



<http://researchspace.auckland.ac.nz>

### *ResearchSpace@Auckland*

#### **Copyright Statement**

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

This thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- Any use you make of these documents or images must be for research or private study purposes only, and you may not make them available to any other person.
- Authors control the copyright of their thesis. You will recognise the author's right to be identified as the author of this thesis, and due acknowledgement will be made to the author where appropriate.
- You will obtain the author's permission before publishing any material from their thesis.

To request permissions please use the Feedback form on our webpage.

<http://researchspace.auckland.ac.nz/feedback>

#### **General copyright and disclaimer**

In addition to the above conditions, authors give their consent for the digital copy of their work to be used subject to the conditions specified on the Library Thesis Consent Form.

THESIS 83-168  
GEOGRAPHY  
Moore, Chris (Chris/Input-output model of Northlan  
35556100423210  
University of Auckland Library

AN INPUT-OUTPUT MODEL OF NORTHLAND'S ECONOMY:  
WITH APPLICATION TO FORESTRY

A thesis submitted in partial fulfilment of  
the requirements of the degree of Doctor of Philosophy  
at the University of Auckland

Christopher I. Moore

Department of Theoretical and Applied Mechanics  
School of Engineering, University of Auckland,  
New Zealand

November 1981

OFF-CAMPUS STORAGE  
UNIVERSITY OF AUCKLAND



Hocken Library Photograph

UNIVERSITY OF AUCKLAND LIBRARY

8	3	6	4	4	0	6	1	1	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---

GEOGRAPHY

Thesis

83-168

## ABSTRACT

This work presents a 50-industry input-output model of Northland's economy and demonstrates how input-output analysis could be used to enhance regional planning in New Zealand. As it is the first regional input-output model in this country to incorporate significant survey and secondary data the survey procedure and model construction are outlined. The input-output table is used to discuss important regional transactions and the purchase and sales patterns of industries. The model analyses industries' contributions to export receipts and import payments and calculates the impact of changes in export receipts on regional income and imports. A comprehensive multiplier analysis of Northland's economy covers output, income, employment and imports and confidence limits for the multipliers are developed using the Monte Carlo technique to simulate survey errors. The model explores the economic implications of forestry expansion in Northland and discusses the areas available for afforestation, planting rates, tree management, wood supply and wood processing options in the region. The modifications made to the model and data requirements for simulating forestry expansion are outlined and employment and income impacts given for three types of processing complexes and for forestry expansion as a whole. Finally an economic evaluation is made of the impacts of processing-plant construction and supporting services.

## ACKNOWLEDGEMENTS

Firstly I would like to thank Associate Professor Mervyn Rosser for his supervision and advice throughout the study. Thanks also to Professor Cecil Segedin for his encouragement over the years. Special thanks go to my wife, Judith and daughter Olivia, for their unflagging support during the study. I am also indebted to the Ministry of Works and Development for their assistance and to many other government departments and private companies for advice and information received. Finally my thanks to Shelley Carlyle for her skilful typing of the thesis.

## TABLE OF CONTENTS

<u>CHAPTER 1 - INTRODUCTION</u>		
1.1	Introduction	1
1.2	Experience with Regional Input-Output Analysis in New Zealand	2
1.3	Objectives and Scope of the Study	3
1.4	The Remaining Chapters	3
<u>CHAPTER 2 - THE INPUT-OUTPUT MODEL</u>		
2.1	Introduction	5
2.2	The Accounting Framework of the Input-Output Model	6
2.2.1	Reading the Transactions Table	6
2.2.2	The Transactions Table as a Descriptive Model	8
2.2.3	The Transactions Table as an Economic Model	9
2.3	The Input-Output Model	10
2.3.1	Derivation of the Model	10
2.3.2	An Example 6-Industry Model	13
2.4	Assumptions	16
<u>CHAPTER 3 - CONSTRUCTION OF THE INPUT-OUTPUT TABLE</u>		
3.1	Preliminary Considerations	19
3.1.1	The Study Area	19
3.1.2	Choice of Base Year	20
3.1.3	Compiling a Business Register	20
3.1.4	Sectoring	23
3.1.5	Questionnaire Design	25
3.2	Survey Procedure	31
3.2.1	Sampling	31

