal models are given, and the methodology is operationalized through the use of a hypothetical n-variable model.

The expansion method is then used to model the Nigerian booming sector experience, and two possible models are proposed. The first model, representing the linear case, is used as a way of establishing any fundamental relationship that might exist between the volume of agricultural commodity exports and the volume of petroleum exports, over time. If any trends are found to exist, the quadratic model is then used to investigate the dynamics of these interrelationships between the agricultural and petroleum sectors in more detail.

In both the linear and quadratic cases, the terminal models are differentiated with respect to time, and the terms are rearranged in order to isolate the two important but distinct impacts: a) the effect of the volume of total petroleum exports on the growth rate of agricultural exports; and b) the growth rate of petroleum exports on the growth rate of agricultural exports. Then, contextual variations in the volume and growth rate of oil exports are introduced, and their impacts on the various modes of agricultural export production are investigated. The results of the various runs are given in tabular and graphical form.
4. **Analysis and Conclusions.**

Chapter VI provides an analysis of the results of Chapter V. Specifically, this chapter discusses the effects on petroleum on the agricultural trade sector, and the growth rate responses of individual agricultural commodities as various hypothetical scenarios related to oil exports are introduced. Export crops whose growth is stagnated by oil are separated from those crops whose exports are stimulated by oil. The results of the linear and quadratic models are compared, in terms of their respective results and their implications for Nigerian agricultural development.

Chapter VII provides a review of the goals of the study presented in Chapter I, and discusses the general conclusions of the study in light of the results and analysis conducted in Chapters V and VI. Two general themes are emphasized: first, the usefulness of the expansion method as a paradigm in which to better understand, indeed integrate, the diverse various literatures on booming sectors under single conceptual "umbrella" is discussed. That is, how can the expansion method help in drawing together the distinct theoretical approaches which characterize the booming sector literature? And second, the usefulness of the expansion method as a methodology which allows for the empirical estimation of how the parameters of models of natural resource exploitation change as variations in which the contexts of these models are applied, change.

Next, the results of the Nigerian study are discussed in the context of any broad agricultural and petroleum policy implications. Given the Nigerian experience, which agricultural subsectors respond "best" and "worst" to variations in the volume and growth rate of petroleum exports? Finally, some of the questions which have emerged as a result of this study are proposed, and a short term and long term research agenda on the basis of the results of this study are proposed.
D. Summary.

The purpose of this chapter has been to introduce the general context of the study. In particular, the research questions, approach, goals, and setting of the study are given. Economic development as a continuous and dynamic process, the speed and direction of which are determined by the spatial and temporal context in which an economy operates, is introduced. The notion that the process of development necessitates structural economic transformation and the reallocation of resources and factors of production between various subsectors of an economy is supported. Fundamental notions relating to booming sectors are introduced, and a brief discussion of the importance of such sectors in accelerating the process of structural transformation is provided; particularly important is the effect that booming sectors may have upon simultaneously stimulating and stagnating more traditional sectors of an economy, particularly agriculture.

Nigeria is the focus of the research study. The overall goal of the study is to determine the effects of Nigeria's petroleum boom of the 1960s upon the performance of Nigeria's international trade in agricultural commodities. Specifically, we seek to isolate and then empirically determine the impacts of two important effects: a) the impact of the volume of total petroleum exports on the growth rate of agricultural commodity exports; and b) the impact of the growth rate of total petroleum exports on the growth rate of agricultural commodity exports. While not developed in detail in this chapter, the expansion method is introduced as the methodology employed in the study, and the usefulness of the expansion method in allowing for contextual variations in the levels and growth rate effects of petroleum exports, and the analysis of parametric drift, is discussed. The contributions of the study at both the interdisciplinary and disciplinary levels are outlined. Finally, a chapter by chapter summary of the role and scope of the remaining chapters of the study is given.
CHAPTER II
NATURAL RESOURCE BOOMS

II. Natural Resource Booms.

The purpose of this chapter is to provide a general background to the concepts associated with natural resource booms in general, and booming sectors in particular, such that the broader theme of this study can be placed in a more appropriate context. Specifically, four issues will be addressed in this chapter, these being: a) the specification of the more important terminology used in the literature; b) a discussion of the economic forces which lead to the transformation of latent sectors of an economy into booming sectors; c) a general categorization of booming sectors based upon the nature of commodities; and d) a general overview of some of the more frequently encountered economic, political, and social impacts which booming sectors induce.

A. Terminology.

In any relatively specialized area of research a vocabulary particular to the field emerges and becomes established over time. While this is no different in the area of research on natural resource booms, the terminology in this field does, unfortunately, suffer from a somewhat more ambiguous set of meanings. Precise definitions do not exist, and it is quite clear that even the academic literature often suffers from a "we don't know
what it is, but we know it when we see it” syndrome.

However, this lack of rigid definitions may in part be due to the fact that unlike many other kinds of economic phenomena, natural resource booms are very dynamic and rapidly changing occurrences, in which the magnitude and length of any given boom is determined by a host of endogenous and exogenous political, economic, and social factors. Not surprisingly then, we cannot expect the definitions to remain constant over spatial and temporal and other contexts.

Indeed, it could be argued that the original research on booming sectors done by Cairnes in 1857, in which he attempted to assess the impacts of the 1851 Australian gold "boom" on other sectors of the Australian economy (Bordo 1975), would today probably not classify as a booming sector. In similar fashion, the California gold rush of the mid to late 1840s, although having significant impacts upon the economic restructuring of both the regional and national economies at that specific period of time, would again probably not be considered "large" enough to be classified as a boom in today's global economic context. Thus, the definitional imprecision and often, ambiguity, contained in the following discussions must be understood to vary. It is with this these cautions in mind that we turn our attention to three important terms in the booming sector literature, and which will be used substantially in this study. These are: "booming sectors," "windfalls," and the "Dutch Disease."

1. Booming Sectors.

Although now commonplace in the natural resource literature and used extensively in the titles of numerous research studies (e.g., Corden 1984, Corden and Neary 1982, Forsyth 1986, Freud 1978) the term "booming sector" itself has neither an exact nor commonly accepted definition. As a result we tend to identify such a sector on the
basis of certain characteristics which are repeated across various settings. Among the most important, is the fact that a booming "sector" is usually not the entire sector of an economy (i.e., the primary, secondary, tertiary, or quaternary sector itself) but is more often a specific subsector, or in rare instances, even a single industry within a given subsector. Examples might include the petroleum industry in the energy subsector, or the cocoa industry of the agricultural economy. In general, we use the term "sector" to refer to these more specific subsectors or industries.

Among other important attributes which are consistently shared by booming sectors are: a) the short length of time required for the emergence of the sector; b) the brief life span of the boom; c) the reliance of the booming sector on the international economy; d) the tradeoff between high versus temporary foreign exchange earnings associated with the sector; and e) the manner in which a particular resource boom is reflected in various indicators of economic growth and structural economic transformation.

In reference to the first two points, we might suggest on the basis of the literature, that economic booms emerge with one to five years, and last a minimum length of one to two years, and a maximum of perhaps ten. Examples illustrating the rapid emergence of booming sectors might come from the observing the rise of natural gas in the Netherlands in the 1950s, petroleum in the OPEC countries in the 1970s, and illegal narcotics in Colombia in the 1980s. In reference the length of booms, Cairnes (1851) and Bordo (1975) suggest about three year boom associated with Australia's gold rush, while Roemer (1983) noted a ten year cycle for the cocoa boom in West Africa between 1970 and 1980. Obviously the time involved in the emergence and sustainability of a boom will vary depending upon a host of considerations, and the above figures are to be taken only as a range of possible values.
A third characteristic of booming sectors is that their reliance on the international economy. Except in very rare instances, the majority of the booming sector output is exported. Petroleum, natural gas, cocoa, coffee, and illegal narcotics are examples of commodities for which domestic demand is limited, particularly when markets are limited by small population and/or low per capita incomes. Reliance upon international markets, is therefore, critical. Thus, while the endogenous factors such as domestic resource policy, political instability, etc. have impacts on booming sectors, a myriad of exogenous political economic, and foreign policy factors have far more significance. Booming sectors, then, while occurring in specific regional and national contexts, cannot be separated from the larger international economy.

In reference to the fourth characteristic of booming sectors, and one which has defined the research focus an entire body of theoretical literature, namely the trade instability school (see Chapter IV), emphasizes the very important tradeoff between the temporary nature of booming sector export revenues on the one hand, and the very high export revenue earnings, on the other. In other words, there is a price to be paid for exploiting a booming sector: while very high incomes are earned within a relatively short period of time, the length of the boom is itself limited by previously alluded to endogenous and exogenous factors. This tradeoff is complicated by the fact that for many natural resource booms, particularly those that are mineral based, there are finite limits to the resource supply, and thus optimal rates of extraction must be taken into consideration, in which the tendency to exploit resources for short-run profits must be balanced against the need for capital for long-run sustained development.

Finally, we note that booming sectors should make rapid and significant contributions (beneficial and/or detrimental) to the economy in which the boom occurs. In this regard, at least two categories of variables might be looked at: a) measures of economic
growth; and b) measures of structural economic transformation. In reference to the former, we would expect a significant and sustained economic boom to affect a variety of economic indicators including foreign exchange earnings, growth rate of exports, expansion of tax base, capital investment in the booming sector, growth rate of the GNP, and per capita income, and inflation. In regard to the latter, booming sectors may have an impact on restructuring the economic and social base of a country as revealed by such indicators as sectoral growth rates, regional growth rates, employment by sector, rural-urban migration, and the reallocation of factors of production including labor and capital. These issues are discussed in greater detail in the following sections.

2. Windfall Revenues.

Simply stated, "windfalls" or more appropriately "windfall revenues," are the foreign exchange earnings a country receives from the sale of the output of a booming sector on the world market. While the primary source of windfall revenues come from the direct foreign exchange earnings from the sale of the commodity, additional revenues are earned from indirect sources, including: revenues from export duties; rent payments by multinational corporations (MNCs) from leasing rights to resource deposits or land tracts; import-export licensing agreements; corporate income taxes on domestic firms directly and indirectly engaged in operations related to the booming resource sector, etc.

Obviously, what we would expect is that windfall revenues should be "large" foreign exchange revenues which are earned in a "short" period of time. Just as with the definitional issues surrounding booming sectors, identifying and defining windfall revenues remains a relatively ambiguous undertaking. However, it is clear from looking at the foreign exchange receipts of various countries presumed to have undergone economic booms that the task of windfall identification is relatively easy to note. For
example in his study on Ecuador's petroleum boom Marshall-Silva (1988) notes that over a ten year period the volume of Ecuadorian petroleum export sales increased substantially from 305.0 million dollars to 1,623.0 million dollars between 1973 and 1983, respectively, while Glassburner's (1988) study of Indonesia shows that foreign exchange revenues from petroleum sales abroad increased from 614.0 million dollars in 1973-74 to 6,016.0 million dollars in 1983-84. Forsyth (1986) suggests that the United Kingdom's foreign exchange revenues from petroleum sales increased dramatically, from 42.3 billion dollars to 103.4 billion dollars between 1977 and 1984. On average, the members of OPEC increased their foreign exchange revenues from the sales of petroleum by a factor of ten between 1972 and 1974.

It should be noted that relatively little work has been conducted on ways of empirical assessing and quantifying booming sector windfalls. To have such measures would help in removing much of the ambiguity associated with the identifying the magnitude of resource booms. In particular, there is a need to focus on the issues of: a) how large foreign exchange revenues have to be, and b) how quickly must such revenues accrue, in order to be considered windfalls? Attempts in this regard include those by Gelb (1988) and Diewer (1976) who provide various empirical measures for assessing the size of foreign exchange windfalls, and Tait, Gratz, and Eichengreen (1979) who propose an index to estimate windfall-induced tax revenues. However, much work remains to be done.

3. The "Dutch Disease".

A third term often used in the literature in conjunction with booming sectors and windfalls is that of the "Dutch Disease". Although various interpretations have been proposed, the term was first coined in The Economist (November 26, 1977), in reference to
the effects of Dutch natural gas discoveries of the 1950s and the subsequent earnings of windfall revenues on the stagnation of the country's manufacturing sector. The concern for the decline of the secondary sector as a natural resource boom emerges and dominates the economy is carried through much of the literature. For example, Buiter and Purvis (1983, p. 226) suggest that

adjustment problems . . . (in) the form of a decline in the level of activity in the export oriented and import-competing manufacturing sector . . . is now commonly referred to as the "Dutch disease," whereby a booming resource sector is presumed to lead to a contraction of the manufacturing sector.

In addition to the decline of industry, there is often a simultaneous tendency appreciation of the domestic exchange rate, and this has now become strongly integrated into most Dutch Disease definitions. In reference to this, Corden (1984, p. 359) states

the term Dutch Disease refers to the adverse effects on Dutch manufacturing of the natural gas discoveries of the nineteen sixties, essentially through the subsequent appreciation of the Dutch real exchange rate.

More recently, however, the term has been used in reference to the impacts of resource booms upon any other non-booming sector of the economy (not just the manufacturing sector, as in Buiter and Purvis' definition). This is particularly important in the context of Third World booming sectors, in which an appreciating exchange rate and other symptoms of the Dutch disease are not likely to affect the secondary sector, due to the relatively underdeveloped nature of the industrial sector in LDCs. The emphasis in more recent attempts to provide a more accurate definition have emphasized the importance of the reallocation of factors of production between the traded and non-
traded sectors, and the general retardation or decline of any non-booming sector of the economy. For example, Bruno and Sachs (1982, p. 845) define the Dutch Disease as a booming demand... (which) leads to a shift of an economy's productive resources from tradeable-goods sectors to non-tradeable goods sectors. The squeeze of the tradeables sector in this context has become known as the "Dutch disease."

Roemer (1983, p. 236) further suggests that export booms set up complex effects that actually retard growth in other parts of the economy. This phenomena has been termed "Dutch disease" because of the observed impact of North Sea gas production on the Dutch economy.

In the context of petroleum exporters, Auyt and Gelb (1986, p. 1161) define the Dutch Disease as the "...substantial weakening of the non-oil traded sectors", while Corden and Neary (1982, p. 832) emphasize "the coexistence within the traded goods sector of progressing and declining, or booming and lagging, subsectors".

As with research on booming sectors, and windfall revenues, a great deal of work has yet to be conducted to establish general empirical guidelines for the identification of the Dutch disease. For the purposes of this study, and as will be evidenced in the following chapters, the Dutch disease will simply be taken to mean the stagnation of certain sectors or subsectors of an economy, as a rapid economic expansion occurs in a booming sector.

B. Emergence of Booming Sectors.

In general, three major reasons can be given for the emergence of booming sectors: a) the discovery and exploitation of previously unknown reserves of a particular natural resource; b) the dramatic and sustained increase in the price of a commodity on the
global market; and c) rapid changes in consumer demand for a commodity on the global market. While each of the three catalysts for the emergence of economic booms may occur separately, evidence from various countries and booming sectors suggests that these catalysts need not be mutually exclusive, as in the case of Nigerian petroleum boom, which was caused by both new resource discoveries and rapid increases in the global price of petroleum. An overview of studies which have dealt with booming sectors is given in Figure 3 on the following page.

1. Resource Discoveries.

In general, the single most important catalyst for the emergence of a booming sector is the discovery of a previously unknown natural resource reserve, and are thus almost always associated with the mineral subsector of the primary sector. Examples of discovery-based resource booms are not difficult to find; historically, the Californian and Australian gold booms of the 1840s and 1850s, respectively, provide excellent case studies, the latter originally analyzed in the context of booming sector theory by Cairnes (1857) and later, by Bordo (1975). More recent examples include those of tin in Malaysia, bauxite in Jamaica, copper in Zaire, and natural gas in Norway and the Netherlands. Clearly, however, the classic example of discovery-induced economic booms remains petroleum, which has had profound social, economic, and political implications for, among others, Indonesia, Brunei, Nigeria, Gabon, Venezuela, Ecuador, Mexico, Trinidad and Tobago, and numerous states in North Africa and the Middle East.

2. Commodity Price Increases.

Rapid increases in the price of a commodity on global markets are a second important cause for the emergence of booming sectors. However, in this regard, at least two
<table>
<thead>
<tr>
<th>DISCOVERY-INDUCED BOOMS</th>
<th>CASE STUDY</th>
<th>BOOMING SECTOR COMMODITY</th>
<th>REPRESENTATIVE STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>gold</td>
<td></td>
<td>Cairnes (1857)</td>
</tr>
<tr>
<td>Spain</td>
<td>Latin American treasure</td>
<td>Forsyth &amp; Nichols (1983)</td>
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<tr>
<td>The Netherlands</td>
<td>natural gas</td>
<td>Forsyth (1986)</td>
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<tr>
<td>Algeria</td>
<td>petroleum</td>
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<td>Auty (1986)</td>
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<td>Britain</td>
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<td>Auty &amp; Gelb (1986)</td>
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<td>Ecuador</td>
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<td>Brewster (1972)</td>
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<td>Mexico</td>
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<td>Corden &amp; Neary (1982)</td>
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<td>Nigeria</td>
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<td>Gelb &amp; Bienen (1988)</td>
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<td>Trinidad &amp; Tobago</td>
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<td>Marshall-Silva (1988)</td>
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<td>Venezuela</td>
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<td>Near &amp; van Wijnbergen (1986)</td>
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<td>Warr (1986)</td>
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</tbody>
</table>

| PRICE-INDUCED BOOMS     | Central America | coffee, cocoa | Struckmeyer (1977) |
|                        | Africa, Asia, Caribbean | coffee, tea, cocoa | Davis (1983)       |
|                        | Jamaica         | bauxite        | Auty (1980)         |

| DEMAND-INDUCED BOOMS    | Colombia        | cocaine, coffee | Kamas (1986)        |

source: complied by author.

Figure 4

The Emergence of Booming Sectors: Case Studies from the Literature
potential problems emerge: first, how high must the price of a commodity be in order to induce boom-type conditions? and second, how long, or over what length of time must the price of a commodity remain at that "higher" level? Once again these definitional ambiguities are evident in the literature as exemplified, for example, by Roemer (in Lundahl, p. 236) who in his attempt to identify 19 booming economies over the decade of 1970 to 1980, suggests that price-induced economic booms are generated by "soaring prices", which in turn lead to "buoyant export revenues".

Just as booms induced by new resource discoveries are generally associated with mineral and mining activities, it would not be incorrect to generalize and suggest that economic booms induced by price increases are more commonly affiliated with agricultural commodities. Examples include the rapid price increases of bananas in the 1950s, cocoa in the late 1960s, or coffee in the mid 1970s.

However, unlike mineral products, it is important to emphasize the fact that in agricultural commodity booms there exists a tradeoff between rapid increases in commodity prices, and the length of time over which the higher price can be maintained; price-induced booming sectors among banana, coffee, tea, cocoa, and sugar exporters are never maintained for any protracted length of time. This results primarily from the fact that substitutes for most agricultural commodities exist, and as the price of a given agricultural good increases and remains high, consumer respond by shifting consumption to acceptable substitutes. The only exceptions to this rule are illegal narcotics, as noted in the case of the opium poppy in Thailand (McCoy, 1982), and coca leaves in Colombia (Kamas, 1986). This notion of demand shifts under rapid and sustained commodity price increases are now discussed in greater detail.
3. Shifts in Consumer Demand.

A third and final way in which booming sectors can potentially emerge relates to changes in consumer demand. Although very little research has been conducted in reference to determining the effects of changes in global consumer demand on inducing economic booms, this would appear to be an important and fruitful area of inquiry, particularly as it correlates with research being conducted in the area of price-induced booms.

For example, as the price of a given commodity, say coffee, increases dramatically and induces booms among coffee exporters, there must necessarily exist a maximum price threshold beyond which point consumers shift their demand away from coffee and towards substitute commodities, say tea or cocoa, resulting in an economic "bust" for coffee exporters. However, there emerges a simultaneous booming sector among tea or cocoa producers as the demand for coffee wanes.

Examples of other commodities in which changes in consumer demand could induce booming sectors might include shifts among certain grades of petroleum (e.g., heavy to light crude) in the mineral energy industry, variations among narcotics (e.g., heroin to cocaine) in the illegal drug market, or changes in tourist destinations (e.g., Haiti to Jamaica) in the travel industry.

C. Classification of Booming Sectors.

On the basis of a review of the general interdisciplinary literature, booming sectors can be divided into two broad types, based upon the nature of the commodity, these being non-mineral-based booming sectors, and mineral-based booming sectors. In the context of booming sectors the former generally relate to agricultural commodities, although one might also include tourism in this category, while the latter primarily encompass fuels (e.g., natural gas, petroleum) and metals (e.g., gold, bauxite, cobalt, iron ore).
Several distinctions must be drawn here between the non-mineral and mineral-based booms which give mineral-based booms their "special" status in both real-world contexts, and the literature on booming sectors and windfall revenues. First, the demand for minerals tends to be far more inelastic than those for non-mineral commodities and as such, producers and exporters of mineral products have a much greater ability to affect prices on global markets by restricting supply, particularly when orchestrated in the context of organized and cohesive producer's associations, such as the OPEC cartel.

Second, unlike non-mineral commodities, there are very few substitutes for mineral products. If the price of coffee increases dramatically and is sustained, the result on the part of the consumer will be to substitute one product — coffee — for another product — perhaps tea or cocoa, even though windfall revenues may accrue to coffee exporters in the short run. The fact that OPEC was able to restrict output of petroleum in the presence of no economically viable substitutes, led at least in part to the rapid price increases in petroleum in both 1973-74 and 1979-80, and the consequent massive windfall revenues for its members.


As mentioned in previous sections, non-mineral booming sectors emerge primarily in response to variations in global commodity markets, such as rapid price increases and/or rapid shifts in consumer demand for a given commodity. In the literature, agricultural commodities are most commonly associated with booming non-mineral sectors. For example, Struckmeyer (1977) conducted an analysis of the impacts of coffee price increases upon Central American coffee exporters. Davis (1983) analyzed the economic impacts of the rapid increase in prices of coffee, cocoa, and tea between 1975 and 1978 upon ten selected countries in Africa, Asia, and the Caribbean. More recently
Kamins (1986) observed the effect of price increases of coffee in the world market, and windfall revenues from the illegal narcotics trade upon the Colombian economy.

Given the fact that rapid price increases in agricultural products are becoming less common due to a variety of reasons — increased competition among LDCs for limited product markets as evidenced by inexpensive African coffees (e.g., Kenyan, Tanzanian, Ethiopian) competing with markets traditionally held by producers such as Colombia, Brazil; the impacts of the substitution of synthetic materials in MDCs for LDC commodities as in the cases of textiles and rubber — we might expect non-mineral windfalls to become less common.


As Corden and Neary suggest, booming sectors are often associated with the discovery and exploitation of mineral resources. Studies on the impacts of mineral booms have burgeoned in recent years, although interest in the subject can be traced to the mid-nineteenth century. Cairnes (1859) was the first to study the impacts of mineral discoveries on an economy with his work on the 1851 Australian gold discoveries and subsequent gold rush, upon other sectors of the Australian economy. Cairnes' study has since been expanded by others, including Maddock and McKean (1983). Bordo (1975) uses John Cairnes' study as the basis for a discussion on the application of methodology of positive economics.

Forsyth and Nicholas (1983) investigate the effects of Latin American gold and other treasure inflows on the Spanish economy in the 1500s in a Dutch Disease framework. Significant attention has been given to the cases of the Netherlands' natural gas, and Great Britain's petroleum discoveries upon the stagnation of their manufacturing sectors. These cases are exemplified in studies by van Wijnbergen (1980), and Corden and Neary

In the context of mineral sectors, no other commodity has received as much attention in the literature as petroleum. This results primarily from petroleum's "special" importance to both petroleum-exporting and importing nations. Studies on the petroleum sector as a booming sector have been covered extensively in both the MDC and LDC contexts. There is no single best definition of a "petroleum economy", and the extent to which an economy is defined as such will depend largely on the nature of research problem being posed. However, some common features serve to delineate economies which are dependent upon petroleum exports from those economies in which petroleum simply provides an additional contribution to economic stimulus, above and beyond more traditional sources (e.g., agricultural exports).

In general, we continue to be locked into a "we know one when we see one"-syndrome when it comes to identifying petroleum-dependent economies. In the literature, the criteria chosen to identify these economies often depends on the nature of the problem being research, the availability of data related to characteristic variables, and the knowledge of the author which allows him/her to implicitly distinguish between those characteristics that might be important from those that are not. Some of the variables which have been used to identify petroleum economies include: the contribution of petroleum to GDP; the contribution of petroleum to foreign exchange revenues; and petroleum's contribution to per capita income. However, certain variables are not commonly employed, including: the percentage of the labor force in the petroleum sector; wages paid to labor in the petroleum sector; or capital investment in the petroleum sector. This results from the fact that even though the net contribution of petroleum to an economy may be significant in terms of revenue, for example, the bulk of
the population does not participate in, nor fully enjoy the fruits of such windfalls. Indeed, even though petroleum can induce fundamental structural transformations of an LDC economy, the sector continues to operate very much as a sectoral enclave (e.g., Mexico, Nigeria, Indonesia).

Studies providing a general overview of the costs and benefits of petroleum booms on political development in oil-exporting LDCs are given in Amuzegar (1982), while Harberger (1983) and van Wijnenbergen (1984) concentrate upon an economic assessment. In the context of the LDCs, Auty and Gelb's (1986) study on the impact of oil windfalls on Trinidad and Tobago focus on the way in which political structures in the form of a "small", parliamentary democracy, affect the manner in which windfall revenues are used. Brewster (1972) concerned himself with trying to assess the impacts of petroleum exports on the growth of employment in Trinidad and Tobago. Pollard (1985) concluded that the decline of Trinidad's agricultural sector can be attributed to financial strain petroleum windfalls placed on agriculture, as funding for "politically motivated job creation schemes" in urban areas induced a migration of labor out of the agricultural sector. More recently, Commander and Peek (1986) have assessed Ecuador's petroleum boom on the dynamics of agricultural change in the Sierra region, focusing on the process of rural-urban migration and changing patterns of agricultural labor use as a consequence of the boom. Conway and Gelb (1988) cast the Algerian petroleum-boom in a fixed-price equilibrium analysis to assess macroeconomic responses to oil windfall revenues.

D. Classification of Petroleum Economies.

Among the few attempts to classify petroleum economies on the basis of specific criteria are those by Olawiyola (1987), who suggests three major features are exhibited by these countries: a) a major proportion of the government's expenditures are financed by
revenues earned from the sale of petroleum; b) the petroleum sector is a main contributor to Gross Domestic Product, even if only a small percentage of the labor force is actually employed in the petroleum sector; and c) the non-petroleum sectors of the economy are price-takers in the market for imported goods and services. His definition, however, suffers from the same one that many others do, namely the ambiguity of terminology: e.g., a "major" proportion, a "main" contributor, a "small" percentage. This problem is not likely to be resolved in the short term, and for the purposes of most research, a strict definition is unlikely to be needed.

In general, we tend to place oil-exporters into a group of homogeneous producers. However, this obscures much of the variability in economic, political, and social structures evident among petroleum producers. Surprisingly, very little work has been done to develop more detailed delineations of petroleum economies. Rather crude attempts are provided for by the World Bank in the World Development Report series, which categorizes petroleum exporters as either middle-income oil exporters, or high-income oil exporters. Olawiyola (1987) suggests those economies which can be classified as petroleum economies, can be further disaggregated into Type I or Type II petroleum exporting economies, based upon the relationship between petroleum revenues and population. These definitions are discussed further, below.

1. Type I Petroleum Economies.

In general, Type I petroleum economies are those economies which have a high inflow of petroleum export revenues in relation to their total populations, i.e., economies which have a high per-capita petroleum income. On the basis of this definition, most of the Middle Eastern and certain Northern African petroleum producers with small total populations would presumably be Type I economies, including Kuwait, Libya, Oman,
Saudi Arabia, and the United Arab Emirates. In addition, Southeast Asia's Brunei would also be included under this classification. In addition, and although Olawiyola does not elaborate on this point, we might generalize to include a further characteristic of Type I oil economies as having a relatively low absorptive capacity for capital in the economy. The issue of absorptive capacities in booming economies have received considerable attention, particularly by El Serafy (1981).

2. Type II Petroleum Economies.

Type II petroleum economies are those in which per-capita petroleum incomes are relatively low. That is, petroleum export revenues, even when substantial, are eroded by very large total populations. Countries classified as Type II petroleum economies would include Algeria, Ecuador, Indonesia, Iran, Mexico, Trinidad and Tobago, and Venezuela. Undoubtedly, Nigeria would be an example of a Type II economy. Further, we would expect such economies to have relatively high levels of absorptive capital capacity.

In addition, Olawiyola (1987, p. 16) states that Type II economies are usually more vulnerable to fluctuations in the global petroleum market, suggesting that

> It is reasonable to expect that in a period of falling petroleum prices and the accompanying sharp drop in oil revenues, the Type II economy is more likely to face severe crisis.

One issue that Olawiyola, among others, does not raise is where MDC petroleum economies "fit" into the petroleum economy classification continuum. That is, the Type I-Type II classification scheme accounts for distinctions among LDC oil exporters based upon population. However, some might argue that Britain and Norway are good examples of MDC petroleum economies. Obviously, then, a new set of criteria needs to be devised.
E. Booming Sector Impacts.

The economic, political, social, spatial and other impacts of booming sectors at the local, regional, national, and international scales have received significant attention in the professional literature. At least three tendencies become clear in reviewing the applied literature on the real-world implications of booming sectors: a) the majority of the analyses are conducted at the national level; b) the literature is dominated by case studies in economics, and to a lesser extent, political science; and c) the literature is approximately equally divided between those from MDC booming economies and LDC booming economies.

The remainder of this chapter will be devoted to a brief overview of the practical, i.e., real-world, effects of booming sectors on LDCs, subdivided on the basis of contributions made by the economic, political, social, and geographic sciences. A diagrammatic summary of the major effects of booming sectors on the urban-industrial and rural-agricultural sectors of LDC economies is given in Figure 5, on the following page. A critical review of the state of the theoretical literature in general, and the contributions of various disciplines to that literature, are given in the following chapter.

1. Economic.

The economic impacts of a booming sector can be assessed through an analysis of the sector’s impact upon various indicators of economic growth such as foreign exchange revenues, income tax revenues, export and import duties, GNP, employment, capital investment, national savings, the development of intra- and inter-industry linkages, etc. If the contribution is sustained for a sufficiently long period of time, or if the sectoral
<table>
<thead>
<tr>
<th>SECTOR</th>
<th>NATURE OF IMPACT</th>
<th>CASE STUDY</th>
<th>REPRESENTATIVE STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
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<td>El Serafy (1981)</td>
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<td></td>
<td>Industrial development</td>
<td>various</td>
<td>Van Long (1983)</td>
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<td>Budgetary deficits</td>
<td>various</td>
<td>Davis (1983)</td>
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<td>Exchange rate problems</td>
<td>Indonesia</td>
<td>Corden &amp; Warr (1981)</td>
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<td>Infrastructural constraints</td>
<td>various</td>
<td>Penrose (1976)</td>
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<td>Recessionary pressures</td>
<td>various</td>
<td>Neary &amp; Van Wijnbergen (1984)</td>
</tr>
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<td>Speculation, hoarding, and emergence of black markets</td>
<td>Nigeria</td>
<td>Amuzegar (1982a)</td>
</tr>
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<td></td>
<td>Decline of domestic agriculture</td>
<td>Iran</td>
<td>Katouzzian (1982)</td>
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<td></td>
<td>Rising food imports</td>
<td>Nigeria</td>
<td>Andrae &amp; Beckman (1985)</td>
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<td></td>
<td>Rural-urban migration</td>
<td>Ecuador</td>
<td>Commander &amp; Peek (1986)</td>
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Figure 5

The Impacts of Booming Sectors on Developing Economics
contributions are sufficiently profound, the booming sector may act as the catalyst for the structural transformation of an economy from one economic base to another. The most obvious examples are the booming-sector induced structural transformations of many economies in the Middle East from virtually no viable economic bases prior to their respective oil booms, to a petroleum-dominated economies (e.g., Saudi Arabia, Kuwait, UAE); and the economies of many tropical LDCs from a primarily export-agricultural base to a petroleum-oriented base (e.g., Ecuador, Indonesia, Mexico, Nigeria, Venezuela).

In the literature on the economic effects of booming sectors the tendency has been for the negative rather than the positive implications to have received more attention. This bias is exemplified by Penrose's (1976, p. 227) statement on the impacts of petroleum windfalls on LDC economies, who suggests that the sudden flow of new riches is creating very serious problems. As governments try to spend their revenue and absorb the enormously increased flow of imports, their monetary systems become strained by inflation, their ports become choked, their transport systems congested, their labor markets distorted, their housing problems intensified and their bureaucracy overloaded and increasingly subject to the temptation of illegitimate rewards.

The discussion on the economic impacts of booming sectors are now subdivided into effects on the urban economy, and the rural economy.

a. Urban-Industrial Impacts.

As previously mentioned, booming sectors and windfall revenues are likely to have detrimental impacts upon the manufacturing sector. In the context of MDCs, Forsyth and Kay (1986), among others, have suggested that the Dutch natural gas boom and the Norwegian petroleum boom actually promoted deindustrialization in these countries.
Others who have supported the tendency towards deindustrialization are Corden (1984) and Kamas (1986).

Since few LDCs have manufacturing sectors which have been established long enough or are sufficiently embedded in the broader national economy such that deindustrialization can occur, the focus in the Third World context has been on the extent to which resource booms can either prevent industrialization from occurring altogether, or disrupting fragile manufacturing policies as in the form of import-substitution industrialization.

For example, Auty and Gelb (1986) point to the general weakening of the non-traded manufacturing sector, even in cases where the government has given careful attention to investment priorities in light of windfalls, as in the case of Trinidad and Tobago, while Corden and Neary (1980) focus on outright shift in production away from non-tradeable production in LDCs. Amuzegar (1982a, 1983) suggests that windfalls do little to promote the development of inter-industry linkages in the industrial sector, or to strengthen those which already exist. This conclusion is supported in the Nigerian context by the research of Kuyvenhoven (1978), who suggests that while Nigeria's petroleum boom did allow for rapid industrialization, it did not lead to greater cohesion and interaction among industrial firms.

Another common economic outcome of a significant and sustained resource boom is the creation of a cycle of inflationary pressures, especially if devaluation policies are not instituted in order to keep the appreciating domestic currency in line with international currencies, as occurred in Nigeria after its first oil boom, and which also occurred in the Indonesia and Mexican contexts. Rapid boom-induced inflation is usually result of rapid and unplanned increases in government subsidies, private sector wages, and public sector salaries. Amuzegar (1982a) has covered the Nigerian experience in some detail, and
reports that inflation which had averaged 2.6 percent per year during the first oil boom between 1960 and 1970, increased dramatically after the second oil boom to an average annual rate of 19 percent.

Resource booms and subsequent windfalls often lead to the institution of massive public spending programs. However, such policies cannot be sustained indefinitely and if public expectations exceed the fiscal ability of the government to meet those expectations during non-boom periods, a government can sustain significant deficits (e.g., Davis, 1983). Nigeria, for example, sustained massive government deficits when the petroleum price expectation the government had counted on to sustain massive public sector expansion programs were not realized. Amuzegar suggests that in addition to deficits and inflation, windfall revenues can "trigger" a whole series of other "familiar imbalances in the economy" (1982a, p. 824), among them unintended redistribution of income, unproductive speculation, commodity hoarding, the emergence of black markets and underground economies, and capital flight. Few of these issues have been researched in any detail.

On the positive side, it has been suggested by various researchers, most notably Amuzegar (1982a, p. 832), that there is likely to be significant reduction in the domestic cost of living resulting from the substitution of relatively highly-priced domestically-produced consumption goods by inexpensive imported products, with the result that capital resources are allocated in a "more efficient" manner. Consumers, too, should benefit from the windfalls as they are given greater access to a wider range of goods. Amuzegar (1982a, p. 817) points to the fact that private consumption in Nigeria rose by five times between 1960 and 1970 in comparison to the previous non-oil boom decade.

In reference to the issue of industrialization, Van Long (1983) argues that windfall revenues may actually lead to an expansion of the industrial sector, not the weakening of
it, as well as to an increase in the profitability of the traditional tradeable sectors. However, there is little empirical evidence to support this contention, particularly in the LDC context. Again in the Nigerian context, Turner (1977) argues that petroleum revenues have made technological transfers between MDCs and LDCs "easier", presumably meaning that it is less expensive for LDCs with substantial capital resources to purchase technology from abroad.

Access to newly found wealth usually leads to an immediate and extensive expansion of the government and service sectors, as state programs expand to meet the increased expectations of the population, particularly in urban areas. Amuzegar (1982, p. 832) notes that in the context of Nigeria, government expenditures on social welfare programs increased at an annual average rate of 20 percent between 1970 and 1979, and by 120 percent between 1973 and 1974 alone. Turner (1977) points to the fact that windfall revenues give countries greater access to technology, and eases the process of technological transfer.

Other potential benefits include employment creation (El Serafy 1981, Brewster 1972); the stimulation of local expenditures on goods and services; the creation of forward and backward linkages to the booming sector (Kuyvenhoven 1978); increasing government revenues and foreign exchange reserves, and improving a country's balance of trade position; and providing economic security through the development of domestic energy supplies (in the context of Nigeria, see Madujibeya 1986).

The fundamental benefit of windfalls, then, is that it allows for the lifting of some of the fundamental constraints to development in the LDCs, especially that of capital shortage. As Gelb et al. (1988, p. 8) suggest "thanks to the oil boom, Nigeria is now in the enviable position of being able to finance her own development plans without the need to rely on foreign assistance". Further, El Mallakh (1984, p. 1) states that
in oil-exporting nations... increased oil revenues have offset the constraints imposed by external and internal economic disequilibria. They have been able to expand imports and domestic expenditures at a rapid pace in the face of slower growth and depressed economic conditions worldwide.

Finally, Onimode (1982, p. 171) suggests that in the Nigerian context, the oil boom and the windfall revenues have created a situation where "... money (is) no longer Nigeria's problem, but how to spend it".

b. Rural-Agricultural Impacts.

Unlike urban-industrial impacts, the effects of booming sectors on the agricultural economy have received very little research attention. Yet, given that LDC populations are predominantly rural, it is here that natural resource booms are likely to have their most profound implications. This is compounded by the fact that, as in the case of Nigeria, among others, it is the booming sector which replaces the agricultural sector as the foundation of the economy.

Among those who have focused on the agricultural implications of resource booms are: Commander and Peek (1986), Kamas (1986), Katouzian (1984), Pollard (1985), Richards (1987), Shenton (1987), Watts (1987a, 1987b, 1988), and Wells (1970). The general consensus in this literature suggests that the benefits agricultural sectors have derived from windfalls have been minimal at best, and that more commonly the impacts have been detrimental, both economically and socio-politically. Madujibeya (1976, p. 284) exemplifies this sentiment in the context of Nigeria, stating that "... in spite of the so-called oil boom, the bulk of the rural population remain unaffected by it".

