

ECONOMICS *of* RESILIENT INFRASTRUCTURE

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CONTENTS

EXECUTIVE SUMMARY.....	III
KEYWORDS.....	III
GLOSSARY.....	IV
1.0 INTRODUCTION	1
1.1 BACKGROUND.....	1
1.2 SCOPE.....	3
2.0 SOCIAL ACCOUNTING MATRICES.....	4
2.1 STRUCTURE OF THE NATIONAL SOCIAL ACCOUNTING MATRIX	4
2.1.1 Component Matrices and Vectors.....	7
2.1.2 SAM Identities	10
2.2 STRUCTURE OF THE REGIONAL SOCIAL ACCOUNTING MATRIX.....	11
3.0 METHODOLOGY	12
3.1 BALANCING NATIONAL SUPPLY USE TABLES	12
3.2 CONSTRUCTION OF THE NATIONAL SOCIAL ACCOUNTING MATRIX (SAM).....	12
3.2.1 National Accounting Data Utilised in the Construction of the National SAM	12
3.2.2 The Approach Utilised in Construction of the National SAM.....	13
3.3 REGIONALISATION OF NATIONAL SUPPLY USE TABLE	18
3.3.1 Step 1 Estimation of Regional Supply of Commodities (V^r).....	22
3.3.2 Step 2 Estimation of Factor Inputs and Industry Taxes (f_L^r, f_K^r, P_T^r).....	26
3.3.3 Step 3 Estimation of Intermediate Consumption, Household Final Consumption, Government Final Consumption, Investment Final Consumption and International Imports (U^r, h_C^r, G_C^r, s_C^r and y_W^r).....	27
3.3.4 Step 4 Estimation of International Exports (W_C^r).....	30
3.3.5 Step 5 Estimation of Interregional Trade in Commodities (n_C^r and y_N^r).....	31
3.4 REGIONALISED SOCIAL ACCOUNTING MATRIX	37
3.4.1 Labour Accounts ($n_L^r, l_H^r, l_N^r, l_W^r$).....	39
3.4.2 Capital Accounts ($n_K^r, k_E^r, k_H^r, k_{Gi}^r, k_N^r$).....	40
3.4.3 Enterprise Accounts ($h_E^r, n_E^r, w_E^r, e_H^r, e_{Gi}^r, e_T^r, e_S^r, e_N^r, e_W^r$).....	42
3.4.4 Households Accounts ($g_{Hj}^r, n_H^r, w_H^r, h_{Gi}^r, h_{Ti}^r, h_S^r, h_N^r, h_W^r$).....	43
3.4.5 Government Accounts (T_G^r, G_T^r, g_S^r).....	45
3.4.6 Taxes (s_T^r, w_T^r).....	46
3.4.7 Savings (n_S^r, w_S^r).....	46
3.4.8 Rest of New Zealand and Rest of World Accounts.....	46
4.0 BIBLIOGRAPHY	47

FIGURES

Figure 1	Structure of the National Social Accounting Matrix.....	5
Figure 2	Structure of the Regional Social Accounting Matrices.....	11
Figure 3	Regionalisation Process for the National Supply Use Tables.....	21

TABLES

Table 1	Matrices, Vectors and Scalars within the Social Accounting Matrix.....	6
Table 1	Matrices, Vectors and Scalars within the Social Accounting Matrix (continued).....	7
Table 2	Scalars and Coefficients for Regionalising 2006–07 Supply Use Tables	19
Table 2	Scalars and Coefficients for Regionalising 2006–07 Supply Use Tables (continued)	20
Table 3	Details of Regionalisation of Specific Cells in Supply Matrix	25
Table 3	Details of Regionalisation of Specific Cells in Supply Matrix (continued)	25
Table 3	Details of Regionalisation of Specific Cells in Supply Matrix (continued)	26
Table 3	Details of Regionalisation of Specific Cells in Supply Matrix (continued)	26
Table 4	Regional SAM Scalars.....	38
Table 4	Regional SAM Scalars (continued).....	39

APPENDICES

APPENDIX A: CONCORDANCES	53
APPENDIX B: INTERREGIONAL TRADE ESTIMATION METHODS	61

APPENDIX TABLES

Table A.1	106IO Industry to ANZSIC Concordance.....	53
Table A.1	106IO Industry to ANZSIC Concordance(continued).....	54
Table A.1	106IO Industry to ANZSIC Concordance(continued).....	55
Table A.2	203IOC to CPC Codes Commodity Concordance.....	56
Table A.2	203IOC to CPC Codes Commodity Concordance (continued).....	57
Table A.2	203IOC to CPC Codes Commodity Concordance (continued).....	58
Table A.2	203IOC to CPC Codes Commodity Concordance (continued).....	59
Table A.2	203IOC to CPC Codes Commodity Concordance (continued).....	60
Table B.1	Interregional Trade Regionalisation Method by IOC203 Commodity.....	61
Table B.1	Interregional Trade Regionalisation Method by IOC203 Commodity (continued).....	62
Table B.1	Interregional Trade Regionalisation Method by IOC203 Commodity (continued).....	63
Table B.2	NZIO to MarketView Commodity Concordance.....	64

EXECUTIVE SUMMARY

The National and Regional Social Accounting Matrices described in this report provide a detailed description of the structure of the New Zealand economic system for the 2006–07 year. The ultimate purpose of creating national and regional Social Accounting Matrices (SAMs) for New Zealand is to provide datasets for use in assessing the economic impacts of social, environmental, and infrastructure policy modelling. The component accounts, which constitute the Social Accounting Matrix framework developed in this report, will be utilised in the application of Economic Impact Assessment, Input-Output Analysis, Environmental Input-Output Analysis, Ecological Footprinting, Decomposition Analysis, Supply-Chain Analysis, and in Computable General Equilibrium Modelling. The legitimacy of applied economic analysis requires reliable and updated databases, and in the case of regional economic model analysis, the use of the most appropriate regional datasets.

This paper sets out the methods used to create national and regional SAMs for New Zealand. It provides a detailed reference for their creation, combining local characteristics of regional economies with aggregate features of the New Zealand economy. The SAMs are developed from data primarily sourced from Statistics New Zealand's 2006–07 Supply-Use frameworks, Institutional Sector Accounts of the National Accounts, the Household Economic Survey, and the Harmonised System for Trade. Specifically, the national SAM records transactions for 106 industries, 205 commodities, 2 factors of production (labour and capital), enterprises, households, local and central government, direct and indirect taxes, savings and investment, and a rest-of-the-world account. The components of the regional SAMs are identical to the national SAM, except for the addition of a Rest of New Zealand account.

KEYWORDS

Social Accounting Matrix, Multi-Region CGE Model New Zealand, Methodology, Datasets.