3.2.2	Introductory Letter	32
3.2.3	Personal Contact	32
3.2.4	Follow-up Procedure	33
3.2.5	Telephone Survey	33
3.3	Survey Response	33
3.3.1	Response	33
3.3.2	Comments and Findings	35
3.4	Development of Control Totals	36
3.4.1	The Processing Sector	36
3.4.2	The Final Demand and Primary Payments Sectors	38
3.5	Input-Output Table Construction	40
3.5.1	Automatic Versus Manual Compilation	41
3.5.2	Purchase Versus Sales Data	41
3.5.3	Information Sources	41
3.5.4	An Outline of the Calculation Procedure	43
3.5.5	The Reconciliation Process	46
3.6	Conclusions	46
<u>CHAPTER 4 - A DESCRIPTION OF NORTHLAND'S ECONOMY</u>		
4.1	Introduction	48
4.2	An Input-Output Description of Northland's Economy	50
4.2.1	Introduction	50
4.2.2	The Transactions Table	50
4.2.3	Purchase Patterns	52
4.2.4	Sales Patterns	55
4.3	Direct and Indirect Exports and Imports	57
4.4	Aggregate Export Multipliers	59
4.4.1	Simple Export Multipliers	61
4.4.2	Total Export Multipliers	63
4.4.3	Conclusions	65
4.5	Economic Base Multipliers	65
<u>CHAPTER 5 - MULTIPLIER ANALYSIS</u>		
5.1	The Multiplier Concept	67
5.1.1	Introduction	67
5.1.2	Input-Output Multipliers	70
5.1.3	An Example	71
5.1.4	Household Consumption Function	73
5.1.5	Mathematical Formulation of Input-Output Multipliers	75
5.1.6	Revised Multipliers	80
5.1.7	The Relationship between Type I and Type II Multipliers	81

5.2	Multiplier Analysis of Northland's Economy	81
5.2.1	Output Multipliers	81
5.2.2	Income Multipliers	84
5.2.3	Employment Multipliers	86
5.2.4	Income-per-worker Indices	91
5.2.5	Import Multipliers	95
5.2.6	Revised Multipliers	95
5.3	Monte Carlo Simulation of Survey Errors	98
5.3.1	Introduction	98
5.3.2	The Simulation Technique	98
5.3.3	Confidence Limits for Income and Employment Multipliers	100
5.3.4	Sensitivity of Confidence Limits to Varying Degrees of Survey Error	106

#### CHAPTER 6 - SIMULATING FORESTRY EXPANSION

6.1	An Historical Background	110
6.1.1	Introduction	110
6.1.2	Exploitation of the Kauri Forests	111
6.1.3	The Rise of Exotic Forestry	112
6.2	Future Forestry in Northland	115
6.2.1	Introduction	115
6.2.2	The Potential for Further Afforestation	116
6.2.3	Future Planting	117
6.2.4	Forest Management	118
6.2.5	Future Wood Supply	118
6.2.6	The Development of Forest-based Industry	120
6.3	Simulating Forestry Development	123
6.3.1	Introduction	123
6.3.2	The Impact Model	123
6.3.3	Data for the Impact Model	124
6.4	Impact of Forestry and Wood Processing	131
6.4.1	Impact Terminology	131
6.4.2	Forest Operations	132
6.4.3	Sawmill	137
6.4.4	Pulpmill and Integrated Pulpmill	137
6.4.5	Integrated Papermill	140
6.4.6	Aggregate Employment Impact	142
6.4.7	Comparing Multipliers with those from other Studies	145
6.5	Impact of Construction Phase	147



REFERENCES		150
<u>APPENDICES</u>		
APPENDIX A	Town and Country Planning Act 1977 : First Schedule - Matters to be dealt with in Regional Schemes	153
APPENDIX B	Northland Sectors in Terms of those used in the New Zealand Interindustry Study 1971/72.	156
APPENDIX C	Questionnaire and Covering Letters	158
APPENDIX D	Introductory and Follow-up Letters plus Calculation Forms	174
APPENDIX E	Information Sources by Industry and Sector	178
APPENDIX F	Error Distribution, Generation Technique and Confidence Limit Calculation	221
APPENDIX G	Error Limits associated With Run 5 and 'Special Run' Plus Confidence Limits for Normal and Revised Income and Employment Type I and Type II Multipliers	227
APPENDIX H	Errors in Direct Coefficients and their effect on Multiplier Accuracy	233
APPENDIX I	Input-Output Tables	236