Other research has focused on the decline of both agricultural output and agricultural productivity, as factors of production are shifted out of agriculture into higher rent-
seeking urban-industrial activities. Speaking of the Nigerian experience, Falola (in Ihnovebrere 1985, p. 122) states that

the present relative prosperity appears to be based on the performance of a single volatile sector dominated by petroleum production for export. Agriculture, which constituted the main engine of growth of our economy up to the early 1960s, is now virtually stagnant, if not declining.

In extreme instances profound and prolonged non-agricultural booms can lead to a change in a country's food status from net food-exporting to net food-importing. In support of this contention, Falola (in Ihnovebrere 1985, p. 223) notes that the Nigerian "agricultural surpluses of the 1950s and early 1960s, have all but disappeared, and we are having to import food to feed ourselves."

Indeed, Nigeria's imports of basic foodstuffs increased rapidly during the oil-boom years, since it was significantly less expensive to import rather than produce food domestically, and has been studied in great detail by Andrae and Beckman (1985). The concern for rapid increases in food imports is also expressed by Amuzegar (1982a), while Ekpo (1986) attempted to establish the point at which Nigeria's status changed from a food exporter to a food importer, suggesting that 1975 is the point at which there was a fundamental change in Nigeria's food status.

Obviously, the causes for the decline in agricultural output and the ability of a country to feed itself as a result of a resource boom are many and complex. However, among the most important justifications would be static agricultural technology, rapid rural to urban migration—particularly of young males, and the fact that the agricultural sectors of certain countries do not have surplus labor, as Gelb (1988) suggests was the case in Nigeria.
Unlike the experience of various other oil-exporting LDCs, in particular Indonesia, which experienced a Green Revolution as a result of its petroleum-boom, Nigeria's agricultural sector performed rather poorly, as both a source of employment and as a source of investment. Falola (in Ihnovebre 1985, p. 125) suggests that in the course of Nigeria's oil boom farming became progressively unattractive and remains characterized by inadequate capital, lack of suitable technology, inadequate supply of farm inputs, including credit and scarcity of farm labour which has worsened in recent years by the migration of young men and women from the rural areas to the cities. With the advent of mineral oil, agriculture suffered an even greater neglect and was relegated to the background.

While windfall revenues have not generally had beneficial impacts upon LDC agricultural sectors, save the case where the boom is induced by a specific agricultural commodity, there remains a great deal more research to be conducted in both the theoretical and applied realms on the interactions between natural resource booms, the urban-industrial complex, and the rural-agricultural sector. The conclusions of the current study for Nigerian agricultural development policy are assessed in greater detail in the final chapter.

2. Political.

While the economic impacts of natural resource booms have received most of the attention in applied research, there has been a marked increase in the number of works related to the implications of such booms for political development. For example, Auty and Gelb (1986) attempt to establish a relationship between the political structure of the state and the manner in which resource windfalls are allocated, by analyzing the case of petroleum revenues in the "small, parliamentary democracy" of Trinidad and Tobago.
Brownsberger's (1983) study of Nigeria, for example, suggests that political fragmentation and corruption in the context of the Nigerian state can be traced to materialism, which in turn is at least partially due to lavish spending made possible from petroleum windfalls. Gelb and Bienen (1988, p. 261) suggest that in countries with an extensive history of public corruption, the government may not be able to invest capital in legitimate activities outside of the country, because of the illusion of mismanagement it creates. As they state, "it may be difficult for governments to save abroad openly since they are vulnerable to accusations that money is being siphoned into officials' pockets". Obviously, this entails an opportunity cost to the state, since it may prevent the government from allocating its windfall revenues to their most profitable use. Amuzegar (p. 832) suggests that windfalls put governments in precarious positions because governments themselves have become alarmingly dependent on oil revenues not only for long term national economic development but for current consumption.

Concern for the manner in which windfalls exacerbate tensions between ethnic groups has received some attention as well. In the context of Nigeria, for example, Gelb and Bienen (1988, p. 223), contend that oil discoveries played a critical role in precipitating the Nigerian civil war had played a role in precipitating the civil war. Prior to 1960, the Northern and Western regions of Nigeria favored the "derivation principle" in the allocation of government revenues, which holds that each region should receive a share of the government budget based upon the extent to which they generated revenues. As cocoa and groundnuts were the major sources of revenues, these regions would receive a relatively greater share of the budget than the poorer Eastern region. However, after petroleum discoveries were made in the Eastern region and the decline of the agricultural economy ensued, "the Northern and Western regions reversed their former position, while
the Eastern Region became the new champion of the principle of derivation" (Gelb and Bienen 1988, p. 234).

The manner in which resource booms can affect class formation, popular uprising, and rural political organization has received attention by Onimode (1982), Watts (1987, 1988), and Andrae and Beckman (1985), among others. Other areas of research has concerned itself with the extent to which booms and windfalls can be translated into the concept of power. Some have suggested that Nigeria's population of over 100 million, the largest in Africa, combined with its massive petroleum revenues, would quickly lead to its emergence as an important regional and perhaps even continental economic and military power. However, the results have been disappointing. Katapu (1986, p. 48) states, rather bluntly, that "Nigeria's economic power is a myth. All Nigeria has is a lot of foreign money from the sale of oil. . .".

As with the issues applied economic analysis, much remains to be done in the area of researching the effects of resource booms on political development and issues of government stability and instability, urban and rural class formation, issues of corruption and mis-management, the development and usage of power, etc.

3. Social.

The social and cultural effects of resource booms have received very little attention, although some concern has been expressed about the extent to which windfall revenues can distort consumption patterns through such processes as the Veblen effect. In particular, there are interesting issues to be raised concerning the consumption conflicts which are likely to emerge between the rural and urban segments of the population, as well as those between the urban elite and urban underclasses. Amuzegar (1982a, p. 832), for one, has suggested that
there is the divisive social impact of the new "oil psychology" — variously termed petromania, quick-money fever, or the catch-as-catch-can syndrome — that emerged in nearly all (oil exporting) countries. On the one hand, those groups seized by what was called the "lyrical illusion" have been both eager for progress and impatient with its slow pace. On the other hand, in countries where deeply ingrained patterns of behavior had not been altered for centuries, there has been intense resistance to change by other groups. Hence, petromania has triggered what many observers see as an interminable struggle between privileged, "Westernized" progressive elites and cultural traditionalists.

Addressing the issue of urban consumption patterns, Falola (1985, p. 89) suggests that the rural-to-urban migration in Nigeria may have been stimulated on account of consumption distortions emanating from the oil boom; in particular, "the way the (petroleum) money was thrown about by the rich in the urban centres attracted people off the land". Other social impacts include a tendency of the population to become fiscally overdependent upon the state, and the state, in turn, to become overdependent upon windfall revenues to maintain state expenditure levels. Amuzegar (1982a, p. 834), in his comparative study of LDC oil-exporters states that

people's dependence on the state, as a nucleus of authority, assistance and support, has palpably increased. The state has not only become the focus of power but the initiator, promoter and monitor of all economic activities.

Some, such as such as Joseph (1978, p. 239) suggest that the social impacts of windfall revenues extend deeper than the distortion of consumption patterns, to affect the very moral fiber of society, stating that in the case of Nigeria, oil revenues have resulted in the "hideous displays of affluence are rapidly eroding the moral and cultural values of a people with a glorious past".
4. Geographic.

Spatial or geographic effects of resource booms have not been adequately analyzed. Geographers, as a whole, have made very few contributions to this vital area of research in either the applied or theoretical literature, as noted by Rees (1987). Exceptions, of course, exist: important work has been done by Watts (1987, 1988), Auty (1980, 1986, 1990) and to a lesser extent, Mabogunje (1980, 1981). However, these geographers approach the subject from very distinct ideological and methodological perspectives.

Within the context of the geographic impacts, two areas have received some attention: first, the effect of resource booms on logistics and physical infrastructure in general, and transportation and port development in particular; and second, the impacts of booming sectors on rural-urban and/or inter-regional migration.

In reference to the former, an article in the *West Africa* magazine (August 11, 1975, p. 923) suggests that, in the context of the Nigerian petroleum boom,

> the benefits of oil revenue . . . seemed largely illusory to most people. Money alone, it seemed, could not relieve port congestion make telephones work, provide reliable power or adequate water, clear traffic jams, transport food, improve agriculture, or run railways.

Bottlenecks occur when ports become congested with imported goods from abroad in the wake of spending sprees resulting from resource booms. Further, there are likely to be important urban spatial ramifications resulting from the construction of new edifices, highway systems, and commercial and residential developments. None of these issues have been explored in the context of Nigeria or other LDC booming sector-based economies.

The second important issue that certainly has geographic implications are the effects of resource booms on migration, both inter-regional and international. For example, in
the case of Nigeria, it has been estimated that the petroleum boom increased the rate of rural-to-urban migration from 5.0 percent prior to the oil boom in the late 1950s to some 12.0 percent by 1965, and 18.0 percent by 1980. In addition to these intranational labor movements, there were significant international migration flows, as laborers in the neighboring countries of Benin, Cameroon, and Niger migrated to Nigeria in search of work in the oil fields, construction, etc. This tendency to import labor from abroad during boom times was replicated in many Middle Eastern oil-exporting countries (Amuzegar, 1982).

Further migration is induced by massive government-sponsored construction schemes, most of which are urban-biased. Commander and Peek (1986) point to the Ecuadorian case and suggest its oil boom resulted not only in rapid urbanization rates, but also in an increase in the demand for food by the expanding urban population, with the simultaneous inability of the rural sector to meet such increased demands.

However, beyond these relatively superficial studies, there has been little in-depth research conducted on a host of problems that could be very well addressed by professional geographers. To date, only a small number of articles on booming sectors have appeared in major professional journals in geography, namely Auty's contributions to the *Singapore Journal of Tropical Geography* (1985), *Geoforum* (1986) and *Tijdschrift voor Economische en Sociale Geografie* (1980, 1986) and the *Professional Geographer* (1991). With these exceptions, however, no research articles on booming sectors have appeared in other major journals, including the *Annals of the Association of American Geographers*, *Economic Geography*, or *Geographical Analysis*. 
F. Summary.

The purpose of this chapter has been to introduce some of the important terminology associated with booming sectors, the reasons for the emergence of booming sectors, the classification of booming sectors on the basis of their resource characteristics, and some of the more important economic, political, social, and geographic ramifications which have received some attention in the applied research literature.

In general, it was noted that the professional terminology is ambiguous at best, characterized by a "we don't know it until we see it" mentality. Attempts have been made by various researchers to quantify booming sectors, empirically estimate the magnitude of windfall revenues, and to measure the impacts of the Dutch disease on industrial stagnation and even deindustrialization. However, as noted, these attempts have generally not been successful, given the fact that each natural resource boom, is, to some extent, a unique occurrence, the length and magnitude of which will vary across spatial, temporal, and other contexts.

We further noted that booming sectors have historically emerged for at least one of three reasons: a) the discovery of a previously unknown or economically unexploited natural resource deposit; b) the sustained increase in the global market price for a given commodity; and/or c) a rapid changes in consumer demand for a product. Mineral-based resource booms, particularly petroleum, tend to emerge from the former, while non-mineral based booming sectors, usually specific agricultural commodities such as cocoa, rubber, or coffee, result not from new "discoveries" but rather from rapid increases in the world market price. Since demand for these agricultural products is inelastic, and substitutes are easily available (although usually not in the short run), such commodity-based booms are relatively short-lived. Lastly, certain commodities, such as illegal narcotic
booms appear to result from changes in consumer demand, e.g., the shift from heroin in the 1970s to cocaine in the 1980s.

Finally, a general overview of the impacts of booming sectors on the economic, political, social, and geographic fabric of a country undergoing a boom was given. Natural resource booms can induce various sorts of societal stability or instability depending upon the manner in which resources and revenues are allocated. Initially such sectors, particularly if petroleum-based, were thought to be the "black gold, the magical *elan vital*" (Gelb, et al., 1988 p. 8) necessary for sustained economic growth; indeed, that "petroleum, in all its forms . . . appears to everyone, especially developing countries, to be a decisive factor in economic expansion" (Diallo, 1982 p. 536).

However, as the number and magnitude of the problems that windfalls could induce became evident -- including hyperinflation, industrial stagnation, rural-urban migration, agricultural stagnation, corruption, and political instability, among others -- this generally positive attitude changed to one in which petroleum was referred to as "the devil's excrement"; in which LDC economies were "dying of indigestion" (Gelb, et al., 1988, p. 8).

However, as more and more of the research agenda is completed, the results have become increasingly mixed. Booming sectors and the associated windfalls provide something of a double-edged sword, particularly in the context of capital-poor, agrarian-based LDCs. As Van Wijnbergen suggests, "(i)t is becoming increasingly clear that high but temporary oil revenues may be somewhat of a mixed blessing" (1984, p. 41). Or as Katapu (1985, p. 44) questions in relation to Nigeria's petroleum boom,

*can vast quantities of oil money end underdevelopment and earn economic power for a backward post-colonial nation that has suddenly struck it rich with oil? The answer is yes and no.*
From an *elan vital*, to a "disease" to a "mixed blessing". Although applied research on the effects of booming sectors remains limited among social scientists, it is clear we have made substantial progress in understanding the fact that there are neither clear nor simple answers to the complex impacts such sectors can induce upon the economic, socio-political, and geographic structures of these few and "fortunate" LDCs. In the context of this study the author will ultimately support the contention, on the basis of the analysis, that Nigeria's oil boom has indeed been a "mixed blessing", especially as it relates to the effects on the Nigerian agricultural export sector.
CHAPTER III

REVIEW OF THE LITERATURE

III. Review of the Literature.

This chapter provides a general survey and critical analysis of the relevant literature in order to place this study in the context of previous research. We begin by classifying the literature into four major schools of thought, and provide brief overviews of the research focus of each, as well as reviews of major exemplary works. Next, a critical analysis of the literature is given in which the theoretical and methodological constraints of the various approaches are highlighted, and some of the major contextual, sectoral, and spatial limitations discussed. Finally, a case for an alternative methodological approach to the study of booming sectors is given, with particular emphasis placed upon the need to overcome three major weaknesses in the literature: a) the lack of studies focusing on intersectoral interaction between the booming and non-booming sectors; b) the lack of explicit consideration for contextual variation in most models; and c) the lack of analysis employing volume-based rather than the much more problematic value-based data.

Two points should be noted: a) the literature outlined and reviewed here could have been organized in a number of different ways; the system chosen here is one which cuts across both disciplinary and methodological boundaries in order to better illustrate both the breadth of the literature, and the lack of a single, conventionally accepted...
approach to the formulation and analysis of booming sectors; and b) given the significant
number of works that directly and indirectly related to booming sectors, the review of the
literature is necessarily representative, not exhaustive. A diagrammatic summary of the
disciplinary origins of the literature is given in Figure 6 on page 65, and a more detailed
overview of the research foci and theoretical strengths and weaknesses of the various
school of thought is given in Figure 7 at the end of the chapter.

A. Characteristics of the Literature.

Although interest in natural resource analysis extends back the early part of this
century, concern for booming sectors has emerged only within the last twenty to thirty
years. The recent nature of the literature may be useful in explaining what appears to be
a lack of a clear direction in the research agenda, and the excessively porous disciplinary
boundaries which define it. Second, the scope of the literature is characterized by breadth
rather than depth, with at least four major bodies of theory drawn on to explain the ori­
gins, functions, and consequences of booming sectors. Although none of the theories are
mutually exclusive, neither is there a tendency in the literature to draw these distinct
theoretical perspectives into a single comprehensive framework. And third, the literature
is dominated by the work of economists, with only limited contributions by other social
scientists, including geographers. To summarize, we note that the literature on
booming sectors is: contemporary; exceptionally broad in both theoretical foundation and
research scope; and dominated by a small number of disciplines, particularly economics.
These issues are now explored in greater detail.

Natural resource analysis as a legitimate area of academic inquiry is generally taken to have begun with the publication of Hotelling's classic 1931 article entitled "The Economics of Exhaustible Resources," in which he developed a general mathematical framework for the optimal depletion of exhaustible resources over time and under various market conditions (purely competitive, monopolistic, duopolistic). Following Hotelling's seminal work, the literature on the economics of natural resources grew dramatically and now forms a significant body of literature with a strong theoretical base; see, for example, Dasgupta and Heal (1974), Dasgupta and Stiglitz (1980), and Pethig (1982). Somewhat ironically, however, the first study on natural resource booms was conducted over sixty years prior to Hotelling's investigations, with Cairnes' 1857 publication of the effects of the 1851 Australian gold boom (see Bordo, 1975). However, while the study is notable because it was the first attempt to explicitly consider natural resource booms in their own right, the work must be taken as the descriptive narrative which it is, and thus it had little impact upon establishing a research agenda.

Cairnes' contribution notwithstanding, there was no consistent thrust of research on natural resource booms and booming sectors until the discovery of natural gas deposits off the coast of the Netherlands in the late 1950s and early 1960s, and the subsequent stagnation and decline of the Dutch manufacturing sector. This not only led to the development of various theories to explain the emergence and behavior of booming sectors, but more importantly, it provided the critical mass necessary to establish a more permanent research agenda on booming sectors. Today, research on a broad range of social, economic, and political aspects of booming sectors is evidenced by several hundred articles and numerous academic texts which deal directly and indirectly with the subject of resource booms and booming sectors.
2. Scope of the Literature.

Two things should be noted about the scope of the literature. First, there is a tremendous range in nature of the topics which have been researched, from attempts to develop empirical indices to assess the capacity of an economy to absorb windfall capital (El Serafy 1981), to the extent to which windfall-induced wealth is reflected in popular culture such as literature and theater (Barberm 1985), to the impacts of petroleum booms on populist movements (Watts 1986). One explanation for the expansive scope is the fact that as an area of legitimate academic inquiry, the study of booming sectors remains in its infancy; there is far more that we do not know about these sectors, that there is about what we do know. Although cores of research have developed, there still exists no general theoretical framework on booming sectors to link the diverse subject matters together as a cohesive set of collective research which emphasizes a single, fundamental theme.

Second, within the broad range of studies, the literature is about equally divided between theoretical and applied works. Theoretical approaches, usually the work of macroeconomists and drawing heavily upon the existing body of theoretical literature on natural resources, reflect a distinctively normative bias and are highly abstract in nature, with a tendency to focus on the attainment of an optimal state under various assumptions and constraints. Among the studies are those which have addressed issues such as optimal rates of resource depletion under limited oligopolistic markets (Schafer 1982), speculation and stability in markets for exhaustible resources (Pflug and Winckler 1982), and efficient pricing of natural resources under limited information (Eichhorst and Spremann 1982). In the context of booming sectors, the work by Kemp and Van Long (1982), Hellwig and Kogelschatz (1982), Hopfinger and Schwefel (1982), Van Long (1983), and Neary and van Wijnbergen (1985) provide excellent examples.
The applied analyses, on the other hand, are studies cast in a positive framework, and are often descriptive interpretations of individual case studies. While some of these investigations are often empirical economic analyses of resource booms such as Kamas' (1986) work on the Colombian export boom, or Stuckmeyer's (1977) analysis of the impacts of coffee price increases on Central American economies, most of the work has concentrated on understanding the effects of booms on the social, political, and even cultural fabric of the state and bureaucratic structures. Examples here include the work of Watts (1987) on the impacts of petroleum booms on rural populist movements, Brownsberger's (1983) study on windfall-induced corruption on issues of materialism and political fragmentation, and Barber's (1982) analysis of petroleum-induced wealth on social perception, elitism, and popular culture in Nigeria. It is in these more applied, case-study contexts that the contributions of geographers, sociologists, political scientists, and applied economics become evident. A final note of interest is that there is very little overlap between the theoretical and applied segments of the literature, and virtually no acknowledgement of each group's contribution to the other's research agenda.

3. Geography's Contribution to the Literature.

As suggested, economists have been the single greatest contributor to the field of natural resources in general, and to the study of booming sectors in particular. This is exemplified by the fact that of the four major theoretical approaches to the literature we will discuss in the following section, the initial contributions to each were made in economics, with investigations by other social scientists following later. Of particular concern is the lack of interest that geography, as a discipline, has shown in the study of booming sectors. In reference to this we ask at least two questions: first, what have the contributions of geographers to this area been? and second, why has the contributions of
geography to booming sector research been so limited, vis-a-vis those of other fields, particularly economics?

In reference to the first question, we note that geography has made many significant contributions to the broader field of natural resource analysis. Indeed, the geography of natural resources is one of the oldest segments of geographic inquiry and substantial work has been done by many, including Whitaker (1954), White (1961), Coppock and Sewell (1975), Mitchell (1979), Mabogunje (1980), and Rees (1990). However, it is also important to note that the lines which separate the spatial analysis of natural resources from various other fields of inquiry of interest to geographers, including natural hazards, risk analysis, environmental assessment, tourism analysis, etc. become blurred. A discussion of the contributions by human geographers to natural resources as a whole must necessarily include these areas, and therefore lies outside the scope of this study.

In reference to booming sectors as a discrete subset of natural resource analysis, however, the role of geographers is more clearly defined even if not more prominent. Among the most important contributors are Richard Auty (1980, 1983, 1985, 1986a, 1986b, 1986c, 1990, 1991) of Lancaster University and Michael Watts (1981, 1987, 1988) of the University of California-Berkeley. Auty, who, were he an economist would fall neatly into the group represented by the theoretical macroeconomists, has published a great deal within the neoclassical and Dutch Disease theoretical frameworks. Watts, on the other hand, adopts a distinctly cultural ecology approach to his analysis, and his studies are cast primarily in the Marxist political economy framework.*

* Interestingly, the paradigmatic foundations and research foci that these two prominent geographers employ are, respectively, a microcosm of the broader rift that exists in the study of booming sectors between theory and application, between the normative and the positive, between the nomothetic and the ideographic. While the work of both authors is important, they characterize the theoretical extremes and polar opposites of the literature.
While the work of both authors is useful and has been well received among peers in their respective academic circles, there is clearly a lack of interest in booming sectors by geography as a whole, even though the discipline is ideally equipped to investigate a wide range of issues associated with the subject. For example, geographers have yet to make substantive contributions to our understanding of how booming sectors affect the patterns and rates of migration, although two non-geographers Commander and Peek (1986), investigate migration processes and its impact on agrarian structures in the context of the Ecuadorian oil boom. Other areas in which geographers could made substantial contributions to booming sector studies include urbanization, industrial location decision making processes, transportation system development, regional development, the spatial implications of sectoral investment priorities, labor productivity, the diffusion and adoption of new technologies, project and investment priorities, and patterns of interregional and international trade activity.

This leads back to our second question in which we asked why, given the significant number of unanswered questions which geographers are uniquely qualified to address in reference to booming sectors, are the substantive contributions so few? One important reason appears to be the fact that in the study of natural resources at the aggregate level, there is the constraint of trying to make spatially explicit a subject matter which is inherently aspatial. That is, the study of natural resources in general relates to the formulation of theories and the testing of certain hypotheses about activities which have both random spatial distributions, and fixed location. In this regard to this point, an extended quote by Rees (1989, p. 367) seems particularly appropriate:

*Despite the fact that geographers once defined their subject as the study of the relationship between human society and the physical environment . . . concern over natural resources largely by-passed human geography. The subject was at that*
time (1960s) preoccupied to the point of obsession with the quantitative revolution, with the search for spatial order and the development of theoretical models ... It was commonly assumed that the location and nature of the resource base were fixed and given; the way in which human societies define resources and give meaning to natural systems was largely ignored and the physical environment vanished behind neat optimising rules for the spacing of economic activities and settlements. In addition, and perhaps most importantly, there was almost total neglect of the critical question of how natural resources, and the wealth or welfare derived from them, were allocated between socio-economic, political and cultural groups over space and time. This neglect was evident at all spatial scales - global, national and local.

Thus, the lack of the human geographer's participation in natural resource analysis in general, and booming sectors in particular revolves in part around the tractability, indeed usefulness, of developing spatial theories based upon an essentially aspatial phenomena. However, it should be noted that attempts to develop locational models of resources have been attempted, such as those by Beckman (1982); such studies are, however, the exception rather than the rule, and appear to have only limited use as theoretical constructs.

Yet if we, as geographers, are unable to develop explicitly spatial theories on the origins of resource booms, it should not prevent us from studying the spatial consequences of such booms, as they relate to clearly defined and historically well-developed geographic themes including diffusion, migration, etc. Indeed, this is here that the contributions of the geographer are likely to be most useful.

In conclusion, then, it is quite clear that geographers have much to say about resource booms, and the various spatial and aspatial consequences that booming sectors induce. However, with the exception of a small number of well-published geographers with
clear methodological and ideological biases, geography as a discipline has yet to make substantial contributions to the broader literature on natural resource booms.

B. Theoretical Approaches in the Literature.

A number of authors have attempted to classify the literature on booming sectors into useful groupings (e.g., Gelb 1988). However, this becomes a difficult task since many studies are mutually exclusive and thus do not fit neatly into single categories. However, given this caveat, we will attempt such a categorization for the purposes of general discussion, although the classification system proposed here differs somewhat from that proposed by Gelb. In doing so it seems useful to subdivide the literature on booming sectors into four segments: a) traditional neoclassical growth models; b) export instability theories; c) the theory of the Dutch Disease; and d) political economy approaches. The reader is referred to Figure 6 below, and Figure 7 at the end of the chapter.

![Diagram](https://example.com/diagram.png)

**Figure 6**

Disciplinary Origins and Major Theoretical Approaches in the Literature to the Study of Booming Sectors
The following section provides a brief summary statement of the major research thrusts in each of these four major categories, followed by a general discussion of some of the more important representative works from each. The literature review presented here is not exhaustive and is provided primarily as a means of illustrating the breadth of the scope of the studies, where this study proposes to fit in light of the current literature, and to highlight some of the major weaknesses resulting from the general lack of research cohesion in the literature.

1. Neoclassical Growth Models.

The first attempts to construct theoretical models of booming sectors emerged from neoclassical economics, which maintains that the growth of output in an economy is accomplished by expanding the production possibilities frontier, the boundary of which is set by the quantity, not the quality, of available factors of production, and the degree of efficiency with which these factors are allocated across different sectoral activities. In the context of booming sectors, two fundamental themes have been emphasized. The first relates to issues of efficiency of sectoral reallocation between the booming and non-booming sectors. The second, and which has received far more research attention, has been on the extent to which windfall revenues relax traditional constraints to economic development, particularly those of limited domestic savings, foreign exchange earnings, and fiscal revenues. Given these foci, the neoclassical formulation generally holds - albeit somewhat optimistically - that windfalls are beneficial so long as these revenues can be taxed away and invested rather than consumed; resource booms should not be seen as detrimental processes characterized as "diseases" or "curses" but rather as "blessings," to use popular terminology from the literature.
Representative Studies.

Neoclassical approaches to booming sectors often cast them in a Walrasian general equilibrium framework, and the comparative static analysis which is conducted is done so on the assumption of open economies, perfect information, perfect factor mobility, etc. One of the first attempts to apply neoclassical theory to resource-based economies was done by Seers' (1964) in his study of what he called the 'open petroleum economy.' This study might have proven the exemplary work of neoclassicists to the literature on resource booms, had it been less of an assault on the inappropriateness of Keynesian economic analysis to the study of such economies. Bruce (1972) responded to the grievances of Seers and others (e.g., Brewster 1972) by comparing theoretical wage rates and employment levels in open petroleum economies under various conditions, and found many of the neoclassicist criticisms to be unwarranted. Other attempts to provide a fundamental theoretical framework in which to analyze various macroeconomic implications of resource booms under neoclassical assumptions have been made by Neary and van Wijnbergen (1986), and Eastwood and Venables (1982).

Although much of the neoclassical literature is theoretical and seeks to analyze, under strict assumptions, the implications on non-booming sectors of marginal changes in isolated parameters, there are also a number of applied studies. Among them are the works of Forsyth and Nichols' (1983) who investigate the relationship between price levels, currency appreciation, and the decline of Spanish manufacturing; Stollery's (1987) study of the Canadian copper industry under the assumption of malleable capital; Conway and Gelb's (1988) fix-price equilibrium analysis of Algerian petroleum windfalls; Brewster's (1972) study of the effects of petroleum exports on employment growth in Trinidad; and Maddock and McLean's (1983) investigation of supply-side shocks in the Australian economy following gold discoveries. In addition, Fajana (1979), and Taylor,
Yurukoglu, and Chaudhry (1985) have tested neoclassical models of resource booms in the Nigerian context. These are discussed in greater detail below.

Fajana's (1979) proposes a two-gap growth model to test the empirical relationship between agricultural and petroleum exports, foreign capital, and economic growth. He concludes that international trade has been an important engine of growth for Nigeria, and strongly supports a policy export promotion. However, he fails to differentiate between the net contributions of petroleum and agricultural exports to economic growth, and does not explain why - if export promotion policies are preferable to ensure continued growth - the Nigerian government has consistently pursued policies which are strongly import-substitution oriented. Further, his conclusion that international trade has been an important engine of growth for Nigeria contests the political economy conclusion which suggests that Nigeria has no viable engine of growth, stated explicitly by Schatz (1984), and implicit in the studies by Andrae and Beckman (1985), Richards (1987), and Watts (1987), among others.

In a second neoclassical-based study on Nigeria, Taylor, Yurukoglu, and Chaudhry (1985), extend Fajana's formulation, and develop a three-gap model to examine the impacts of alternative policy packages aimed at easing capital constraints in the Nigerian economy in the early 1980s. The study is unique in that it is one of the few simulation models aimed to compare policy packages in the context of resource-based booming economies. Among the scenarios explored were the impacts of variations in devaluation rates, changes in tariffs on inputs and/or final goods, reduced agricultural subsidies, higher internal oil prices, and changes in wage indexation. The authors conclude that in order to minimize the detrimental macroeconomic effects such as hyperinflation and unemployment which result in the wake of a boom, sector-specific policies should be instituted (e.g., increasing tariffs on specific imports, or the reduction
of agricultural subsidies on specific commodities), rather than broader-based solutions such as currency devaluation or wage indexation. However, very little attention is given to the interdependence between the booming and non-booming sectors, and the mechanisms which link and operate between them, which are notions developed explicitly in the Fajana (1979) and Kuyvenhoven (1978) studies, for example. Other applied studies on economic booms in the Nigerian context and firmly entrenched in neoclassical paradigm are those by Tims (1974), Folayan (1983), and Olawiyola (1987).

b. General Commentary.

While the neoclassicists have made valuable contributions to the theoretical formulation, if not applied analysis, of booming sectors, some fundamental weaknesses emerge. First, the neoclassical formulation is one in which developmental change is conceived as a gradual and continuous process. However, this contradicts the very nature of booming sectors are characterized by rapid and abrupt change; indeed Marshall's (1920, p. 6) belief that "... the maxim that 'Nature does not willingly make a jump'... is especially applicable to economic development..." is directly challenged by the existence of boom-based economies. Second, neoclassicists see growth, in the words of Yotopolous and Nugent (1974, p. 9), as "... harmonious and cumulative" process, based on "... automatic equilibrating mechanisms." Again in the context of resource booms, there is no evidence to suggest that any such equilibrating mechanisms in the economy exist, and given the enormous structural economic and bureaucratic transformations that windfalls induce, never would such mechanisms be automatic. Finally, the neoclassical models are perhaps too optimistic in their outlook for continued and sustained economic growth, and overemphasize the importance of spread and trickle-down effects. Our experiences with economic booms, particularly in LDC contexts, strongly contradicts the perceptions.
Studies such as those by Roemer (1983), for example, suggest that LDCs that have undergone resource booms have generally not fared any better than those that have sought continued economic growth through more traditional means. In addition, most studies from the political economy perspective - as well as many of the Dutch Disease theorists - would balk at the neoclassical suggestion that windfall revenues have tricked down the societal ladder, and/or that Pareto-optimality can be achieved in boom economies.

Obviously, for the purposes of formulating static theories in which to analyze the changes of various model parameters within the confines of strict assumptions, neoclassical models may be a useful contribution to the broader literature on booming sectors. However, most of the studies which have employed this paradigm suffer from weaknesses that render their practical applicability questionable. Indeed, there is an intrinsic danger in using essentially normative conceptualizations for prescribing policy solutions, as has been attempted by Fajana (1979) and Taylor, et. al. (1985). If one is willing to make allowances for the many restrictive assumptions upon which the models are based, then neoclassical growth do serve a valuable purpose in providing a fundamental theoretical basis upon which other conceptualizations of booming sectors have emerged.

2. Export Instability Theories.

A second major body of research on booming sectors are trade instability theories, which focus on the contradictory nature of resource booms. Of particular concern is the tradeoff that exists between the massive size of windfall earnings on the one hand, and the temporary nature of the earnings on the other. Given this focus, the literature on export instability has generally emphasized on a limited range of topics including the effects of resource booms and windfalls on: the balance of payments, external reserve positions,
commodity stabilization schemes, export competitiveness, and international trade policy. It should be noted that while the smaller number of studies reviewed in this section may give the impression that this segment of the literature is not well developed, this results from the fact that much of the work overlaps considerably with theories of the Dutch Disease, and is therefore discussed at greater length in the following section.

a. Representative Studies.

In one of the ground-breaking studies on booming sectors and their effect on trade instability, Gregory (1976) investigates the impacts of the Australian mineral export boom on the country's balance of payments position, particularly as it relates to adjustment problems in the non-mineral traded sector. Using a simple two-sector, partial equilibrium model, he concludes that the impact of mineral discoveries on the agricultural sector, which exports, and the manufacturing sector, which competes with imports, had an impact tantamount to a 25 percent across-the-board reduction in tariffs.

Snapc (1977), using Gregory's model as a departure, proposes a general equilibrium model, and in doing so extends Gregory's conclusions by suggesting that although a boom is likely to weaken the non-tradeable sector, it is not necessarily true that the production of all goods in this sector must necessarily decline; further, social gains are still possible, even if the output of goods in the non-tradeables sector remain constant; and finally, while the price of non-tradeables will increase following a boom in the tradeables sector, the production of non-tradeables as a sector may increase or decrease.

In a further investigation, Davis (1983) analyses the impacts of rapid tea, coffee, and cocoa prices between 1975 and 1978 on government fiscal, monetary, and trade policy, and found that most governments did not pay farmers higher prices for their crops, even in light of global commodity price increases. The windfall revenues accrued to the
governments and were used to finance the purchase of imports from abroad, with the ultimate impact being that the external reserve positions from most of the countries remained relatively unchanged prior to and after the boom. Struckmeyer (1977) reached similar conclusions in his earlier study on the effects of the coffee price boom on Central America economies in the 1960s.

In other studies, Corden and Warr (1981) investigate the the impacts of the Indonesian oil boom on the government's exchange rate policies, and in a similar study Gelb and Bienen (1988) discover that a "vicious cycle" exists between windfall revenues, inflationary pressures, deficits, and exchange rates by examining the case of Nigeria. Svenson (1982) adopts an intertemporal approach to explore the relationship between petroleum prices, social welfare, and trade balances, while Bulter and Davis (1983) attempt to model the interactions between petroleum prices, disinflation, and export competitiveness by examining the case of the United Kingdom. Motamen (1979) analyzes Iranian oil revenue expenditures and commodity import trends using an optimal control model, and then employs sensitivity analysis to project governmental consumption patterns under various scenarios. Finally, Roemer (1983) explores the impacts of booming sectors across twelve commodities and twenty LDCs, concluding that LDCs that have undergone booms have generally not improved their long run trade positions vis-a-vis LDCs which have maintained steady export growth under non-boom conditions.

b. General Commentary.

In general, the contributions of export instability theories have been more useful than the neoclassical models when used in an applied contexts, as most of these studies have been. This is true because this paradigm highlights the integration of a) the national economy in which the consequences of the boom are felt (such the impacts of wind-
fall revenues on trade restructuring) and b) the international economy in which the boom originates, the conditions in which ultimately dictate the "boundaries", i.e., size and length, of the boom. Another strength of this literature is that it provides an important link in between the more theoretical studies of the neoclassicists, and the more applied work done on theories of the Dutch Disease. Finally, export instability theories bring to the forefront the notion of tradeoffs between the massive size of windfalls, versus the fact that the windfalls are only temporary.

There are, however, a number of weaknesses that should be addressed. The first focuses on definitional issues on the characteristics of resource booms, namely those that relate to the "length" of the boom, and the "size" of the windfalls. There are no good measures available to quantify resource booms using mathematical indices, and may therefore lessen the usefulness of comparative studies; indeed, the lack of an accepted set of definitional yardsticks may account for much of the debate on whether resource booms are indeed a "boon or bust", a "remedy or disease", a "mixed blessing", and explain some of the contradictory results in the literature. Although there have been attempts to develop indices, such as Auty and Gelb's (1986) measure to determine tax revenues under boom conditions, these have generally proven to be unsuccessful, largely because of variations not only in the booming commodity itself, but the cultural, social, political, and economic contexts which define the size and length of the boom.

The second drawback in this literature is lack of prescriptive policy solutions that are made, yet the very fact that there is a tradeoff between high but temporary windfalls makes a strong case for the need for appropriate policy aimed at coping with trade, investment, and other imbalances that result from rapid and fundamental economic restructuring. While there is an excellent range in both commodity and country case studies in this literature, the studies generally tend to focus on specific case studies or scenarios, and
rarely propose broad policy solutions useful to countries undergoing booms. There is an urgent need for social scientists well acquainted with the fundamentals of resource booms, particularly those conducting applied analyses, to venture into the policy-making realm.

3. **Theory of the Dutch Disease.**

Research on the theory of the Dutch Disease is the most extensive of any of the competing schools of thought, and it is also among the oldest, tracing back to 1857 when John Cairnes studied the impacts of the 1851 Australian gold boom on other sectors of the economy. After lying dormant for much of the 1900s, the school emerged again in the late 1950s and early 1960s in response to the impacts of the Dutch natural gas boom on the stagnation of the country's manufacturing sector. The term "Dutch Disease," coined by *The Economist* in reference to the "mixed blessings" that such resource discoveries entail, has since led to a broad and well developed body of theoretical and applied literature.

The focus of this approach is the manner in which sectoral reallocation of factors of production takes place, following a price- or discovery-induced boom. Assuming that income from windfall revenues is spent rather than saved, two outcomes result: the first, known as a resource movement effect, draws factors of production out of other activities and into the booming sector; the second is a spending effect, which draws factors of production out of sectors producing traded commodities (now substituted by imports) and into the non-traded sectors. The stagnation or even possible contraction of the traded sector is known as the Dutch Disease.

General issues that have been explored in this segment of the literature include the effects of windfalls on the appreciation of currencies and exchange rates, "deindustrialization," impacts on unemployment, and a host of investigations related to factor allocation and reallocation, factor movements, and the impacts of booms of factor in-
tensity. Unlike the neoclassical models, the Dutch Disease theories are generally more concerned with issues of sectoral reallocation, and as evidenced by its paradigmatic label, are often less optimistic in their view of how beneficial booms and windfalls are.

a. Representative Studies.