GLOSSARY

Key Definitions

- *Australian and New Zealand Industrial Classification 2006 (ANZSIC06)*: The ANZSIC06 system is utilised in Australia and New Zealand for the production and analysis of industry statistics. Further information on ANZSIC06 is available on Statistics New Zealand's website.
- *Basic Price*: The amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes wholesale and retail margins.
- *Capital Transfers from the rest of the world*: The value of capital transfers by non-residents to New Zealand residents.
- *Changes in Inventories*: The change in the value of inventories of raw materials, work-in-progress, and finished goods, between the beginning and the end of an accounting period.
- *Commodity Grouping (CG)*: A classification used for commodities in Statistics New Zealand's 2006–07 Supply and Use tables.
- *Compensation of Employees (COE)*: Consists of salaries and wages, whether in cash or in kind, and generally all other allowances to employees that are taxable.
- *Computable General Equilibrium (CGE)*: A class of applied economic models typically used to illustrate an economy's responses to changes in policy, technology or other external shocks.
- *Consumption of Fixed Capital (COFC)*: A measure of the decline in value of fixed assets used in production, as a result of physical deterioration and normal obsolescence.
- *Employee Counts*: Statistics New Zealand's measure of employment taken from the Business Demography database, and is a head count of salary and wage earners of all ages, employed at any time during the February month, irrespective of the number of hours worked or the number of days employed. If an individual had multiple jobs during a month with different employers, all jobs are counted.
- *Exports*: Goods, valued at FOB (free on board), and services that are produced by New Zealand residents and purchased by non-residents.
- *Geographic Unit (GU)*: A separate operating unit engaged in one, or predominately one, kind of economic activity from a single physical location or base in New Zealand.
- *Government Subsidies*: Grants on current account made by central and local government to industries.
- *Gross Domestic Product (GDP)*: The total market value of goods and services produced in an economy after deducting the cost of goods and services utilised in the process of production, but before deducting allowances for the consumption of fixed capital.

- *Gross Fixed Capital Formation (GFCF)*: The net outlays (purchases less sales) of producers on durable fixed assets, such as buildings, motor vehicles, plant and machinery, hydro-electric construction, roads and improvements to land. The term 'gross' indicates that consumption of fixed capital (i.e., depreciation) has not been deducted from the value of the outlays.
- *Gross Operating Surplus (GOS)*: A measure of the profit accruing from production after the deduction of costs of materials used in production (intermediate consumption), compensation of employees and taxes on production less subsidies. Mathematically, valuation is the sum of operating surplus and consumption of fixed capital.
- *Gross Output (GO)*: For each industry, gross output consists of intermediate consumption and value added. Value added is comprised of compensation of employees, operating surplus, consumption of fixed capital, other tax on products, and subsidies. Intermediate consumption is comprised of commodity use and taxes on products. For each industry, gross output must be equivalent to total supply.
- *Household Final Consumption Expenditure*: All outlays on consumer goods and services by households, including expenditure on durables such as motor vehicles and furniture and the imputed rent of owner-occupied dwellings. This includes consumption expenditure by household both in New Zealand and overseas (i.e., as tourists plus remittances from abroad).
- *Households*: New Zealand resident individuals and families, and Private Non-Profit Organisation (PNPO) serving households.
- *Imports – International*: All goods and services provided by the rest of the world and purchased by New Zealand residents. Imports on goods are valued at CIF prices (cost including insurance and freight).
- *Imports – Interregional*: Goods and services imported into one region from another region in the same country.
- *Industry Grouping (IG)*: A classification used for industries in Statistics New Zealand's 2006–07 supply and use table.
- *Intermediate Consumption*: Consists of the value of the goods and services (at producer's prices) consumed as inputs by a process of production, excluding fixed assets the consumption of which is recorded as a consumption of fixed capital.
- *Joint Production*: When a single manufacturing process generates two or more outputs simultaneously by using common input. By definition, joint products incur undifferentiated production costs, until a point after which each product requires separate processing.
- *Modified Employee Counts*: This is an indicator developed by Market Economics Ltd., which captures both employees and working proprietors.
- *Owner Occupied Dwellings*: Privately owned residential houses, apartments, condominiums or similar.
- *Private Non-Profit Organisations serving households (PNPOs)*: These represent organisations, not controlled by government, through which households and individuals collectively exercise part of their role as final consumers.

- *Producer's Price*: The amount receivable by the producer from the purchaser for a unit of a good or service produced as output less any deductible taxes invoiced to the purchaser. The producer price excludes any transport charges invoiced separately by the producer.
- *Six Digit Harmonised System (HS)*: The 6-digit harmonised commodity classification used in the classification of traded goods and services in New Zealand.
- *Supply Use Table (SUT)*: A system of supply and use matrices used to construct an economic accounting model of commodities flows between industries in the economy.
- *Taxes – Direct*: Tax levied directly off an organisation or an individual by the government, e.g., income tax.
- *Taxes – Indirect*: Tax collected by an agent from the person who bears the ultimate burden of the tax, e.g., GST paid by the consumer to retail stores.
- *Taxes on Production and Imports*: Taxes which are assessed on producers in respect of the production, sale, purchase and use of goods and services, and which add to the market prices of those goods and services. Included are sales tax, local authority rates, import and exercise duties and fringe benefits tax. This class of tax is divided into Taxes on products, Other Taxes on Production, Taxes on Production (Industry) and Import Duties.
- *Taxes on Production and Imports – Taxes on Products*: Taxes payable on goods and services when they are produced, delivered, sold, transferred or otherwise disposed of by their producers.
- *Taxes on Production and Imports – Other Taxes on Production*: Predominantly taxes paid on the ownership or use of land, buildings or other assets used in production, or on labour employed or compensation of employees paid. Examples include local authority rates, exercise duties, fringe benefits tax and road user charges etc.
- *Taxes on Production (Industry)*: For each industry, this is comprised of taxes on production and imports – taxes on products and other taxes on production.
- *Taxes on Production and Imports – Import Duties*: Taxes and duties on imports that become payable when goods enter the country or when services are delivered to residents by non-resident units.
- *Trade Margins*: The difference between the actual, or imputed price, realised on a good purchased by a distributor (either wholesale or retail) for resale and the price that would have to be paid by the distributor to replace the good, at the time it is sold, or otherwise disposed of.
- *Value Added*: The value added to goods and services by the contributions of capital and labour, i.e., the value of output after the cost of bought-in materials and services has been deducted. It includes gross operating surplus, compensation of employees, other taxes on productions and subsidies.