As suggested, the literature on the Dutch Disease is the most extensive of any of the bodies of theory outlined. Excellent introductions to the theory and application of the Dutch Disease are given in several summary studies, particularly those by Corden (1984) and Neary and van Wijnbergen (1986). However, with the exception of these review and consolidation pieces, much of the literature in the area of the Dutch Disease is varied in terms of both theory and methodology. In terms of general theoretical studies, Neary and Van Wijnbergen (1985) provide an excellent introduction to theory of the economics of natural resource booms, by beginning with a simple two-sector general equilibrium model consisting of a non-traded goods sector, whose prices are determined endogenously, and a traded goods sectors, whose prices are fixed exogenously. The authors then investigate the familiar spending effects, and resource-movement effects. Wage and price rigidities are introduced, as well as intertemporal adjustments, with and without market imperfections. The various theoretical constructs are then used to address important policy issues, and suggest that deindustrialization is not always a necessary outcome of a resource boom, nor is the real appreciation of the currency, although they do suggest that resource booms can generate high levels of unemployment.

Harberger (1983), drawing from the neoclassicists, develops a three-sector, open-economy model with a tradeable, non-tradeable, and oil sector, to show that if a fixed exchange rate is assumed, a rise in the global price of petroleum will lead to a rise in the price of goods in the non-tradeable sector. This is followed by a dynamic version of the model,
in which he concludes that the price of non-tradeable commodities is likely to increase by following a path which overshoots the equilibrium price level substantially, before equilibrium in this sector is ultimately attained.

A dynamic approach is also found in a study by Bruno and Sachs (1982) by allowing the temporal parameters of the model to vary. Specifically, they consider short run capital specificity and long run capital mobility, and also allow for international capital flows, and intertemporal optimizing behavior by firms and households. Using a simulation approach, they conclude that the net effect of a boom in the energy sector is to reduce the production of non-booming tradcables in the long run, adding to the well-established conclusion that under certain assumptions resource booms lead to increases in the prices of non-tradeable sector commodities.

In another study Van Long (1983) challenges the conventionally held views about non-booming sectoral stagnation held by others, including Van Wijnbergen (1984), Neary (1986), by stressing the importance of factor intensity and factor mobility when conducting sectoral reallocation, and suggests that an export boom can have the effect of expanding all industries in an economy, while simultaneously increasing the profitability of the tradeable sector as well as reducing the relative prices of non-tradeables. Other studies which have stressed various theoretical issues include Neary's (1984) investigation of the monetary aspects of the Dutch Disease, and Neary and Purvis (1984) examine the how the tradeable and non-tradeable non-booming sectors of an economy adjust to economic booms in the short-run and long-run.

In the context of applied studies, Auty and Gelb (1986) examine the impacts of the petroleum boom on the economy of Trinidad and Tobago. By composing an index of the Dutch Disease, they conclude that the case of Trinidad and Tobago parallels that of most other petroleum-exporters in that windfall revenues were used to finance both
consumption in the form of imports, and the subsidization of large projects. However, they add that the country's distinctive political economy and size, a "small, parlimentary democracy" would have made it much easier to administer proper policy remedies before the full impacts of the Dutch Disease were felt.

Butler and Davis (1983) develop a simple theoretical model of an open economy, based largely on the British petroleum experience, in order to identify and isolate the economic interplay between the effects of the real exchange rate of increases in the world market price for petroleum, the discoveries of domestic deposits of oil, and monetary disinflation. In the macroeconomic model which follows, petroleum is treated as both income and wealth and the longer run comparative statics of the model, analyzed. The authors conclude that the effects of a petroleum price increase are to increase the relative prices of non-oil goods if a country is a net oil exporter. In addition, they conclude that increases in the price of oil tend to have negative impacts on the manufacturing sector, and tie these conclusions in with those of Harberger (1983) concerning the overshooting of the price level of non-traded commodities before long run equilibrium is attained. Another comparative study is Forsyth's (1986) comparison of the structural transformation of the British and Norwegian economies after oil discoveries.

The focus of El Serafy's study (1981) is on the absorptive capacity among OPEC countries in an investigation on the ability of these countries to dispose of windfall revenues so as to prevent any surplus of capital from emerging, concluding that although windfall-induced capital surpluses can generate inflationary pressures, there is no good reason to dispose of excess windfalls indiscriminately. Rather, he suggests booming economies with absorptive capacity problems would do better to make temporal adjustments, such as reducing the rate of resource extraction in order for the economy to better absorb capital. Obviously this should overlap with studies related to optimal rates of re-
source depletion under various conditions, including limited price information, etc. As yet, however, very little work has been done in this area. Returning again to the issue of capital accumulation, Van Wijnbergen (1982): optimal capital accumulation and investment over traded and non-traded sectors in oil exporting countries.

Another area which has received attention is the impact of resource booms on technological progress. In a very interesting work, Van Wijnbergen (1984) breaks new ground in the study of the Dutch Disease by investigating the degree to which the stagnation of the non-oil traded goods sector can be understood in the context of the Learning by Doing approach to development. He argues that the techniques have the ability to help may LDCs overcome technological constraints in the manufacturing sector, but as this sector stagnates, so too does the speed with which such technologies can be applied. He concludes that countries which choose to use windfall revenues to increase consumption in the short run must necessarily have to subsidize their non-oil traded goods sectors in the long run, if the Learning by Doing approach to technological development and innovation in the manufacturing sector is to be maintained.

b. General Commentary.

Obviously, the theoretical foundations on which theories of the Dutch Disease are built, draw heavily from the neoclassical growth models. Indeed, it could be argued that Dutch Disease theories are nothing more than an extension of the former. However, at least four important theoretical distinctions can be made. First, the Dutch Disease models are concerned with sectoral reallocation of factor of production, whereas neoclassical growth models have emphasized issues of reallocation at the broader macroeconomic level. Second, Dutch Disease models conduct analysis on the assumption that windfall revenues are spent rather than saved, while neoclassical models assume the reverse:
income is taxed away, saved, and invested, not consumed. This is important because the Dutch Disease formulation adds a dimension of realism sadly lacking in neoclassical versions; indeed, it is now quite apparent from real-world case studies that the overwhelming tendency in countries that undergo resource booms is to increase consumption, not investment. Third, theories of the Dutch Disease make explicit the key equilibrating factor determining the degree to which factors of production are sectorally reallocated, i.e. the real exchange rate, while neoclassical models have little use for exchange rate analyses. This issue, as well as those related to devaluation, inflation, etc. are fundamental to Dutch Disease studies, and it is here that the overlap between Dutch Disease models and export instability theories becomes apparent. And finally, while neoclassical models are largely based on Walrasian general equilibrium theories, most Dutch Disease approaches have made use of Marshallian partial-equilibrium formulations.

Also important is the fact that Dutch Disease theories have taken up some of the policy-oriented slack that export instability approaches, which while imminently qualified to deal with such issues, have generally disregarded. Dutch Disease approaches can also been seen as the balance between the strictly normative and theoretical formulations characteristic of the neoclassical growth approach, and the generally descriptive case studies offered by the political economists. Finally, although most of the studies in this segment of the literature have assumed that booms are the result of new resource discoveries and/or sustained price increases, there is no reason why we should not explore the emergence of booms under conditions of rapid changes in consumer demand.

4. Political Economy Theories.

Interest in the impacts of resource booms from the political economy perspective did not emerge as a strong research school until the late 1970s and early 1980s. Since then,
however, the number of articles published has increased substantially and the literature in this area now covers a wide range of subject matter. Not surprisingly, the underlying themes represented in this literature are the roles and responses of the state to natural resource booms, and the implications that such booms have had on issues ranging from the development of capitalism, to class formation and class consciousness, to imperialism and underdevelopment. As such, much of the literature is based upon Marxist tenants, and in particular the manner in which windfalls affect the process of accumulation. In addition, a growing literature on the effects of windfalls on the restructuring of the social and political fabrics of states has emerged, emphasizing explorations in corruption, bureaucratic restructuring, and materialism.

a. Representative Studies.

The political economy literature on resource booms are the result of contributions of numerous disciplines, among the most important being geography, political science, and sociology. Among the most important contributors is Watts (1983, 1986, 1987). In his first study (1986) he investigates the process of agrarian transformation in the Nigerian context, focusing on how petroleum windfalls have affected the relationship between large-scale agriculture, i.e., the "agrarian capitalists", and the peasant agriculture, concluding that the post-boom fiscal crisis has had a detrimental effect on agricultural accumulation as a whole, and for smallholders in particular. Richards (1986) argues that petroleum booms have engendered few substantive changes in the LDC agricultural economies, and that the impact of windfalls leads to little more than the development of "rent-seeking society" (see Kreuger 1979), in which urban accumulation, urban construction, and urban migration are the only substantive outcomes.
Andrae and Beckman (1985) explore the capitalist penetration of the Nigerian economy by foreign multinational wheat and bread companies, and argue that a Marxian interpretation of the Nigerian petroleum boom explains Nigeria's shift from a net food exporter to a net food importer over the course of the boom years (as domestic production was replaced cheaper food imports from abroad). Watts (1983) investigates the interrelationship between food production and famine in Northern Nigeria, and the petroleum boom, in the context of capitalist accumulation. Other studies on the political economy and Marxist interpretation of the Nigerian oil boom are given by Angaye (1985), Caccia (1983), Ekpo (1983), and Onoh (1983), and Toyo (1986). Further, it is clear that roots of much of the Marxian literature on the rural impacts of booming sectors can be found, albeit rather implicitly, in the literature on agricultural policy and agricultural stagnation, exemplified, for example, by Bates' (1984) book, Market and States in Tropical Africa: The Political Basis of Agricultural Policies.

In the context of the social reactions to natural resource booms, Barber (1982) investigates how Nigerians have responded to that country's oil revenue windfalls, popularly known as the 'petronaira,' and the extent to which changing attitudes have been incorporated into popular culture, especially literature and theater. She concludes that the perception among the rural and urban underclasses is one in which the petronaira has generated wealth for a small elite, and that such wealth was not the outcome of hard work, but a process of unproductive accumulation. Further, the windfalls are seen to have been used to promote policies of materialism and self-aggrandizement for the wealthy, as well as corruption, thereby loosening the moral fabric of the state. These beliefs are then reflected in the themes underlying popular plays and writing.
Schatz (1984) investigates the Nigerian economy's response to the petroleum boom by expounding two themes: first, he suggests that Nigeria has, since the oil boom, gradually developed into "inert" economy, in which the state and the state's bureaucratic structures have responded to the boom passively and that once such windfalls have been exhausted there will be no internal engine-of-growth to replace those lost oil revenue sources. He then attributes the development of this inert economy, i.e., "... the transition from an economy with a weak engine of growth to one with virtually no engine at all ..." (p. 54), to pirate capitalism. This form of capitalism, he argues, is based on one in which wealth is not created by investment in productive activities, but rather is captured by having access to the state resources, and by manipulating the state spending process. While the author makes no attempt to do so, the clear catalyst in this process of transformation to pirate capitalism is corruption, which is reinforced by other studies on corruption, e.g. Brownberger (1983). There are interesting studies yet to be conducted on the relationships between resource booms, corruption, and the expansion of black markets and informal segments of the economy, particularly as imports increase, and appreciation in the real exchange rates induces inflationary pressures.

Joseph (1978) provides yet another attempt to balance the social and economic costs of windfall inheritances, again the Nigerian context. In particular, the author is concerned with the extent to which the appearances of oil-induced development are indeed development, and that in the Nigerian experience there has simultaneously been both increased affluence and greater underdevelopment, with the elite benefiting from the former and the underclasses suffering the effects of the latter. Using various examples of oil's impacts on Nigerian socio-economic life, ranging from industrial policy, to the decline of agriculture, to corruption, he argues that the oil-boom has largely been a facade, a "myth" in the words of the author, and that in reference to the rhetorical questions posed
by Gelb, et. al. (1988) and van Wijnbergen (1984), Nigeria's petroleum boom has indeed been more curse than blessing, more disease than remedy.

b. General Commentary.

Political economy conceptualizations of booming sectors are the most recent of the four major approaches in the literature. Unlike the neoclassical growth models, export instability theories, and theory of the Dutch Disease, Marxian interpretations are cast in much more fluid theoretical terms. Further, the range of topical coverage is perhaps excessively broad, thereby reducing the cumulative impact of this approach in the overall literature (although criticism may be levied against any of the other paradigms). However, while the efforts may appear somewhat diffuse, the issues which are addressed are exceedingly important and have been largely disregarded by the other segments of the literature. Although it takes a good deal of time for the economic ramifications of resource booms and windfall revenues to work their way through the social and political fabric of the state, it is very clear the consequences can be devastating, and the political economists lucidly draw our attention to these declinations. Indeed, the Marxist perspective provides the more pessimistic real-world counterweight to balance the overly optimistic theoretical constructs of the neoclassicists; to political economists, resource booms are generally "bitter medicines," not the "elan vital". In addition, the scale of spatial resolution is much more refined, focusing on the impacts of resource booms at the regional and local levels, thereby making explicit fundamental interactions that broader macroeconomic analyses gloss over.

However, the political economy perspective suffers from a number of weaknesses. First, the investigations tend to be conducted on a case-by-case approach and as such generalizations on the impacts of booming sector on different state apparatuses are rarely pos-
sible, let alone the development of a broad theoretical framework in which to analyze re-
source booms. Yet this may be a curse as well as a blessing, since it brings to the forefront
the fact that the development of broad theoretical constructs in booming sector analysis
may be impossible because of contextual - social, political, temporal, spatial - variation. In
addition, the inadequacy for theoretical generalization in this school appears to parallel
the definitional constraints plaguing Dutch Disease formulations. A second weakness lies
in the fact that most of the studies are weak in terms of empirical analysis, and thus
fundamental trends and interrelationships between booming sectors and the state are
difficult to observe.

As a final note, it is important to realize that most of the conclusions reached in
this segment of the literature portend policy recommendations, yet few authors have actu-
ally proposed any such guidelines to remedy various socio-economic and socio-political
imbalances. In this regard, it seems that much of the concern of the political economists is
shared by those in the realm of the Dutch Disease researchers and that the chances for col-
laborative work appear ample. Overall, this is an important segment of the literature
because it brings to the forefront the fact that while economic conditions may be the cata-
lyst for inducing resource booms in the short run, in the long run the social, political, and
cultural dimensions of such booms are equally necessary to address.

C. Critical Analysis of the Literature.

The usefulness of the research literature, as a means of providing an adequate
body of information concerning the development, operation, and consequences of
booming sectors must, as with any other literature, be assessed on the merits of both its
strengths and its weaknesses. The purpose of this section is to provide a general summary
of some of the more important shortcomings inherent in the literature as a whole, and the
will not involve a critical discussion of either individual works or schools of thought. For the purposes of clarity, the major criticisms in the literature are divided into theoretical limitations, methodological limitations, a combined section on sectoral and spatial limitations, and finally, contextual limitations.

1. Theoretical Limitations.

Perhaps the most significant of the theoretical limitations in the literature on booming sectors is that it remains characterized by a broad series of individual case studies, albeit each of them couched in a specific paradigmatic or methodological framework. What is lacking, however, are any attempts to develop a unifying theme which could bring the various fragmented subschools of the literature into a cohesive whole. Further, this constraint does not appear to be drawn along disciplinary bounds; for example, much of the applied empirical work in economics is much more closely related, at least in theme, to the descriptive contributions made by the political scientists or geographers. This leaves the highly theoretical based works alone, without the any intra- or interdisciplinary overlap. What is needed appears to be a greater move towards the “closure” of the literature, that is, deliberate attempts to building research bridges across the various schools of thought such that a more general theoretical framework may result.

A second major problem in the literature is that lack of definitional rigor in the use of terminology corresponding with the literature. Few authors have made attempts to develop simple indices which might be used as a benchmark to determine when a sector of an economy is indeed “booming”, or when the rapid earning of foreign exchange revenues do indeed constitute “windfalls”. While the need for such definitions is probably less in the strong theoretical work, it poses problems in the area of applied research since it prevents useful comparative studies from being conducted. For example, how can we compare the
impacts of the Nigerian petroleum boom to the Venezuelan or Indonesian cases if we don't have a similar yardstick for comparison. While attempts to measure windfalls and their impacts have been made some by some, e.g., Auty and Gelb (1988), there still remains the need to test the usefulness of such measures as well as develop alternative indexes, such that a more useful and cross-comparable literature can evolve.

A final general constraint in the literature, particularly those theoretical formulations in the neoclassical growth models and the models of the Dutch Disease, is the static nature of the models. Very few authors have attempted to develop dynamic models of the Dutch Disease in which resource allocations are assumed to be functions of time, this impacts of which thus vary over the short, medium, and long runs. An excellent exception to this is the work by Bruno and Sachs (1982), in which the authors allow for short-run and long-run capital mobility, international capital flows over time, and intertemporal optimizing behavior by both firms and households. However, few have followed their lead. Obviously, allowances need to be made in the models for temporal, as well as spatial and other contextual dynamics, and their results investigated, if a more complete understanding of the complex operations of booming sectors is to be gained.

2. Methodological Limitations.

A second general category of criticism in the literature can be grouped under methodological limitations, in which four major weaknesses can be identified: a) the emphasis on value-based analysis; b) the assumption of parametric stability; c) the lack of simulation studies under alternative scenarios; and d) general issues related to data requirements.

In reference to the first point, there is a tendency in the applied literature to conduct analysis on booming sectors using value based data such as on commodity prices and
subsequent windfall revenue incomes. Studies which have employed monetary-based analyses in conjunction with booming sectors include those of Attiga (1981), Auty and Gelb (1986), Buiter and Purvis (1983), Carrada-Bravo (1982), Conway and Gelb (1983), Davis (1983), El Serafy (1981), Forsyth and Kay (1981), Forsyth and Nichols (1983), Gelb and Bienen (1988), Neary (1984), Stuckmeyer (1977), and Van Wijnbergen (1982a, 1982b). While such value-based studies are undoubtedly important, it is also important to note that problems of price indexation, currency appreciation and devaluation, inflation, etc. must all be accounted for if the data are to be meaningful. In contrast, there are very few studies in the literature which attempt to identify and investigate booming sectors on the basis of rapid and sustained increases in the volumes rather than the values of commodity exports. Yet this appears to be an area of research which can and needs to be exploited.

A further limitation, particularly evident in the applied empirical analyses is the assumption of underlying parametric stability of the models. Although this issue is discussed in greater detail in Sections V.E.1 and V.E.2, several general remarks will be made here. A recurring constraint in most social science modelling of real-world phenomena is the assumption that the value of the parameters of the models remain constant across spatial, temporal, and other contexts. However, as Jones (1987), Casettt and Pandit (1987), and others have pointed out, there is no reason to assume such parametric stability. This issue becomes even more critical in the context of modelling booming sectors as the very nature of these sectors are defined by erratic behaviors captured in boom-bust cycles. To make the assumption that the parameters of the models remain constant as various instabilities are introduced into these models, then, becomes questionable. As a consequence, the usefulness of various macroeconomic econometric models which have application to the booming sector phenomena, such as those developed by the World Bank (1975), may be weakened. The assumption of parametric stability is
likely to affect the outcomes of various models proposed by many others, including Timmer (1982), Dick et. al (1983), ul Haque (1982), Motamen (1979).

A third methodological weakness in the literature is the general lack of simulation studies or forecasting models. To date, most of the empirically-based studies on booming sectors have been used in an strictly explanatory capacity to assess the impact of a resource boom on such things as exchange rate fluctuations, unemployment, inflation, migration, etc. Representative empirical works which reflect this tendency of explanation include Davis (1983), Dick (1983), Attiga (1981), Gelb and Bienen (1988), and Kamas (1986). However, very few authors have made any attempts to either simulate the impacts of natural resource booms under a range of alternative scenarios, or to use simple models of booming sectors for predictive purposes. Exceptions to this are Kuyvenhoven's (1978) semi-input-output model of the Nigerian economy, Motamen's (1979) intertemporal macroeconomic planning model simulation for the Iranian oil economy, Taylor, et. al. (1985) macro model of the Nigerian economy, and Conway's (1982) fix-price equilibrium simulations of the Algerian petroleum economy. While explanatory models have provided us with a basic understanding of the mechanisms at work during resource booms, it is also clear that such booms have important planning and policy consequences and that much more work needs to be conducted in the area of simulation and prediction, if these important issues are to be addressed in a useful manner.

A final methodological criticism relate to data reliability issues. Obviously, a model will only be as good as the data available to generate it, and while not much of a concern in the context of MDCs where accurate records on a wide range of economic activity are generally kept, this is not the case in many LDCs. Indeed, various authors including Stolper (1966), Berry (1984), Watts (1987), and Gelb, et. al. (1988) have expressed concerned about issues ranging from poor data collection procedures, to problems of data
tabulation, to outright data falsification, as have major international organizations such as the IMF (1975).

This problem will not likely bring the outcome of results of studies at the national level into question, particularly when they relate to international trade activity, since alternative data sources often exist and can be compared with statistics published by governments. However, for studies conducted at the regional level, the implications are far more serious. For example, Kuyvenhoven (1978) constructed a semi-input-output (IO) table for the Nigerian economy which, presumably, could be used for analyzing various outcomes resulting from the Nigerian petroleum boom. However, he too, notes that the accuracy of the IO table is a function of the available data, and while "serious efforts to remedy this (lack of accurate data) situation are being undertaken... as of the end of 1977, no new results had been announced" (Kuyvenhoven 1978, p. 45).

3. Sectoral and Spatial Limitations.

A further set of weaknesses in the current literature falls quite generally under the category sectoral and spatial resolution criticisms, to which two limitations need to be addressed. First, the bulk of the literature on booming sectors concerns itself with analysis at the macroeconomic level. Whether positive or normative analysis, whether applied and theoretical, regardless of theoretical or ideological biases, the tendency in the literature has been to conduct research on booming sectors at the national level. This is evidenced by a wide range of works, for example Attiga (1981), Bartsch (1971), Bienen (1981), Eastwood and Venables (1982), El Mallakh (1984), Snape (1977), Stuckmeyer (1977), Svensson (1982), and Taylor, et. al. (1986). Although some studies have been conducted at the regional levels, for example Watts (1988), these have not only been few and far between, but they have generally lacked empirical analysis and/or have been studied such
from the standpoint of clear ideological biases. The need to conduct further studies of the economic and non-economic impacts of natural resource booms at the regional, local, and even household levels is an area of research that needs to be greatly expanded.

A second important sectoral bias in the literature is on the mineral sector in general, and the energy subsector in particular as the focus of research on natural resource booms. While certain non-energy minerals have been studied, for example gold by Cairnes (1857), Bordo (1975), and Maddock and McLean (1983), and copper by Lasaga (1981), the bulk of the research has emphasized two commodities: petroleum and natural gas. Obviously, the political and economic motivations for emphasizing research in these areas is clear. However, in the context of many countries, particularly LDCs, important economic booms can and have been induced in non-mineral sectors, particularly agriculture. While some authors have conducted research in the area of agricultural commodity induced booms, notably those of Davis (1983) and Kamas (1986), other commodities or services would also seem to provide excellent case studies, for example tourism, illegal narcotics, and offshore banking.

There exists, then, a need to reorient certain aspects of the spatial-sectoral research agenda to include an analysis of the workings of booming sectors at scales other than the macroeconomic level, and particularly the regional level, as well as the need to better understand the operation and consequences of natural resource booms induced by a wide range of non-mineral products, particularly agricultural commodities. By taking steps to expand the research agenda in these areas there is hope that we may develop both a more useful and more general theoretical framework in which to understand booming sectors.

The contextual criticisms of the literature can be divided into three major arguments: first, a tendency towards an overemphasis on the experience of the more developed countries; second, too much weight being placed on the economic causes and effects of resource booms; and finally, there general lack of comparative studies.

In reference to the former, we note that relatively little attention has been given to the effects of natural resource booms in Third World contexts, vis-a-vis that given to the MDC experience. Indeed, if we were to allocate the applied literature on booming sectors on the basis of economic orientation, at least three-quarters would be clearly MDC oriented. This is not to say that LDCs have been intentionally slighted; this is certainly not the case. Indeed, much of the "recent", i.e., early to mid-1980s literature has been dominated by studies on the Third World experience with economic booms, for example Auty and Gelb (1986), Conway (1982), Gelb and Bienen (1988), Kamas (1986), and Roemer (1983). However, given the fact that Third World economies are much more structurally fragile entities than their MDC counterparts, and as such the impacts of economic booms and busts have significantly greater social, economic, and political consequences, more resources need to be allocated to the understanding of the causes, effects, and remedies of such boom-bust cycles in the context of LDCs.

The second major contextual criticism in the literature is that the overwhelming majority of the studies have emphasized the economic circumstances surrounding natural resource booms, and the subsequent economic implications of such booms. In comparison, very little attention has been paid to the spatial, social, political, and cultural connotations which are also necessary outcomes. While some research has been conducted in these other areas, such as those of Andrae and Beckman (1985), Barber (198-), Commander and Peek (1986) Edogun (1985), Joseph (1978), Madujibeya (1982), Watts (1987, 1988), and
Watts and Shenton (1984), among others, the literature remains distinctly economic in orientation.

The final contextual criticism, levelled primarily at the applied literature, is the lack of comparative studies that have been conducted. Very few authors have attempted to understand the impacts of a cocoa price-boom on agricultural labor input reallocations among various cocoa exporting countries, or the effects of petroleum windfalls on rural-urban migration or the construction sector among various oil-exporting LDCs. Exceptions, do of course exist, for example Forsyth's (1986) comparative study of petroleum-induced structural change in the British and Australian economies, or Davis' (1983) comparative research on policy responses to price booms among various LDC coffee, tea, and cocoa producers. However, these exceptions are rare, and this lack of comparative study, then, has led to a proliferation of unique, applied case studies, without providing a broader theoretical framework in which to make intersectoral or international associations. While some of the responsibility for the lack of comparative analysis must certainly lie with definitional problems inherent in this area of research, this should not preclude further attempts to conduct such studies.

As with a need to reoriented research priorities towards the LDC experience, and the necessity to conduct more studies which emphasize the non-economic causes and implications of resource booms, there is also a necessity to conduct applied comparative studies, both cross-sectorally and cross-nationally.

D. Justification for Alternative Approaches, and the Place of the Study in the Context of the Literature.

Although the research literature on booming sectors has expanded dramatically in recent years, it is also evident that the literature contains significant weaknesses, many of which have been previously addressed. In light of these constraints, it appears useful to
propose and justify an alternative approach to the study of booming sectors. In reference to this, three specific arguments for alternative formulations will be given: a) the need to explore the relationship between and the impacts of a new booming sector upon a country's traditional generator of foreign exchange, i.e., the agricultural trade sector; b) the need to introduce various sorts of contextual variation into models; and c) the need to incorporate volume-based analysis into a literature dominated by value-based studies.

1. **Accounting for Intersectoral Interactions.**

In regard to the first point, it is clear from the literature that much of the research has focused on the fundamental mechanics, i.e., the operation of the booming sector, under various constraints and assumptions. This is exemplified in the neoclassical approach to booming sectors, but is also a fundamental theme in other segments of the literature. In the process of investigating this narrow range of concerns, the effects of a boom on other sectors of the economy is often glossed over (and, although the Dutch Disease models do attempt to address issues of sectoral reallocation, their primary focus has been on the impacts of booms on the secondary sector of the economy). Very little attention has been paid to the interrelationships between the booming resource sector, and the traditional, and non-booming generator of foreign exchange earnings for most countries, i.e., the agricultural trade sector. What this study seeks to do is to make a contribution in which, using a general booming sector framework, we explicitly investigate the interactions between the booming and non-booming sector in the context of the international trade arena. To my knowledge this has not been previously attempted using strict empirical analysis; in the context of Nigeria, a number of studies have observed these interactions in a descriptive manner, e.g., Pearson (1970), Folayan (1983), Onoh (1983), Andrae and Beckman (1985), Watts (1986), and Olawiyola (1987).
2. Introducing Contextual Variation.

In reference to the second point, no attempts have been made to investigate the manner in which booming sectors behave as the contexts in which they operate, change. It should be noted that this is a fundamentally different question than a mere comparative study; in such a case the focus would be on understanding the similarities and distinctions between two or more similar countries undergoing a boom involving the same commodity; this kind of approach has been taken by a number of authors including Struckmeyer (1977), Buitcr and Davis (1983), and Davis (1983). The current study, however, seeks to address how the behavior of a commodity boom changes as the parameters which define the boom and place the boom in context, are allowed to vary. These issues of parametric "drift" and contextual variation are explored in greater depth in Chapter V. However, another expected contribution of this study is to get at fundamental issues of the behavior of booming sectors, i.e., how booming sectors respond and impact other sectors of an economy as the environments in which they operate, change.

3. Analysing Volume-based Data.

The final point is rather self-explanatory and requires little elaboration. The vast majority of the empirical literature has focused on identifying and understanding booming sectors using data which is based upon the value of recorded commodity transactions. Among the many studies adopting this approach are those by Gregory (1976), Struckmeyer (1977), Motamen (1979), Davis (1983), Roemer (1983), Kamas (1986), and Gelb and Bienen (1988), and among others. Only a few studies have given attention to volume based figures e.g., Onoh (1983), Folayan (1983), Andrae and Beckman (1985), and Watts (1983, 1986); however, we've already noted the general lack of empiricism contained in these po-
litical economy approaches, and the value-based statistics these authors employ are usually only in support of more descriptive statements.

Yet it is clear that value-base data are subject to significant constraints, particularly when used: a) in the context of economic booms; and b) in the context of the LDCs. In reference to the former, there exist entire research literatures in the form of export instability theories and the theories of the Dutch Disease, which focus on the effects of booming sectors on everything from currency appreciation to inflation. When economies go through rapid expansions and contractions of the kind induced by economic booms, it has the effect of fundamentally altering currency values. Unless exceedingly careful attention is given to develop monetary indices to account for the effects of inflation, appreciation, devaluation, variations in global market prices, and a host of other problems, the usefulness of such value-based statistics can be all but meaningless.

In reference to the latter, the quality of government statistics compiled and distributed by LDC governments on the value of commodity transactions is often questionable, a point which has been expressed by many (e.g., Jones 1981). Volume-based statistics on the other hand, are generally less subject to scrutiny. Exports of the volumes of commodities are relatively easy to obtain, and can government statistics can often be compared to figures compiled by international agencies and organizations. Further discussion of data problems and issues is covered in Section V.I.4. In the context of this study, we seek to contribute to a growing literature on the use of volume-based data for investigations of booming sectors.

E. Summary.

This chapter has provided a general introduction to the existing literature on natural resource booms, and the place of this study in the context of that research
literature. We began with a review of the historical development of the literature, in which initial interest in booming sectors as a field of academic inquiry was traced to the narrative work of Cairnes' study 1857 Australian gold boom. The theoretical academic literature is found to be of much more recent vintage, having been introduced in the 1960s in response to the Dutch natural gas boom, and the subsequent stagnation of its manufacturing sector. In recent years, particularly since the 1980s, the literature has expanded rapidly, now encompassing a vast range of issues, both theoretical and applied, related to economic booms. In reference to disciplinary contributions, we note that studies on booming sectors are dominated by the work of economists, while those of other disciplines including geography, remain relegated to the margin of the literature, at best. The major theoretical approaches to the study of booming sectors, including neoclassical growth models, trade instability theories, linkage analysis, theories of the Dutch Disease, and political economy formulations were introduced, and examples of the kinds of work contributed by each of these schools were highlighted.

The remainder of the chapter was devoted to a critical analysis of the literature, in which major theoretical, methodological, and other weaknesses were noted. Among the points emphasized was the preponderance of highly abstract theoretical studies, particularly in the context of neoclassical and Dutch Disease models, in which extremely restrictive assumptions are made. At the other extreme, the political economy literature is characterized by a large number of very detailed case studies of the impacts of booms on the state and state structures, as well as an array of social, political, economic, and cultural issues. While useful, many of these works lack strict empirical analysis to support various claims. In light of the existing literature we note that "a middle ground", in studies are based on strong theoretical foundations while simultaneously testing, in an empirically rigorous manner, individual case studies of booming sectors, remains limited.
Finally, we note the place of this study in the broader context of the literature by noting the need to explicitly investigate three issues lacking from previous studies: first, the need to explore in greater detail the relationship between booming sectors and the traditional "engine of growth" for many LDCs, namely the agricultural trade sector; second, the need to introduce contextual variations into models related to booming sectors; and third, the need to overcome many of the problems introduced by value-based analysis by investigating the behavior between booming and non-booming sectors using volume-based data.
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<tr>
<th>PROBLEM FOCUS</th>
<th>NEOCLASSICAL GROWTH THEORIES</th>
<th>THEORIES OF THE DUTCH DISEASE</th>
<th>EXPORT INSTABILITY THEORIES</th>
<th>POLITICAL ECONOMY THEORIES</th>
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<tr>
<td>Analysis of the impacts of resource booms on the sectoral reallocation of classical factors of production, including land, labor, and capital resources.</td>
<td>Analysis of the impacts of resource booms on the degree of contraction and/or stagnation of non-booming traded sectors of the economy.</td>
<td>Analysis of the impacts of resource booms on the tradeoffs between the high and the temporary nature of resource boom windfall revenues.</td>
<td>Analysis of the impacts of resource booms on the socio-political aspects of resource booms, including their effect on the state, class formation, and social relations.</td>
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<td>Draws on a well-established literature in economics.</td>
<td>Concern for the effects of booming sectors on non-booming sectors.</td>
<td>Addresses the need to consider the effects of booms on the international trade sector.</td>
<td>Addresses the social and political effects of booming sectors on the economy.</td>
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<td>Theoretical strengths</td>
<td>Empirically testing of booming sector hypotheses in case studies.</td>
<td>Provides a theoretical link between the neoclassical and Dutch Disease theories.</td>
<td>An explicit concern for regional implications of booms.</td>
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<tr>
<td>Theoretical weaknesses</td>
<td>Value-based analyses.</td>
<td>Assumes an open economy.</td>
<td>Little overlap with other theoretical approaches.</td>
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<td>Highly abstract &amp; normative.</td>
<td>No disaggregation of non-booming sectors.</td>
<td>Analyses are static, not dynamic.</td>
<td>Few empirical tests.</td>
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Figure 7

Booming Sector Theory: An Overview of Theoretical Approaches in the Literature
IV. The Nigerian Setting.

The purpose of this chapter is to provide an overview of the Nigerian petroleum and agricultural sectors in order to place the analysis of the more specific oil-agricultural export interactions in a more appropriate and useful context. We begin with a discussion of the geographic and economic characteristics of Nigeria, followed by a more detailed discussion of the agricultural and petroleum economies. The major agricultural exports are identified including their modes of production and location. An overview of the development of the Nigerian petroleum industry is given. Finally, the contributions of agriculture and petroleum to the macroeconomy are given as a means of illustrating the rapid structural transformation which has occurred in Nigeria over the last thirty years.

A. General Characteristics.

Nigeria is, by virtually any measure, the economic and political giant of Sub-Saharan Africa. Its population of over 100 million (World Bank 1989) is the largest in Africa, provides both a large labor force and consumer market, and solidifies Nigeria's position as the premier regional power. The population is made up of over a hundred different ethnic groups, four of which are dominant: the Ibo in the Southeast (17.0% of the total
population); the Yoruba in the Southwest (20.0%); and the Hausa (21.0%) and Fulani in the North (9.0%). The total land area of 923,773 square kilometers makes Nigeria the thirteenth largest in Africa, and is bordered by Niger to the North, Cameroon to the East, Benin to the West, and the Gulf of Guinea to the South. Geographically, Nigeria can be divided into four East-West regions; moving from South to North, these are: a) coastal mangrove swamps, 10 to 60 miles wide; b) a region of tropical rain forest, 60 to 100 miles wide; c) a plateau of savannah and open woodland; and d) semi-desert in the North, which borders on the Sahel. A British colony since 1861, Nigeria achieved independence on October 1, 1960, and became a republic on October 1, 1963.

Figure 8
The Political Map of Africa
B. Phases in the Development of the Nigerian Economy.

The economic development of Nigeria prior to the discovery of petroleum was typical for an agriculturally-dependent, ex-colonial LDC and according to Collier (1983) post-independence Nigeria can be thought of as having passed through three distinct phases in the course of its economic development: a) the Colonial phase from 1861 to 1960, b) the import substitution industrialization (ISI) phase from 1960 to 1968, and c) the oil-boom phase from 1968 to the present.

1. The Colonial Phase.

The Colonial phase began with the arrival of the British in 1861 and continued until Nigerian achieved independence in 1960. This phase is important because it allowed for the initial penetration of British foreign capital and agricultural and transportation technology into the economy, which resulted in an economic growth pattern based on the production and export of unprocessed agricultural commodities and other raw materials, much like other European colonies throughout the world.

However, it is important to note that Nigeria is something on a colonial developmental anomaly: unlike most colonies, the British did not actively encourage large-scale plantation agriculture in Nigeria, as they had, for example, in Kenya, Ceylon, Burma, or Malaya. As Helleiner (1966, p. 44) notes

It was . . . not through foreign exploitation of . . . plantation enclaves, but, rather, through indigenous peasant responses to orderly economic incentives that Nigeria entered upon the world economy.

In reference to the oil palm for example, which is typically grown on plantations in countries such as Malaysia and Indonesia, Ekundare (1972, p. 281) states
Palm oil, (once) one of Nigeria's principal sources of export earnings, remained in the hands of individual farmers or families; plantations or estates accounted for only about 6-7 percent of Nigeria's output.

Although British policy favored smallholder production over large-scale plantation agriculture, the goal was very much the same: to produce basic primary commodities for export to European markets, and to further integrate Nigeria into the global capitalist economy. In this regard Collier (1983, p. 192) notes that the interest of the colonial government lay in encouraging smallholder production of export crops, thus supplying low-cost materials to the metropolitan Power and providing a market for industrial output.

The British colonial impact on the economic development of modern day Nigeria has been covered extensively (e.g. — ).

2. The Import Substitution Phase.

The second phase of economic development began at the time of independence in 1960. Like many other LDCs, particularly those in Latin America, Nigeria's primary post-independence goal was to achieve rapid and sustained economic growth. This led to the adoption of ISI, popularized during that era in the Latin American context.

Based on the conclusions drawn from studies by Raul Prebisch and the Economic Commission for Latin America (ECLA) it was noted that the terms of trade turn against exporters of primary commodities in the long run. The goal of ISI, then, is to shift the base of vulnerable agricultural exporting economies from the primary to the secondary sector quickly and deliberately, by imposing tariff barriers to keep imported manufactured items out of the local markets, which will in turn be substituted by
domestically produced industrial output. In the context of Nigerian ISI policies Bienen (1988, p. 232) states that

(it) was to manufacturing rather than to agriculture that politicians and planners looked for economic autonomy in the early 1960s. These first years of independence mark the beginning of a shift in the structure of manufacturing from processing traditional primary products for export to processing imported materials for the domestic market.

Numerous segments of Nigeria's secondary sector received protection from competition against inexpensive imported manufactures, including textiles, food processing, and metals and plastics fabrication. However, this was not an inexpensive proposition for in many cases the effective rates of protection for domestic industries was in excess of 100 percent. The ISI phase lasted until 1968, and during this eight year period the industrialization of Nigeria was financed largely through the taxation of agricultural exports by the marketing boards. In this regard, Collier (1983, p. 192) notes that

(the) first indication that (Nigeria's) successful (economic) performance was not evenly distributed throughout the economy emerges when growth is disaggregated by sector. The sectoral data . . . reveal that both during the import-substitution phase and during the oil boom, agriculture stagnated.

While it has not been investigated in any detail, it is possible that the heavy taxation of the agricultural sector during the ISI period provided the initial impetus for agricultural decline, and that the trend was only exacerbated and solidified by the discovery and export of petroleum. Collier (p. 206), again, states that

(i)n an economy in which growth of GNP has been very rapid, agriculture has in aggregate stagnated . . . The stagnation of Nigerian agriculture, and in particular the decline in export-based agriculture, during the phase of
import substitution industrialization is of no surprise to
development economists.

The industrialization program Nigeria had embarked on during this era was
supported with the massive windfall revenues she earned during the oil-boom phase
which followed after 1968.

3. The Petroleum Boom Phase.

The third phase of development, from 1968 to the present, is the oil-boom phase.
In many ways the path followed during this era is similar to the agriculturally-led growth
phase of the colonial era, in that Nigeria was reimmersed in the international economy.
The Nigerian oil industry is discussed in greater detail in sections IV.D.1 and IV.D.2., and
as such no further analysis is conducted at this juncture.

C. The Agricultural Economy.

Nigeria has an enormous agricultural production base, with a potential cropland
area of 91.1 million hectares, although only 23.8 million hectares (26.2 percent of the
total land area) are actually under cultivation. An additional 20.8 million hectares (20.8
percent) is in permanent pasture. Another 34.1 million hectares (34.1 percent) is in forest
and woodland, while 15.4 million hectares (16.9 percent) is comprised of land in urban
uses, is wasteland, or currently unclassified (Country Study, p. 147).

Nigeria's agricultural development remains very much an extensive rather than
intensive production process in which new lands can be converted to agricultural
production with relative ease. As of the mid-1980s the agricultural sector was comprised
of about five to six million individual farm families, with average land holdings ranging
from 0.5 hectares to 2.0 hectares, which together accounted for more than 90 percent of
Nigeria's total agricultural output (Country Study, p. 150).
The importance of agriculture to the health of the Nigerian economy has long been noted. Indeed, in what was in retrospect a very premature statement on his part, Helleiner (1966, p. 4) notes in reference to Nigerian agriculture that

No matter how much development and structural transformation is achieved (agriculture) will retain its relative dominance in the economy for many decades to come. More important, it is from agriculture, and in particular agricultural exports, that the economy has received its principal stimulus to economic growth.

While the importance of agriculture has steadily declined since the discovery of oil, it remains exceptionally important to the health of the Nigerian economy as a whole, particularly in terms of its contribution to employment and gross domestic product. In the following sections the importance of agriculture is highlighted, and a general outline of the major agricultural production zones and modes of production is given.

1. Production Zones.

Nigeria’s spatial patterns of agricultural production are very much a function of variations in regional climates and soil fertilities. In general, Nigerian soils are classified as being of low to medium productivity, and agricultural production can be subdivided into three general climatic-vegetative zones: the Northern grain zone; the Central mixed root zone; and the Southern tree crop zone (see Figure 9).

a. Northern Grain Zone.

The Sudan savanna vegetation of the Northern grain zone, also known as the “Grain Belt” or “Groundnut Belt”, is the driest agricultural region in Nigeria, much of it falling within the arid Sahel. The long dry season allows for the growing of millet, sorghum, soybeans, and maize for internal markets, and cotton and groundnuts for export.
b. Central Root Crop Zone.

The Central zone or "Middle Belt" is the transition between the northern and southern regions. The northern edge borders on the limits of the south's root economy, while the southern edge borders on the north's grain economy. In an area in which the Guinea savanna is the dominant, the Middle Belt is Nigeria's major domestic crop.
production of yams, cassava, and rice. Further, small quantities of sorghum, millet, and maize are grown. The only commercial (i.e., export) crop of any significance is the benniseed (or sesame), although it is unimportant vis-à-vis Nigeria's other agricultural exports and is not investigated in this study.

c. Southern Tree Crop Zone.

The Southern zone is characterized by a predominantly moist forest vegetation, in which there is abundant precipitation and a relatively short dry season; this translates into an ideal climate for the production of a wide range of tropical and subtropical crops. The agricultural economy of this southern region can be further subdivided into two major zones: the Cocoa Belt in the Southwest, and the Oil Palm Belt in the Southeast. In addition to these export crops, rubber, oil palm, coffee, and tropical hardwoods are also harvested. Bananas, once an important export before Nigeria's banana producing regions were seceded to what is today Cameroon, are grown in small quantities in the far southeastern corner of the country. Among the most important commodities produced in this region for domestic consumption are cocoyams, cassava, plaintins, yams, and sweet potatoes.

2. Modes of Agricultural Production.

One of the objectives of this study as outlined in section I.B.1 is to identify whether or not Nigeria's petroleum boom has had distinct impacts upon different subsectors of the agricultural export economy. In order to identify any differential impacts it is necessary to disaggregate the export agricultural sector by mode of production, i.e., agricultural production techniques. In the Nigerian case, agricultural technologies can be classified into three general types: a) labor intensive production, b)
capital intensive production, and c) non-cultivated or tree-crop production. The characteristics of production are outlined diagrammatically in Figure 10, on page 113.

Given these modes of production, certain hypotheses relating to the impacts of petroleum exports and windfall revenues on their relative performance can be investigated. For example, one could argue that the petroleum boom is likely to have had positive impacts on capital intensive agriculture, as windfall revenues from oil sales were channelled back into agricultural production methods which were already highly capitalized. Similarly, one might also argue that heavily subsidized, labor intensive crops were hurt by the oil boom, since there was no longer a viable rationale for expensive government subsidies to farmers for crops whose foreign exchange potential could be replaced quickly and inexpensively by petroleum. The general characteristics of each of the modes of production are summarized in the following sections.

a. Capital Intensive Subsector.

Capital intensive agricultural production is commonly associated with one of two kinds of agricultural activities: a) the plantation or monocultural agricultural system, which has received a great deal of attention, e.g., Udo (1965, 1982), Harrison (1969), Grigg (1974, 1980), Courtenay (1980), and Graham and Floering (1984); and b) agroprocessing, or increasing the value added of raw agricultural commodities through simple processing of the commodity into a more refined form. Unlike most colonies, Nigeria never developed into a monocultural economy; indeed British colonial policy actually discouraged the establishment of plantations as noted in Onyemelukwe (1983), Collier (1983), and Udo (1965, 1967). As a result of this discouragement, commodities produced on plantations currently account for very little of Nigeria's total agricultural output: about 5 percent of rubber, 3 percent of cocoa, and 3.5 percent of palm produce in 1985.
The reasons for Nigeria's lack of adopting plantation agriculture on a large scale are complex. Eicher (1969, 1970), for example, states that strong ethnic and tribal bonds made the establishment of plantations impossible and thus British colonial agricultural policy concerned itself more with establishing a viable transportation system for the movement of agricultural commodities from the interior to ports along the coast.

However, it is interesting to note that attempts were made by the Nigerian government to expand the role of the plantation system in the economy after independence, perhaps as a means of reducing the relative importance of ethnicity among the various geographic regions. Further, it should be noted that capital intensive agriculture was vigorously supported and pursued in the wake of the petroleum boom and windfall revenues. As Bienen (in Gelb, et. al., p. 245 states)

All through the 1970s government policies affecting agriculture were contradictory ... Instead of funds going to existing smallholder activities ... they were used largely to promote the growth of large-scale, mechanized, parastatal farms.

Among the crops the Nigerian government targeted for plantation production was the oil palm. In addition, the government promoted a policy of shifting the process of extracting oil from the palm kernels from the traditional labor-intensive methods (largely performed in the villages using female labor) to capital-intensive, mechanized "pioneer mills". By adopting capital intensive extraction techniques it was estimated that an additional 85 percent of the oil could be extracted from the palm kernels, vis-a-vis conventional labor intensive methods. However, these attempts to capitalized the pal oil industry were largely unsuccessful; as Olaloku (1979, p. 73) notes these mills

... met with great opposition from the women-folk who feared the inevitable loss in their traditional share of the proceeds of the oil palm economy.
Capital-intensive agroprocessing activities are much more common in Nigeria than are plantations. Indeed, many of Nigeria's important agricultural commodities undergo basic processing through mechanized operations prior to export. In the context of this study, three agricultural commodities fall under the category of capital intensive production: oilseed cake, groundnut oil, and sawn wood. It should be noted that palm oil and rubber, two crops which are often associated with capital intensive production in other countries such as Ghana, Malaysia, and Indonesia, are generally produced using labor intensive techniques in Nigeria.

b. Labor Intensive Subsector.

Labor intensive agriculture has always been the dominant mode of production in Nigeria and the output provided by the agricultural peasantry did, prior to the discovery and export of petroleum, serve as the primary generator of Nigerian foreign exchange. Even under colonial rule, labor intensive agriculture was of primary importance, as noted by Watts (1988, p. 467) who states that the

... material basis of the Nigerian colonial economy was provided by the export commodity production from an indigenous peasantry, principally cocoa in the West, palm oil in the East, and groundnuts and cotton in the North.

Labor intensive agriculture in Nigeria is characterized by high labor inputs vis-à-vis capital inputs, and generally low levels of agricultural technology. Most farms are small (between 0.5 and 1.5 hectares) and are generally highly diversified in their mix of crops for family, domestic, and export consumption, as a means of minimizing risk. As with other highly agriculturalized LDCs, labor intensive production can be further subdivided into subsidized and non-subsidized production. Usually instituted in the form of floor and ceiling prices, agricultural subsidies serve to increase small-holder
production of targeted crops by guaranteeing the farmer a minimum income; essentially subsidies serve two purposes: first, they reduce the perception of risk for the farmer, and second, they increase the output of specific commodities and hence the government's foreign exchange receipts from their sale on global markets; cocoa and groundnuts have traditionally been heavily subsidized by the Nigerian government. Non-subsidized commodities in Nigeria are less important in terms of output and foreign exchange receipts than are subsidized crops; cotton, coffee, and benniseed (sesame) all fall under the category of non-subsidized labor intensive agricultural production.

c. Non-cultivated (Tree Crop) Subsector.

Perhaps the most problematic of the agricultural production techniques are the non-cultivated crops. The term 'non-cultivation' is not meant to imply that farmers do not take care in the cultivation and harvesting of these crops, but rather that the production technology involves very few labor, and virtually no capital inputs. Occasionally this type of agricultural production has been referred to as 'wild' cultivation. In the context of Nigeria non-cultivated production occurs with two crops: a) with the production of tropical hardwoods or timber, which until a recent ban on their cutting and export were primarily harvested in the country's national forests and parks; and b) the oil palm, which is often found at the edges of villages and towns.

D. The Petroleum Economy.

The development of the petroleum economy of Nigeria has received significant attention by Schatzl (1969), Pearson (1970), Olaloku (1979), Onoh (1983), Olawiyola (1987), and Gelb and Bienen (1988), among many others. Although the petroleum-induced structural economic transformation of Nigeria is a relatively recent phenomena, the search
<table>
<thead>
<tr>
<th>COMMODITY CATEGORY</th>
<th>SUBCATEGORY</th>
<th>CAPITAL INPUTS</th>
<th>LABOR INPUTS</th>
<th>COMMODITIES</th>
<th>GEOGRAPHIC REGION of PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPITAL INTENSIVE</td>
<td>none</td>
<td>large</td>
<td>small</td>
<td>groundnut oil, oilseed cake, sawn wood</td>
<td>northern, southern</td>
</tr>
<tr>
<td>LABOR INTENSIVE</td>
<td>Subsidized</td>
<td>large</td>
<td>large</td>
<td>cocoa, groundnuts</td>
<td>southern, northern</td>
</tr>
<tr>
<td></td>
<td>Non-subsidized</td>
<td>small</td>
<td>large</td>
<td>coffee, cotton, palm oil, rubber</td>
<td>southern, northern, southern</td>
</tr>
<tr>
<td>NON-CULTIVATED or TREE CROPS</td>
<td>none</td>
<td>none</td>
<td>varies*</td>
<td>palm kernels, timber</td>
<td>southern</td>
</tr>
</tbody>
</table>

* = labor inputs at specific times of the year, such as harvesting, may be high.

Source: compiled by author based on FAO (1965), Udo (1970), Folayan (1983), and Mountjoy and Hilling (1988)

Figure 10
Production Characteristics of Nigerian Agriculture
for oil in Nigeria extends back to the early part of the century when, in 1908, the German-owned Nigerian Bitumen Corporation drilled the first wells. Although they were dry, the search for oil continued unabated, with minor interruptions during World Wars I and II. In 1951 the Shell-British Development Company of Nigeria began to concentrate drilling efforts near the Southern coast of Nigeria, and in 1956 the first oil was struck at Oloibiri in the Niger River Delta. Commercial exports began in 1958, and immediately after independence the Nigerian government began its search for offshore deposits along the continental shelf, leasing twelve 1,000 square mile tracts to multinational petroleum corporations. The first offshore discoveries were made by the Texaco Overseas Petroleum Corporation in 1964, and today oil from offshore wells account for one-third of Nigeria's total petroleum exports.

1. The Development of the Nigerian Petroleum Industry.

Following the discovery of petroleum, four major developments can be identified which have had a fundamental impact upon the restructuring of the Nigerian economy. The first was the formation of the Nigerian National Oil Corporation (NNOC) in 1971, in an attempt to vertically integrate the petroleum industry, to include a range of activities from exploration, to drilling, to transportation, to refining and marketing, in an attempt to reduce foreign control of Nigeria's petroleum resources. The second development was the acquisition of majority interest (i.e., 51% or more of the shares) in foreign petroleum companies, not only to reduce foreign control but also as a means of exerting greater pressure on the companies to generate additional oil-based revenues in the form of royalties, taxes, etc. Third, Nigeria's admission to the Organization of petroleum Exporting Countries (OPEC) in 1971, was a critical factor in not only bolstering Nigeria's status as the region's economic power by belonging to a successful international cartel, but it also
allowed Nigeria the opportunity to participate in the sharing of the massive windfalls, the petrodollars, that would soon fill the government coffers. And finally, largely as a result of membership in OPEC, Nigeria benefitted from the petroleum price increases of the early seventies, in which a barrel of heavy Nigerian crude increased from 3.17 dollars per barrel in January of 1972, to 8.17 dollars per barrel in January of 1973, to 14.69 dollars per barrel in January of 1974.

2. The Life-Cycle of the Nigerian Petroleum Industry.

In reference to the petroleum industry, Olawiyola (1987) introduces the concept of the life-cycle to analyze the Nigerian experience in the same manner that Levitt (1966) applied it to marketing, and Brigham (1979) applied it to capital budgeting aspects of financial management. Specifically, Olawiyola suggests that the Nigerian petroleum industry can be described in four stages: development, growth, maturity, and saturation or decline. These various cycles are captured in Figure 11 on the following page.

The development stage is said to have begun in 1958 and lasted until 1963. During this period, petroleum had just been discovered, it was a small industry controlled largely by foreign interests (particularly Shell-British Petroleum joint ventures), and made negligible contributions to the economy. Exports were small, accounting for less than three percent of the total value of exports, and were limited to markets in Britain and Holland.

The growth phase of Nigeria's petroleum industry lasted from 1964 until 1969. This era saw the rapid development of the industry, additional exploration, and exports increasing from 4.0 percent to 56.0 percent of the value of total exports. In addition, the market expanded to include the United States, Argentina, France, Canada, West Germany, as well as initial market penetration in the region with exports to Ghana.
The maturity stage from 1970 to 1980 saw a reduction in the fervor with which new fields were explored, but an increase in the intensity with which producing fields were exploited. Oil exports rose from about 57.0% to over 95.0% of total exports, and new markets in Japan were added. The United States became Nigeria's largest market, and additional regional markets were added in Benin, Chad, Niger, and Togo. According to Olawiyola, this stage was a critical stage for the Nigerian economy, because oil windfalls allowed for diversification of the economy, including re-investment in the agricultural sector; however, evidence suggests that such diversification did not occur.

Source: Olawiyola (1987, p. 174)

Figure 11
The Life Cycle of the Nigerian Petroleum Industry

The fourth stage began in 1981 and has continued until the present. While Nigeria had some control over its destiny in the previous stages, this era of saturation and decline is largely determined by exogenous economic forces. In particular, three events seem to
on individual production quotas; second, increased production by non-OPEC members
leading to an over-supply of petroleum in the global market; and finally, a reduction in
global oil consumption, particularly in the industrial West. In the context of Nigeria,
production dropped to a low of 0.6 million barrels per day, although OPEC quotas for
Nigeria allowed for pumping of up to 1.3 million barrels per day. In addition, petroleum
export revenues fell from 13.99 billion naira in 1980, to 7.78 billion naira in 1983, a decline
of over 44 percent over a three year period, while the value of petroleum in total exports
fell from 96.0 in 1980 to slight under 90.0 percent in 1987.

E. Agricultural Stagnation and Decline.

The stagnation of Nigerian agriculture over the past three decades been well
Joseph 1978, Madujibeya 1976, Watts 1987 and 1988). Not surprisingly, the most often
cited culprit of Nigerian agricultural stagnation is the rise of the oil economy. As Onoh
(1983, p. i) states

(unttil 1960 Nigeria was little known as a world producer of
oil. She was known rather as a producer of cash crops such
as palm produce, groundnuts, cocoa, cotton and timber and
her export earnings depended on these products. Then
suddenly Nigeria became a world producer of oil and the
traditional sources of income were neglected. Policy-makers
paid lip service to the diversification of Nigeria's economy
and reiled heavily on oil revenues for carrying out the
country's development programmes.

In similar fashion, Olaloku (1979, p. 12) states that the decline of the importance of
the agricultural sector

... can be explained by the greater diversification which has
taken place in the economy. In particular, the phenomenal
growth of the mining ... sector has been a major factor...
The neglect of the agricultural sector in the past has been a contributory factor, given the fact that considerable resources have been devoted to other sectors in the belief that these 'new' sectors were the economy's 'leading sectors.'

Collier (p. 192) notes that

The first indication that (Nigeria's) ... economic performance was not evenly distributed throughout the economy emerges when growth is disaggregated by sector. The sectoral data ... reveal that both during the import-substitution phase and during the oil boom, agriculture stagnated.

Any number of measures can be used to trace Nigeria's agricultural decline. For example, Nigeria's index of per capita agricultural output has declined from 100 in 1970, to 79 in 1985, while the average value for LDCs as a whole increased annually from 100 to 107 over the same period. This trend is captured in Figure 12 below.

![Average Annual Indexes of Per Capita Agricultural Output: Nigerian and LDC Averages: 1970-1985](image-url)
By and large, the consensus is that the decline of Nigerian agriculture in general, and export agriculture in particular, can be directly and indirectly attributed to the simultaneous dominance of petroleum in the economy. For example, Olawiyola (1987, p. 110) notes that:

Agriculture, which grew at an average annual rate of only 1.3 percent during the 1960s, did not grow during the 1970s and, in fact, recorded a negative annual growth rate of 1.5 percent. Agricultural products constituted over 80 percent of total exports in 1960; by 1970, 44 percent; and by 1978-79, only 6 percent of the total. "No doubt the phenomenal growth of the petroleum sector contributed to this decline.

Similarly, Joseph (1978, p. 230), in reference to the period between 1970 and 1980, states:

A near parallel over the past decade to the boom in oil production and export earnings in Nigeria has been the decline of agriculture in the generation of national wealth.

Iyegeha (1989, p. 17) also notes:

Agriculture, which is the mainstay of the continent's population, is in complete disarray. Nigeria, a country which was self-sufficient in food in the 1950s, 60s, and early 1970s has been unable to feed itself since the mid 1970s. Production of all agricultural products has declined. Land area under cultivation in 1981 was less than one-half that of 1965, although the country was once a world leader in exporting several agricultural products, most of which no longer find their way to the export market. The country engaged in substituting domestic production with imported foodstuffs and spent enormous amounts of money importing food that could be produced locally. It even imported some of those same products it used to export. This decline in agricultural activities coincides with the period in which the country became a leading petroleum exporter. With the potential of a more lucrative petroleum export market, the country turned its back on the more lasting agriculture resource base, whose population mass migrates to the cities to share the oil money there.
Finally, Bienen (in Gelb, et. al., 1983, p. 227) says that

By the end of the (1970s) decade Nigeria was widely cited as suffering acutely from the 'oil syndrome.' Non-oil exports had collapsed, (and) the relative size of the agricultural sector was declining sharply . . .

While the massive increase in oil exports is undoubtedly the single most important factor in the decline of Nigerian agriculture, to suggest that petroleum alone is the culprit is oversimplifying an extremely complex set of interactions. As such, other causes of agriculture's stagnation continue to be actively debated among scholars. Folayan (1983) notes a wide range of human-related problems afflicting Nigerian agriculture including inadequate crop storage, rapid urbanization, poor infrastructure, low levels of education among farmers, rapid population growth, inefficient land tenure, and rapid population growth; in addition, he lists a number of environmental causes, chief among them inadequate precipitation, and low levels of soil fertility. Olaloku (1979) notes that the government's Third Development Plan lists eleven major causes of agricultural stagnation, including a lack of qualified labor, few inputs and extension services, inadequate credit, disease and pest infestation, a lack of appropriate technology, seasonal labor shortages, and the "drudgery of farm work" (p. 19).

However, it is important to note that even in these contexts, the dominant effect of petroleum on accelerating the decline in Nigerian agriculture cannot be overemphasized. Even Watts (1988, p. 489) suggests this by stating, in the context of the drought of the early and mid-1970s, that the "...famine of 1973-74 simply highlighted an already crisis-ridden agrarian economy" and also noted that by the end of Nigeria's second Development decade plan (1970-75), "the agricultural export commodity sector had quite literally disintegrated" (p. 471) due to governmental pricing policy, and an increased demand for labor in other sectors of the economy (due primarily to oil-boom induced construction activity).
F. Sectoral Contributions.

This section seeks to highlight the fundamental structural economic transformation that took place between 1965 and 1970. As with many LDCs, the agricultural sector has historically been the primary "engine of growth" for the Nigerian economy, making substantial contributions in a variety of ways. However, fundamental shifts in the structure of the economy took place with the discovery of petroleum. This kind of structural economic change can be captured by various indicators, including: the contribution of each sector to contribution to the gross domestic product (GDP), the value of foreign exchange earnings and changes in the composition of exports, changes in the balance of trade, and the restructuring of the labor force.


A further indication of structural economic transformation is to observe changes in sectoral contributions to the gross domestic product (GDP) over time. GDP is simply a measure of the market value of commodities produced by a national economy over the course of a given period of time, normally one year. In the context of Nigeria, the agricultural sector generated 68.8 percent of the GDP at the time the first oil discoveries were made in 1958, and that sector's contribution declined only slightly to 65.2 percent at the time of independence in 1960; these trends are captured in Figure 13, on the following page.

This trend towards a marginal decline in agriculture's share of the GDP continued for much of the next decade. Indeed at the beginning of the oil crisis in 1972 agriculture still comprised 43.0 percent of GDP; however, only one year later, at the end of the oil crisis in 1973, the share of agriculture had declined precipitously, to only 27.6 percent of GDP. By now it was clear that petroleum, not agriculture, was the primary generator of
economic growth in the Nigerian economy. The agricultural sector continued to post declines in its share of the contribution to GDP, dropping to only 15.2 percent of the total by 1985, the year for which latest figures are available.

![Share of Agriculture in GDP](image)

**Figure 13**

_Agriculture's Share of the Nigerian GDP: 1950-1985_

2. Foreign Exchange Revenues.

The bulk of Nigeria's foreign exchange revenues have traditionally been accounted for by exports of a wide range of agricultural commodities. Indeed as early as 1958, agricultural commodities accounted for 99.3 percent of the value of the country's total exports (see Figure 13). Even at the time of the first exports of petroleum in 1960, agriculture still accounted for a full 97.3 percent of the value of exports, while petroleum accounted for only 2.6 percent. However, in 1970 the total value of Nigeria's exports was
886 naira with petroleum exports accounting for 57.5 percent of the total, and agriculture only 42.5 percent. This trend in the decline of the importance of agriculture continues: of the 4,791 million naira worth of exports in 1975, petroleum accounted for 96.0 percent, while agriculture comprised only 4.1 percent; by 1980 the percentage of petroleum in total exports peaked at 95.6 percent of total foreign exchange receipts of 13,999 million naira, while agriculture dipped to its lowest percentage ever at 4.3 percent of the total. The most recent data reveal the mid-1980s slump in the global petroleum market, and as such Nigeria's total foreign exchange revenues total 8,427 million naira for the year, of which 92.3 percent and 7.6 are petroleum and agriculturally-generated, respectively.

3. Employment.

Perhaps one of the most revealing statistics by which we can gauge the structural transformation of an economy is the change in the sectoral allocation of the labor force. In particular, let us divide the labor force into three sectors: the primary (agricultural) sector, secondary (industrial) sector, and tertiary (service) sector. In the context of Nigeria we note that the percentage of the labor force directly engaged in agriculture has declined both consistently and substantially since the oil boom, from 77 percent in 1960, to 56 percent in 1975, 54 percent in 1980, and 22 percent in 1985 which is the last year for which statistics are available (see Figure 15). This decline in agricultural employment is matched by a dramatic increase in the percentage of the labor force in the secondary and tertiary sectors.

On the other hand, employment in industrial occupations increased from only 10 percent of the labor force in 1960, to 17 percent in 1975, to 19 percent in 1980, and to a high of 39 percent in 1985. In addition, the percentage of the labor force in services grew from 19 percent in 1960, to 27 percent for both 1975 and 1980, to a high of 39 percent in 1985.
The bulk of this structural shift can be attributed to rapid rural-urban migration resulting from the adoption of import substitution industrialization policies, and rapid increases in construction-based activities in urban regions, both fueled by petroleum windfalls.

Figure 14
Sectoral Composition of Nigerian Exports: 1950-1985

Figure 15

The severity of the stagnation of the Nigerian agriculture following the petroleum boom is probably most clearly evidenced in the massive increase in food imports from abroad. Although various attempts have been made to trace the causes of this trend (e.g., drought, rural-urban migration, etc.), the most plausible explanation is that the inflow of windfall revenues from petroleum exports led to an appreciation of the exchange rate; since policies to devalue the naira vis-a-vis other currencies were not implemented quickly, indeed in many cases devaluation was actually discouraged, it became less expensive to purchase food from abroad than to produce it domestically. Nigeria's food import crisis has been studies by numerous researchers including Andrae and Beckman (1985), and Folayan (1987).

While Nigeria has always been an importer of certain agricultural commodities and food items, it is only recently that its status has changed to that of a net food importer. At the time of independence in 1960 the annual value of food imports was 45.00 million naira, and while the expenditures on food imports varied from year to year, they reached a low of only 28.39 million naira in 1968. A pattern reflecting annual increases in the value of food imports began in 1969 at 41.73 million naira, reaching a high of 1820.22 million naira in 1981. Although dropping slightly to 843.56 million naira in 1984, both 1985 and 1986, for which the latest figures are available, once again reflected increases to 1134.08 and 1287.34 million naira, respectively. Nigeria's food import trends between 1960 and 1986 are captured in Figure 16 on the following page.

G. Summary.

This chapter has served as a general introduction to the social, economic, and geographic conditions of Nigerian in order to place the study in a more useful contextual
framework. An overview of the structure of the post-independence Nigerian economy is given, including the historical importance of the agriculture and agricultural exports. This sector is then disaggregated by capital, labor, and non-cultivated modes of production, and the main agricultural producing regions of Nigeria's most important agricultural commodity exports are noted. Various statistics, including agriculture's contribution to GDP, foreign exchange receipts, and employment, and the trend towards increased food imports from abroad trace the rapid transformation of the economy from an agricultural to a petroleum base.

A case is presented to support the contention that much of the decline in both domestic and export agriculture in Nigeria can be directly and indirectly attributed to the rise, and ultimately dominance, of the petroleum sector in the Nigerian economy. In this regard, Madujibeya (1976, p. 311) states that "... in spite of the so-called oil
boom, the bulk of the rural population remain unaffected by it," while Bienen (in Gelb, et. al., 1988, p. 228) notes that in the wake of the petroleum boom "... there was little pressure to use oil revenue to improve the productivity of traditional agriculture."

However, while the stagnation of Nigeria's agricultural is paramount, it must be remembered that the Nigerian economy as a whole was seen as falling victim to the petroleum boom (see Sections II.D.1 through II.D.4); in the words of Onoh (1983, p. 84),

"the discovery of oil gave rise to emotions of pride and joy in terms of what the discovery meant to the health and development of the Nigerian economy. But it led the country into false expectations, uncoordinated planning, staggering projects and miscalculation. The boom has turned to doom."
CHAPTER V
METHODOLOGY, MODEL FORMULATIONS,
AND MODEL INTERPRETATIONS

V. Methodology, Model Formulations, and Model Analysis.

This chapter introduces the expansion method, the methodological approach adopted in this study. The origin and purpose of the expansion method is given, a review of the literature is provided, and the justification of the expansion method for the study of booming sector is discussed. Two expansion models — one linear, and one quadratic — are developed, in which the interactions between Nigerian agricultural and petroleum interactions over time, can be analyzed. The theoretical bases of these model formulations and their respective interpretation in the booming sector context is given. The chapter concludes with a review of the data sources, data problems, and the statistical tests and procedures used in the study.

A. The Expansion Method.

First introduced by Casetti (1972), as a methodological technique the expansion method provides a mathematical routine for investigating how the parameters of models change, or drift, as contextual variations are introduced. The concern for introducing contextual variations and examining parametric drift in models is important because the
conventional approach to modeling in social science has been focused on a clearly
defined and strictly limited set of concerns. These concerns have primarily been the
identification of appropriate variables to include in models, the organization of
appropriate variables into useful model structures, the estimation of model parameters,
and the recalibration of models in order to improve explanatory or predictive capacities.

In this conventional modelling process, social scientists have implicitly assumed
that the models they use remain stable and invariant, regardless of the contexts in which
the models are applied. In other words, once a useful model is formulated and specified,
it can be applied over a wide range of spatial, temporal, and other contexts, without
concern as to whether or not the model itself remains stable as the characteristics which
define these contexts change. In reference to this point, Casetti (in Mandal, ed., p. 81)
states that

(m)ost of the attention of . . . scholars working with models
tend to be focused on parameter estimation, or on extracting
the implications of propositions formalized into specific
mathematical models, or on producing models required by
the pursuit of specific research leads within a disciplinary
context.

Further, Casetti and Pandit (1987, p. 335) note that

... parametric stability tends to be an untested assumption
(italics are the author's) rather than a conclusion from
unsuccessful searches for it. In many if not most cases,
assumptions of parametric stability are unwarranted
because social science models are usually portraits of
sub-systems that are likely to drift across contexts.
Questions concerning contextual drift need to be addressed
and answered if we wish to evolve models more useful and
more representative of complex realities.

Finally, Jones (1987, p. 286) notes that
(mathematically oriented social scientists tend to assume the contextual invariance of their models without testing for it . . . they construct mathematical models and estimate their parameters under the presupposition that these models will hold identically in every context. In fact, most researchers assume either implicitly or explicitly that their models' parameters are "stable" and will not "drift" across environments.

Thus, our conventional modeling approaches suggest that once an appropriate model has been correctly formulated and specified, it can be applied across a wide range of contexts. In general, we assume — implicitly rather than explicitly — that social science models conform to the same fundamental laws of nature that models in the physical sciences do, and can therefore be applied universally. However, as Casetti and Jones (1987, p. 286) state,

... the quest for the social counterparts of the law of gravity has not proven to be a fruitful pursuit. Social science models are not the expression of universal laws, but rather mathematical portraits of empirical regularities and/or of subsystems that tend to vary across "contexts".

The problem, then, is how to overcome the contextually static nature of social science models. Two solutions appear possible: a) the continued search for fundamental laws of human behavior, in order to "discover" the social science equivalents of the physical laws of the universe, although as numerous attempts to render such universal laws operational in the geographic, economic, and other social sciences have shown, this does not appear to have been a particularly useful pursuit; or b) to develop the methodological tools necessary to understand how models "drift" across contexts.

The latter is essentially what the expansion method has addressed. This technique provides us with not only the methodological tools necessary to conduct investigations related to parametric drift, but also gives us the conceptual framework necessary to render such investigations meaningful. Indeed, the expansion method allows the weaknesses in-
herent in social science modeling — the uniqueness of specific contexts embedded within model structures — to be transformed into a fundamental strength.

B. Operationalizing the Expansion Method.

To operationalize the expansion method for modeling purposes requires three steps: a) defining an initial model; b) introducing appropriate expansion equations; and c) constructing a terminal model by replacing the expansion equations into the terminal model. These steps are discussed in greater detail below.

The initial model is the starting point, in which a functional relationship between a dependent variable and one or more independent variables is suggested. Once this has been done, we develop expansion equations by expressing the parameters of the independent variables in the initial model as a function of another set of variables; that is, the parameters in the initial model are "expanded" as functions of other variables. We can think of the expansion equations as capturing the manner in which the initial model drifts across contexts. Finally, the expansion equations are replaced in the initial model, with the result that each of the parameters in the initial model is now described by a more detailed subset of expansion equations. The terminal model, then, encompasses both the fundamental model structure expressed by the initial set of variables, and the manner in which the initial model drifts across contexts as captured by the expansion equations.

From this point, the parameters of the terminal model can be estimated, and analysis and interpretations corresponding to the nature and scope of the research problem can be addressed. An example of the procedures whereby an arbitrary n-variable expansion model is generated, is given on the following pages.
1. Initial Model.

The variables to include in the initial model, and the structural relationship among the variables will depend on the particular phenomena being studied. Assuming a functional relation between a single dependent variable and \( n \)-independent or explanatory variables, we can express the relationship as

\[
Y = f(X_1, X_2, X_3, \ldots, X_n)
\]

(1)

If the nature of the functional relationship between \( Y \) and the \( X \)'s is intrinsically linear, we could cast the nature of the relationship as a simple linear regression model, for example,

\[
Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 \ldots + a_n X_n + e
\]

(2)

where the \( Y \) is the dependent variable, the \( X \)'s are the independent variables, the \( a \)'s are the parameters to be estimated, and \( e \) is the stochastic error term.

It should be noted that there is no reason why we should restrict ourselves to the linear case. Various studies employing the expansion method have incorporated non-linearities in the initial models (e.g., Casetti, 1973; Casetti and King, 1975; Casetti and Gauthier, 1977; and Pandit and Casetti, 1989, among others). The selection of the most appropriate form for the initial model will largely depend upon the body of theoretical literature surrounding the nature of the problem.

2. Expansion Equations.

The development of expansion equations is the second step in operationalizing the expansion method. The purpose of the expansion equations is to redefine the parameters of the independent variable(s) in the initial model, into functions of one or
more exogenous variables. It is not incorrect to think of the parameters of the independent variables, the "a's" in equation (2) in the initial model, as becoming the dependent variables in the expansion equations. That is, the a's are now thought of as functions of other variables, defined by the variable, Z. That is,

\[ a = g(Z_1, Z_2, Z_3, \ldots, Z_n) \]  

(3)

Returning to equation (2), and assuming an intrinsically linear relationship between the variables a and Z, we might generate the following expansion equations:

\[
\begin{align*}
a_0 &= c_{00} + c_{01}Z_1 + c_{02}Z_2 + \ldots + c_{0n}Z_n \\
a_1 &= c_{10} + c_{11}Z_1 + c_{12}Z_2 + \ldots + c_{1n}Z_n \\
a_2 &= c_{20} + c_{21}Z_1 + c_{22}Z_2 + \ldots + c_{2n}Z_n \\
\vdots & \quad \vdots \\
a_n &= c_{n0} + c_{n1}Z_1 + c_{n2}Z_2 + \ldots + c_{nn}Z_n
\end{align*}
\]  

(4)

Equation (4) is an example of expansion equations having been developed from a specific initial model, in this case, from equation (2). In the same manner that \( Y = f(X) \) in the initial model, the parameters of X in the initial model, i.e., the a's, are expanded as functions of some other variable, Z, such that these parameters can themselves be expressed in the form \( a = g(Z) \).

As with the formulation of the initial model, there is no reason to confine ourselves to intrinsically linear expansion equation structures. Among the various studies which have employed non-linear expansion equations in expansion models are: Casetti, 1973; Casetti and Jones, 1987a; and Casetti and Jones, 1987b.

It should be emphasized here that there is no strict process by which one identifies by which specific variables the parameters of the independent variables in the initial model are to be "expanded" by. Appropriate variables to include will depend upon the
particular study; however, the researcher's own knowledge of the problem, and the body of theory surrounding the problem should provide important clues in identifying potential variables.

Further, if there is no reason to assume a specific structure (e.g. linear, quadratic, exponential, etc.) among the variables in the expansion equations, the expansion method itself provides the opportunity to "search" for a most appropriate structure, i.e., to develop more complex series of interactions from relatively simple initial models.

3. Terminal Model.

The terminal model is generated by the simple substitution of the specified expansion equations into the initial model. For the n-independent variable example provided here, we merely substitute equation (4) into equation (2) to produce equation (5), as follows

\[ Y = c_{00} + c_{01}Z_1 + c_{02}Z_2 + \ldots + c_{0n}Z_n 
+ (c_{10} + c_{11}Z_1 + c_{12}Z_2 + \ldots + c_{1n}Z_n)X_1 
+ (c_{20} + c_{21}Z_1 + c_{22}Z_2 + \ldots + c_{2n}Z_n)X_2 
+ (c_{30} + c_{31}Z_1 + c_{32}Z_2 + \ldots + c_{3n}Z_n)X_3 
+ \ldots \]

or, more explicitly, equation (6)

\[ Y = c_{00} + c_{01}Z_1 + c_{02}Z_2 + \ldots + c_{0n}Z_n 
+ c_{10}X_1 + c_{11}Z_1X_1 + c_{12}Z_2X_1 + \ldots + c_{1n}Z_nX_1 
+ c_{20}X_1 + c_{21}Z_1X_1 + c_{22}Z_2X_1 + \ldots + c_{2n}Z_nX_1 
+ c_{30}X_1 + c_{31}Z_1X_1 + c_{32}Z_2X_1 + \ldots + c_{3n}Z_nX_1 
+ \ldots \]

or, more explicitly, equation (6)
Now that a terminal model has been specified, we can empirically estimate the values of the $c$-parameters using various regression procedures. In addition, the terminal model provides the basis from which more complex analysis can be conducted and more detailed information extracted. In the case of this study, for example, derivatives of the variables in the terminal model are taken in order to understand the dynamics associated with the growth rates of agricultural and petroleum exports.