1.0 INTRODUCTION

1.1 BACKGROUND

National accounting data derived from the concepts and definitions of the System of National Accounts (SNA) can be presented in a variety of ways, but most common is via a matrix-style format. One of the principal advantages of using a matrix presentation over other methods of presentation (e.g., a T account)¹ is the unrestricted possibilities for expanding or condensing data according to specific circumstances and needs (Commission of the European Communities *et al.*, 1993). Among the more widely applied matrix-type frameworks are Input-output (IO) tables and Supply-and-use tables (SUT).² The two frameworks, which are closely related, provide detailed information on the production and consumption of goods and services, and by corollary the generation of income within an economy. However, the interrelationships between income and final expenditures are missing from both frameworks.

The Social Accounting Matrix (SAM) framework provides an extension to the SUT framework. In addition to describing how domestic industries (along with imports) provide goods and services to meet domestic and international demand, the SAM describes the way in which factor (i.e., capital and labour) income generated from production is allocated among the institutional sectors providing factors of production (e.g., enterprises, households). Secondary distributions of income among institutions, for example through tax payments and government transfers, are also included. The SAM further describes how the disposable income available to institutions is then allocated among either savings or purchases of commodities: thus completing the circular flow of income (Goce-Dakila and Dakila, 2004).

The first description of the modern SAM framework appeared in 1976 (Pyatt and Thorbecke, 1976). Since then, SAMs have been constructed for developed and developing countries and for a wide range of applications. For example, SAMs have been used in the study of income distribution and redistribution (Pyatt and Roe, 1977; Keuning, 1996; Harun *et al.*, 2012), regional development (Andre and Cardenete, 2007), growth strategies in developing economies (Pyatt and Round, 1979; Robinson, 1988; Vos and Jong, 2003; Pieters, 2010) and decomposition of activity multipliers describing the circular flow of income (Stone, 1981; Pyatt and Round 1979; Santos, 2004; Das *et al.*, 2013). SAMs have further been used in the study of synergistic relationships between social, technological, environmental and economic issues (Resosudarmo and Thorbecke, 1996; Duchin, 1998; Alarcón *et al.* 2000; Hartono and Resosudarmo, 2007). Regional SAMs have been produced for Canada and the Philippines (Bahan *et al.*, 2003; Goce-Dakila and Dakila, 2004) among other countries.

¹ Typically a two-column account comprised of debits and credits respectively.

² Reference can be made to Chapter XV of the System of National Accounts 1993 (Commission of the European Communities *et al.*, 1993) for a detailed description of the two frameworks.

This report describes the methods used in compiling a national and regional SAM framework for New Zealand, with the ultimate purpose of building comparative static and dynamic economic models, including Input-Output and Computable General Equilibrium (CGE) models. CGE models, which are generally embedded in a neoclassical economic framework, are typically used to simulate the effects of a policy change or some other 'external shock' on an economic system.³ The models can be used to address a wide range of policy issues, for example, analysis of the effects of a major infrastructure investment on economic growth and income distribution, and analysis of the implications of a change in the tax regime.

The need for a regional SAM arises due to policy decisions and exogenous events having a spatial dimension (Goce-Dakila and Dakila, 2004). A regional SAM lends itself to regional economic impact analysis, including through the construction of single and multi-regional CGE models. Within development economics, regional SAMs have been used, in particular, to evaluate the welfare effects of intervention or targeted assistance across regions and households (Morley and Pineiro, 2013; Martana *et al.*, 2012). Regional SAMs have been used within the EU to analyse the effect of changes within one particular sector (namely agriculture) on the European economies (Lizarraga *et al.*, 2011) and as the economic basis for dynamic rural development models (Bryden *et al.*, 2011).

The significant resources (time and data) required for the production of regional SAMs are, however, a factor that greatly limits the more-widespread application of these models. In New Zealand, only a limited number of regional SAMs have been produced. The authors of this report previously constructed regional SAMs for New Zealand by breaking down a national SAM into regional components (Zhang, *et al.*, 2008). Robson (2012) has also developed a prototype multi-regional CGE model for New Zealand, including the construction of an underlying SAM distinguishing 25 industry types and 5 different regions. The accounts for the production sector are constructed in an input-output form, meaning that each industry produces just one type of commodity. To our knowledge, the work described in this report, building on the previous work described in Zhang *et al.* (2008), is the only current example of the construction of fully-integrated regional SAMs, incorporating SUTs for the production components of the economy. SUTs have several advantages over IOs including being the key building blocks underlying input-output tables, allowing for the implications of joint production to be included in economic assessments, and enabling regionalisation based on not only industry, but also commodity data.

³ CGE models constitute a subset of the wider class of models known as 'general equilibrium models' and are founded on the ideas introduced by Walras (1954) and Leontief (1941). Among the more immediate bases for modern CGE models are the work of Johansen (1960) and Scarf (1973).

1.2 SCOPE

The primary purpose of this report is to describe the methods and data used to construct the national and regional SAMs for New Zealand for the base year 2006–07. As an introduction, a complete description is provided of the SAM framework, including the various accounts that make up the SAM, and the accounting identities followed. We pay particular attention to describing the process by which we regionalised the national SUT framework. We acknowledge that models are only as good as the data that go into them. In this regard, we have set about to document thoroughly all procedures used in the regionalisation process – thus making transparent the assumptions we have based our modelling on. We believe our approach is unique in the New Zealand context; the vast majority of economic models used in NZ are either poorly documented or documentation is non-existent. The report also sets out in detail all data sources utilised.

Overall 106 industries, 205 commodities, two factors of production (labour and capital), one enterprise, one household account, two government categories (local and central government), two tax accounts (direct and indirect) and one savings and investment account are developed for each regional SAM. Note that the method produces a fully multi-regional framework for the 16 regions within New Zealand.

2.0 SOCIAL ACCOUNTING MATRICES

2.1 STRUCTURE OF THE NATIONAL SOCIAL ACCOUNTING MATRIX

SAMs are built to identify all monetary flows from sources to recipients, within a disaggregated national account (Mitra-Kahn, 2008). A SAM is a square matrix consisting of row and column accounts that represent various sectors, agents, and institutions of an economy. Each cell records a transaction of expenditure by column account and income to row account. Hence each row has a corresponding column, and accordingly for every income there is a corresponding expenditure (Susana, 2005).

The structure of the national and regional SAMs presented in this report complies with the SUT framework recommended for national accounting by the United Nations (1999). The general structure of the national SAM is depicted in Figure 1. This structure is modified only slightly in producing the regional SAM. In short, the national SAM consists of six sub-matrices (U, G_c, V, T_G, P_T, G_T), 24 vectors ($h_C, s_C, w_C, \alpha, \beta, f_L, f_K, g_H, k_G, e_G, h_G, \pi, h_T, e_T, s_T, w_T, \theta, g_S, y, g_W, \alpha', \beta', \pi', \theta'$) and 26 scalars ($\delta_L, \delta_K, k_E, h_E, w_E, \mu, l_H, k_H, e_H, h_H, w_H, \lambda, e_S, h_S, w_S, \omega, l_W, e_W, h_W, \rho, \delta_L', \delta_K', \mu', \lambda', \omega', \rho'$). Bold capital letters are used to denote matrices, bold lower case letters denote vectors and lowercase letters denote scalars. Table 1 provides a full list of matrices, vectors and scalars and their corresponding full name. It should also be noted that the SAM is read as income to row i from column j .⁴

⁴ For example Governments tax income (T_G) comes *from* taxes and is paid *to* governments.