Further, the terminal model provides the base upon which contextual variations are introduced and the drift of the model's parameters can be investigated. Once the $c$-parameters have been estimated we can change the values associated with the $X$ and $Z$ variables, and thereby construct a mathematical portrait of the manner in which the dependent variable, $Y$, changes, as the $X$ and $Z$ variables change. By changing the values of the $X$ and $Z$ variables in correspondence with the realities and complexities of our particular problem, the notion of contextual variation is thereby introduced.

C. Summary of the Literature.

The expansion method first appeared in Casetti's 1972 article in Geographical Analysis entitled "Generating Models by the Expansion Method: Applications to Geographical Research". Since that time, there has been a rapid increase in both the number of works and the breadth of research topics that have employed the expansion method. Among the areas of investigation, have been: social welfare analysis; urban dynamics; demographic change; regional, national, and international economic development; and industrial structure and change.

Jones (1984) used the expansion method to test for spatial variations in welfare program participation in the United States, by expanding the initial model's parameters by the $X$-$Y$ centroids of each state. In a similar vein, Casetti and Jones (1987) explored spatial
welfare participation rate variations in space by using the expansion method in conjunction with orthogonal trend surface analysis. Kodras (1986) explores the structure of labor markets and policy constraints on social welfare.

The expansion method has been employed to investigate various aspects related to urban dynamics. Casetti (1973) used the methodology in order to investigate spatial temporal variations in urban population densities in the United States and Canada. Danta (1984) models urban growth dynamics using the expansion method, while Krakover (1983) investigates the spatial and temporal patterns of spread and backwash phenomena.

The expansion method has also been used widely in demographic applications. Casetti and King (1975) used the expansion method to model the speed and direction of the diffusion of declining birth rates and death rates across Europe. Casetti (in Mandal, 1982) employed the expansion method in an analysis of the spatial temporal migration movements in pre-World War One Europe, the expanding the initial model's coefficients by a linear function of distance from London. Casetti (1982), and Zdorkowski and Hanham (1983) analyzed fertility trends in the expansion method framework.

The expansion method has also been used to conduct research investigations on aspects related to international economic development. In the area of agricultural development, Casetti and Gauthier (1977) test for and prove the existence of the "hollow frontier" hypothesis in the context of Brazilian coffee production. Pandit (1986) explored the effects of international trade activity on the allocation of labor forces across economic sectors. In similar fashion, Pandit and Casetti (1989) use the expansion method to model variations in the sectoral allocation of labor during the process of economic development.

In the context of industrial development, Casetti (1984a) tests Vining's thesis using the expansion method, by exploring the variations in productivity between the core and peripheral regions of more advanced economies. Casetti (1984b) employs the
expansion method to test the Verdoorn Law, and analyzes the hypothesis that productivity increases are greater in rapidly expanding sectors of an economy, in the context of Snowbelt to Sunbelt productivity shifts in American manufacturing. In similar fashion, Casetti and Jones (1987) explore regional spatial ramifications of the manufacturing productivity slowdown in the context of the United States.


As the previous section suggests, there has been considerable range in the subject matter in which the expansion method has been employed. While a number of works have either implicitly or explicitly concerned themselves with aspects related to agricultural development and international trade (e.g., Casetti and Gauthier, 1977; Pandit, 1986; Casetti and Pandit, 1989), these two literatures have yet to be linked in the context of natural resource analysis in general, or Booming Sector Theory specifically. It is to the linking of these literatures through the use of the expansion method, at both the paradigmatic and methodological levels, that this study can make its most profound contributions.

1. Paradigmatic Justifications.

The use of the expansion method as an appropriate tool for the analysis of natural resource booms can be justified at both the paradigmatic and the methodological levels. As paradigm, it allows the linking of diverse literatures within the field of natural resource analysis. As Chapter III emphasized, although the literature on the subject of natural resource booms is rather substantial it is, unfortunately, characterized by a wide range of conceptual, methodological, and ideological approaches. Although there is likely to be strength in such diversity, in that so many facets of the subject have been investigated from so many distinct viewpoints, the inherent weakness lies in that these literatures are
not particularly well integrated; there is no common thread which ties the various themes together as a cohesive body of literature.

The expansion method could provide the paradigm necessary to define a new class of models leading to the integration of the disparate literatures. It's fundamental usefulness in this regard is that it neither requires nor assumes, a priori, a specific ideological or methodological conceptualization of the problem. Thus, the largely positivistic, political economy approaches to investigating natural resource booms, characteristic of Watts or Onimode can be cast in the same fundamental paradigm as the more normative, classical models exemplified by the research of Auty, Gelb, or Van Wijnbergen.


The use of the expansion method to investigate the underlying dynamics of natural resource booms can also be justified on methodological grounds. A review of the current literature on natural resource booms will reveal two primary weaknesses: first, at the theoretical level, a concern for the development of abstract, context-free models which seek to understand the manner in which factors of production are reallocated in highly-simplified, 2-sector economies; and, at the level of applied empirical research, a concern for the development of models which more accurately estimate the impacts of natural resource booms on price levels, inflation, capital absorption, etc. which, once appropriately calibrated are employed across numerous contexts. Little concern has been expressed for the theoretical modeling and empirical analysis of natural resource booms which explicitly incorporate contextual variations, and acknowledge the possibility of models drifting as such contextual variations occur.
Yet as previous chapters have emphasized, these very economic, political, and social circumstances that surround a specific natural resource boom will ultimately determine the impact of the boom. That is, the context in which the boom occurs will itself define the nature and scope of the impacts. As endogenously generated and exogenously induced economic, political, and social pressures emerge, the fundamental contributions of these booming sectors will change rapidly in both space and time.

The methodology in the analysis of booming sectors, the expansion method allows us to both: model the underlying dynamics of natural resource booms which are more consistent with real world complexities than highly abstract models in the literature currently allow; and to more realistically assess the empirical impacts of booming sector contributions, not by the continual recalibration of the model, but rather by investigating the parametric drift of the model as contextual variations are introduced.

E. Model Formulation: The Linear Case.

As a means of investigating the impacts of the Nigerian petroleum boom upon the performance of her agricultural export sector, two expansion models are formulated. The first is a simple linear model, designed primarily as an exploratory model to assist in the identification of any patterns in the underlying petroleum-agriculture export dynamics. Assuming that meaningful patterns are found to exist, a second, more complex quadratic formulation is employed to uncover the empirical nature of these more subtle interactions.

1. Model Structure.

The simple linear model begins by hypothesizing the existence of a functional relationship between the volume of Nigerian agricultural commodity exports, and time. Specifically, we assume that the total volume of any given agricultural export will vary
from one time period to another: certain crops which once dominated the Nigerian export economy prior to the 1960s petroleum boom, such as cocoa and rubber, are now relatively unimportant. For each one of Nigeria's agricultural exports, we can capture the functional relationship between the volume of exports and time by writing

\[ AE = f(t) \]  

where \( AE \) is the volume of exports of a specific agricultural commodity in thousands of metric tons (TMT), and \( t \) represents time, taken in two-year intervals. The initial time period for conducting the study was designated as \( t = 0 \), representing the year 1950, while the terminal year of the study, 1985, was designated by \( t = 30 \). The data on the volume of exports for certain agricultural commodities was transformed by taking the natural logarithm. The purpose of this was to linearize the data such that ordinary least squares (OLS) regression procedures could be used. Thus the function relationship can be expressed as equation (8)

\[ \ln AE = f(t) \]  

\[ \ln AE = a_0 + a_1 t + e \]  

In order to illustrate the manner in which the volume of agricultural exports changes over time, we can express the functional relationship between exports and time given in equation (9) in the form of a simple linear regression model as

\[ \ln AE = a_0 + a_1 t + e \]  

in which \( \ln AE \) is the dependent variable; \( t \) is the independent variable; \( a_0 \) and \( a_1 \) are the model's parameters to be estimated; and \( e \) is the stochastic error term. Obviously, expressing the volume of agricultural exports directly as a linear (or nonlinear) function of
time could lead to problems of temporal autocorrelation. However, the Durbin-Watson statistic revealed no evidence of temporal autocorrelation among the data. The sample initial equation expressed in equation (9) for an arbitrary agricultural commodity export was specified for each of the agricultural export commodities.

b. **Expansion Equations.**

The initial model in equation (9) is expanded by redefining the model's parameters as functions of temporal variables via expansion equations capable of resolving the hypothesized temporal variation. In order to investigate the link between agricultural exports and petroleum exports over time, the initial model's parameters were expanded by the volume of petroleum exports, measured in thousands of metric tons. By choosing petroleum as the variable by which the expansions are conducted, we are stating that there exists a functional relationship, the exact form of which as of yet remains unknown, between the volume of petroleum exports, the volume of agricultural exports, and time. The functional form of this relationship, expressed as expansion equations, can is given as

\[
\begin{align*}
    a_0 &= c_{00} + c_{01} \ln OE \\
    a_1 &= c_{10} + c_{11} \ln OE
\end{align*}
\]

where \( \ln OE \) is the volume of petroleum exports, expressed in logarithmic terms in order to linearize the data; and the \( c \) variables are the parameters to be estimated.

c. **Terminal Model.**

The terminal model is developed by substituting the expansion equations (10) and (11) into equation (9), which yields equation (12), below
or, more explicitly,

\[
\ln AE = c_{00} + c_{01} \ln OE + (c_{10} + c_{11} \ln OE) t + e 
\]  

(12)

The structure of the terminal model in equation (13), then, identifies two sets of variables deemed important in explaining the volume of Nigerian agricultural commodity exports. These are the time parameter on the one hand, and the volume of petroleum exports on the other, and in which time and volume of petroleum exports are themselves functionally tied to each other via the expansion equations. As the initial model and the expansion equations are intrinsically linear, so too, is the terminal model. Thus, the parameters in equation (13) can be empirically estimated using the Nigerian data sets via OLS regression procedures.

2. Model Analysis.

While it specifies a particular model structure, the model given in equation (13) is not in its present form, terribly useful. If the underlying dynamics of the interrelationships between agricultural exports, the booming petroleum sector, and time are to be understood, and contextual variations in the model are to be introduced and analyzed in a meaningful way, further analysis of the terminal model must be conducted. In order to capture the changes in the volume of agricultural exports over time, we can differentiate the terminal model (equation 13) with respect to time. This gives equation (14), below.

\[
\frac{1}{AE} \frac{dAE}{dt} = \frac{1}{OE} \frac{dOE}{dt} + c_{01} + c_{10} + c_{11} \ln OE t + e 
\]  

(14)
By rearranging the terms in equation (14), we derive equation (15)

\[
\frac{1}{AE} \frac{dAE}{dt} = c_{10} + \left( c_{01} + c_{11} t \right) \frac{1}{OE} \frac{dOE}{dt} + c_{11} \ln OE
\]  

Equation (15) is the preferred form because it allows us to explicitly identify and distinguish between two important dynamics in the model, namely a volume or level effect, and a growth rate effect. These distinctions, and their implications, are discussed in the following section.

3. Model Interpretation.

There are several aspects to consider with regard to the interpretation of equation (15). First, in reference to the left hand side of the equation, i.e., the dependent variable, we have, by taking the derivative of the logarithm of the volume of agricultural exports with respect to time, explicitly identified the average rate of growth in the volume of each of the Nigerian agricultural commodity exports, over the thirty-year time span. The more interesting interpretations come by introducing contextual variations into the model. In particular, we might ask how the growth rate of agricultural exports changes, as we vary the total volume of petroleum exports on the one hand, and the growth rate at which petroleum is exported on the other, over some plausible range of values? These volume and growth rate effects are discussed in greater detail, below.

a. Volume Effects.

If we take equation (15), and isolate the term \( c_{11} \ln OE \) we can explicitly identify the impacts of the volume, or level, of petroleum exports upon the growth rate of agricultural exports. In essence, we are capturing the effects of changes or variations in the
volume of petroleum exports on the growth rates of individual agricultural exports. The range of possible outcomes could be that very large volumes of petroleum exports may stimulate, stagnate, or have no effect at all on the growth rate of specific agricultural exports.

Alternatively, other groups of agricultural commodity exports may be stimulated, stagnated, or have no effect at all when the level of petroleum exports is relatively low. Further, will variations in the volume of petroleum exports have an differential impacts upon agricultural export growth rates, once disaggregated by capital-intensive, labor-intensive, and non-cultivated modes of production; and if such distinctions can be identified, what is the empirical nature of the modal responses?

b. Growth Rate Effects.

In the same manner that the we isolate the impacts of variations in the levels of oil exports as given by $c_{11} \ln OE$, so too can we isolate the effects of variations in the growth rate of petroleum exports on the growth rate of agricultural exports over time. This growth rate effect is captured by

$$\frac{1}{OE} \frac{d}{dt} \text{OE}$$

The interpretation here is rather straightforward. That is, as we change the values associated with the growth rates of oil exports, given by

$$\frac{1}{OE} \frac{d}{dt} \text{OE}$$

over some realistic range of values representative of the Nigerian oil boom experience, how do the growth rates of agricultural commodity exports change over?

Obviously, we might again hypothesize a range of possible outcomes: very high growth rates of petroleum exports may stimulate, stagnate, or have no effect upon the growth rate of specific agricultural exports; alternatively, very low growth rates of
petroleum exports may stimulate, stagnate, or have no effect at all upon another group of
agricultural exports. Further, we can disaggregate groups of agricultural commodities by
modes of production in order to isolate the differential impacts of variations in the growth
rates of oil exports. A diagrammatic representation of the possible effects is given in
Figure 17 at the chapter.

F. Model Formulation: The Quadratic Case.

In the same way that the initial linear formulation of the model is exploratory in
that it seeks to establish the existence of any underlying trends between the volume and
growth rates of petroleum exports and the growth rates of agricultural exports over time,
we can use higher order polynomial expansions to investigate these dynamics in greater
detail.

1. Model Structure.

The quadratic model formulation is exactly the same as the linear model in regard
to the initial model structure. The difference between the two models lies in the nature of
the expansion equations and the corresponding terminal model. Further, the interpretation
of the growth rate and volume effects in the quadratic model are not only more
interesting, but are also probably more reflective of the actual Nigerian petroleum boom
experience.

a. Initial Model.

The initial model in the quadratic formulation is identical to that in the linear
formulation; that is, the volume of agricultural exports is assumed to be a linear function
of time. For the sake of completion, we reproduce equation (13) in the linear case as equation (16) for the quadratic case. Thus,

\[ \ln AE = a_0 + a_1 t + e \]  

(16)

where \( t \) once again represents time, \( \ln AE \) is the logarithm of the volume of agricultural exports, and \( e \) is the stochastic error term. An equation corresponding to each of the Nigerian agricultural commodity exports was developed.

b. Expansion Equations.

The distinction between the linear and quadratic cases is revealed in the nature of the expansion equations. As in the linear case, the expansion equations in the quadratic model formulation expand the parameters of the initial model as functions of the volume of Nigerian petroleum exports. Unlike, the linear case, however, the quadratic case allows for the possibility of non-linearities in the relationship between the volume of petroleum exports and time to be captured in an explicit fashion. In certain instances, it might be useful to use stepwise regression procedures to attempt to determine the appropriate variables to include in the expansion equations, and/or the nature of the non-linearity, i.e., the degree of the polynomial. However, in the case of Nigeria's petroleum boom, particularly over the thirty-year span of the study, there is a good theoretical basis for assuming a quadratic as the basis for the expansions.

What the quadratic formulation allows us to capture is the possibility of Nigerian petroleum exports having differential impacts over time. That is, over the thirty years which the study spans it is not unreasonable to postulate that oil exports might at first stimulate the growth rate of agricultural exports, and at some later point in time, proceed to stagnate them. Alternatively, petroleum may at first stagnate, and ultimately stimulate
the growth rate of agricultural exports. In order to capture these differential effects, the polynomial expansion equations in (17) and (18) are proposed.

\[ a_0 = c_{00} + c_{01} \ln OE + c_{02} \ln OE^2 \]  
\[ a_0 = c_{10} + c_{11} \ln OE + c_{12} \ln OE^2 \]  

in which \( \ln OE \) is the logarithm of the volume of exports, and \( \ln OE^2 \) the square of the logarithm of the volume of oil exports. Depending upon the nature of the values of \( \ln OE \) and \( \ln OE^2 \) we will have maxima or minima.

c. Terminal Model.

The expansion equations are replaced into the initial model to develop the terminal model. By substituting equations (17) and (18) into equation (16), we have the terminal model in equation (19) is yielded:

\[ \ln AE = c_{00} + c_{01} \ln OE + c_{02} \ln OE^2 \]  
\[ + (c_{10} + c_{11} \ln OE + c_{12} \ln OE^2) t + e \]  

or, more explicitly,

\[ \ln AE = c_{00} + c_{10} \ln OE + c_{02} \ln OE^2 + c_{10} t \]  
\[ + c_{11} \ln OE t + c_{12} \ln OE^2 t + e \]  

The terminal model in (20) suggests the volume of oil exports, the volume of oil exports squared, time, the volume of oil exports multiplied by time, and the volume of oil exports square multiplied by time will together provide a meaningful representation of the structural relationship between the volume of agricultural exports and the volume of
petroleum exports, in which underlying non-linearities in the dynamics of the oil-agricultural interactions are made explicit.

2. Model Analysis.

As in the linear case, the analysis in the quadratic formulation is conducted by taking the derivatives of the terminal model with respect to time. Upon differentiating equation (20) we have equation (21), below.

\[
\frac{1}{AE} \frac{dAE}{dt} = \frac{1}{OE} \frac{dOE}{dt} + \frac{1}{OE} \frac{dOE}{dt} + 2c_{12} \ln OE \frac{1}{OE} \frac{dOE}{dt}
\]

\[
+ c_{10} + c_{11} \frac{dOE}{OE} t + c_{11} \ln OE
\]

\[
+ c_{10} + c_{12} \ln OE \frac{dOE}{OE} t + c_{12} \ln OE^2
\]

We can rearrange the variables in equation (22) into a form more compatible with substantive analysis, namely

\[
\frac{1}{AE} \frac{dAE}{dt} = \left[ c_{01} + 2c_{02} \ln OE + c_{11} t \right]
\]

\[
+ 2c_{12} \ln OE \frac{1}{OE} \frac{dOE}{dt} + c_{10}
\]

\[
+ c_{11} \ln OE + c_{11} \ln OE^2
\]

The form in equation (22) is preferred because it allows for the effects of the volume of petroleum exports on the growth rate of agricultural commodity exports to be explicitly isolated from the effects of the growth rate of petroleum exports on the growth
rate of agricultural exports. The distinctions between the differential impacts are discussed in greater detail in the following section.

3. Model Interpretation.

As with the linear model, the interpretation of the quadratic model can be broken down into two distinct impacts: a volume, or level effect; and a growth rate effect. However, because of the linearity inherent in the linear terminal model, the effects of the volume or growth rate of oil on the growth rate of agricultural exports is constant over the study period.

a. Volume Effects.

The impacts of the volume of oil exports on the growth rate of Nigerian agricultural commodity exports is captured by the term \( c_{10} \ln OE + c_{11} \ln OE^2 \) which is drawn from the results of the analysis given by equation (22). The interpretation of the equation is that the level effects are strictly a function of the volume of oil exports. However, we do make allowances for the effects of Nigeria's petroleum exports to have differential effects on the growth rate of agricultural exports, over time. This is captured by the squared logarithm of oil exports term. Further, the opportunity for the existence of maxima and minima would reflect either an oil-induced stagnation-to-stimulation, or stimulation-to-stagnation phenomena in the growth rate of the exports of agricultural commodities much more likely to correspond with Nigeria's oil-boom realities.

Again, a range of hypothetical, but realistic, values corresponding to the level of Nigerian petroleum exports can be introduced, and the effects on the growth rates of individual agricultural commodities, isolated. These volume values were 0.1 thousand
metric tons (tmt) per year, 1.0 tmt, 10.0 tmt, and 100.0 tmt, and are representative of the actual Nigerian experience.

b. Growth Rate Effects.

As with the linear model, we can also distinguish a growth rate effect. This particular impact is isolated from equation (22), and reproduced in the form of equation (23) as

\[
\begin{align*}
1 & \frac{d\text{OE}}{\text{OE} \, dt} \\
\left( c_{01} + 2c_{02} \ln \text{OE} + c_{11} t + 2c_{12} \ln \text{OE} \, t \right) & \\
\end{align*}
\]

The purpose of the growth rate effect is to understand the dynamics of variations in the growth rate of Nigerian petroleum exports, on the growth rate of her agricultural exports. Unlike the linear model, where the growth rate effect was strictly a function of the volume of oil exports, in the quadratic model the growth rate effects are functions of both the volume of oil exports, and time. Once again, we can substitute a realistic range of plausible values for the growth rates of Nigerian petroleum exports and in doing so, isolate their effect on the growth rate of specific agricultural commodities. The range of values we assume for the growth rate of oil exports is 0.0 percent, 2.5 percent, 5.0 percent, and 10.0 percent. Once again, a diagrammatic representation of the effects of oil on agricultural exports in the quadratic formulation is given in Figure 17 at the end of the chapter.

G. Statistical Procedures.

Because the expansion equations in both the linear and quadratic models are intrinsically linear, so too are the terminal models. Thus, we can estimate the parameters of the terminal models using ordinary least squares (OLS) regression procedures. In both
model formulations, regular regression procedures were employed in which the t-statistics were used to test for the overall significance of the regression equations. A case could be made for the use of stepwise, backward, or forward regression procedures as has been done in other studies using the expansion method (e.g., Casetti, 1986; Casetti and Jones, 1987b) but this was not necessary since there was a good theoretical base upon which to base the structure of the expansion equations, particularly in the case of the quadratic.

As time-series data over a thirty year span were used, there was some concern for the possibility of temporal autocorrelation, in which case a generalized least squares model might have to be employed. However, the Durbin-Watson statistic revealed there was no evidence of autocorrelation, with the exception of two agricultural commodities, which later had to be removed from the analysis for reasons discussed in Chapter VI. A summary table of the linear and quadratic parameter estimates, and the results of their statistical significance are given in various tables in the following chapter.

H. Data Sets.

Empirical research in the context of Third World countries can be an inherently difficult and frustrating task, due largely to the fact that reliable data on economic activities are often suspect. This problem is compounded in regard to Nigerian research, and many researchers have suggested that most data published by the Nigerian government to be of exceedingly poor quality. Indeed, certain international organizations refer to "official" data from Nigeria as being "inherently suspect", and "should not be used when alternative sources are available" (Jones 1978). Given these constraints, it is important to discuss various issues related to the data employed in this study. Specifically, these relate to the data sources which are used, the type of and units associated with the data, and potential problems with the data.
1. Types and Units.

The data used in this study are international trade statistics, particularly export data based upon volume of production statistics. In beginning the study, comparisons were made between "official" Nigerian government data and data published by other "official" sources. In many cases discrepancies between sources of over 200 percent were noted, although the common range of discrepancy was more on the order of 20 to 35 percent. However, even the mismatches of the lower range between data sources could not be tolerated (for specific problems see Section 3). As such, a decision was made to rely entirely upon data published by either: a) internationally recognized development organizations (e.g., United Nations, World Bank), or b) upon statistics published by the United States Department of Agriculture (USDA). In order to standardize the units, all export data are converted into thousand of metric ton equivalents, henceforth denoted by \( tmt \).

2. Sources.

In line with Gelb, et al. (1988) at least five major data sources can be identified in the context of Nigerian agricultural data. These are the Nigerian Federal Office of Statistics (FOS), the Central Bank of Nigeria (CBN), the Nigerian Federal Department of Agriculture (FDA), the United Nations Food and Agricultural Organization (FAO), and the USDA, particularly the Foreign Agricultural Service (FAS) branch. It should be noted that the data requirements for export agriculture are different than those for domestic agriculture. The most reliable data sources on the former are generally taken to be the UN's Yearbook of International Trade Statistics (Volumes 1 and 2, Trade by County, and Trade by Commodity, respectively), while data on the latter generally come from the USDA's Monthly Production Statistics.
Data on more general macroeconomic trends come from the World Bank's World Development Report series for various years, and the special Accelerated Development in Sub-Saharan Africa issue, commonly known as the Berg Report. In order to put agricultural trade data in historical perspective, particularly during Nigeria's period under British colonial rule, the Encyclopedia of Historical Statistics: Africa and Asia was referred to. Data on Nigerian petroleum production and exports come from OPEC's Monthly Production Statistics, and the Petroleum Intelligence Weekly. Occasional reference is made to The Economist's The World in Figures, and the excellent statistical appendices in Schatzl (1973). All data from reliable sources was cross-referenced with those published by the Nigerian government, and as such certain Nigerian government documents were used, including: the Office of Statistics' Trade Reports, and Monthly Petroleum Information from the Petroleum Division of the Federal Ministry of Mines and Power.

3. Categorization.

An initial attempt was to employ value-based data. However, after a number of considerations were taken into account this approach was dropped. Reasons for not using the dollar-value of trade, included: a) the impacts of Nigeria fiscal policy which allowed rapid appreciation of the Nigerian naira vis-a-vis other currencies, with no subsequent devaluations, thereby distorting the purchasing power of the naira, particularly during the era of massive petroleum boom revenues (1973-74); b) rapid increases in the rate of inflation following the first oil boom, and the lack of availability of appropriate price indexes by which to deflate the currency and hence value-based trade figures; c) the fact that unlike volume-based trade data, there are no good alternatives to estimating value-based data, and hence one is forced to rely upon "official" data figures, which is undesirable in the context of Nigeria; d) political instability in which the macroeconomic fiscal and monetary
policies of each new regime are likely to be dissimilar, where as the production and export of agricultural and petroleum products continues relatively uninterrupted. Thus, a volume-based approach was adopted.

A common means of classifying internationally traded commodities such that cross-national comparisons can be easily made is the Standard International Classification (SIC) scheme, formerly known as the Standard International Trade Classification Scheme (SITC). The SIC scheme disaggregates commodities and assigns them to one of 10 sections (represented by one-digit codes). In turn, each section is subdivided into 52 divisions (two-digit codes); each division is then subcategorized into 150 groups (three-digit codes), and finally each group is again subdivided into 570 items (four-digit codes) (UN Statistical Paper Series, 1963). The study presented here disaggregates relevant trade data to the three-digit, group level. The relevant three-digit SIC groups employed in this study are: a) capital-intensive agricultural export products, including groundnut oil (SIC —), oilseed cake (SIC 08138), and sawn (or shaped) wood (SIC 243); b) labor-intensive agricultural export products, including cocoa (SIC 072), cotton (SIC 263), rubber (SIC 231), coffee (SIC 071), groundnuts (SIC —), palm oil (SIC 4242), and rubber (SIC 23); c) non-cultivated agricultural export products, including timbers (SIC 242) and palm kernels (SIC 2232); and d) crude petroleum exports (SIC 331).

4. Problems.

Obviously, a model is only as good as the data upon which it is developed. An important problem, then, is one as basic as having access to acceptable data sets. The poor quality of African agricultural production statistics is well known to anyone working in this area, and has even been noted in the literature (e.g., Berry, 1984); indeed Watts (1987, p. 1) refers to the "wholly disreputable quality of the most basic rural (African) production
statistics". Gelb, et al., (1988, p. 260) points to the high degree of dissimilarity of estimates among various sources, noting that the 1981 FOS estimated Nigerian cassava output at 580,000 tons, while the USDA estimated production at 11.8 million tons. Given the generally unreliable nature of the statistics published by Nigerian officials, emphasis was placed upon data from internationally recognized sources, particularly the UN, the USDA, and the World Bank.

I. Summary.

The purpose of this chapter has been to introduce the study's methodology, the expansion method, at both the paradigmatic and methodological levels. The notation of parametric stability in social science models is challenged, and a discussion of the manner in which the expansion method can be used to explore parametric drift, and the contextual variation in models is provided. In addition, a summary of the literature on the expansion method is given, including the problematic and regional contexts in which the technique has been employed.

A hypothetical n-variable case is given, in which the initial model, expansion equations, and terminal model are developed. Next, a case is made for the use of the expansion method as an appropriate methodology in which to analyze booming sectors, two models, one linear and one quadratic, to explain the Nigerian petroleum export and agricultural export interactions is made. The linear model is justified primarily as a tool to establish any fundamental relationships which might exist between the booming petroleum sector, and the agricultural export sector. The non-linear quadratic model is then employed to analyze these underlying dynamics between booming and non-booming sectors in greater detail.
The initial models of both cases are based upon a simple relation, in which the volume of Nigerian agricultural commodity exports are taken to be a function of time. In the linear model, the parameters of the initial model are expanded as a simple linear function of the volume of Nigerian petroleum exports. Depending upon the particular agricultural commodity in question, petroleum can either stimulate, stagnate, or have no effect on the exports of agricultural commodities over time. In the quadratic case, the initial model's parameters are expanded as non-linear functions of the volume of oil exports. This formulation allows for the possibility that petroleum exports may have had differential impacts on agricultural exports over time. In this somewhat more realistic scenario, it might be that oil first stimulates agricultural exports and later stagnates them; alternatively, oil might first stagnate, and then stimulate the exports of agricultural commodities.

Terminal models are developed by substituting the expansion equations into the initial models, and the derivatives of the terminal models with respect to time are taken. The resultant terms are rearranged in such a form that we can identify two distinct impacts of oil: the effect of the volume or level of oil exports on the growth rate of agricultural exports; and the effect of the growth rate of petroleum exports on the growth rate of agricultural exports. In the following chapter, we will analyze how variations in both the volume and growth rate of Nigerian oil exports have affected the growth rate of agricultural commodity exports thereby explicitly introducing the notion of contextual variations which the expansion method seeks to address. The last part of this chapter has dealt with the data sources and data problems, the time period of the study, and a general overview of the statistical procedures and tests used for the analysis of the Nigerian data sets.
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157

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CHAPTER VI
RESULTS AND ANALYSIS

VI. Results and Analysis.

This chapter reports on the statistical results of and the analysis for the linear and quadratic expansion models developed in the previous chapter. First, the statistical results for each mode of production are given, and the statistically significant variables in the equations for each commodity are identified. For those variables that are not found to be statistically significant in either the linear or quadratic expansion formulations, portions of the final chapter are devoted to a discussion of possible reasons for the weak statistical results. These explanations are given in light of the historical, economic, environmental or other realities surrounding the Nigerian experience.

For those commodities where the models are found to be statistically significant, the derivatives of the terminal models are taken with respect to time in order to isolate the growth rates of the agricultural commodities. Variations in the volume and growth rate of oil exports are then introduced into the resulting equations, and their influence on the growth rate of the commodity export in question over time are assessed. The chapter concludes with a comparative analysis of the linear and quadratic expansion model formulations, possible modifications to the model that might be made, and a general discussion of the results in the context of the Nigerian petroleum boom.

*: All of the tables and figures are assembled, in order, at the end of the chapter. Exceptions include Tables 1 and 11 which are embedded in the body of the text.
A. Summary of the Results.

A diagrammatic summary of the results is given in Figure 33 for the linear model, and 34 for the quadratic model. Further, such that the more detailed statistical analyses which follow can be better understood, a brief summary of the results is given. Among the findings are that both the linear and quadratic model formulations have provided useful results. However, the linear model is generally found to be more applicable than the quadratic. Further, the results in either the linear or quadratic case are relevant only to the highly capitalized Nigerian agricultural exports. Thus, we note that it is indeed important to disaggregate the agricultural export sector into the various modes of production discussed in section 4.C.2, since the oil boom has been found to be discriminatory in its effects of agricultural exports.

Second, although the effects of the oil boom have discriminated between agricultural export categories, the effects of the boom have generally been similar within these subcategories. That is, even though the effects of oil may be different on capital intensive exports and subsidized labor intensive exports, all of the commodities within the capital intensive subsector have responded similarly, while all those commodities within the subsidized labor intensive subsector have also responded in similar fashion.

Third, we also find that it important to distinguish between the growth rate effect of oil exports from the volume of oil exports, when assessing the impacts of the oil boom on agricultural exports. However, beyond this it is difficult to generalize, since there are no general trends suggesting that either the growth rate or the volume effect plays a more dominant role; rather, the outcomes associated with variations in the volume and growth rate of oil exports on the growth rate of agricultural exports depends on the specific commodity under analysis.
Fourth, the contextual variations introduced by the time variable have important implications. In the linear model, the growth rate of certain commodities is stimulated over time, while it is stagnated for others; in the linear model it is difficult to generalize across export subsectors, so the specific impacts on individual commodities are assessed in detail in later sections. In the quadratic model, for which the model is appropriate for three commodities, the growth rates of exports are stimulated and then stagnated for the capital intensive subsector, while for the subsidized labor intensive subsector the reverse occurs: exports are first stagnated and then stimulated.

Fifth, we note that large increases in either the growth rate or the volume of oil exports in general do not lead to a proportional change, either positive or negative, in the growth rate of affected agricultural commodity exports. We note that even the agricultural export subsectors that have been directly affected by the oil boom, some degree of insulation from rapid changes in the parameters of the oil boom exist.

Finally, although the various model formulations do not yield good statistical results for a number of commodities, primarily non-subsidized labor intensive and non-cultivated crops, the lack of a good statistical fit can often be traced to the influences of specific Nigerian historical, economic, and other realities. With these comments in mind, we now turn our attention to a more detailed analysis of the expansion model results.

B. Linear Model.

As suggested in the previous chapter, the linear expansion model formulation was developed primarily as a way of establishing whether or not a functional relationship existed between oil and agricultural exports. In the context of mathematical formulation, this initial exploratory relationship was captured in the expansion model represented in equation (12) and (13). The overall significances of the parameters of the terminal
models for are given in Table 1, below. Specific statistical values generated for each commodity are given in Tables 2, 3, 4, and 5 at the end of the chapter.

Table 1

Summary of Statistical Significances in the Linear Expansion Terminal Model

<table>
<thead>
<tr>
<th>Commodity</th>
<th>ln OE</th>
<th>t</th>
<th>ln OE t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut Oil</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Oilseed Cake</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Sawn Wood</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Cocoa</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Coffee</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cotton</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Palm Oil</td>
<td>*</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Rubber</td>
<td>+</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Palm Kernels</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Timber</td>
<td>+</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

+, - = statistically significant at the 5 percent level.
* = not statistically significant.


The results show that the variables for the capital intensive agricultural exports, which include groundnut oil, oilseed cake, and sawn wood were all statistically significant. Although none of these crops have historically been a major contributor to the country's foreign exchange revenues, this subsector has nonetheless been affected by the Nigerian oil boom. These crops are particularly important to include in the analysis because of their capital intensive nature of production, characterized by the processing of raw
commodities into semi-finished and finished products, such as groundnuts in groundnut oil, palm kernels into oilseed cake, and tropical timbers into sawn wood and lumber. As will be discussed in the conclusion, it appears clear that the oil induced windfalls have been channelled back into these capital intensive processing activities. The specific statistical results associated with these commodities are now developed more fully.

### a. Model Results

Overall, the linear model provided very good results for this subset of agricultural commodities. The petroleum variable, \(\ln OE\), the time variable, \(t\), and the variable capturing the interacting between oil exports and time, \(\ln OE \times t\), were statistically significant at the 5.0 percent level for all of the crops in this category; the t-values and other relevant statistics are captured in Table 2. The sign on the oil variable was positive for groundnut oil and oilseed cake, and negative for sawn wood, while the time variable and oil-time variables were positive and negative, respectively, for all three commodities.

The \(R^2\) and adjusted \(R^2\) values were high groundnut oil exports: 0.796 and 0.634, respectively, and the Durbin-Watson statistic of 1.945 revealed no evidence of temporal autocorrelation. However, the \(R^2\) and adjusted \(R^2\) values for oilseed cake and sawn wood were markedly lower: for oilseed cake the values were 0.323 and 0.251, respectively; for sawn wood the values were for 0.357 and 0.282, respectively. However like groundnut oil, temporal autocorrelation was not problematic for either commodity; Durbin-Watson statistics for oilseed cake and sawn wood were 1.980 and 2.018, respectively.

On account of the very good overall statistical results, i.e., the statistical significance of the variables (even for oilseed cake and sawn wood with low correlation
coefficients), all three commodities were taken to the next step of the analysis which involves the introduction of contextual variations into the models.

b. Model Analysis.

In line with the analysis described in section 5.E.1 and 5.E.2 we determine the growth rate of each agricultural commodity export by taking the derivative with respect to time. With reference to equations (14) and (15) from the previous chapter, and reproduced here as equation (24), we have

\[
\frac{1}{AE} \frac{dAE}{dt} = c_{10} + \left( c_{01} + c_{11} t \right) \frac{1}{OE} \frac{dOE}{dt} + c_{11} \ln OE \tag{24}
\]

where \( \frac{1}{AE} \frac{dAE}{dt} \) is the growth rate of the agricultural export commodity being investigated, \( \frac{1}{OE} \frac{dOE}{dt} \) is the growth rate of oil exports, \( \ln OE \) is the volume of oil exports, and \( t \) is the time period. Substituting the regression results given in Table 2 for the appropriate commodities, we derive equations (25), (26), and (27) for groundnut oil, oilseed cake, and sawn wood exports, respectively.

\[
\frac{1}{GO\ Ex} \frac{dGO\ Ex}{dt} = 0.304 + \left[ 0.554 - 0.033 t \right] \frac{1}{OE} \frac{dOE}{dt} - 0.033 \ln OE \tag{25}
\]

\[
\frac{1}{OC\ Ex} \frac{dOC\ Ex}{dt} = 0.338 + \left[ 1.210 - 0.052 t \right] \frac{1}{OE} \frac{dOE}{dt} - 0.052 \ln OE \tag{26}
\]

* The linear expansion model for capital intensive exports is discussed in detail, in order that the analysis for the remaining exports can be discussed more briefly.
\[
\frac{1}{\text{SW Ex}} \frac{d}{dt} \text{SW Ex} = 0.329 + \left( -0.360 - 0.006 t \right) \frac{1}{\text{OE}} \frac{d}{dt} \text{OE} - 0.006 \ln \text{OE} \quad (27)
\]

\[
\frac{1}{\text{GO Ex}} \frac{d}{dt} \text{GO Ex}, \quad \frac{1}{\text{OC Ex}} \frac{d}{dt} \text{OC Ex} \quad \text{and} \quad \frac{1}{\text{SW Ex}} \frac{d}{dt} \text{SW Ex}
\]

where \( \frac{1}{\text{GO Ex}} \frac{d}{dt} \text{GO Ex}, \quad \frac{1}{\text{OC Ex}} \frac{d}{dt} \text{OC Ex} \quad \text{and} \quad \frac{1}{\text{SW Ex}} \frac{d}{dt} \text{SW Ex} \) represent the average growth rates of groundnut oil exports, oilseed cake exports, and sawn wood exports, respectively.

We can now assess the impacts of changes in the growth rates and volume of oil exports on the growth rates of these exports, over time. As outlined in the last chapter, a realistic range of values reflective of Nigeria's oil boom experience was chosen. For the growth rates of oil exports these values were: 0.0 percent, 2.5 percent, 5.0 percent, and 10.0 percent per year. For the volume of oil exports these values were: 0.1 thousand metric tons (tmt), 1.0 tmt, 10.0 tmt, and 100.0 tmt per year. These values were then replaced in equations (25), (26), and (27), and the resulting values are expressed as 4 x 4 matrices in Table 6 for groundnut oil, Table 7 for oilseed cake, and Table 8 for sawn wood. These results are also captured diagrammatically in Figures 17 and 18 for groundnut oil, 19 and 20 for oilseed cake, and 21 and 22 for sawn wood; again, all of the Tables and Figures are given at the end of the chapter.

i. Growth Rate Effects.

The growth rate effects of oil can be assessed in two ways. The first is by investigating how the growth rates of agricultural commodities change over time as the volume of oil exports remains constant. For example, we can ask: assuming a volume of oil exports of 10.0 tmt, what will the growth rate of an agricultural commodity export be for 1960, 1970, and 1980 if the growth rate of oil exports is 2.5 percent? The second is to assess the impacts of a range of growth rates of oil exports on the growth rates of
agricultural exports within a given time period. For example, we can ask: for 1960, what is the difference on the growth rate of an agricultural export if we have a 2.5 percent rate of growth in oil exports, rather than a 5.0 percent or 10.0 percent rate of growth?

In reference to the first question, we find that if we hold the growth rate of oil exports at some arbitrary level, the growth rate of all three commodity exports decreases over time. For example, using the results for groundnut oil given in Table 2, and assuming a volume of oil exports of 1.0 tmt, an average annual growth rate of oil exports of 5.0 percent will reduce the growth rate of groundnut oil exports from 8.4 percent in 1960, to 6.7 percent in 1970, to 5.1 percent in 1980. This information is garnered by looking at the values in row 2 and column 3 (henceforth given as c23) in Table 6 for the respective years of 1960, 1970, and 1980. These reader is also referred to Figures 18, 20, and 22 for a diagrammatic representation of the growth rate effects of oil on groundnut oil, oilseed cake, and sawn wood exports, respectively.

In reference to the second question we have posed, we note that during the early time periods of the analysis a higher average annual growth rate of oil exports has a positive effect on the growth rates of both groundnut oil and oilseed cake exports. For example in 1960, assuming a 1.0 tmt volume of oil exports, a 2.5 percent, 5.0 percent, and 10.0 percent growth rate of oil exports leads to an 8.0 percent, an 8.4 percent, and a 9.2 percent growth rate in groundnut oil exports, respectively (given by elements c22, c23, and c24 in Table 6). This trend is also illustrated diagrammatically in Figure 18. A similar set of trends is evident for oilseed cake exports.

However, beginning sometime around 1970 for groundnut oil exports, and slightly later for oilseed cake exports, the trend is reversed. That is, while higher oil growth rates of oil exports initially increased the growth rates of agricultural exports, we now have a scenario where high growth rates of oil exports actually decrease the growth
rates in the exports of these goods. This is a very important trend because it suggests that at discrete points in time different growth rates in oil exports can have either positive or negative impacts on agricultural exports, depending on the specific growth rate of oil exports.

For example, by 1980, at the 1.0 tmt level of oil exports, the growth rate of groundnut oil exports at the 2.5 percent, 5.0 percent, and 10.0 percent oil growth rate values are 6.4 percent, 5.1 percent, and 2.3 percent. These values are given elements $c_{22}$, $c_{23}$, and $c_{24}$ in Table 6. This is also shown diagrammatically by the shift in the lines representing the growth rates of oil exports in Figure 18. Again, this same trend holds true for oilseed cake exports. However, as Table 8 clearly illustrates, the effect of high versus low oil growth rates on sawn wood exports is to reduce the growth rate in exports during all time periods.

ii. Volume Effects.

This section assesses the effects of volumes of oil exports on capital intensive exports. Like the growth rate effects, the volume effects affect both the groundnut oil and oilseed cake exports in a similar fashion. In particular, the volume effects of the oil boom lead to a decline in the growth rates of both commodity exports. For example, if we assume a growth rate of oil exports of 2.5 percent, the effect of a 10.0 tmt volume of oil exports induces a reduction in the growth rate of groundnut oil exports from 4.0 percent, to negative 0.4 percent (i.e., -0.4), to negative 1.25 percent for 1960, 1970, and 1980, respectively. These are given by elements $c_{32}$ in Table 6 for the various years. Illustrations are given in Figures 17, 19, and 21 for groundnut oil, oilseed cake, and sawn wood exports, respectively.
In reference to the impacts of high versus low volumes of oil exports at discrete points in time we note that lower volumes of oil exports translate into higher growth rates of agricultural exports for all time periods, and for all commodities. In the case of oilseed cake in 1970, for example, given a 2.5 percent growth rate in oil exports, an initial volume of 1.0 tmt of oil exports would lead to the growth in oilseed cake exports of only 3.0 percent, while increasing the volume of exports to 10.0 tmt and 100.0 tmt would decrease oilseed cake export growth rates to -8.9 percent and -20.9 percent, respectively. Thus, the greater the volume of oil exports, the more the agricultural export growth rates are decreased. This impact is clearly noted in Figures 17, 19, and 21 for groundnut oil, oilseed cake, and sawn wood exports, respectively. It should be noted that oilseed cake exports are most adversely affected by dramatic shifts in the volume of oil exports, while groundnut oil and particularly sawn wood exports are less influenced.


Prior to the oil boom, Nigeria's export economy was heavily dependent on two crops, cocoa and groundnuts, for the bulk of its foreign exchange revenue. Further, the production of both of these commodities have historically been heavily subsidized by the government. Given the dependency of this subsector on capital infusions in the form of subsidies, it is not surprising that the results show that subsidized, labor intensive exports have been influenced by the oil boom, with cocoa and groundnuts exports most clearly impacted. The specific outcomes are now discussed in greater detail.

a. Model Results.

The statistical results of the linear expansion model for cocoa and groundnut exports are the strong for any of the subsectors. Although this subsector consists of only
two exports, all three of the variables in the terminal model equations for both crops proved to be strongly significant, as illustrated more generally in Table 1 and in more detail in Table 3. Note in particular the fact that the signs of the parameters were positive for both the oil, ln OE, and time, t, variables and negative for the oil-time variable, ln OE t. The R² and adjusted R² values for groundnuts were 0.732 and 0.685, respectively. However, those for cocoa were significantly lower: 0.403 for the R² and 0.396 adjusted R². As with the capital intensive exports, temporal autocorrelation was not found to be a problem; the Durbin-Watson statistics of 1.989 for groundnuts and 2.082 for cocoa fell within the acceptable range of values. Given the promising statistical results, both commodities were taken to the next stage of analysis. These results are discussed in the next section.

b. Model Analysis.

As all of the variables in the models were significant, we take the derivatives of the terminal models with respect to time just as we did for the capital intensive subsector. The results for cocoa are given in equation (28), and for groundnuts in equation (29).

\[ \frac{1}{C_{Ex}} \frac{dC_{Ex}}{dt} = 0.945 + \left[ 0.304 - 0.011 t \right] \frac{1}{OE} \frac{dOE}{dt} - 0.011 \ln OE \] (28)

and

\[ \frac{1}{G_{Ex}} \frac{dG_{Ex}}{dt} = 0.191 + \left[ 1.940 - 0.071 t \right] \frac{1}{OE} \frac{dOE}{dt} - 0.071 \ln OE \] (29)

where C Ex and G Ex are cocoa and groundnut exports, respectively. The same range of values for the growth rates and volumes of oil exports used for the previous analysis were employed, and the results are again captured in a 4 x 4 matrix in Table 9 for cocoa, and Table 10 for groundnuts. We notice at first glance that the dynamics of the oil
boom have affected both commodity exports in a similar fashion. Further, it is interesting to note that the average annual growth rates that cocoa and groundnut exports posted under the various oil volume-growth rate scenarios was very similar. A detailed analysis and discussion of these results follows.

1. Growth Rate Effects.

Not only are cocoa and groundnut exports similarly affected by the growth rates of oil exports over time, but their response largely replicates that of the capital intensive exports. The ramification of this finding will be discussed in detail in the final chapter. Using the results for cocoa exports given in Table 9 as a guide and assuming a volume of oil exports of 1.0 tmt per year, and a growth rate of oil exports of 10.0 percent per year, the growth rate of cocoa exports declines from 3.6 percent in 1960, to 2.5 percent in 1970, to only 1.4 percent by 1980. This trend is also illustrated in Figure 24.

Similar trends reflecting a decline in the growth rate of groundnut exports are given in Table 10, and illustrated in Figure 26. The outcomes of the growth rate analysis for subsidized labor intensive exports are repeated so consistently for all time periods and ranges of oil export growth rates that we can generalize, and suggest that the oil boom has been detrimental to this important subset of Nigeria's export sector.

The effect of low versus high growth rates of oil exports within a given time period suggest are for this subsector are similar to those for groundnut oil and oilseed cake exports. At early time periods a higher rate of growth in oil exports leads to higher growth rates for both cocoa and groundnut exports. But again, after 1980, higher oil export growth rates lead to lower growth rates in commodity exports. For example, assuming a volume of oil exports of 100.0 tmt in 1960, a 2.5 percent, 5.0 percent, and 10.0 percent rate of growth of oil exports will translate into -6.0 percent, -5.7 percent, and -5.2 percent rates of
growth in groundnut exports (i.e., an improvement or increase in the commodity’s export growth rates); these values are given in $c_{42}$, $c_{43}$, and $c_{44}$ in Table 10. However, by 1980 the same 2.5 percent, 5.0 percent, and 10.0 percent growth rates in oil exports leads to -6.3 percent, -6.4 percent and -6.6 percent growth rates in groundnut exports, respectively; this is captured by these values given in $c_{42}$, $c_{43}$, and $c_{44}$ in Table 10 for the year 1980.

II. Volume Effects.

The volume effects on the growth rates of the commodity exports over time parallel those of the growth rate effects of oil. Over time, the volume of oil exports acts to decrease the growth rate of cocoa and groundnut exports. In addition, and like the capital intensive exports, regardless of the growth rate of oil exports, lower volumes of oil exports do not have a detrimental an impact on agricultural exports as do higher volumes of oil exports. For example, assuming a growth rate in oil exports of 5.0 percent for 1970, a 1.0 tmt volume of oil exports is reflected in a growth rate of cocoa exports of 2.2 percent. However, a 10.0 tmt or 100.0 tmt volume translates into cocoa export growth rates of approximately 0.0 percent and -2.9 percent, respectively. This is noted by the values in $c_{21}$, $c_{31}$, and $c_{41}$ in Table 9 for 1970 and illustrated in Figure 23. Similar impacts of the volume of oil exports are noted for groundnut exports as illustrated in Table 10 and Figure 25.

An important distinction should be noted between the effects of oil on the growth rates of cocoa and groundnut exports. For cocoa, there exist certain combinations of volume and growth rates of oil exports that result in the shift in the growth rate of cocoa exports from positive to negative growth. These combinations are best noted in Figures 23 and 24. However, regardless of the volume and growth rate combinations of
petroleum exports, the growth rate of groundnut exports consistently remains below zero, i.e., negative; in fact there exists no combination of oil growth rates and volumes that will induce positive growth in groundnut exports. The reader is referred to Figures 25 and 26. Obviously this has implications for Nigerian oil policy, the ramifications of which are discussed in the final chapter.


The non-subsidized labor intensive agricultural subsector includes coffee, cotton, palm oil, and rubber exports. While these cultivation of these commodities require enormous labor inputs, unlike cocoa and groundnuts they are not the recipients of Nigerian government assistance in the form of subsidies. However, like the capital intensive exports none of the commodities in this subsector, with the exception of rubber, has ever made important contributions to Nigeria's foreign exchange earnings. The statistical results suggest that this subsector has been completely insulated from the effects of the oil boom. The only exceptions are palm oil and rubber exports, which appear to have been marginally affected by the oil boom. At this point the reader is referred to Table 1 for an overview of variables which proved significant in the model.

In terms of the numerical results the reader is referred to Table 4. We note that only none of the three variables in the linear expansion model was significant for either coffee or cotton exports. Further only the time variable, \(t\), proved significant for palm oil exports, and the volume of oil exports, \(\ln OE\), for rubber exports. Autocorrelation was not a problem for either the palm oil or rubber exports, although although the Durbin-Watson statistic for cotton was inconclusive; coffee exports clearly revealed evidence of positive autocorrelation.

Our general conclusions must be that petroleum exports have not had an impact
on this export subsector. However, while the linear expansion model results are generally weak and may appear disparaging at first glance, we will note in section 6.3.D that very good reasons exist for this sector's apparent insulation from the oil boom, if we are willing to consider the results in the context of Nigerian realities. However, as a consequence of the statistical results, all of the non-subsidized labor intensive commodities are dropped from further analysis.


The non-cultivated subsector includes crops which do not require significant infusions of either capital or labor in the production process; the exports, then, are usually the produce of tree crops. As previously outlined, this subsector of the agricultural export economy includes the production of palm kernels, and timber. It should be noted that while rubber and coffee are also tree crops and could potentially be classified in this subsector, their labor requirements are much greater than palm kernels, or timber and must therefore be placed under the labor intensive cultivation scheme.

An overview of the model results is given in Table 1 and the details of the statistical output are given in Table 5. Like the non-subsidized labor intensive subsector, the results indicate that oil exports have had no apparent influence on the exports of this commodity. None of the three variables in the linear expansion model proved to be significant for banana exports. Only one variable was significant for each of the other two crops: time, $t$, for palm kernels, and the volume of oil exports variable, $In OE$, for timber exports. There was no evidence of autocorrelation for either palm kernel or timber exports, although the Durbin-Watson statistic for banana exports was strongly positively autocorrelated.
Due to the statistical results of the linear model, no further analysis on any of the commodities is conducted. In terms of general conclusion, it seems clear that like the previous subsector, oil exports have had no clear and direct effect of the exports of non-cultivated commodities. While this could potentially be due to misspecifications in the structure of the linear model, it is more likely the results of the peculiarities and historical realities surrounding the production of the tree crops in the Nigerian context. These are discussed in detail in the final chapter.

C. Quadratic Model.

As noted, the purpose of the quadratic expansion model was to proposed a more realistic set of oil-agricultural export interactions than that provided by the linear model. To recapitulate, the quadratic expansion model sought to allow oil exports to have differential effects on agricultural exports over time. That is, boom-induced oil exports could have a range of outcomes: a) stimulate the growth rate of agricultural exports at one point in time and then stagnate them; b) stagnate and later stimulate the growth rate of agricultural exports; or c) have consistently positive, negative, or no impacts at all. Further, while the linear model was developed largely for exploratory purposes in which general trends were investigated, the quadratic expansion was developed as a more sophisticated and refined representation of the realities associated with booming sector dynamics, from which the complex interactions between booming and non-booming sector sectors could be investigated (e.g., Folayan 1983).

The mathematical formulation of the terminal quadratic expansion model is represented in equations (19) and (20), while results related to the significance of the parameters of the terminal model for each of the commodities is listed in Table
Specific statistical values which were generated for each commodity under the quadratic expansion model are given in Tables 12, 13, 14 and 15.

Table 11

<table>
<thead>
<tr>
<th>Commodity</th>
<th>ln OE</th>
<th>ln O\textsuperscript{2}</th>
<th>t</th>
<th>ln OE t</th>
<th>ln O\textsuperscript{2} t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut Oil</td>
<td>-</td>
<td>+</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Oilseed Cake</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Sawn Wood</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Cocoa</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>*</td>
<td>+</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Coffee</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cotton</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Palm Oil</td>
<td>+</td>
<td>-</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Rubber</td>
<td>*</td>
<td>+</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Palm Kernels</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Timber</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

+ or - = statistically significant at the 5 percent level.
* = not statistically significant.


As Table 12 illustrates, the statistical results of the quadratic model for capital intensive exports are very good for two of the three commodities under consideration. Indeed, all of the variables in the models for both oilseed cake and sawn wood exports are significant, although only two of the five variables were significant are found for groundnut oil. While groundnut oil exports are dropped from further analysis because of
generally poor statistical results, the impacts of the oil boom on both oilseed cake and sawn wood are now analyzed in greater detail.

For those exports for which the quadratic model is applicable, however, portend extremely interesting results. This is particularly true of the growth rate effect on agricultural exports. Both oilseed cake and sawn wood exports exhibit similar overall responses to petroleum exports, although the amount of time it takes for the effects to filter through the system are distinct. The general nature of this behavior, as captured in Figures 27 and 29, suggests that oil exports have the effect of initially promoting the growth rate of the agricultural exports, and ultimately deterring from it. More generally, this trend suggests a stimulation-to-stagnation effect, the analysis of which is now conducted in greater detail.

a. Model Results.

We recall from Table 2 that while all of the variables in the linear expansion models for capital intensive exports are found to be statistically significant, both oilseed cake and sawn wood had very low adjusted $R^2$ values: 0.251 and 0.282, respectively. However, by employing the quadratic version of the model we find that the adjusted $R^2$ values for both commodities increase substantially to 0.783 for oilseed cake, and 0.772 for sawn wood. The Durbin-Watson values of 2.035 for oilseed cake, and 2.101 for sawn wood reveal no evidence of temporal autocorrelation in the quadratic model formulation. However, as previously suggested, the results for the groundnut oil were not particularly strong: the only variables that entered the model were the volume of oil exports, $ln OE$, and time, $t$. These findings replicate the linear model results and suggest that the linear model was indeed optimally specific for this commodity. Reasons why the quadratic might not have been useful for groundnut oil exports are discussed in Chapter VII.
b. Model Analysis.

The derivatives of the terminal quadratic model were taken with respect to time, as outlined in equations (21) and (22) of the previous chapter, and reproduced on the following page for convenience as equation (30)

\[
\frac{1}{AE} \frac{dAE}{dt} = \left[ c_{01} + 2\, c_{02} \ln OE + c_{11} \, t + 2\, c_{12} \ln OE \, t \right] \frac{1}{OE} \frac{dOE}{dt} \\
+ c_{10} + c_{11} \ln OE + c_{11} \ln OE^2
\]  

(30)

Substituting the numerical values from the regression procedures given in Table 12 and rearranging the terms, we derive equations (31) for oilseed cake exports and (32) for sawn wood exports, below.

\[
\frac{1}{OC\, Ex} \frac{dOC\, Ex}{dt} = \left[ -5.589 - 1.120 \ln OE - 0.291 \, t + 0.002 \ln OE \, t \right] \frac{1}{OE} \frac{dOE}{dt} \\
+ 2.596 - 0.291 \ln OE + 0.001 \ln OE^2 
\]  

(31)

and

\[
\frac{1}{SW\, Ex} \frac{dSW\, Ex}{dt} = \left[ -1.134 - 0.152 \ln OE + 0.471 \, t - 0.038 \ln OE \, t \right] \frac{1}{OE} \frac{dOE}{dt} \\
- 2.455 + 0.471 \ln OE - 0.019 \ln OE^2 
\]  

(32)

where \( \frac{1}{OC} \frac{dOC\, Ex}{dt} \) and \( \frac{1}{SW} \frac{dSW\, Ex}{dt} \) represent the growth rates of oilseed cake and sawn wood exports, respectively. Having derived these equations the same range of values associated with the growth rates (0.0, 2.5, 5.0 and 10.0 percent) and
volumes (0.1, 1.0, 10.0 and 100.0 tmt) of oil exports that were employed in the linear model can be substituted into equations (31) and (32), and the impacts on the growth rates of oilseed cake and sawn wood exports, assessed. The results of these substitutions are captured in matrix form in Table 16 for oilseed cake, and Table 17 for sawn wood exports, while the diagrammatic results are illustrated in Figures 27 and 28 for oilseed cake, and Figures 29 and 30 for sawn wood.

1. Growth Rate Effects.

The effect of the growth of oil exports tend to induce a negative effect on the growth rate of oilseed exports over time. For example, if we assume a growth rate in oil exports of 2.5 percent and a constant volume of oil exports of 10.0 tmt, the growth rate of oilseed cake exports decreases from 7.5 percent in 1960, to 2.5 percent in 1970, to 0.9 percent in 1980. This is captured by moving from element $c_{32}$ in Table 16 for the three respective time periods. In addition, this tendency towards decreasing growth rates over time appears to hold true for all growth rates of oil exports, regardless of the volume of oil exports.

However, within a given time period we note that during the initial period a higher growth rate of oil exports stimulates the growth rate of oilseed exports more than does a lower oil export growth rate. For example, for 1960 a 10.0 tmt volume of oil exports and a 2.5 percent, 5.0 percent, and 10.0 percent growth rate of oil exports translates into a 7.5 percent, 11.2 percent, and 18.5 percent growth rate of oilseed cake exports. Yet after this initial time period the effects become reversed: higher growth rates of oil exports induce a decline in the growth rates of oilseed cake exports. This trend is clearly captured in Figure 28.
The effect of the growth rate of oil exports is one which induces a positive response in the growth rate of sawn wood exports over time. For example, if we assume a growth rate in oil exports of 5.0 percent and a constant volume of oil exports of 100.0 tmt, the growth rate of sawn wood exports increases from 8.5 percent, to 13.0 percent, to 17.6 percent for 1960, 1970, and 1980, respectively. Further, this tendency towards to increase the growth rate of sawn wood exports holds true for all growth rates of oil exports, regardless of the volume of oil exports. Oil's growth rate effect on sawn wood exports then, is one which stimulates that commodity's exports over time. This is shown in Table 17.

Further, within a given time period we note that the effect of increasing the growth rate of oil exports is to increase the growth rate of sawn wood exports, at all volume of oil exports. Thus, higher growth rates effect a positive response in the growth rates of sawn wood exports. For example, given a constant volume of 10.0 tmt for 1960, an increase in the growth rate of oil exports from 2.5 percent, to 5.0 percent, to 10.0 percent will be reflected in an increase in the growth rate of oil exports from 4.5 percent, to 6.4 percent, to 10.0 percent. Similar trends are reflected for other volume levels at different time periods. As a result we conclude that the effect that higher growth rates of oil exports stimulate the growth rate of sawn wood exports. The reader is directed to Figure 30.

II. Volume Effects.

The volume effects of oil exports show that increases in the volume of oil exports result in a decline in the growth rate of the oilseed cake exports. However, within a given time period we note that the growth rate of oilseed cake exports is maximized at the lowest possible volumes of oil exports. For example, in the context of Table 16 and assuming a constant growth rate in oil exports of 2.5 percent for the year 1970, an decrease
In the volume of oil exports from 1.0 tmt to 10.0 tmt to 100.0 tmt is reflected in a growth rate in oilseed cake exports of 15.7 percent, 2.5 percent, and -13.8 percent, respectively. In summary, then, the effect of high volumes of oil exports within given time periods is to stagnate the growth rate of oilseed cake exports.

For sawn wood exports the effect of the volume effect stimulates the growth rate of sawn wood exports over time. For example at a 10.0 tmt volume of oil exports, assuming a 25 percent growth rate, the growth rate of sawn wood exports increases from 4.5 percent in 1960, to 6.6 percent in 1970, to 8.5 percent in 1980. This holds true for all other volumes of oil exports, regardless of the growth rates of oil exports.

Within a given time period we note that sawn wood export growth rates are maximized at very high volumes of oil exports. In other words, sawn wood exports are highest when the volume of oil exports is highest. This is true for all possible growth rates in oil exports. For example, in the context of Table 17 and assuming a constant growth rate in oil exports of 2.5 percent for the year 1970, an increase in the volume of oil exports from 1.0 tmt to 10.0 tmt to 100.0 tmt is reflected in a growth rate in sawn wood exports of 2.4 percent, 6.6 percent, and 8.8 percent, respectively. Thus the effects of higher volumes of oil exports within given time periods is to stimulate the growth rate of sawn wood exports.

Given the statistical results, we note that an important conclusion is that the volume effect of oil exports on relevant capital intensive agricultural exports in one which initially stimulates the growth rate of these exports, and then acts to stagnate them. Although oilseed cake exports decline (or stagnate) from an initial maxima, while sawn wood exports increase (or are stimulated) to a maximum value before declining, the fundamental behavior of both commodities is the same. This stimulation-to-stagnation trend is one of the most important and revealing outcomes of the study. This conclusion is
made clear by the trends which emerge in Figure 27 for oilseed cake, and Figure 29 for
sawn wood.


The only commodity which proved to be significant under the subsidized labor inten-
tensive production scheme was cocoa. The results of the analysis for this commodity
reveal some very interesting results which are discussed in the next section. Groundnuts,
the only other major commodity in this subcategory, were statistically insignificant and
dropped from further analysis. This is likely to be due at least in part to a rapid
expansion of the domestic market for groundnut oil, a possibility which is discussed at the
end of the chapter. For the case of cocoa, however, the results of the quadratic expansion
model are extremely interesting. Unlike the quadratic formulation for the capital inten-
ensive commodities which suggest a stimulation-to-stagnation effect, cocoa exports are initially
stagnated and ultimately stimulated by oil exports. The details associated with the
quadratic model for cocoa exports are now explored in greater detail.

a. Model Results.

The quadratic expansion model proved to have very good results for cocoa
exports, although disappointing one for groundnuts. The statistical results are shown in
Table 13 For groundnuts, only the square of the volume of oil exports, \( \ln OE^2 \), proved
significant. As with the linear model the Durbin-Watson statistic revealed no evidence of
temporal autocorrelation. For cocoa, all of the variables were found to be significant.
Further, the \( R^2 \) values increased significantly from 0.403 and 0.386 for the \( R^2 \) adjusted \( R^2 \)
values, respectively, for the linear model, to 0.875 and 0.765, respectively, for the quadratic.
The Durbin-Watson statistic of 1.998 fell within the acceptable range of values and
indicated no problems of autocorrelation. The analysis of variations in growth rates and volumes of oil exports on cocoa exports are now analyzed.

b. Model Analysis.

The analysis for cocoa exports mirror those of sawn wood exports for the quadratic model formulation. The derivative of equation (30) is taken with respect to time in order to establish the growth rate of cocoa exports. This is given in equation (33) as

\[
\frac{1}{\text{C Ex}} \frac{d \text{C Ex}}{dt} = \frac{1}{\text{OE}} \frac{d \text{OE}}{dt} (1.949 - 0.154 \ln \text{OE} - 0.186 t + 0.018 \ln \text{OE} t) - 0.969 + 0.186 \ln \text{OE} + 0.009 \ln \text{OE}^2
\]

where \( \frac{1}{\text{C Ex}} \frac{d \text{C Ex}}{dt} \) represents the growth rate of cocoa exports. The results of investigating variations in the growth rate and volume of oil exports over time are captured in matrix form in Table 18, expressed visually in Figures 31 and 32.

1. Growth Rate Effects.

The growth rate effects of oil on cocoa exports over time are varied. In particular we note the paradoxical nature of the effects. At low volumes of oil exports, both low and high growth rates of oil exports act to stagnate the growth rate of cocoa exports. For example, if we assume a volume of oil exports of 1.0 tmt, a 2.5 percent growth rate is reflected in an 11.7 percent growth rate of cocoa exports in 1960, 10.2 percent for 1970, and 8.6 percent for 1980. However, if the volume of oil exports increases to, say, 100.0 tmt, the impact of the growth rate effect is to stimulate the growth rate of cocoa exports. If we assume a 100.0 tmt volume of oil exports, and the same 2.5 percent growth rate of oil
exports effects a 3.1 percent, 3.7 percent, and 4.2 percent growth rate in cocoa exports, respectively. Thus, if we are to assess the impacts of the growth rate of oil exports over time we need to consider the volume of oil exports at which the analysis is conducted.

Within a given time period we note that the growth rate of oil exports can be both beneficial or detrimental to the growth rate of cocoa exports, again depending on the volume of oil exports. At low volumes of oil exports (i.e., less than 10 tmt) the effect of oil exports is to decrease the growth rate of cocoa exports. For example, at a volume of 10.0 tmt and a growth rate of oil exports of 10.0 percent, the growth rate of cocoa exports for the years 1960, 1970, and 1980, respectively, will be 4.8 percent, 2.8 percent, and 0.8 percent. However, if we increase the volume to 100.0 tmt the growth rate of cocoa exports increases from 6.4 percent, to 8.5 percent, to 10.6 percent, respectively.

II. Volume Effects.

Over time we note that the effect of the volume of oil exports on the growth rate of cocoa exports varies over time. In particular it is found that at very low volumes of oil exports the growth rate of cocoa declines, but at higher volumes of oil exports the growth rate of cocoa is stimulated. For example, at a volume of 0.1 tmt and a constant growth rate in oil exports of 5.0 percent, the growth rate of cocoa exports declines from 30.3 percent in 1960, to 25.2 percent in 1970, to only 20.0 percent by 1980. However, if the volume of oil exports were increased to 100.0 tmt, the growth rate of cocoa exports would be 4.2 percent, 5.3 percent, and 6.3 percent for 1960, 1970, and 1980, respectively. Thus, the volume effect of oil exports on the growth rate of cocoa exports changes from stagnation to stimulation, over time. This stagnation to stimulation effect in the case of cocoa exports, is the mirror image of what occurred with oilseed cake and sawn wood exports, in which the effect of the volume of oil exports was one which initially stimulated the growth rate of those
exports, and then acted to stagnate them. The stagnation-to-stimulation effect of the volume of oil exports on cocoa exports under the quadratic model assumption is an important conclusion; the trend is clearly illustrated in Figure 31.

Within a given time period we note that cocoa growth rates are maximized at very low and very high volumes of exports. That is, cocoa's growth rates are very high when the volume of oil exports is low, a tendency which holds true regardless of the growth rate of oil exports. However, as we begin to increase the volume of oil exports to some middle range, the growth rate of cocoa exports declines precipitously. Then, as we continue to increase oil exports to a higher volume, the growth rate of cocoa exports begins to increase once again. For example, in the context of Table 18 and assuming a constant growth rate in oil exports of 2.5 percent for the year 1960, an increase in the volume of oil exports from 1.0 tmt to 10.0 tmt to 100.0 tmt is reflected in a growth rate in cocoa exports of 11.7 percent, 2.7 percent, and 3.2 percent, respectively. Note the initial decline in the growth rate of cocoa exports between the 1.0 tmt and 10.0 tmt volume of oil values, and the subsequent increase between the 10.0 tmt and 100.0 tmt values. The volumes effect of oil exports on the growth rate of cocoa exports within a given time period holds true for each of the time periods. The results are illustrated in Figure 31.


As Table 14 suggests, the non-subsidized labor intensive agricultural exports did not perform well under the quadratic expansion model scenario. Indeed none of the variables were found statistically significant for either cotton or coffee exports; the volume of oil exports, ln OE, was found to be significant for palm oil and rubber exports, and the square of the volume of oil exports, ln OE^2, was also found to be significant for rubber. With the exception of coffee exports, temporal autocorrelation is not a problem with the
results. Due to the results of the model no further analysis on any of the four commodities is conducted. However possible explanations for the apparent lack of usefulness of the quadratic model, such as the of these commodities from export to domestic markets as Nigerian consumption increases, are discussed in the last chapter.


Like the non-subsidized labor intensive subsector, the results for non-cultivated exports were not at all strong. The more detailed statistical results are given in Table 15, and show that none of the variables for either the palm kernel, or timber exports were found to be significant. Although positive temporal autocorrelation proves to be a problem with timber exports, this is not the case with the other two commodities. Overall the statistical results of the quadratic model suggest that, like their linear counterparts, the expansion formulation has no application for non-cultivated exports. One plausible explanation relates to time lags involved between the planting and harvesting of non-cultivated commodities, which are all tree crops; this is discussed further in the concluding chapter.

D. A General Assessment of the Empirical Results.

This section places the results of the linear and quadratic models into a useful context by making general comments concerning the formulation of the models, including areas of possible model modification. Particular attention is given to a comparison between the linear and quadratic model structures. Other issues addressed include the possibility of employing higher order expansions, a discussion related to the disaggregation of the agricultural export sector, and the possible impacts of value added resulting from agricultural processing on the behavior of the models. These are now discussed in greater detail.
1. **Linear versus Quadratic Expansion Model Formulations.**

   It is clear from the results of the analysis that, in general, the linear model provides more statistically meaningful results than does the quadratic model. Clearly, it is important to address why this might be the case, particularly given the fact that the quadratic formulation, given its ability to incorporate a more realistic stagnation-to-stimulation or stimulation-to-stagnation scenario is, at least intuitively, a more likely representation of booming sector realities. In general, it appears that four possible explanations for the relative success of the linear model over the quadratic model exist.

   First, the linear model may simply perform better than the quadratic on the basis that the former is a more accurate representation of reality. Although the literature would have us believe that natural resource boom set up series of very complex economic interactions, which in certain instances is undoubtedly the case, there is no reason to believe that in the context of the export sector, a more simple representation may actually exist.

   Second, while it may be that the linear model is a useful representation of booming sector realities in the short run, the quadratic model may actually provide a better statistical "fit" over the longer run, and that the time series over which this particular study is based does not allow for sufficient time for the more complex ramifications contained in the quadratic model to "filter" through or "trickle" down the economic system.

   In other words, there is a minimum supply response time between when a resource boom occurs and when the first effects of the shock are felt in non-booming sectors. In the context of Nigeria it may be that only for sawn wood and cocoa exports were the sensitive enough to feel these shocks in the short to medium runs. There is no reason to believe that the stagnation-stimulation or stimulation-stagnation scenarios implicit in the quadratic model will not be revealed in other agricultural exports over a longer period of time.
A third possible source of bias may be that for many of Nigeria's traditionally export-oriented commodities have, in recent years, been subjected to a burgeoning domestic market. Agricultural produce once destined for foreign markets are now being consumed internally. This fact may be reflected, at least implicitly, in the structure of the quadratic model.

A fourth and final possibility is that while the linear model is most useful at this point, and the quadratic model has only been partially illuminating, in actuality it may be that a much more complex series of booming-non-booming sector interactions is occurring that either of the two models suggests. It is plausible, for example, that a cubic or quartic (or possibly even higher) term in either the initial model or the expansion equation may be a more accurate portrayal of reality. However, in this regard, it should be noted that initial "searches" for possible model structures using cubics and quartics did not reveal any useful possibilities.

2. On Model Modifications to the Linear and Quadratic Expansion Models.

This section seeks to address some of the problems that might be associated with the formulation of the models, and possible ways which they might be remedied in future analyses. In particular, the discussion centers on: a) general modifications to the model structures, including higher order expansions; and b) definitional problems arising from the agricultural sector's subcategorization based upon modes of production. We now discuss each of these in turn.

a. Higher Order Expansions.

It may be that the linear and quadratic model structures are incorrect reflections of booming sector realities. That is, it is possible that a more complex relationship exists
between the volume of petroleum exports on the one hand, and its impact on the volume of agricultural exports on the other. However, it seems clear from the analysis that the linear model, at least, provides a very good "fit" for a range of Nigerian agricultural exports, particularly those that are highly capital dependent.

Obviously, what needs to be done, then, is investigate the non-capital intensive subsectors, since their structure has been misspecified. However, initial runs using higher order terms - cubics and quartics in particular - in both the initial model and the expansion equations yielded no better results. Further, it should be emphasized that one of the purposes in employing the expansion methodology has been to take the relatively complex dynamics which resource booms entail, and dismantle these complexities into a smaller set of simpler interactions. To the extent that the linear and quadratic model can accomplish these goals, there is no reason to pursue the development of unnecessarily complex models.

b. Disaggregation of the Agricultural Export Subsector.

A final and general problem which emerges is the process by which the agricultural export subsector has been disaggregated into capital intensive, subsidized labor intensive, non-subsidized labor intensive, and non-cultivated or tree crop production. Obviously, the degree of capitalization of the production process is the criteria by which these four subcategories are identified, and in the case of Nigerian agriculture this is a relatively uncomplicated task to handle. Take, for example, the subsidized labor intensive subsector: only two commodities - groundnuts and cocoa - receive government production subsidies, and are thus easily allocated to this subgroup.

However, the commodities categorized under the others subsector are much more difficult to handle. For example, in 1963 25,000 acres of land was allocated to rubber
production under the government's capital intensive plantation scheme, while 350,000 acres were produced under non-subsidized labor intensive modes of production (Udo 1970, p. 41). However, no information is available in terms of the total volume of rubber exports produced under the various techniques, and as a result the decision was made to classify all of Nigeria's rubber exports under the non-subsidized labor intensive category. Similar problems on the criteria required for sectoral disaggregation are found to exist for oilseed cake, which is again produced under both mechanized and labor intensive processes. A more accurate disaggregation of production techniques for certain crops for which arbitrary mode of production assignments were made would necessarily entail on site interviews and surveys.

c. Value Added and Agricultural Processing.

Closely related to the issue of needing more stringent criteria by which to sectorally disaggregate the agricultural export sector is the potential problem concerning value added during the processing of commodities from raw to semi-finished or finished form. Generally, agricultural exports are one of two types, either: a) products in their raw or unprocessed form, in which no value had been added; or b) products which are partially refined and to which some value has been added during processing. In the context of Nigeria this problem affects three categories of commodities: groundnuts, palm kernels, and timber. Historically, these commodities were exported in their raw form, but more recently they have been exported in more highly processed forms: groundnuts in the form of peanut oils, palm kernels as palm oils and oilseed cake, and timber as sawn wood or lumber. While the effects of the oil boom on agricultural exports are to some extent captured by the process of sectoral disaggregation, more research needs to be conducted on the extent to which the oil boom affects agricultural commodities on
the basis of their relative value added. For example, even though groundnut oil and sawn wood are both classified as capital intensive exports, it still needs to be established whether or not petroleum has had a stronger impact on sawn wood exports than on groundnut oil exports, even though the latter has a significantly higher degree of value added than the former.

E. Summary.

The purpose of this chapter has been to present the statistical results for the expansion models developed in the previous. Both the linear and quadratic models were tested, and further analysis was conducted for those equations which remained statistically significant. In particular, the derivatives of the remaining terminal models were taken with respect to time such that the impacts of varying the volume and growth rate of Nigerian oil exports on the growth rate of specific agricultural exports over time, could be assessed.

The results of the models were generally good. Four general results have emerged. First, the linear model provided a better overall statistical representation of agricultural-petroleum export interactions than did the quadratic model, for a broader range of agricultural exports; however, for a small subset of commodities, particularly those that are heavily capital dependent, the quadratic model formulation provides a much better statistical fit.

Second, and in reference to the quadratic model, the growth rates of certain capital intensive agricultural exports are initially stimulated and ultimately stagnated by oil exports, while subsidized labor intensive commodities that are affected by the oil boom show a reverse trend: their growth rates are initially stagnated and then stimulated.
Third, we have shown that heavily capitalized subsectors of the agricultural export economy (i.e., capital intensive and subsidized labor intensive exports) were more sensitive to the petroleum boom than non-capitalized subsectors. However, the exact nature of the sensitivity depends upon the specific commodity in question.

And fourth, the growth rates of agricultural commodity exports are significantly affected by variations in both the volumes and growth rates of oil exports over time. This is true of both the linear and the quadratic expansion model formulations.