		Commodity 1 ... B	Industry 1 ... F	Factors of production		Enterprises	Households	Governments 1 ... Ø	Taxes 1 ... Λ	Savings - Investment	Rest of World	Total
				Labour	Capital							
Commodity 1 ... B			U Intermediate Consumption				h _C Household Final Consumption	G _C Government Final Consumption		s _C Investment Final Consumption	w _C Exports	α Gross Com Demands
Industry 1 ... F		V Domestic Supply										β Domestic Production
Factors of production	Labour		ℓ _L Labour Inputs to Production									δ _L Total Factor Income (Labour)
	Capital		ℓ _C Capital Inputs to Production									δ _C Total Factor Income (Capital)
Enterprises					k _E Gross Operating Surplus (Enterprises)		h _E Household Transfers to Enterprise				w _E Foreign Transfers to Enterprise	μ Enterprises Income
Households				I _H Labour Factor Income (Domestic)	k _H Gross Operating Surplus (Households)	e _H Enterprise Transfers to Households	h _H Inter-household Transfers	g _H Government Transfers to Households			w _H Foreign Transfers to Households	λ Household Income
Governments 1 ... Ø					k _G Gross Operating Surplus (Government)	e _G Enterprise Transfers to Government	h _G Household Transfers to Government		T _G Government Tax Income			π Government Income
Taxes 1 ... Λ			P _T Industry Taxes			e _T Enterprise Taxes	h _T Household Taxes	G _T Government Taxes		s _T Investment Taxes	w _T Rest of World Taxes	θ Total Taxes
Savings - Investment						e _S Enterprise Saving	h _S Household Savings	g _S Government Savings			w _S Foreign Savings	ω Total Saving
Rest of World		y Imports		I _W Labour Factor Income (RoW)		e _W Enterprise Transfers to the RoW	h _W Household Transfers to the RoW	g _W Government Transfers to the RoW				ρ Total Foreign Outlays
Total		α' Gross Com Supply	β' Cost of Production	δ _L ' Total Factor Expenditure (Labour)	δ _C ' Total Factor Expenditure (Capital)	μ' Enterprise Expenditures	λ' Household Expenditures	π' Government Expenditures	θ' Total Taxes	ω' Total Investment	ρ' Total Foreign Earning	

Figure 1 Structure of the National Social Accounting Matrix

Table 1 Matrices, Vectors and Scalars within the Social Accounting Matrix

Symbol	Name
e_G	Enterprise Transfers to Governments
e_H	Enterprise Transfers to Households
e_S	Enterprise Transfers to Savings
e_T	Enterprise Taxes (income tax)
e_W	Enterprise Transfers to Rest of World
f_L	Labour inputs to production
f_K	Capital inputs to production
G_C	Government Final Consumption
g_H	Government Transfers to Households
g_S	Government Savings
G_T	Government Taxes (GST on consumption, income tax)
g_W	Government Transfers to Rest of World
h_C	Household Final Consumption
h_E	Household Transfers to Enterprises
h_G	Household Transfers to Governments
h_S	Household Savings
h_T	Household Taxes (GST on consumption, income tax, other direct)
h_W	Household Transfers to Rest of World
P_T	Industry Taxes (GST on products, other taxes on products and subsidies)
k_E	Gross Operating Surplus to Enterprises
k_H	Gross Operating Surplus to Households
k_G	Gross Operating Surplus to Governments
l_H	Labour Factor Income to Domestic Households
l_W	Labour Factor Income to Rest of World Households
s_C	Investment Final Consumption (changes in inventories and gross fixed capital formation)
s_T	Investment Taxes (GST on consumption)
T_G	Government Tax Income
U	Intermediate Consumption
V	Domestic Supply
w_C	Exports
w_E	Rest of World Transfers to Enterprises
w_H	Rest of World Transfers to Households
w_S	Rest of World Savings
w_T	Rest of World Taxes (taxes on consumption, income tax)
y	Imports

Table 1 Matrices, Vectors and Scalars within the Social Accounting Matrix (continued)

Symbol	Name
α	Gross Commodity Demands
β	Domestic Production
δ_L	Total Factor Income (Labour)
δ_K	Total Factor Income (Capital)
μ	Enterprise Income
λ	Household Income
π	Government Income
θ	Total Taxes
ω	Total Savings
ρ	Total Foreign Outlays
α'	Gross Commodity Supplies
β'	Cost of Production
δ_L'	Total Factor Expenditure (Labour)
δ_K'	Total Factor Expenditure (Capital)
μ'	Enterprise Expenditures
λ'	Household Expenditures
π'	Government Expenditures
θ'	Total Taxes
ω'	Total Investment
ρ'	Total Foreign Earning

2.1.1 Component Matrices and Vectors

The detailed description of the SAM structure begins with the commodity accounts which consist of matrices U ($B \times \Gamma$), and G_C ($B \times \Theta$) as well as vectors h_C ($B \times 1$), s_C ($B \times 1$) and w_C ($B \times 1$) and α ($B \times 1$). The first of the matrices, U , defines the intermediate consumption of commodities by industries, with an element u_{ij} representing, in basic price, the value of commodity i used by industry j ($i = 1 \dots B, j = 1 \dots \Gamma$) within the study year. Together matrix G_C , and vectors h_C , s_C and w_C represent the complete set of final demand categories. Vector h_C records household consumption of commodities, with an element h_{Ci} representing the consumption of commodity i by households in basic prices within 2006–07.⁵ Matrix G_C is the first of the government matrices in Figure 1, with an element g_{Cij} denoting, in basic prices, the consumption of commodity i by government category j . Next, elements of the vector s_C , denote the use of commodity i for capital formation in basic prices. Finally, an element of the exports vector, w_{Ci} , denotes, in free on board (fob) terms, the consumption of commodity i as exports during the study year.

⁵ There are a number of possible methods by which the household accounts could be further disaggregated according to different types of household categories; e.g., rural versus urban, income level, by household type and so on. For the purposes of this report, the household accounts in the national and regional SAMs consist of only one household type.