While all of the results provide important insights into the dynamics associated with oil-agricultural export interactions in the Nigerian context, certain results are particularly interesting and are highlighted here. First, in both the linear and quadratic models, increases in the growth rate of oil exports lead to less than proportional increases in the growth rates of affected agricultural exports. This suggests that agricultural commodities are, for various reasons, at least partially insulated from the absorbing the direct impacts of the oil boom. Second, for the linear model, we note that both the volume and growth rate effects of oil exports results in decreases in the growth rates of affected agricultural exports. However, under the quadratic model we note that while the growth rate effects are similar to those in the linear model, the volume effect initially stimulates and then stagnates the growth of capital intensive exports, while it initially stagnates and then stimulates the growth rate of subsidized labor intensive exports.

A general discussion of the relative strengths and weaknesses of the linear and quadratic models, and the socio-economic realities of Nigerian agriculture were introduced as possible explanations for statistical weaknesses in the models which were not found to be significant. Issues related to model structure and possible modifications to the models, including the possibility of using higher order terms in either the initial model or expansion equations were discussed. As final section was devoted to some of the
problems of the models in their current form, and in particular the need to address how rapid increases in domestic demand, the impacts of drought, and time lags between the planting and maturation for tree crops may have affected the statistical outcome for specific agricultural commodities.
### Table 2

**Linear Expansion Model Parameter Estimates: Capital Intensive Agricultural Exports**

<table>
<thead>
<tr>
<th>Export</th>
<th>Y-intercept</th>
<th>in OE</th>
<th>t</th>
<th>ln OE t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut Oil</td>
<td>-0.694</td>
<td>+0.554</td>
<td>+0.304</td>
<td>-0.033</td>
<td>0.796</td>
<td>0.634</td>
<td>1.945</td>
</tr>
<tr>
<td></td>
<td>(5.090)</td>
<td>(2.849)</td>
<td>(3.295)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oilseed Cake</td>
<td>-0.377</td>
<td>+1.210</td>
<td>+0.338</td>
<td>-0.052</td>
<td>0.323</td>
<td>0.251</td>
<td>1.980</td>
</tr>
<tr>
<td></td>
<td>(4.340)</td>
<td>(4.231)</td>
<td>(3.552)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawn Wood</td>
<td>+3.147</td>
<td>-0.360</td>
<td>+0.329</td>
<td>-0.006</td>
<td>0.357</td>
<td>0.282</td>
<td>2.018</td>
</tr>
<tr>
<td></td>
<td>(3.547)</td>
<td>(4.538)</td>
<td>(2.892)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3

**Linear Expansion Model Parameter Estimates: Subsidized Labor Intensive Agricultural Exports**

<table>
<thead>
<tr>
<th>Export</th>
<th>Y-intercept</th>
<th>in OE</th>
<th>t</th>
<th>ln OE t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa</td>
<td>+2.708</td>
<td>+0.304</td>
<td>+0.0945</td>
<td>-0.011</td>
<td>0.403</td>
<td>0.386</td>
<td>2.082</td>
</tr>
<tr>
<td></td>
<td>(5.793)</td>
<td>(1.552)</td>
<td>(2.353)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnuts</td>
<td>-3.690</td>
<td>+1.940</td>
<td>+0.191</td>
<td>-0.071</td>
<td>0.732</td>
<td>0.685</td>
<td>1.989</td>
</tr>
<tr>
<td></td>
<td>(6.657)</td>
<td>(3.551)</td>
<td>(3.267)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4
Linear Expansion Model Parameter Estimates: Non-Subsidized Labor Intensive Agricultural Exports

<table>
<thead>
<tr>
<th>Exports</th>
<th>Y-intercept</th>
<th>ln OE</th>
<th>t</th>
<th>ln OE t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>+ 15.919</td>
<td>-1.798</td>
<td>-0.954</td>
<td>+0.113</td>
<td>0.557</td>
<td>0.308</td>
<td>3.663</td>
</tr>
<tr>
<td></td>
<td>(0.554)</td>
<td>(0.592)</td>
<td>(0.655)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>+ 12.359</td>
<td>-0.105</td>
<td>-0.202</td>
<td>+0.013</td>
<td>0.456</td>
<td>0.339</td>
<td>2.398</td>
</tr>
<tr>
<td></td>
<td>(0.323)</td>
<td>(0.834)</td>
<td>(0.573)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Oil</td>
<td>+ 14.918</td>
<td>-0.375</td>
<td>-1.232</td>
<td>+0.083</td>
<td>0.868</td>
<td>0.754</td>
<td>2.109</td>
</tr>
<tr>
<td></td>
<td>(1.536)</td>
<td>(4.255)</td>
<td>(3.725)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber</td>
<td>+ 9.165</td>
<td>+0.366</td>
<td>-0.011</td>
<td>-0.008</td>
<td>0.886</td>
<td>0.785</td>
<td>2.003</td>
</tr>
<tr>
<td></td>
<td>(5.074)</td>
<td>(0.130)</td>
<td>(1.292)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5
Linear Expansion Model Parameter Estimates: Non-cultivated Agricultural Exports

<table>
<thead>
<tr>
<th>Export</th>
<th>Y-intercept</th>
<th>ln OE</th>
<th>t</th>
<th>ln OE t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm Kernels</td>
<td>+ 7.501</td>
<td>+0.289</td>
<td>-0.430</td>
<td>+0.017</td>
<td>0.856</td>
<td>0.739</td>
<td>1.994</td>
</tr>
<tr>
<td></td>
<td>(1.556)</td>
<td>(1.951)</td>
<td>(1.023)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber</td>
<td>+ 2.948</td>
<td>+0.863</td>
<td>-0.077</td>
<td>-0.023</td>
<td>0.911</td>
<td>0.831</td>
<td>1.920</td>
</tr>
</tbody>
</table>
### Table 6

**Linear Expansion Model: Growth Rates of Groundnut Oil Exports**

#### Growth Rate of Oil Exports (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.0500</th>
<th>0.1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.100</td>
<td>+ 0.1520</td>
<td>+ 0.1560</td>
<td>+ 0.1599</td>
<td>+ 0.1678</td>
</tr>
<tr>
<td>Volume of Oil Exports (tmt)</td>
<td>1.000</td>
<td>+ 0.0760</td>
<td>+ 0.0800</td>
<td>+ 0.0839</td>
</tr>
<tr>
<td>10.00</td>
<td>+ 0.0001</td>
<td>+ 0.0040</td>
<td>+ 0.0080</td>
<td>+ 0.0159</td>
</tr>
<tr>
<td>100.0</td>
<td>- 0.0759</td>
<td>- 0.0720</td>
<td>- 0.0680</td>
<td>- 0.0601</td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.100</td>
<td>+ 0.1520</td>
<td>+ 0.1477</td>
<td>+ 0.1434</td>
<td>+ 0.1348</td>
</tr>
<tr>
<td>Volume of Oil Exports (tmt)</td>
<td>1.000</td>
<td>+ 0.0760</td>
<td>+ 0.0717</td>
<td>+ 0.0674</td>
</tr>
<tr>
<td>10.00</td>
<td>+ 0.0001</td>
<td>- 0.0042</td>
<td>- 0.0085</td>
<td>- 0.0171</td>
</tr>
<tr>
<td>100.0</td>
<td>- 0.0759</td>
<td>- 0.0802</td>
<td>- 0.0845</td>
<td>- 0.0931</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.100</td>
<td>+ 0.1520</td>
<td>+ 0.1395</td>
<td>+ 0.1269</td>
<td>+ 0.1018</td>
</tr>
<tr>
<td>Volume of Oil Exports (tmt)</td>
<td>1.000</td>
<td>+ 0.0760</td>
<td>+ 0.0635</td>
<td>+ 0.0509</td>
</tr>
<tr>
<td>10.00</td>
<td>+ 0.0001</td>
<td>- 0.0125</td>
<td>- 0.0250</td>
<td>- 0.0501</td>
</tr>
<tr>
<td>100.0</td>
<td>- 0.0759</td>
<td>- 0.0885</td>
<td>- 0.1010</td>
<td>- 0.1261</td>
</tr>
</tbody>
</table>
Figure 17

Groundnut Oil Exports: Volume Effects in Linear Model
Figure 18

Groundnut Oil Exports: Growth Rate Effects in the Linear Model
Table 7
Linear Expansion Model: Growth Rates of Oilseed Cake Exports

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate of Oil Exports (%)</th>
<th>Volume of Oil Exports (tmt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>+ 0.1458</td>
<td>+ 0.1632</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0288</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0909</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>- 0.2107</td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>+ 0.1458</td>
<td>+ 0.1502</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0288</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0909</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>- 0.2107</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>+ 0.1458</td>
<td>+ 0.1372</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0288</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0909</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>- 0.2107</td>
</tr>
</tbody>
</table>
Figure 19

Oilseed Cake Exports: Volume Effects in the Linear Model
Figure 20

Oilseed Cake Exports: Growth Rate Effects in the Linear Model
### Table 8
Linear Expansion Model: Growth Rates of Sawn Wood Exports

#### Growth Rate of Oil Exports (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume of Oil Exports (tmt)</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.050</th>
<th>0.100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>0.100</td>
<td>+ 0.3014</td>
<td>+ 0.2906</td>
<td>+ 0.2798</td>
<td>+ 0.2582</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.2876</td>
<td>+ 0.2768</td>
<td>+ 0.2660</td>
<td>+ 0.2444</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>+ 0.2737</td>
<td>+ 0.2629</td>
<td>+ 0.2521</td>
<td>+ 0.2305</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>+ 0.2599</td>
<td>+ 0.2491</td>
<td>+ 0.2383</td>
<td>+ 0.2167</td>
</tr>
</tbody>
</table>

#### Growth Rate of Oil Exports (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume of Oil Exports (tmt)</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.050</th>
<th>0.100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>0.100</td>
<td>+ 0.3014</td>
<td>+ 0.2891</td>
<td>+ 0.2768</td>
<td>+ 0.2522</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.2876</td>
<td>+ 0.2753</td>
<td>+ 0.2630</td>
<td>+ 0.2384</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>+ 0.2737</td>
<td>+ 0.2614</td>
<td>+ 0.2491</td>
<td>+ 0.2245</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>+ 0.2599</td>
<td>+ 0.2476</td>
<td>+ 0.2353</td>
<td>+ 0.2107</td>
</tr>
</tbody>
</table>

#### Growth Rate of Oil Exports (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume of Oil Exports (tmt)</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.050</th>
<th>0.100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0.100</td>
<td>+ 0.3014</td>
<td>+ 0.2876</td>
<td>+ 0.2734</td>
<td>+ 0.2462</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.2876</td>
<td>+ 0.2738</td>
<td>+ 0.2599</td>
<td>+ 0.2324</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>+ 0.2737</td>
<td>+ 0.2600</td>
<td>+ 0.2461</td>
<td>+ 0.2185</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>+ 0.2599</td>
<td>+ 0.2324</td>
<td>+ 0.2323</td>
<td>+ 0.1905</td>
</tr>
</tbody>
</table>
Figure 21
Sawn Wood Exports: Volume Effects In the Linear Model
Sawn Wood Exports: Growth Rate Effects in the Linear Model
Table 9

Linear Expansion Model: Growth Rate of Cocoa Exports

<table>
<thead>
<tr>
<th>Volume of Oil Exports (tmt)</th>
<th>1960</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.0500</th>
<th>0.1000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.100</td>
<td>+ 0.0443</td>
<td>+ 0.0459</td>
<td>+ 0.0474</td>
<td>+ 0.0486</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0190</td>
<td>+ 0.0233</td>
<td>+ 0.0276</td>
<td>+ 0.0362</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0063</td>
<td>- 0.0020</td>
<td>+ 0.0023</td>
<td>+ 0.0109</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>- 0.0316</td>
<td>- 0.0273</td>
<td>- 0.0230</td>
<td>- 0.0144</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume of Oil Exports (tmt)</th>
<th>1970</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.0500</th>
<th>0.1000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.100</td>
<td>+ 0.0443</td>
<td>+ 0.0459</td>
<td>+ 0.0474</td>
<td>+ 0.0505</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0190</td>
<td>+ 0.0206</td>
<td>+ 0.0221</td>
<td>+ 0.0252</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0063</td>
<td>- 0.0048</td>
<td>- 0.0032</td>
<td>- 0.0001</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>- 0.0316</td>
<td>- 0.0301</td>
<td>- 0.0285</td>
<td>- 0.0254</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume of Oil Exports (tmt)</th>
<th>1980</th>
<th>0.0000</th>
<th>0.0250</th>
<th>0.0500</th>
<th>0.1000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.100</td>
<td>+ 0.0443</td>
<td>+ 0.0431</td>
<td>+ 0.0419</td>
<td>+ 0.0395</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.0190</td>
<td>+ 0.0178</td>
<td>+ 0.0166</td>
<td>+ 0.0142</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>- 0.0063</td>
<td>- 0.0075</td>
<td>- 0.0087</td>
<td>- 0.0111</td>
</tr>
<tr>
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<td>100.0</td>
<td>- 0.0316</td>
<td>- 0.0328</td>
<td>- 0.0340</td>
<td>- 0.0364</td>
</tr>
</tbody>
</table>
Figure 23

Cocoa Exports: Volume Effects in the Linear Model
Figure 24
Cocoa Exports: Growth Rate Effects in the Linear Model
Table 10
Linear Expansion Model: Growth Rates of Groundnut Exports

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate of Oil Exports (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0000</td>
</tr>
<tr>
<td>1960</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.100</td>
</tr>
<tr>
<td></td>
<td>Volume of Oil Exports (tmt)</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
<tr>
<td>1970</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.100</td>
</tr>
<tr>
<td></td>
<td>Volume of Oil Exports (tmt)</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
<tr>
<td>1980</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.100</td>
</tr>
<tr>
<td></td>
<td>Volume of Oil Exports (tmt)</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>
Figure 25

Groundnut Exports: Volume Effects in the Linear Model
Figure 26

Groundnut Exports: Growth Rate Effects in the Linear Model
### Table 12

**Quadratic Expansion Model Parameter Estimates: Capital Intensive Agricultural Exports**

<table>
<thead>
<tr>
<th>Export</th>
<th>Y-intercept</th>
<th>ln OE</th>
<th>ln OE²</th>
<th>t</th>
<th>ln OE t</th>
<th>ln OE² t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut Oil</td>
<td>+ 4.222</td>
<td>- 1.123</td>
<td>+ 0.112</td>
<td>+ 0.394</td>
<td>- 0.011</td>
<td>- 0.003</td>
<td>0.827</td>
<td>0.684</td>
<td>2.180</td>
</tr>
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<td></td>
<td></td>
<td>(0.713)</td>
<td>(1.443)</td>
<td>(0.331)</td>
<td>(0.053)</td>
<td>(0.277)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oilseed Cake</td>
<td>+ 8.796</td>
<td>- 5.589</td>
<td>+ 0.560</td>
<td>+ 2.596</td>
<td>- 0.291</td>
<td>+ 0.001</td>
<td>0.959</td>
<td>0.783</td>
<td>2.035</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.574)</td>
<td>(2.831)</td>
<td>(6.706)</td>
<td>(4.101)</td>
<td>(3.067)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawn Wood</td>
<td>+ 16.531</td>
<td>- 1.134</td>
<td>- 0.076</td>
<td>+ 2.455</td>
<td>+ 0.471</td>
<td>- 0.019</td>
<td>0.826</td>
<td>0.772</td>
<td>2.101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.589)</td>
<td>(4.210)</td>
<td>(3.047)</td>
<td>(3.471)</td>
<td>(3.514)</td>
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</tbody>
</table>

### Table 13

**Quadratic Expansion Model Parameter Estimates: Subsidized Labor Intensive Agricultural Exports**

<table>
<thead>
<tr>
<th>Export</th>
<th>Y-intercept</th>
<th>ln OE</th>
<th>ln OE²</th>
<th>t</th>
<th>ln OE t</th>
<th>ln OE² t</th>
<th>R²</th>
<th>adj R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa</td>
<td>- 5.692</td>
<td>+ 1.949</td>
<td>- 0.077</td>
<td>+ 0.969</td>
<td>- 0.186</td>
<td>- 0.009</td>
<td>0.875</td>
<td>0.765</td>
<td>2.512</td>
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<tr>
<td></td>
<td></td>
<td>(4.737)</td>
<td>(4.191)</td>
<td>(3.800)</td>
<td>(3.912)</td>
<td>(4.947)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Groundnuts</td>
<td>+ 8.608</td>
<td>- 5.257</td>
<td>+ 0.564</td>
<td>+ 2.948</td>
<td>- 0.358</td>
<td>+ 0.003</td>
<td>0.986</td>
<td>0.972</td>
<td>1.998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.919)</td>
<td>(4.158)</td>
<td>(1.423)</td>
<td>(0.958)</td>
<td>(0.179)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>Y-intercept</td>
<td>In OE</td>
<td>In OE$^2$</td>
<td>t</td>
<td>ln OE t</td>
<td>ln OE$^2$ t</td>
<td>R$^2$</td>
<td>adj R$^2$</td>
<td>DW</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
<td>-------</td>
<td>-----------</td>
<td>-----</td>
<td>---------</td>
<td>--------------</td>
<td>-------</td>
<td>-----------</td>
<td>-----</td>
</tr>
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<td>Cotton</td>
<td>+2.538</td>
<td>+4.543</td>
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<td>-1.088</td>
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<td>+0.006</td>
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<td>0.522</td>
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<td>(1.541)</td>
<td>(0.295)</td>
<td>(0.100)</td>
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<td></td>
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<td>Coffee</td>
<td>+172.987</td>
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<td>-5.162</td>
<td>+1.295</td>
<td>-0.079</td>
<td>0.585</td>
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<td>(0.229)</td>
<td>(0.236)</td>
<td>(0.134)</td>
<td>(0.154)</td>
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<td></td>
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<td>Palm Oil</td>
<td>-5.527</td>
<td>+6.746</td>
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<td>-0.180</td>
<td>+0.023</td>
<td>+0.010</td>
<td>0.939</td>
<td>0.881</td>
<td>1.591</td>
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<td>(3.706)</td>
<td>(0.905)</td>
<td>(0.063)</td>
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<tr>
<td>Rubber</td>
<td>+5.642</td>
<td>+0.564</td>
<td>+0.014</td>
<td>+0.770</td>
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<td>+0.005</td>
<td>0.869</td>
<td>0.802</td>
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<td></td>
<td></td>
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<td>(4.158)</td>
<td>(1.423)</td>
<td>(0.958)</td>
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</table>

Table 15

Quadratic Expansion Model Parameter Estimates: Non-cultivated Agricultural Exports

<table>
<thead>
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<th>Export</th>
<th>Y-intercept</th>
<th>In OE</th>
<th>In OE$^2$</th>
<th>t</th>
<th>ln OE t</th>
<th>ln OE$^2$ t</th>
<th>R$^2$</th>
<th>adj R$^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm Kernels</td>
<td>-6.872</td>
<td>+2.070</td>
<td>-0.035</td>
<td>+1.937</td>
<td>-0.399</td>
<td>+0.018</td>
<td>0.871</td>
<td>0.758</td>
<td>1.858</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.744)</td>
<td>(0.253)</td>
<td>(0.921)</td>
<td>(1.051)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber</td>
<td>-25.358</td>
<td>+3.303</td>
<td>+0.058</td>
<td>+5.552</td>
<td>-1.003</td>
<td>+0.041</td>
<td>0.944</td>
<td>0.890</td>
<td>2.567</td>
</tr>
<tr>
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<td>(1.042)</td>
<td>(0.391)</td>
<td>(1.826)</td>
<td>(1.829)</td>
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</table>

210
Table 16
Quadratic Expansion Model: Growth Rates of Oilseed Cake Exports

<table>
<thead>
<tr>
<th></th>
<th>Growth Rate of Oil Exports (%)</th>
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<tr>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>0.0500</td>
</tr>
<tr>
<td></td>
<td>0.1000</td>
</tr>
<tr>
<td></td>
<td>0.100 + 0.2797</td>
</tr>
<tr>
<td></td>
<td>0.2824</td>
</tr>
<tr>
<td></td>
<td>0.2871</td>
</tr>
<tr>
<td></td>
<td>0.2905</td>
</tr>
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<td>Volume of Oil Exports (tmt)</td>
</tr>
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<td></td>
<td>1.000 + 0.1749</td>
</tr>
<tr>
<td></td>
<td>0.1946</td>
</tr>
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<td>0.2143</td>
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<tr>
<td></td>
<td>0.0750</td>
</tr>
<tr>
<td></td>
<td>0.1118</td>
</tr>
<tr>
<td></td>
<td>0.1853</td>
</tr>
<tr>
<td></td>
<td>100.0 - 0.1301</td>
</tr>
<tr>
<td></td>
<td>-0.0765</td>
</tr>
<tr>
<td></td>
<td>-0.0226</td>
</tr>
<tr>
<td></td>
<td>+0.0850</td>
</tr>
<tr>
<td></td>
<td>1970</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>0.0500</td>
</tr>
<tr>
<td></td>
<td>0.1000</td>
</tr>
<tr>
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<td>0.100 + 0.2797</td>
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<td>Volume of Oil Exports (tmt)</td>
</tr>
<tr>
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<td>1.000 + 0.1749</td>
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<td>0.1566</td>
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<td>0.1384</td>
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<tr>
<td></td>
<td>+0.1019</td>
</tr>
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<td></td>
<td>10.00 + 0.0382</td>
</tr>
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<td></td>
<td>0.0253</td>
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<td>0.0123</td>
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<td></td>
<td>-0.0136</td>
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<td>100.0 - 0.1303</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>-0.1609</td>
</tr>
<tr>
<td></td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>0.0500</td>
</tr>
<tr>
<td></td>
<td>0.1000</td>
</tr>
<tr>
<td></td>
<td>0.100 + 0.2797</td>
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</tr>
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<td></td>
<td>0.2133</td>
</tr>
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<td>+0.1470</td>
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<td>Volume of Oil Exports (tmt)</td>
</tr>
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<td>1.000 + 0.1749</td>
</tr>
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<td>0.1435</td>
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<td>0.1122</td>
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<td>+0.0495</td>
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<tr>
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<td>10.00 + 0.0382</td>
</tr>
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<td>0.0087</td>
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<td>-0.0798</td>
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<td></td>
<td>-0.1579</td>
</tr>
<tr>
<td></td>
<td>-0.1856</td>
</tr>
<tr>
<td></td>
<td>-0.2400</td>
</tr>
</tbody>
</table>
Figure 27

Oilseed Cake Exports: Volume Effects in the Quadratic Model
Figure 28

Oilseed Cake Exports: Growth Rate Effects in the Quadratic Model
Table 17

Quadratic Expansion Model: Growth Rates of Sawn Wood Exports

<table>
<thead>
<tr>
<th>Growth Rate of Oil Exports (%)</th>
<th>1960</th>
<th>1970</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.100</td>
<td>-0.0688</td>
<td>-0.0379</td>
<td>-0.0218</td>
</tr>
<tr>
<td>Volume of Oil Exports (tmt)</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>10.00</td>
<td>+0.0271</td>
<td>+0.0659</td>
<td>+0.0854</td>
</tr>
<tr>
<td>100.0</td>
<td>+0.0449</td>
<td>+0.0876</td>
<td>+0.1194</td>
</tr>
</tbody>
</table>

Growth Rate of Oil Exports (%)

<table>
<thead>
<tr>
<th>Growth Rate of Oil Exports (%)</th>
<th>1960</th>
<th>1970</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.100</td>
<td>-0.0688</td>
<td>-0.0379</td>
<td>-0.0218</td>
</tr>
<tr>
<td>Volume of Oil Exports (tmt)</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>10.00</td>
<td>+0.0271</td>
<td>+0.0659</td>
<td>+0.0854</td>
</tr>
<tr>
<td>100.0</td>
<td>+0.0449</td>
<td>+0.0876</td>
<td>+0.1194</td>
</tr>
</tbody>
</table>
Figure 29

Sawn Wood Exports: Volume Effects in the Quadratic Model
Figure 30

Sawn Wood Exports: Growth Rate Effects in the Quadratic Model
Table 18
Quadratic Expansion Model: Growth Rates of Cocoa Exports

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate of Oil Exports (%)</th>
<th>Volume of Oil Exports (tmt)</th>
<th>Growth Rate of Oil Exports (%)</th>
<th>Volume of Oil Exports (tmt)</th>
<th>Growth Rate of Oil Exports (%)</th>
<th>Volume of Oil Exports (tmt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0000</td>
<td>0.0250</td>
<td>0.0500</td>
<td>0.1000</td>
<td>0.100</td>
<td>0.1136</td>
</tr>
<tr>
<td>1960</td>
<td>0.100</td>
<td>+ 0.3033</td>
<td>+ 0.3034</td>
<td>+ 0.3036</td>
<td>1.000</td>
<td>+ 0.1136</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>+ 0.1136</td>
<td>+ 0.1172</td>
<td>+ 0.1209</td>
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<td>+ 0.0194</td>
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<tr>
<td></td>
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<td>+ 0.0205</td>
<td>+ 0.0313</td>
<td>+ 0.0421</td>
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<td>+ 0.0205</td>
</tr>
<tr>
<td>1970</td>
<td>0.100</td>
<td>+ 0.3033</td>
<td>+ 0.2776</td>
<td>+ 0.2519</td>
<td>1.000</td>
<td>+ 0.1136</td>
</tr>
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<td>1.000</td>
<td>+ 0.1136</td>
<td>+ 0.1018</td>
<td>+ 0.0900</td>
<td>10.00</td>
<td>+ 0.0194</td>
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<td>+ 0.0366</td>
<td>+ 0.0527</td>
<td>100.0</td>
<td>+ 0.0205</td>
</tr>
<tr>
<td>1980</td>
<td>0.100</td>
<td>+ 0.3033</td>
<td>+ 0.2518</td>
<td>+ 0.2003</td>
<td>1.000</td>
<td>+ 0.1136</td>
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<td>+ 0.1136</td>
<td>+ 0.0864</td>
<td>+ 0.0592</td>
<td>10.00</td>
<td>+ 0.0194</td>
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<td>+ 0.0205</td>
<td>+ 0.0419</td>
<td>+ 0.0633</td>
<td>100.0</td>
<td>+ 0.0205</td>
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</table>
Figure 31

Cocoa Exports: Volume Effects in the Quadratic Model
Figure 32

Cocoa Exports: Growth Rate Effects in the Quadratic Model
<table>
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<th>AGRICULTURAL EXPORT</th>
<th>COMMODITY</th>
<th>GROWTH RATE EFFECTS</th>
<th>VOLUME EFFECTS</th>
<th>Maximum growth rate of commodity achieved when the growth rate of oil exports is:</th>
<th>Maximum growth rate of commodity achieved when the volume of oil exports is:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundnut Oil</td>
<td>forces decrease</td>
<td>forces decrease</td>
<td>maximized and then minimized</td>
<td>minimized</td>
</tr>
<tr>
<td>CAPITAL INTENSIVE</td>
<td>Oilseed Cake</td>
<td>forces decrease</td>
<td>forces decrease</td>
<td>maximized and then minimized</td>
<td>minimized</td>
</tr>
<tr>
<td></td>
<td>Sawn Wood</td>
<td>forces decrease</td>
<td>forces decrease</td>
<td>minimized</td>
<td>minimized</td>
</tr>
<tr>
<td>SUBSIDIZED LABOR INTENSIVE</td>
<td>Cocoa</td>
<td>forces decrease</td>
<td>forces decrease</td>
<td>maximized and then minimized</td>
<td>minimized</td>
</tr>
<tr>
<td></td>
<td>Groundnuts</td>
<td>forces decrease</td>
<td>forces decrease</td>
<td>maximized and then minimized</td>
<td>minimized</td>
</tr>
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<td>not applicable</td>
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<tr>
<td></td>
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<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
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<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
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<td>Rubber</td>
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<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
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<td>no impact</td>
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<td>not applicable</td>
</tr>
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<td>Timber</td>
<td>no impact</td>
<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
</tbody>
</table>

Figure 33

Summary of Contextual Variations for the Linear Expansion Model
<table>
<thead>
<tr>
<th>AGRICULTURAL EXPORT</th>
<th>COMMODITY</th>
<th>GROWTH RATE EFFECTS</th>
<th>VOLUME EFFECTS</th>
<th>Maximum growth rate of commodity achieved when the growth rate of oil exports is:</th>
<th>Maximum growth rate of commodity achieved when the volume of oil exports is:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundnut Oil</td>
<td>no impact</td>
<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td>CAPITAL INTENSIVE</td>
<td>Oilseed Cake</td>
<td>forces decrease</td>
<td>forces increase, then decrease</td>
<td>maximized</td>
<td>minimized</td>
</tr>
<tr>
<td></td>
<td>Sawn Wood</td>
<td>forces increase</td>
<td>forces increase, then decrease</td>
<td>maximized</td>
<td>minimized</td>
</tr>
<tr>
<td>SUBSIDIZED LABOR INTENSIVE</td>
<td>Groundnuts</td>
<td>forces decrease</td>
<td>forces decrease, then increase</td>
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<td>maximized</td>
</tr>
<tr>
<td></td>
<td>Cocoa</td>
<td>no impact</td>
<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NON-SUBSIDIZED LABOR INTENSIVE</td>
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<td>no impact</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td></td>
<td>Cotton</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Palm Oil</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rubber</td>
<td></td>
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<td>NON-CULTIVATED</td>
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<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td></td>
<td>Timber</td>
<td></td>
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</tbody>
</table>

Figure 34

Summary of Contextual Variations for the Quadratic Expansion Model
CHAPTER VII

CONCLUSIONS AND RESEARCH IMPLICATIONS

VII. Conclusions and Research Implications.

This final chapter of the study serves various purposes. First, a brief recapitulation regarding the purpose of the study is given, including specific research questions that have been posed. Second, a summary of the results of the analysis is given, and the major conclusions based on the analysis are outlined. Third, the implications of the conclusions for booming sector policy formulation in general, and the Nigerian experience in particular, are discussed. Fourth, a series of important research questions that have emerged as a result of the study are proposed. And lastly, the contributions of the study to both the relevant literatures and to the discipline of geography are assessed.*

A. Review of the Study.

For most LDCs the process of developmental change from a rural-agricultural foundation to an urban-industrial base is one which requires both time, and heavy reliance upon a productive agricultural sector. In many models, the role that agricultural exports

* A final caveat in regard to this last chapter: while the latter sections are devoted to a discussion of broader issues related to booming sectors in general, the conclusions proposed and discussed are generally done so in reference to the Nigerian context.
are expected play in the process of structural economic transformation is especially
critical. Agricultural exports are, for many LDCs, the true "engine of growth." However,
for a small subset of LDCs, structural shifts from a primary to secondary base can occur
much more quickly if the benefits of booming sectors can be appropriately harnessed.
Indeed, natural resource booms have had clear influences on the rate and direction of the
developmental paths of such countries as Ecuador, Gabon, Indonesia, Mexico, Nigeria,
Trinidad and Tobago, and Venezuela.

While there exists a sizeable literature on the costs and benefits of resource booms
in more general or aggregated socio-economic space, very little remains known about the
effects of booming sectors on the agricultural export sector, which as previously alluded to,
is often the primary catalyst for development prior to the emergence of a booming
sector(s). Thus, the focus of this study has been on the modelling and empirical analysis
of the interactions between booming and non-booming sectors of an LDC economy.

1. Purpose.

The purpose of this study has been to investigate the manner in which natural
resource booms affect the performance of non-booming sector of the economy. In this
regard the study has followed closely the concerns laid out by the theory of the Dutch
Disease related to the effects of booming sectors on non-booming sectors of the economy.
Specifically, the study has concerned itself with the degree to which the expansion method
can be employed to analyze how the variations in the volume and growth rate of Nigerian
oil exports have affected the growth rate of Nigerian agricultural exports, over time. The
mathematical models and empirical results of the study have, at all junctures, been placed
in an appropriate context by incorporating the socio-economic realities consistent with the
Nigerian experience.
To recapitulate the research problems stated in Chapter I, the specific goals of the study have been the following:

a) assuming that a fundamental relationship between the booming petroleum sector and the agricultural sector exists, in what way can the expansion method provide an appropriate conceptual and methodological framework for the analysis of these interactions?

b) assuming that a useful set of equations to model the petroleum-agricultural interactions in the context of the expansion method can be proposed, what is the empirical nature of the effect of the exports of petroleum on the exports of agricultural commodities?

c) assuming that statistically significant interactions can be identified, can the impacts of petroleum exports be disaggregated? Specifically, can we isolate the differential impacts of: a) the volume of petroleum exports, and b) the growth rate of petroleum exports, on the growth rate of agricultural commodity exports, over time?

d) assuming that statistically significant interactions can be identified, can the impacts of petroleum exports on the growth rate of agricultural exports be disaggregated by each agricultural commodity's mode of production? That is, does petroleum have different effects upon capital intensive, labor intensive, and non-cultivated agricultural commodity exports?

e) assuming that statistically significant interactions between the petroleum and agricultural export sectors exist, what happens to the parameters in the model as contextual variations are introduced? Specifically, how do the growth rates of sectorally disaggregated agricultural exports affected by variations in
the growth rate and volume of oil exports, as the temporal context is allowed to vary?

In addition to these specific research questions, the study has sought at the more general level, to: a) contribute to the rapidly expanding literature on booming sectors; b) to introduce the expansion method into the literatures related to booming sectors, as it appears the methodology has application for a wide range of booming sector related research issues; and c) to highlight the contribution that the discipline of geography can make to the study of booming sectors.

2. Methodology.

The study has employed the expansion method (Casetti 1973) as the primary means of modelling and investigating the research questions posed on the previous pages. The choice of the expansion method was one based on both conceptual and methodological grounds. At the conceptual level, the expansion method challenges the conventional assumption of parametric stability of most social science models. That is, social science models should be allowed to "drift", i.e., their parameters should be allowed to change, as the contexts in which they are employed, varies. At the methodological level, the expansion method provides a series of logical sequences, or more generally a mathematical routine, for empirically investigating the extent to which the parameters of a model drift as contextual variations are introduced.

In reference to this study, temporal variations were incorporated into various expansion model formulations such that changes in the effects of natural resource booms on the non-booming sectors of the economy might be empirically assessed. In particular, two expansion models were proposed, one linear and the other quadratic. The linear model was developed largely for exploratory purposes, in order to isolate the
fundamental statistical dynamics which existed between oil exports and agricultural exports. Assuming that meaningful statistical interactions between the booming (i.e., oil) and the non-booming (i.e., agricultural) export sectors could be found, the quadratic model, sought to explore the complexities of these dynamics in greater detail. Specifically, the quadratic formulation allowed oil exports to have a range of differential impacts on agricultural exports over time; indeed, the quadratic model allowed for testing the hypothesis that: a) oil exports may first stimulate and then stagnate agricultural exports; b) oil exports may first stagnate and then stimulate agricultural exports; or c) oil export have no effect on agricultural exports.

3. Analysis.

The derivatives of the linear and quadratic terminal models that remained significant in the terminal expansion models were taken with respect to time, in order to isolate the growth rate and volume effects of oil exports on the growth rate of the agricultural export in question. To isolate potential differences in the response to a resource boom, the agricultural export sectors was disaggregated by mode of production into four subsectors: capital intensive exports, subsidized labor intensive exports, non-subsidized labor intensive exports, and non-cultivated (or tree crops exports). This was done on the assumption that the Nigerian oil boom has affected different subsectors of the agricultural sector differently, based upon each commodity's relative capital and/or labor requirements. This sectoral disaggregation represents an important contribution to research on booming sectors, in that most studies in the literature assume that when the impacts of booming sectors are assessed on other sectors of the economy, the non-booming sectors can be treated as a single, non-differentiated subset of economic activities.
4. Results.

The results of the study have provided very important insights into the nature of the interactions between the oil and agricultural export sectors in the context of Nigeria. Among the more important are that the linear expansion model provided greater utility in terms of overall applicability; that is, it could be applied to a larger number of agricultural export commodities than could the quadratic. However, the quadratic expansion model was more appropriate for a small but important subset of Nigerian agricultural export: those that were either highly capitalized and/or historically very important Nigerian export commodities.

In general, the analysis revealed that petroleum exports have had the most profound impacts on the agricultural exports which were either heavily capitalized (as in the case of capital-intensive agricultural exports), or highly capital-dependent (as in the case of subsidized labor intensive agricultural exports). Further, agricultural export commodities that were not heavily capitalized, i.e., non-subsidized labor intensive and non-cultivated commodities were found to be unaffected by petroleum exports.

The derivatives of all statistically significant linear and quadratic models were taken with respect to time, and a range of values for the volumes and growth rates of petroleum exports reflective of the Nigerian oil boom experience were introduced. The results provided the average annual growth rates associated with specific agricultural commodity exports, which were captured in both matrix and graphical form.

B. Research Conclusions.

On the basis of the results of the study a number of important conclusions about the impacts of natural resource booms on the performance of the agricultural export sector can be noted. Keeping in line with the research questions posed in section 1.B.1 and
VII.A.1 at least nine major conclusions can be drawn related to the effects of the Nigerian oil boom on the performance of her agricultural export sector. These conclusions are summarized briefly in the following pages, and then explored in greater detail under four separate subheadings: 1) On the Expansion Method and Model Structure; 2) On Contextual Variations in Models; 3) On Agricultural Export Performance under Booming Sector Conditions; and 4) On Nigerian Booming Sector Realities.

a) **Applicability of the Linear Expansion Model.** In general we have found that the more simple linear expansion model formulation is applicable to largest number of Nigerian agricultural exports. The general tendency was for the oil boom to force declines in the growth rates of agricultural exports. However, the linear model was not applicable across the board; the linear expansions were not useful at all for some commodities, and for others the more powerful quadratic was found to have greater applicability.

b) **Applicability of the Quadratic Expansion Model.** The quadratic model was found to have application only to highly capitalized agricultural commodities, i.e., capital intensive and subsidized labor intensive agriculture. In this context, capital intensive exports are initially stimulated and then stagnated by the oil boom, whereas subsidized labor intensive exports are initially stagnated and then stimulated by the oil boom. In the instances where the quadratic model is appropriate, it is found to be much more powerful than its linear counterpart.

c) **Distinction between Growth Rate and Volume Effects of Oil Exports.** It is indeed important, as hypothesized, to distinguish between the effects of volumes of oil exports on the one hand, and the growth rate of oil exports on the other. The combined effects of very low volumes of oil exports coupled with high growth rates of oil exports, on the growth rate of a given agricultural export, can be very
different than the effects of high volumes of oil exports in conjunction with low
growth rates of oil exports.

d) Change in Oil Sector Dynamics. Large changes in the growth rates and/or volumes
of oil exports does not generally lead to equally large changes in the growth rates
of certain agricultural commodity exports.

e) Contextual Variation and the Impacts of Time. The effects of the oil exports on the growth rates of agricultural exports changes significantly over time. The linear and quadratic terminal equations, having been expanded by time, are thus found to provide a useful structural base for the models.

f) Disaggregation of the Agricultural Export Sector. The effects of the oil boom on the growth rates of agricultural exports are found to be heterogeneous; the oil boom has significantly affected the growth rate of some agricultural exports, affected other exports only marginally, and had no effect at all on still other commodities. Disaggregation of the agricultural export sector allows for these differential impacts to be empirically assessed in an explicit manner.

g) Degree of Capital Dependency of Agricultural Exports. The results suggest that heavily capitalized or capital dependent agricultural exports are most clearly and directly affected by the oil boom, while relatively non-capitalized or capital dependent subsectors are least affected by the oil boom.

h) Net Contributions to Foreign Exchange Earnings. It appears that commodities which have traditionally been important sources of foreign exchange revenues are more clearly and directly affected by the oil boom that export commodities which have been only marginal contributors to foreign exchange earnings.

i) Incorporation of Historical Realities. It is important to consider historical realities associated with the production and export of specific agricultural commodities,
when assessing the impact of the oil boom on the performance of the agricultural export in question. While the linear and quadratic models may not have proven useful for all Nigerian agricultural exports, oftentimes the lack of statistical significance can be traced to specific realities surrounding the production and export of the commodity.