The gross commodity demanded vector α is found by summing the row elements in matrices U , h_C , G_C , s_C , and w_C , i.e.,

$$\alpha_i = \sum_{j=1}^{\Gamma} u_{ij} + h_{Ci} + \sum_{j=1}^{\Theta} g_{ij} + s_{Ci} + w_{Ci} \quad \text{Equation 2.1}$$

Moving to the next row in Figure 1, the production relationships within the New Zealand economy are captured by the supply matrix V ($\Gamma \times B$). An element v_{ij} represents the output of commodity j produced by domestic industry i in basic price within 2006–07. In this way, matrix V describes the source of supply of products to the economy. Overall the vector β ($\Gamma \times 1$) describes the total output of each industry and is defined as,

$$\beta_i = \sum_{j=1}^B v_{ij} \quad \text{Equation 2.2}$$

Next, the value added components of labour and capital are recorded in vectors f_L ($\Pi \times \Gamma$) and f_K ($\Pi \times \Gamma$), respectively. An element f_{Lj} represents the total compensation of employees paid by industry j within the study year, while f_{Kj} represents the income paid to capital during that period. The sum of the row elements of f_L gives the total income paid to labour, δ_L . Similarly, total income paid to capital is given by the sum of the row elements for f_K .

The total value of enterprise income, represented by the scalar μ , comprises the sum of the capital income scalar k_E , the household transfers scalar h_E , and the international transfers scalar, w_E , i.e.

$$\mu = k_E + h_E + w_E \quad \text{Equation 2.3}$$

The first scalar, k_E , denotes the capital income received by enterprises through the provision of capital as a factor in production. This is commonly referred as gross operating surplus. Investments in enterprises by households, and the rest of the world are captured by the elements h_E , and w_E , respectively.

Households receive income by providing labour and capital as a factors of production, and from transfers from other agents. The income received from labour is often referred to as ‘compensation of employees’ and is recorded by scalar l_H . Similarly, gross operating surplus allocated to households is contained in scalar k_H . The income households receive from transfers is recorded as returns on investment in enterprises, scalar e_H , as social security benefits transferred from government, vector g_H ($1 \times \Theta$), and in the transfers from the rest of world, w_H . Summing the row elements across all four accounts provides the total income, λ , for households,

$$\lambda = l_H + k_H + e_H + \sum_{j=1}^{\Theta} g_{Hj} + w_H \quad \text{Equation 2.4}$$

Total income for government i is defined by π_i according to the equation,

$$\pi_i = k_{Gi} + e_{Gi} + \sum_{j=1}^{\Lambda} h_{Gi} + \sum_{j=1}^{\Lambda} t_{Gi} \quad \text{Equation 2.5}$$

The element k_{Gi} represents gross operating profits paid directly to government i , while e_{Gi} represents return to investments from enterprises to government i . Households' transfers to government i as social security contributions are captured by element h_{Gi} . Lastly, the element t_{Gij} represents total income from tax j received by government i .

The next row in Figure 1 describes all the SAM accounts pertaining to taxes. Each of the component accounts (matrices $\mathbf{P}_T (\Lambda \times \Gamma)$ and $\mathbf{G}_T (\Lambda \times \Theta)$, and vectors \mathbf{e}_T , \mathbf{h}_T , \mathbf{s}_T , and \mathbf{w}_T) are comprised of two rows ($i = 1, 2$), one pertaining to direct taxes and one pertaining to indirect taxes. It should, however, be noted that for certain accounts only one type of tax is present (i.e. the entries in the other row are all zero). Beginning with matrix \mathbf{P}_T , it contains a vector describing the sum of taxes charged to and subsidies received by each j industry. These values are contained within the indirect taxes row. In the case of taxes paid by enterprises, \mathbf{e}_T , however, all taxes are classified as direct. For vector \mathbf{h}_T , an element h_{Ti} represents either the direct or indirect taxes paid by households. The direct taxes are the household income taxes, while the indirect taxes are the taxes paid on consumption of goods and services by households. Direct and indirect taxes are also paid by the two government categories and are recorded in matrix \mathbf{G}_T . Finally, the vectors \mathbf{s}_T and \mathbf{w}_T respectively record total taxes on gross capital formation (indirect) and export taxes (direct and indirect). The total value of either direct or indirect taxes paid within the economy, θ_i , is found by summing row i across all the tax accounts:

$$\theta_i = \sum_{j=1}^{\Gamma} p_{Ti} + e_{Ti} + h_{Ti} + \sum_{j=1}^{\Theta} g_{Tij} + s_{Ti} + w_{Ti} \quad \text{Equation 2.6}$$

Total savings within the economy are represented by the scalar ω . This is calculated by summing all elements within the enterprise savings scalar, e_s , the household savings scalar, h_s , the government savings vector, \mathbf{g}_s , and the rest of world savings scalar, w_s , i.e.,

$$\omega = e_s + h_s + \sum_{j=1}^{\Theta} g_{sj} + w_s \quad \text{Equation 2.7}$$

Finally, the scalar representing total rest of world income, ρ , is calculated by summing the scalars l_w , e_w and h_w and vectors \mathbf{y} ($1 \times B$) and \mathbf{g}_w ($1 \times \Theta$),

$$\rho = \sum_{j=1}^B y_j + l_w + e_w + h_w + \sum_{j=1}^{\Theta} g_{wj} \quad \text{Equation 2.8}$$

The element y_j represents the value, including insurance and freight (CIF terms – cost including insurance and freight), of imports of commodity j within the study year. Labour income generated from domestic production but paid to the rest of world is captured by scalar l_w . Scalar e_w denotes transfers from enterprises to rest of world, while element h_w denotes the current transfers from households and g_{wj} denotes the current transfers from government j to the rest of the world.

2.1.2 SAM Identities

The preceding Section describes the revenue or income accounts of the SAM (i.e., across the rows of Figure 1). The SAM accounting method also requires careful balancing between revenues and expenditures within the economy. A key principle is that all-purchases of a given commodity by all sectors must equal the supply of that commodity, or in other words, α_i equals α'_j , where $i = j$ and α'_j is defined as,

$$\alpha'_j = \sum_{i=1}^{\Gamma} v_{ij} + y_j. \quad \text{Equation 2.9}$$

Another key principle in balancing revenues and expenditures is that the total value of production of industry j , β_j , equals the cost of production for that industry, β'_j , where $i = j$. Summing all elements of column j within \mathbf{U} , \mathbf{f}_L , \mathbf{f}_K and \mathbf{P}_T produces the total costs of production for domestic industry j , β'_j . In equation form this is defined as,

$$\beta'_j = \sum_{i=1}^B u_{ij} + f_{Lj} + f_{Kj} + \sum_{i=1}^{\Lambda} p_{Tij}. \quad \text{Equation 2.10}$$

Also, total payments by each factor must equal total income of that factor. In terms of labour, total payments, δ'_L are defined as,

$$\delta'_L = \sum_{i=1}^{\Lambda} l_{Hi} + l_W, \quad \text{Equation 2.11}$$

while total payments for capital, δ'_K , are defined as,

$$\delta'_K = k_E + k_H + \sum_{i=1}^{\Theta} k_{Gi}. \quad \text{Equation 2.12}$$

Similarly, the balancing principle applied to the rest of the accounts is that the total value of expenditure for a given expenditure category equals the total income for the equivalent income category. For example, the total enterprises income scalar, μ , is equivalent to total enterprises expenditure scalar, μ' , which is calculated by summing all the total transfers (investment return) to households e_H , government e_G , taxes paid e_T , savings e_S , and the rest of world e_W ,

$$\mu' = e_H + \sum_{i=1}^{\Theta} e_{Gi} + \sum_{i=1}^{\Lambda} e_{Ti} + e_S + e_W. \quad \text{Equation 2.13}$$

In the case of households, the total income for Households, λ , is equivalent to total expenditure by that households category, λ' , where,

$$\lambda' = h_E + \sum_{i=1}^{\Theta} h_{Gi} + \sum_{i=1}^{\Lambda} h_{Ti} + h_S + h_W. \quad \text{Equation 2.14}$$

Analogous identities are also derived for government incomes and expenditures, tax incomes and total taxes, total saving and total investment and rest of world incomes and rest of world expenditures.

2.2 STRUCTURE OF THE REGIONAL SOCIAL ACCOUNTING MATRIX

Figure 2 provides an overview of the component matrices and vectors for a SAM created for any region r . Essentially, the regional SAMs follow the same structure as the national SAM except for the inclusion of an additional row and column, which capture the income and expenditure flows between the subject region r and other New Zealand regions.

	Commodity 1...B	Industry 1...r	Factors of production		Enterprises	Households	Governments 1...θ	Taxes 1...Λ	Savings - Investment	Rest of New Zealand	Rest of World	Total
			Labour	Capital								
Commodity 1...B		t^r Intermediate Consumption				h^r_C Household Final Consumption	G^r_C Government Final Consumption		s^r_C Investment Final Consumption	n^r_C Interregional Exports	w^r_C International Exports	u^r_m Gross Com Demands
Industry 1...r	y^r Domestic Supply											β^r_r Domestic Production
Factors of production	Labour	f^r_L Labour Inputs to Production								n^r_L Labour Income from RoNZ		δ^r_L Total Factor Income (Labour)
	Capital	f^r_K Capital Inputs to Production								n^r_K Gross Operating Surplus from RoNZ		δ^r_K Total Factor Income (Capital)
Enterprises				k^r_E Gross Operating Surplus (Enterprises)		h^r_E Household Transfers to Enterprise				n^r_E Transfers to Enterprises from RoNZ	w^r_E Foreign Transfers to Enterprise	μ^r Enterprises Income
Households			I^r_H Labour Factor Income (Domestic)	k^r_H Gross Operating Surplus (Households)	e^r_H Enterprise Transfers to Households		g^r_H Government Transfers to Households			n^r_H Transfers to Households from RoNZ	w^r_H Foreign Transfers to Households	λ^r Household Income
Governments 1...θ				k^r_G Gross Operating Surplus (Government)	e^r_G Enterprise Transfers to Government	h^r_G Household Transfers to Government		T^r_G Government Tax Income				π^r Government Income
Taxes 1...Λ		p^r_r Industry Taxes			e^r_r Enterprise Taxes	h^r_r Household Taxes	G^r_r Government Taxes		s^r_r Investment Taxes		w^r_r Rest of World Taxes	θ^r Total Taxes
Savings - Investment					e^r_S Enterprise Savings	h^r_S Household Savings	g^r_S Government Savings			n^r_S Interregional Savings	w^r_S Foreign Savings	ω^r Total Saving
Rest of New Zealand	y^r_N Interregional Imports		I^r_N Labour Factor Income (RoNZ)	k^r_N Gross Operating Surplus (RoNZ)	e^r_N Enterprise Transfers to RoNZ	h^r_N Household Transfers to RoNZ						ϕ^r Total RoNZ Outlays
Rest of World	y^r_W International Imports		I^r_W Labour Factor Income (RoW)		e^r_W Enterprise Transfers to the RoW	h^r_W Household Transfers to the RoW	g^r_W Government Transfers to the RoW					ρ^r Total Foreign Outlays
Total	u^r Gross Com Supply	β^r Cost of Production	δ^r_L Total Factor Expenditure (Labour)	δ^r_K Total Factor Expenditure (Capital)	μ^r Enterprise Expenditures	λ^r Household Expenditures	π^r Government Expenditures	θ^r Total Taxes	ω^r Total Investment	ϕ^r Total RoNZ Earning	ρ^r Total Foreign Earning	

Figure 2 Structure of the Regional Social Accounting Matrices

3.0 METHODOLOGY

This Section outlines the steps for creating the national and regional SAMs for the period 2006–07. The methodology consists of four steps: (1) balancing the 2006–07 National Supply Use Tables; (2) creating a National SAM for 2006–07; (3) creating Regional 2006–07 Supply Use Tables from the 2006–07 National Supply Use Tables; and (4) creating a 2006–07 Regional SAM from the 2006–07 National SAM and the 2006–07 Regional Supply Use Tables.

3.1 BALANCING NATIONAL SUPPLY USE TABLES

The National Supply Use Tables provide the data for the commodity and industry accounts (i.e., U , h_C , G_C , s_C , w_C , V , f_L , f_K , P_T , s_T and y). National Supply Use Tables were published by Statistics New Zealand in July 2012, for the period 2006–07.⁶ In order for this data to be incorporated into the national SAM, the tables must satisfy the conditions: (1) total supply of any commodity equals the total use of that commodity, and (2) the total income of each industry equals the total expenditure of that industry. In mathematical notation, $\beta_i = \beta'_j$, $\forall i = j$ and $\alpha_i = \alpha'_j$, $\forall i = j$. However, the tables published by Statistics New Zealand show small differences in row and column totals, meaning that the conditions are not entirely satisfied. A least squares optimisation (i.e., quadratic program) algorithm is employed to adjust the elements in the tables so as to satisfy the row and column total constraints. Where there exist differences between row and column totals for any commodity or industry (i.e., commodity i equals commodity j but $\alpha_i \neq \alpha'_j$, or industry i equals industry j but $\beta_i \neq \beta'_j$), the target total is set as the mean of the two alternative estimates.

3.2 CONSTRUCTION OF THE NATIONAL SOCIAL ACCOUNTING MATRIX (SAM)

This Section outlines how the National SUT and other data sources are used to construct a National SAM for 2006–07.