In the following sections these conclusions are discussed in greater detail, and their implications for Nigerian economic development and policy choices are assessed.


One of the important conclusions of the study addresses the issue of the applicability of the expansion method as an appropriate methodology for investigating natural resource booms, and the extent to which the proposed linear and quadratic expansion models provide useful theoretical formulations for the analysis of booming sectors in the Nigerian context. The conceptual formulation of the problem and the statistical results which followed suggest that the expansion method has been a valuable tool for the investigation of booming sectors.

This study has been among the first to employ the expansion method in order to address problems related to natural resources, and the only to to explicitly address the issue of booming sectors. In the context of booming sectors the methodology seems to be particularly useful, since the expansion method allows us to investigate the drift in the parameters of a model as the contexts in which model is applied vary. This is particularly important in the study of resource booms since the very characteristics of booms imply abrupt shifts in the exports of a booming commodity, as endogenous and exogenous economic, political, and other forces change rapidly. The expansion method seems particularly well suited for exploring other issues related booming sector phenomena.
Having established that the expansion method has been an appropriate methodological technique for the study of booming sectors, what can we say about the specific expansion model formulations that have been proposed? As a general statement we can say that both the linear and quadratic model formulations have applicability, although their relative degree of usefulness depends in part on the agricultural commodity under analysis; in turn, this is related to the characteristics associated with each commodity's mode of production, and in particular the extent to which the production process is capitalized. Conclusions related to the linear and quadratic expansion models are discussed in greater detail.

a. The Linear Expansion Model.

As suggested the study has employed two distinct formulations of booming sector behavior in the expansion method framework. The first of these, captured by the linear formulation, was proposed as a means of exploring the overall, i.e., general, nature of oil-agricultural export interactions under booming sector conditions. The second and more complex formulation was based on quadratic expansion, which purported to hypothesize a more realistic set of boom interactions because it allowed for the possibility of oil exports to have differential impacts on agricultural export growth rates over time. Specifically, the quadratic allowed for the growth rate of a given agricultural export to be stimulated and then stagnated, or vice versa, over time. This idea of a more complex model structure is highlighted by Folayan (1983, p. 131) who suggests that

The important observation from the 1970s has been that export booms set up complex effects that actually retard growth in other parts of the economy.
While Folayan does little to help us in terms of what sort of mathematical formulation this more complex set of interactions ought to have, we must conclude that the quadratic model chosen to represent this complexity was neither a more useful nor a more accurate representation of the Nigerian experience. Indeed, the quadratic model was useful in understanding the response of only two the twelve commodities under consideration. Further, exploratory attempts at higher order expansions, including cubics and quartics, proved even less useful. Thus it must be concluded that the simpler linear formulation provides a more accurate representation of the effects of the Nigerian oil boom on the agricultural export sector. Yet for a small set of exports the quadratic was useful and the results are discussed below.

b. The Quadratic Expansion Model.

The quadratic model formulation proved to be a useful formulation for only two exports: sawn wood, and cocoa. Further, the effect of variations in the growth rates and volumes of oil exports over time is different for each commodity. For sawn wood, the effect of increasing the volume and growth rate of oil exports has its most profound impact at later time periods, while for cocoa the most dramatic effects of variations in the oil sector dynamics are felt at earlier time period. In addition, the growth rate of sawn wood exports are initially stimulated by the oil boom, reach a maximum, and then decline; in this regard, oil has a stimulation-to-stagnation effect. The reverse holds true for cocoa exports: the oil boom first serves to stagnate growth rates, then reaches a minimum value, before increasing once again; for cocoa, then, oil has a stagnation-to-stimulation effect.
2. On Contextual Variation in the Models.

One of the primary reasons for employing the expansion method is that it allows for the explicit investigation of how the parameters of a model drift as contextual variations are introduced. In the context of this study the initial model assumed a function relationship between agricultural exports and time. However, the time variable was in turn expanded by petroleum exports. The result, then, was the construction of a terminal model that was able to capture an even more complex set of variables related to both time and oil exports. How the agricultural export subsector responded as these temporal and petroleum export dynamics changed across context was the focal point of the study. The conclusions related to this analysis are now discussed.

a. Growth Rate Effects and Volume Effects, and Agricultural Export Performance.

One of the fundamental research questions posed in this study was whether or not it was possible to distinguish between the effects of the volume of exports associated with a booming sector export, and the growth rate of exports associated with the booming sector commodity. The conclusion is that not only is it possible to distinguish between volume and growth rate effects, but that if one wants to gain an appreciation of the impacts of booming sectors on non-booming sectors of the economy, it is necessary to make such a distinction.

However, the specific impacts of variations in the growth rate and volume of oil exports on the growth rate of agricultural exports will depend on the specific commodity in question; no generalization appear possible, even within the disaggregated groups of commodities. As it is not particularly useful to recapitulate the results of volume and growth rate effects for individual crops from the previous chapter, the reader is directed to Chapter VI for a review of the results.
b. The Effects of Oil Sector Dynamics on Agricultural Export Performance.

It is clear from the analysis that changing the parameters which define the oil export sector affect the growth rates of certain agricultural commodity exports. However, what is particularly interesting is that large changes in the values of either oil export growth rates and/or volumes does not generally lead to equally large changes in the growth rates of agricultural commodity exports. For example, if we take the linear version of groundnut exports, an increase in the growth rate of oil exports from 0.0 percent to 10.0 percent per year, leads to an increase in groundnut exports of less than 1.0 percent. Interestingly, this trend of major variations in the oil dynamics having only a minor effect of agricultural export growth rates holds true for all of the commodities for which there were statistically significant results. This result suggest that at least to some degree, the agricultural export sector is at least partially insulated from dramatic fluctuations in the dynamics which define the oil boom.

c. The Effects of Time on Agricultural Export Performance.

A further conclusion of the study is that the effects of booming sectors on non-booming sectors of an economy vary over time. Indeed, the very structure of both the linear and quadratic expansion models was one which emphasized the temporal variable: the initial models in each were expanded by time, in order to investigating how booming sectors affect non-booming sectors as the temporal context changed. The results of the analysis suggest that the effect of time on the growth rate of agricultural exports is influenced by at least four factors: a) the structure of the model being used; b) the volume of oil exports; c) the growth rates of oil exports; and c) the specific agricultural commodity export being examined.
Because a discussion of the numerous combinations would not be particularly useful at this juncture, the reader is directed to the various tables and graphs associated with specific crops given in the previous chapter. However, at least two general comments can be made. First, in relation to the research question posed in section A.1.e, we conclude that the effect of the Nigerian oil exports on specific agricultural exports does indeed change as temporal variations are introduced into the models. Second, it the effect of time is most strongly felt among agricultural exports that are again heavily capital dependent; in this regard, groundnut oil and sawn wood within the capital intensive subsector, and cocoa and groundnuts among the subsidized labor intensive subsector are most sensitive to changes over time.

3. On the Agricultural Export Sector under Booming Sector Conditions.

This section addresses what we can conclude about the Nigerian agricultural export sector under booming sector conditions. In particular, two important issues are raised. The first suggests that if we are to accurately assess the impacts of the Nigerian oil boom on agricultural export, we must take the agricultural exports to be a heterogeneous rather than a homogeneous sector. This is the first time that a study has raised the issues of disaggregating the non-booming sector under boom conditions in other sectors of the economy. The second, and somewhat more tentative conclusion, would be that the way in which this disaggregation can be done in the context of Nigeria, is on the basis of relative capitalization based upon the mode of agricultural production. A third and final conclusion, again tentative, is that those commodities which have historically been important contributors to Nigeria's foreign exchange earnings appear to have been most clearly and decisively affected by the oil boom. These conclusions are now discussed in greater detail.
a. Disaggregation of Agricultural Export Sector.

It is clear from the statistical results of the expansion models that in order to say something meaningful about the impacts of the oil boom on the performance of individual agricultural export commodities, it is first necessary to disaggregate the agricultural subsector based on the mode of production. For the purposes of this study, the Nigerian agricultural sector was originally divided into capital intensive, subsidized and non-subsidized labor intensive, and non-cultivated or tree crop production. Based on the results of the analysis, however, it generally appears that only two subdivision are necessary: capital dependent agriculture, including capital intensive and subsidized labor intensive exports, and non-capital dependent agriculture, incorporating non-subsidized and non-cultivated exports.

The primary motivation for disaggregation of the agricultural export sector is to account for the degree of capitalization of Nigerian export agriculture, and thus the extent to which petroleum exports affect the allocation of capital resources across modes of production as windfall revenues accrue. It was presumed that the impacts of the oil boom on capital dependent agricultural exports should be different than those for the relatively non-capitalized export subsectors, and the results of the models suggest that this is indeed the case.

However, what was not know prior to the analysis is what the nature of the impact of the oil boom on the sectorally disaggregated agricultural export sectors was going to be. It was originally hypothesized that capital-dependent agricultural exports could, on the one hand, be hurt by the oil boom since such a boom might lead to the reallocation of resources away from agriculture and towards more productive activities. On the other hand, it was also argued that a boom might actually stimulate this agricultural export
subsector since already capitalized activities would be able to attract additional windfall capital relatively easily.

While the exact nature of the effects of the oil boom on the agricultural subsectors is discussed in greater detail in the following section, it should be noted at this juncture that it is indeed important to disaggregate the agricultural export subsector into distinct groups based upon a given commodities mode of production. Booming sectors have discriminatory impacts on non-booming sectors based on the production characteristics of individual commodities within the non-booming sector.

b. Mode of Production and Capital Dependency.

A second conclusion of the study is that for the linear model formulation, the more capitalized the agricultural subsector, the more adversely affected it was by the oil boom. In particular, capital intensive and subsidized labor intensive commodities were adversely affected by the boom, while non-subsidized labor intensive and non-cultivated commodities were not at all affected by the boom. If we return to the first conclusion, we must accept the hypothesis that booming sectors, at least in the Nigerian context, act to prevent the growth rates of capital dependent agricultural exports.

In reference to this, some insights into the the reasons as to why this might be the case are given by Stevens (1984) who suggests that in post oil boom Nigeria very little attention was paid to labor intensive, peasant agriculture, even though 9 of 10 farmers and over 60 percent of the Nigerian work force is involved in this subsector. Further, Auty (1990, p. 217) add that too much emphasis was placed on capital intensive agricultural projects after the Nigerian oil boom, stating that

Nigerian agricultural investment was . . . deficient in quality.
It concentrated largely on infrastructure with a long payback
period and when it was directed at boosting supply it was channelled into the expansion of large, inefficient state farms.

This study generally supports the contentions of Stevens, Auty, and others who maintain that although the oil boom did lead to increased capitalization of Nigerian agriculture, it did not lead to an increase in the growth rates of capital dependent agricultural commodity exports.

c. Agricultural Export Contributions to Foreign Exchange.

The last conclusion related to the effects of the oil boom on the Nigerian agricultural export subsector proposes that those agricultural commodity exports which have historically been major contributors to foreign exchange earnings are those which are also most affected by the oil boom, while commodities which contribute only marginally to such earnings are relatively less affected. For example, both cocoa and groundnuts, Nigeria's major pre-oil boom foreign exchange earners, were strongly negatively affected by the boom, while relatively less important commodities such as coffee, cotton, or bananas were not affected at all, at least given the structure of the models under consideration. Interesting studies can be conducted in an attempt to assess the effects of the oil boom on agricultural exports while concurrently reconciling the historical significance of a given commodity to foreign exchange earnings, and the classification of the commodity based upon its mode of production.

4. Incorporation of Nigerian Historical Realities.

It has been a goal of this study to model booming sector impacts on non-booming sectors not just as general phenomena which have, for better or worse, influenced the development choices and patterns of a host of LDCs, but as a means of understanding the Nigerian oil boom experience in particular. To this end, it is not possible to say assess
with any meaning the results of the various models and propose conclusions, without incorporating historical realities which make the Nigerian experience unique. Indeed a number of the models with relatively weak statistical results may be weak not so much on account of a misspecification of the model itself, but rather the lack of incorporating important realities associated with the cultivation of the crop.

In particular, three historical realities seem to be particularly important to address if a complete portrait of the Nigerian oil boom experience on the agricultural sector is to be accurately accounted for: a) how to assess the impacts of the rapid growth of the Nigerian population, and in particular how this may have shifted agricultural commodities from the export market to internal markets for domestic consumption; b) how to assess the environmental influences on the model results, particularly the extent to which the drought in Northern Nigeria over the last decade has affected agricultural output, and hence agricultural exports of certain commodities; and c) how to account for the time lag between when particular crop is planted, and when it is harvested. This last reality is especially important in the context of tree crop production. These three issues are now addressed in greater detail below.

a. Internal Consumption: The Domestic Market.

A second complicating factor that has not been explicitly incorporated into the expansion models developed in the study is the possible influence of internal consumption. Nigeria, with a total population over 110 million provides an enormous domestic market, and is growing at over 3.0 percent annually (World Development Report 1990). As this market expands, the demand for agricultural commodities will rise. Although Nigeria's post-oil boom agricultural policy has largely been one of meeting domestic demand through imports of cheap staples - particularly wheat - from abroad
(Andrae and Beckman 1985), it is also likely that Nigeria's agricultural exports have declined, at least in part, due to increased domestic consumption. The rapid expansion in domestic consumption has been noted for the following commodities: rubber (Udo 1970, p. 41); palm products, including palm kernels, palm oils and cotton (Folayan 1983, p. 13). The effects of a rapid increase in domestic demand for commodities once destined for export markets appears to be particularly important for at least two categories of crops: groundnuts products and palm products.

For example, as domestic demand for these commodities increases in both their raw form, and equally important as processed peanut oils and palm oils for cooking, relatively less of these commodities is available for export. Given the fact that the structure of the linear and quadratic models is based on the total volume of agricultural commodity exports, this domestic consumption leakage may very well be reflected in relatively poor statistical "fits" of the models for specific agricultural products. Obviously one way of overcoming this problem would be to employ per capita agricultural export volumes as opposed to total volume, since the incorporation of the Nigerian population into the equation would be a reasonably good surrogate measure for the size of the domestic market.


While the effects of an enlarged domestic market for agricultural commodities on the export subsector is an important consideration, it is even more important to address the issue of environmental impacts on export levels. Over the last decade the Northern Region of Nigeria has undergone extended periods of severe drought, which has been at least partially responsible for a decline in agricultural output from the region (Folayan 1983, Iyegha 1988). Although the impact has been felt primarily on the staple
commodities of the region, at least one important cash crop - groundnuts - have also felt the effects. For example, between 1961 and 1983 groundnut production declined from 614,000 metric tons to zero tons, the major cause of the decline being traced to the impacts of drought.

Clearly, however, the difficulty lies not in acknowledging the influence of and extent to which Nigerian environmental constraints have affected the volume of agricultural exports, but rather in how one incorporates these realities into the expansion models. We will not pursue the issue here other than to emphasize, once again, the potential for some of the weaker statistical results being attributed at least in part to environmental causes, particularly in the Northern Region and on the groundnut crop. However, it should be noted that only the Northern Region has endured severe and prolonged climatic influences, and as groundnuts are the only major export crop of the region, it is unlikely that climate has had a substantial impact on other export commodities.

c. Tree Crop Production and Time Lags.

A third and final problem emerging as a result of Nigerian realities is the difficulty in assessing the long run impacts of the oil boom on the non-cultivated agricultural subsector. The problem is relatively simple: unprocessed palm kernels, rubber, and timber, are the produce of tree crops, which require a significant lag between the first planting of the tree and the time at which the tree actually bears fruit. Cocoa and coffee, grown on bushes, may also be subject to similar lags. The approximate time lags between planting and maturation for rubber, palms, and timber are 10 years, 12 years, and 30 years, respectively, and 5 to 8 years for cocoa and coffee (various, including FAO (1966) and Udo (1970)).
In the Nigerian case we can largely disregard the time lag problem for palms and timber; palm produce continues to be harvested from trees that grow haphazardly near the edges of villages, and only a small proportion are actually grown on plantations or estates using regimented agricultural systems; and the primary source for timber, until the export ban was put into effect in the 1980s, was from national forests in Nigeria, and involved the felling of primary growth. Since then, only limited attention has been given to forest replanting schemes. The coffee crop is excluded from further analysis on account of its relative unimportance both in the country’s total export bill, as well as Nigeria’s loss of competitiveness vis-a-vis other major African and Latin American coffee exporters.

However, the time lag may very well have application for the rubber and cocoa industries. Interest in reviving the Nigerian rubber industry received attention in the post-oil boom years, with the government taking an active role in promoting rubber plantations (Udo 1970). The result was the planting of new seedlings that would not come into production for at least 10 years. Similarly, the oil windfalls gave a new impetus to the cocoa industry, with the government partially subsidizing the planting of new cocoa bushes. The problem in both the cases of rubber and cocoa is that we don’t have critical data on: a) the total areas and production harvested as a direct consequence of the oil boom; and b) the time lag between the new plantings and the harvesting of the new crops, and the share of total production that these new plantings have accounted for. While the analysis can be taken no further at this juncture, it is important to acknowledge this aspect of the Nigerian agricultural production system.

To reiterate, a general conclusion must be that the commodities which didn’t perform well statistically under the linear and quadratic model formulations are not necessarily meaningless; rather, it is possible that their lack of statistical significance can
be reconciled by paying close attention to the historical influences and real world realities associated with the Nigerian experience, and in which the models are developed.

C. Implications for Nigerian Agricultural Development.

The analysis in this chapter thus far have focused on conclusions that have been derived directly from the statistical analysis. However, it is clear that the study also portends certain ramifications for Nigerian agricultural development policy choices. In particular, it may be useful to assess how Nigerian development paths might be influenced in the future by some of the conclusions of the study.

It is clear that Nigeria must reassess its current development strategy which continues to rely exclusively on the petroleum sector, and therefore makes it vulnerable on at least two fronts. First, as discussed in Chapter II, resource booms are temporary phenomena; the very definition of a boom implies that at some point in time it is followed by a bust. The cyclical nature of revenues earnings associated with booms makes planning a very difficult process. Second, Nigeria and other oil based economies are depending, for long run economic development, on a commodity that exists in finite supply. In this regard, Romer (in Lundahl 1983, p. 247) states

> When the exportable natural resource is in limited supply and expect to run our in the foreseeable future, as is petroleum in . . . Nigeria, there is an obvious imperative to diversify into other tradeable production that can sustain economic development when the resource runs out. . . . (W)ithout other goods to offer on world markets the country faces an eventual slide towards autarky and reduced income. These countries face a mammoth task in trying to transform the economy away from its natural resource base to a more diversified productive base in a short period of time.

Obviously, the problem of finite resources need not pose an insurmountable problem if windfall revenues derived from the exploitation of these resources are used to
diversify the economic base, and to strengthen traditional and sustainable economic activities, particularly agriculture. Unfortunately for Nigeria, oil revenues have not been used to fundamentally diversify or strengthen the economy; only the image or perception of such undertakings has occurred. Particularly hard hit has been the agricultural sector.

The devastating impacts of the Nigerian oil boom on agriculture have received extensive attention by Watts (1987, 1988), Folayan (1983), Iyegha (1989), among others. What is important at this juncture is not to list once again the problems that the oil boom has made for the agricultural sector, but what needs to be done to improve the agricultural sector. Indeed, consensus in the literature is that without a renewal of the agricultural sector long run economic development in Nigeria will be impossible. In this regard, Folayan (1983, p.131) states that

without this (agricultural) revival, we may have tremendous . . . problems if we want to use the oil to vault into modernization. Any country that neglects agricultural improvements . . . does so at its peril.

However, unlike many other oil dependent economies, Nigeria is fortunate in having a vast agricultural resource base available to exploit. It is critically important for the Nigerian government to reinvest in and exploit these agricultural resources. In particular, the strengthening of the agricultural sector must occur simultaneously on at least two fronts: production of commodities for domestic consumption, and the production for export.

1. Domestic Agriculture.

Domestic agriculture has clearly borne the brunt of the oil boom, and two important issues need to be addressed. First, there has been a rapid increase in the consumption of agricultural commodities that were once exported, a point which may at
least partially explain the relatively poor statistical results for certain groups of products, particularly groundnut-based and palm-based commodities. If Nigeria hopes to reduce its foreign exchange dependence on petroleum and increase the share of agricultural commodities in the total export bill, it needs to be aware of the size of the task ahead, given the rate at which once-exported commodities are now being siphoned off to be consumed domestically.

Second, and perhaps more important problem that Nigeria faces is the extent to which the rapid infusion of windfall capital undermined domestic production, not because of a lack of investment in agriculture on the part of the Nigerian government, but because the rapid appreciation of the domestic currency made importing agricultural products from abroad (particularly wheat) relatively less expensive than producing it domestically. This subject matter has been researched extensively by Andrao and Beckman (1985). To reverse this trend towards increased reliance on, and vulnerability to, foreign sources for basic foodstuffs needs to receive high priority in the future.

2. Export Agriculture.

The implications of the Nigerian oil boom on agricultural export policy are reasonably clear. For all capital intensive and subsidized labor intensive commodities, with the exception of sawn wood and cocoa (for which the quadratic model is more appropriate and thus entails different policy ramifications that will be discussed later), the government would do well to promote a policy which attempts to minimize both the growth rate and volume of oil exports. The statistical results revealed that increases either the volume and/or growth rate of oil exports will generally lead to a stagnation, if not outright decline in the growth rate of most capital dependent agricultural exports. Thus, if the government were concerned with promoting agricultural exports, it would
entail a tradeoff by making the petroleum sector less prominent. However, given the fact that the agricultural commodities that would be benefitted by such a change in policy include oilseed cake, groundnut oil, and groundnuts, only the last of which has ever made important foreign exchange contributions, such a policy would not likely be enacted, at least in the short run.

However, in the long run, we can expect Nigeria to pay renewed attention to agricultural exports, by necessity if not choice. Fajana (1979, p. 77) suggests that although the evidence ... indicates tentatively that the impact of petroleum exports on economic growth may have been stronger than that of agricultural exports, trade expansion of the exports of ... agricultural commodities should be given more emphasis in Nigeria's trade policy. This would help lessen the high and precarious dependence of Nigeria on a wasting asset - petroleum - for exports and growth.

However, the difficulty for Nigeria will be in how to allocate its agricultural resources between production of commodities for domestic consumption to feed an expanding population, and thereby conserving foreign exchange that would otherwise be used for the importation of food, and the production of commodities for export, in order to increase the share of agricultural contributions to foreign exchange earnings vis-a-vis those of petroleum.

D. Implications for Further Research.

While this study has served to answer various questions related to the petroleum boom experience of Nigeria, it has also served to raise more questions than it has answered. There are, clearly, a significant number of directions in which future research resulting from this study might be focused. What follows is a brief summary of what appear to be the most fruitful directions in terms of the importance of the research
questions being asked; keeping in line with the current directions in research in
gEOgraphy and allied disciplines; and the research interests of the author. In reference to
these issues, at least four areas of research related to resource booms need to receive
greater attention; these are: a) studies which focus on the demand-side, i.e., import
implications of booming sectors; b) studies which focus on issues related to the scale and
spatial resolution of booming sector analyses; c) studies which assess the impacts of non-
petroleum commodity booms on non-booming export sectors; and d) studies which
incorporate time lags into the analyses.

1. Demand Side Analysis.

The study presented here has been a supply side analysis in the sense that it has
congered itself only with the agricultural export subsector. However, there are also im-
portant demand side (i.e., import sector) implications for economies undergoing resource
booms. As suggested in Chapter Three, and developed at length in theories of the Dutch
Disease, unless clear and decisive steps are taken to devalue the exchange rate, the
massive windfalls that natural resource booms induce can lead to the rapid appreciation
of domestic currencies. Unfortunately, in many LDCs, the lag time between
macroeconomic policy formulation and implementation can be a lengthy one, which in the
meantime means that the country's non-booming sector exports become more expensive
(i.e., less competitive) on the world market, while imports become less expensive. The
result is a spending spree characterized by the importation of vast quantities of
commodities.

Among the most disturbing of trends is the importation of agricultural commodi-
ties, which increase dramatically since the cost of importing food products from abroad
becomes cheaper than producing them domestically. This can have dire consequences for
many LDCs, even those well endowed with vast agricultural resources, since dependence on foreign source food sources ultimately undermines domestic food security; in this regard, the Nigerian shift from reliance on domestic to imported food sources has been studied in great detail (Andrae and Beckman, 1985). Further, Mabogunje (1980, p. 294) states that we

... cannot ignore the paradoxical reversal that seems to characterize primary productive activities. From a situation in which the role of the countries of the periphery was seen as essentially one of supplying basic food and industrial raw materials to those of the centre, we are faced increasingly with one in which the developed countries are now supplying a significant part of the staple food items of developing countries. This is in spite of the fact that between 50 and 80 percent of the population of these countries are said to be engaged in agricultural pursuits.

The extent to which natural resource booms in LDCs leads to a simultaneous undermining of the capacity to produce food for domestic consumption, while making them vulnerable by increasing their reliance on cheaper foreign sources requires further analysis.

2. Issues of Scale and Spatial Resolution.

This study has been a national level analysis. That is, the effects of the oil were assessed at the macroeconomic level. However, it is clear that in order to understand the range of booming sector dynamics, studies must be conducted at other scales of spatial resolution. It may or may not be true that stimulation or stagnation behaviors will remain constant as the spatial scales shift. Further studies, then, need to be conducted at at least three distinct levels: the international comparative scale, the intranational or regional scale, and the local scale. These issues are explored in greater detail below.
a. **Intranational Scale.**

In a state as ethnically diverse as Nigeria, it is clear that political fragmentism can easily be translated into spatial economic disparity, through inequitable distribution of development projects, capital investment levels, etc. In the face of the potential for capital accumulation resulting from the petroleum discoveries, it is clear that further studies need to look at the regional dimension of the oil boom. While some studies have focused on assessing regional differences in rural structures and incomes, such as those by Collier (1983), we have yet to incorporate the expansion methodology into an analysis of booming sector interactions at the regional level. Of particular interest would be comparative studies that focus on geographic location (i.e., Northern, Middle, or Southern Belt), modes of agricultural production, and the degree of agricultural capitalization, to variations in agricultural productivity, and agricultural incomes.

b. **International Scale.**

A critically important area in which to pursue the analysis is at the international scale. In particular, it is important to understand whether or not the dynamics of oil-agricultural export interactions which appear to hold for the Nigerian case will be replicated in similar oil exporting LDCs. For example, if the impact of oil on LDCs with abundant agricultural resource such as Indonesia, Venezuela, or Mexico are dissimilar from those of the Nigerian case, it would suggest that policy rather than innate characteristics of oil boom responses are important. Alternatively, it may be that regardless of variations in the agricultural or oil policies instituted by different countries, the impacts of petroleum booms have similar dynamics on agricultural sectors.
3. Non-petroleum Commodity Booms.

Just as this study has emphasized the dynamics of oil-induced impacts on non-booming sectors, it is also important to investigate the effects of non-oil commodity booms on non-booming sectors. For example, would a boom in an agricultural commodity export, such as a price-induced boom in the cocoa market, affect non-booming commodity exports in the same manner as an oil-induced boom? Nigeria might provide a useful case since it, like many other LDCs, underwent a cocoa boom in the early 1960s. Other agricultural commodities might include the coffee, rubber, and/or banana booms at various points in time. While Kamas (1986) has explored issues related to agricultural commodity booms, the study made no attempt to assess the impacts on non-booming agricultural commodities.

4. Incorporating Temporal Parameters and Time Lags.

The results of this study suggest that, at a minimum, there is not only important work to be done concerning the spatial resolution at which booming sectors need to be analyzed, but that important temporal parameters need also be accounted for. This study has developed a series of models in which the assumption is that there is an immediate response by the agricultural commodity export sector to events corresponding with the booming sector. Thus, as either the volume or the growth rate of Nigerian petroleum exports changes, there is an immediate effect on the growth rate of agricultural commodity exports.

However, it is possible, indeed quite likely, that some form of time lag needs to be factored into the equation. Once booming sectors are initially stimulated, the non-booming sectors are not likely to "feel" the response for a matter of months, and quite possibly, years. However, virtually nothing is known about the nature and implications of such
time lags in the context of booming sectors, the only exception being a chapter from a very recent text by Auty (1990) in which he devotes marginal attention to time lags.

5. Memberships in Producer Associations.

A final area that appears to be an interesting is the extent to which the agricultural sector of a country undergoing a resource boom is affected the that country's membership in either a producer's association or cartel, such as OPEC, or a regional economic group such as the Latin American Free Trade Association (LAFTA), the Economic Community of West African States (ECOWAS), or the Association of Southeast Asian Nations (ASEAN). For example, to what extent does Nigeria's membership in the OPEC, with its numerous production and price quotas, have an effect on the agricultural sector, in comparison with a country such as Mexico, which while similar to Nigeria in having an expansive agricultural base which was transformed since the discovery of oil and the 'petrolization' of the economy, is not a member of OPEC? This is both an important area of research in that the results might suggest that no matter what a given government's agricultural and/or policy might be in light of a resource boom, the ultimate consequences are dictated not by individual governmental policy decisions as much as by international cartel policy decisions.

E. Contributions of the Study.

This study has made contributions the social sciences at least three important levels. First, it has contributed to relevant research literatures, both inside the discipline of geography, and outside the field. Second, it has introduced the expansion method to disciplines related to natural resources in general, and booming sector analysis in particular, that have not been previously exposed to the technique as either paradigm or
methodology, but to which the expansion method appears to hold particular promise. And third and last, the study has suggested that geographers should not only have an interest in researching the effects of natural resource booms on the LDC development experience, but that the discipline makes them imminently qualified to do so.

1. Implications for Relevant Literatures.

This study contributes to two general sets of literatures. The first is the geographic literature, and the second is the non-geographic literatures. In reference to the former, while geography has historically maintained an interest in natural resource analysis, we find that all too often the geographic aspects of natural resource analyses have become the concern of people outside of the discipline (e.g., Beckman 1982). This study has sought to make an attempt, however small, to correct this unfortunate turn of events not so much by adding another name to the list of geographers making contributions to our understanding of natural resource booms, but by exposing some of the ways in which geography, as a discipline, is exceptionally well positioned to conduct research in exciting new areas related to booming sectors; specific examples are given in the following sections.

A second way in which the study makes contributions to the literature relate to literatures outside of geography. In this context, at least three important contributions can be identified. First, the study has introduced the expansion method as an alternative methodology by which booming sectors and their impacts can be modelled and investigated. The study suggests that to understand the impacts of booms on other sectors of the economy, the non-booming sectors need to be disaggregated into subsectors since booms appear to have differential effects upon sectors of the economy exposed at a finer
level of structure. In the context of the present study we note that the oil boom has affected capital dependent agriculture differently than non-capital dependent sectors.

And third, the study has suggested that natural resource booms are not an 'all or nothing' proposition in the development process, that they should not be cast as either a blessing or a curse, as much of the literature would have us believe, but rather that natural resource booms have mixed impacts - some beneficial and some detrimental - over time. In this regard the study has suggested that booming sectors are far from simple phenomena; they are complex events which set up intricate sets of effects in other sectors of the economy.

2. The Expansion Method and Booming Sector Research.

The utility of the expansion methodology for social science research must not be underestimated. It provides a means of investigating valuable new insights into our understanding of a wide range of social science phenomena because it challenges the notion of parametric stability of social science models, and provides a mathematical routine by which contextual variations in models can be empirically assessed.

In the context of this study the expansion method has sought to analyze the effects of variations in the temporal contexts of booming sectors. Further studies should explore alternative expansion model formulations. For example, more complex model formulations of the temporal variable might be proposed by employing higher order expansion in the initial model or expansion equations (although an attempt at introducing cubic and quartic expansion equation did not prove particularly useful).

Another set of questions might explore the effect of distance variables and their relation to booming sectors. For example, does the distance from the booming sector region (or perhaps the nearest urban-industrial center) affect such things as migration
processes, patterns or urbanization, agricultural productivity, or industrial investment? Understanding the spatial rather than temporal contextual variations may ultimately reveal some very important conclusions.

3. Geography and Booming Sector Research.

A paradox exists in that while natural resource analysis has historically been a fundamental concern in the discipline of geography, natural resource booms as discrete phenomena have received virtually no attention at all by geographers. Not only has geography given up much of its territory in the area of natural resource analysis, but the discipline has had disappointingly little to say about natural resource booms and booming sectors; indeed, were it not for the contributions of a small subset of geographers such as Watts (1987, 1988) and Auty (1980, 1985, 1986, 1990, 1991), the discipline of geography might not be represented at all. This state of affairs is particularly disparaging given the fact that geography is a discipline ideally suited to investigating a wide range of problems associated with booming sectors.

The process of migration has been an important concern of geographers. In the context of booming sectors, Nelson, a non-geographer (in Auty 1990, p. 217) has alluded migration in the context of the Nigerian oil boom by suggesting that a major reason for the decline of Nigerian agricultural production was "the drainage of (rural) manpower" due to migration. However, a detailed understanding of the manner in which booms induce migration is sketchy at best. We have yet to determine the rates, patterns, motivations, and destinations of persons that have either directly or indirectly made the decision to migrate in light of the emergence of booming sectors, and it is here that geographers have an excellent opportunity for contributions.
Geography has long been concerned with problems related to agriculture. In the context of booming sectors it will be interesting for geographers to establish how, if at all, a resource boom and the subsequent depopulation of agricultural sectors resulting from migration and urbanization, induce changes in land tenure patterns. That is, as rural-urban migration occurs and agricultural productivity declines, does this lead to land tenure changes which increase the size of farms and efficiency of farmers remaining in agriculture? Further, it would be interesting to examine how countries with distinct land holding patterns are affected by resource booms; for example, were the effects of the oil boom in Ecuador, a country characterized by a latifundia-minifundia land distribution system, different than those in Indonesia, which is characterized by a land tenure system focused on small-holder production? How do resource booms affect regional variations in agricultural productivity? Regional agricultural specialization? The choice of agricultural technologies?

F. Summary.

Natural resource booms are very complex phenomena, and only recently have geographers begun to focus their attention on the impacts of booming sectors on the restructuring of LDC economies. This study has focused on one specific subset of research questions associated with booming sectors, namely the impacts of variations in: a) the volume and b) growth rates of oil exports on the non-booming agricultural sector of an LDC economy, over time.

The expansion method was used to operationalize the booming-non-booming sector interactions, and the Nigerian oil boom experience was used as a test case. Variations in the volumes and growth rates of oil exports revealed that the petroleum boom has been partially responsible for influencing the growth rates of certain Nigerian...
agricultural exports. In particular, the results suggest that variations in oil exports have tended to affect the heavily rather than less heavily capitalized subsectors of the agricultural export economy. In reference to the capital intensive agricultural subsector, the oil boom has been responsible, in conjunction with other factors, for an initial increase and subsequent decline in the growth rate of these commodity exports; conversely, the growth rates of subsidized labor intensive exports were initially stagnated and then stimulated by the boom. The non-capitalized subsectors (non-subsidized labor intensive, and tree crops) were generally immune to the direct effects of the oil boom, as captured by the various expansion model formulations.

The results have made contributions to two distinct literatures. First, the study has furthered the range of applications of the expansion methodology by employing the technique in the context of booming sector research, an area that has received only limited research attention by geographers. To this extent aspects related to the versatility of the methodology have been revealed, particularly as a means of identifying and assessing patterns resulting from the introduction of contextual variations in models. Second, the study adds to a growing body of literature on the Dutch Disease syndrome. However, unlike much of the Dutch Disease literature which portrays resource booms as problematic, this study suggests that, in particular instances and under specific conditions, resource booms can be associated with positive developmental impulses in non-booming subsectors of an economy. It is in the incorporation of the expansion methodology into the area of natural resource boom analysis that the study makes its most important contribution, and in the process links the geographic and non-geographic research literatures, at both the theoretical and applied levels.
## APPENDIX

### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BOP</td>
<td>Balance of Payments.</td>
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<tr>
<td>BOT</td>
<td>Balance of Trade.</td>
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<td>BST</td>
<td>Booming Sector.</td>
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<tr>
<td>DW</td>
<td>Durbin-Watson statistic.</td>
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<tr>
<td>ECLA</td>
<td>Economic Commission for Latin America.</td>
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<td>ECOWAS</td>
<td>Economic Community of West African States.</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization.</td>
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<tr>
<td>FAS</td>
<td>Foreign Agricultural Service.</td>
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<tr>
<td>FRP</td>
<td>Forwards regression procedure.</td>
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<td>GDP</td>
<td>Gross Domestic Product.</td>
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<td>GLS</td>
<td>Generalized Least Squares.</td>
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<tr>
<td>GNP</td>
<td>Gross National Product.</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund.</td>
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<td>IO</td>
<td>Input-output Analysis.</td>
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<tr>
<td>ISI</td>
<td>Import Substitution Industrialization.</td>
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<tr>
<td>LDC</td>
<td>Less Developed Country.</td>
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<tr>
<td>MDC</td>
<td>More Developed Country.</td>
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<td>MRP</td>
<td>Multiple regression procedure.</td>
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<tr>
<td>NIC</td>
<td>Newly Industrializing Country.</td>
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<td>NNPC</td>
<td>Nigerian National Petroleum Company.</td>
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<td>OAU</td>
<td>Organization of African Unity.</td>
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<tr>
<td>OLS</td>
<td>Ordinary Least Squares.</td>
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<tr>
<td>SIC</td>
<td>Standard International Classification.</td>
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<td>SITC</td>
<td>Standard International Trade Classification.</td>
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<tr>
<td>OPEC</td>
<td>Organization of Petroleum Exporting Countries.</td>
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<tr>
<td>SWR</td>
<td>Stepwise regression procedure.</td>
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<tr>
<td>tmt</td>
<td>thousands of metric tons</td>
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<td>USDA</td>
<td>United States Department of Agriculture.</td>
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<td>UN</td>
<td>United Nations.</td>
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<td>WB</td>
<td>World Bank.</td>
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257
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