3.2.1 National Accounting Data Utilised in the Construction of the National SAM

- The National Supply Use Table 06–07 as described in Section 3.1
- Statistics New Zealand's Institutional Sector Accounts. The accounts for each institutional sector include an Income and Outlay Account and a Capital Account. In particular we used the:
 - Producer Enterprises Sector Accounts, (Table 1)
 - Financial Intermediaries Sector Accounts, (Table 6)
 - Central Government Sector Accounts, (Table 8)
 - Local Government Sector Accounts, (Table 9)
 - Private Non-Profit Organisations Serving Households Sector Accounts, (Table 10)
 - Households Sector Accounts, (Table 11)
 - Rest of World Sector Accounts, (Table 12)

⁶ <http://www.stats.govt.nz/>

3.2.2 The Approach Utilised in Construction of the National SAM

A detailed summary of the methods utilised in constructing the National SAM is provided below.

- *Commodity and Industry Accounts* ($U, h_C, G_C, s_C, w_C, V, f_L, f_K, P_T, y$) – A total of 205 commodities and 106 industries⁷ are defined in the national SAM according to the same definitions applied in the 2006–07 National SUT. The data required for all industry and commodity accounts is obtained directly from the 2006–07 National SUT. Note that the Household Final Consumption account, h_C , is derived by taking the sum of final demands for both ‘households’ and ‘private non-profit organisations serving households’ (PNPOs) in the National Use Table. Similarly, the Investment Final Consumption account, s_C , is the sum of final demand categories ‘gross fixed capital formation’ and ‘change in inventories’ within the National Use Table. Labour Factor Inputs to Production, f_L , are taken directly from the primary inputs category ‘compensation of employees’ within the National Use Table, while Capital Factor Inputs to Production, f_K , are derived from the sum of the primary input categories ‘operating surplus’ and ‘consumption of fixed capital’. Finally, the Industry Taxes account, P_T , is derived by summing the primary input categories ‘taxes on products’, ‘other taxes on products’ and ‘subsidies’ from the National Use Table. These accounts are all classified as a type of indirect tax within the SAM.
- *Factors of Production* ($f_L, f_K, k_E, l_H, k_H, k_G, l_W$) – In the national SAM, two factors of production are identified, labour and capital. On the income side, the value of total factor income is derived from payments received from domestic industries and the data sources for these two accounts, f_L and f_K , are already described above. On the expenditure side, total factor income is redistributed as capital return to enterprises (k_E), households (k_H) and governments (k_G), as well as labour income to households (l_H) and to the rest of the world (l_W). The labour income from New Zealand but received by the rest of world is recorded within the Rest of World Sector accounts under ‘compensation of employees’ (Table 12, Series Ref. S2ND1000S6000). The difference between total labour income and that paid to the rest of the world is assigned as the labour income to households (l_H).
- To derive the value of capital income distributed to enterprises (k_E), we take the total capital income received, and subtract the values distributed to households (k_H) and government (k_G). For households this value is derived by summing ‘gross operating surplus’ income received by both the household and PNPOs sectors, as specified within their relevant Income and Outlay Accounts (Table 10, Series Ref. S2NB0200S4000; Table 11, Series Ref. S2NB0200S5000). Similarly ‘gross operating surplus’ received by central and local government is used to derive total capital income transferred to government (Table 8, Series Ref. S2NB0200S3100; Table 9, Series Ref. S2NB0200S3200).

⁷ The definitions of the 106 industries are directly compatible with the 2006 ANZSIC System.

- **Enterprises Accounts** (k_E , h_E , w_E , e_H , e_G , e_T , e_S , e_W) – Enterprises receive income from capital (k_E), transfers from households (h_E) and transfers from the rest of the world (w_E). The transfers from households are (h_E) pension fund contributions made by households, as recorded in the Financial Intermediaries Sector Accounts (Table 6, Series Ref. S2ND6115S2000) and an adjustment for miscellaneous current transfers. The adjustment for miscellaneous current transfers is required to account for the relatively significant difference between income receivable and payable in the miscellaneous current transfers between residents recorded in the household sector accounts (Table 11, Series Refs. S2ND7530S5000 and S2ND7540S5000). This difference relates to a variety of unknown or unidentified sources for irregular income, and the inclusion of some child support payments within the government welfare payments (pers. communication with SNZ). Without further information to inform the structure of these transfers we allocate the difference as transfers between the enterprise, household and government accounts in a manner that minimises the overall adjustment.

Transfers to enterprises from the rest of the world (w_E) is comprised of two components: (1) investment income from the rest of the world as detailed in the Producer Enterprises Sector Accounts (Table 1, Series Ref. S2ND4600S1000), and (2) reinvested earnings on direct investment in New Zealand from the Rest of World Sector Accounts (Table 12, Series Ref. S2ND4301S6000).

Turning now to the expenditure side, enterprise transfers to households, e_H , are derived by summing together three different forms of household income derived from enterprises; entrepreneurial income, property-related income and pension fund benefits. Household entrepreneurial income is taken directly from the Households Sector Accounts of the Institutional Sector Accounts (Table 11, Series Refs. S2NB4100S5000, S2NB4200S5000). The property-related income is comprised of dividend incomes received by households and PNPOs (Table 10, Series Ref. S2ND4210S4000; Table 11, Series Ref. S2ND4210S5000) and income received by households and PNPOs attributed to insurance/pension policies (Table 10, Series Ref. S2ND4400S4000; Table 11, Series Ref. S2ND4400S5000) Pension fund benefits received by households are recorded within the Household Sector Accounts (Table 11, Series Ref. S2ND6220S5000) but an adjustment also needs to be made to account for changes in the net equity of pension funds (Table 6, Series Ref. S2ND8010S2000).

Transfers from enterprises to governments, e_G , are also made up of a number of sub-components. In the case of central government there are altogether four components: (1) dividend income received by the Central Government Sector (Table 8, Series Ref. S2ND4210S3100), (2) income received from rent on natural assets (Table 8, Series Ref. S2ND4500S3100), (3) income earned by the Central Government Sector attributed to insurance/pension policies (Table 8, Series Ref. S2ND4400S3100), and (4) net miscellaneous current transfer payments to enterprises which includes the aforementioned adjustment to miscellaneous current transfers. For local government the transfers from enterprises are the sum of: (1) dividend income received by the Local Government Sector (Table 9, Series Ref. S2ND4210S3200) and (2) income earned by the Local Government Sector attributed to insurance/pension policies (Table 9, Series Ref. S2ND4400S3200).

The Enterprise Taxes account (e_T) is taken as the income tax paid by enterprises and the financial intermediaries sector (Table 1, Series Ref. S2ND5120S1000; Table 6, Series Ref. S2ND5120S2000).

To complete the Enterprise Savings account, e_s , we also look primarily to the Producer Enterprise Sector and Financial Intermediaries Sector accounts. Total savings and investments by enterprises is derived by summing across both sectors: (1) savings, as specified in both the Income and Outlay and Capital Accounts for both sectors (Table 1, Series Ref. S3NB8000S1000; Table 6, Series Ref. S3NB8000S2000), (2) consumption of fixed capital (Table 1, Series Ref. S2NK1000S1000, Table 6, Series Ref. S2NK1000S2000), (3) net capital taxes received (Table 1, Series Ref. S3ND9100S1000), and (4) net capital transfers received (Table 1, Series Ref. S3ND9900S1000; Table 6 Series Ref. S3ND9900S2000). A final adjustment is then made to the savings figure to balance the SAM.

Enterprise transfers to the rest of the world (e_W) are derived from the sum of: (1) net property interest paid by the Producer Enterprise and Finance sectors (Table 1, Series Refs. S2ND4100S1000, S2ND4101S1000; Table 6, Series Refs. S2ND4100S2000, S2ND4101S2000), (2) net dividends received by the rest of the world (Table 12, Series Refs. S2ND4210S6000, S2ND4211S6000), (3) reinvested earnings on overseas direct income (Table 12, Series Refs. S2ND4300S6000), and (4) net non-life insurance premiums for the Producer Enterprise and Finance sectors (Table 1, Series Refs. S2ND7200S1000, S2ND7100S1000; Table 6, Series Refs. S2ND7200S2000, S2ND7100S2000).

Households Accounts ($h_C, h_E, h_G, h_T, h_S, h_W, l_H, k_H, e_H, g_H, w_H$) – Households' income is comprised of labour income (l_H), capital income (k_H), transfers from enterprises (e_H), transfers from governments (g_H), and international transfers (w_H). The derivation of the first three accounts is already described above. The central government transfers to households included in the SAM are made up five general types of transactions – social security benefits in cash, social assistance benefits in cash and miscellaneous transfers to PNPOs, interest concessions, and the adjustment to miscellaneous current transfers. Social security benefits include cash benefits and lump sum payments to individuals by ACC as income maintenance, while social assistance benefits are all cash benefits to individuals and households by public authorities, private non-profit organisations and private enterprises, such as unemployment benefits, national superannuation and education scholarships. The transfers from central government to households of these types can be obtained directly from the Central Government Sector Accounts (Table 8, Income and Outlay Account, Series Ref. S2ND6114S3100). Miscellaneous transfers to PNPOs are obtained from the Private Non-Profit Organisations Serving Households Sector Accounts, by taking miscellaneous current transfers received, less miscellaneous current transfers payable (Table 10, Income and Outlay Account, Series Ref. S2ND7500S4000) less miscellaneous current transfers to private non-profit organisations from households (Table 11, Series Ref. S2ND7520S5000). Interest concessions are obtained from the household sector accounts (Table 11, Series Ref. S2ND7570S5000). Household income received from the rest of the world, w_H , is made up of two separate components: investment income from the rest of the world and miscellaneous current transfers from overseas. Both data points are obtained directly from the Income and Outlay Account for the Households Sector (Table 11, Series Refs. S2ND4600S5000 and S2ND7550S5000).

On the expenditure side, households spend money on the consumption of commodities (h_C), making transfers to enterprises, other households, government and the rest of the world (h_E , h_G and h_W , respectively), paying taxes (h_T) and savings (h_S). Final consumption expenditures and transfers to enterprises and between households are already discussed above. Turning therefore to household transfers to government (h_G), this account is calculated differently for the two different types of government, i.e., central and local. Household transfers to central government are the sum of social security contributions, pension fund contributions and fines and penalties paid by households to central government, while household transfers to local government are comprised only of the fines and penalties component. Social security and pension fund contributions can be found in the Income and Outlay Account for the central government sector (Table 8, Series Refs. S2ND6114S3100 and S2ND6115S3100). Total fines and penalties paid by households are listed as a category of 'secondary income payable' within the Household Sector Income and Outlay Account (Table 11, Series Ref. S2ND7510S5000). Of this total, the majority is assigned as a payment by households to central government.

Household transfers to the rest of the world (h_W) are similarly made up of a number of sub-components, i.e., (1) miscellaneous current transfers by households to overseas (Table 11, Income and Outlay Account, Series Ref. S2ND7560S5000), (2) the net receipt of interest by households and PNPOs (Table 10, Series Refs. S2ND4100S4000, S2ND4101S4000; Table 11, Series Refs. S2ND4100S5000, S2ND4110S5000, S2ND4120S5000) and (3) net benefits (i.e., income from claims less expenditure on premiums) from non-life insurance benefits for households and PNPOs (Table 10, Series Refs. S2ND7200S4000, S2ND7100S4000; Table 11, Series Refs. S2ND7200S5000, S2ND7100S5000).

The household taxes account (h_T) is derived by summing together: (1) taxes on products purchased by households and PNPOs, as derived from the National Use Table, (2) income tax paid by households, as specified in the Household Sector Income and Outlay Account (Table 11, Series Ref. S2ND5120S5000), and (3) other taxes paid by households, as specified in the Household Sector Income and Outlay Account (Table 11, Series Ref. S2ND5900S5000). Of these taxes, only category (1) is classified as an indirect tax, and the remaining as direct taxes.

Finally, the household savings and investments account (h_S) is derived by adding together across households and PNPOs: (1) savings, as specified in both the Income and Outlay and Capital Accounts (Table 10, Series Ref. S3NB8000S4000; Table 11, Series Ref. S2NB8000S5000), (2) consumption of fixed capital by households and PNPOs, as defined in the Income and Outlay Accounts for those sectors (Table 10, Series Ref. S2NK1000S4000; Table 11, Series Ref. S2NK1000S5000), (3) net capital taxes received by households, as defined in the Capital Account for the Household Sector (Table 11, Series Ref. S3ND9100S5000), and (4) net capital transfers received by households and PNPOs, as defined in the Capital Accounts for those sectors (Table 10, Series Ref. S3ND9900S4000; Table 11 Series Ref. S3ND9900S5000). Again, an adjustment is made to the savings figure to balance the set of accounts.

- **Government Accounts (k_G , e_G , h_G , T_G , G_C , g_H , G_T , g_S , g_W)** – The data sources, used to construct the accounts describing governments income from capital (k_G) and from transfers from enterprises and households (e_G and h_G), are described above. Governments also receive income from taxes (T_G), which can be further categorised as direct taxes and indirect taxes received by each of central and local government. Starting with indirect taxes received by central government, it is comprised of (1) the total taxes on production and imports (including GST) received as income, along with a related time adjustment (Table 8, Series Refs. S2ND2000S3100, S2ND2010S3100), (2) subsidies (Table 8, Series Ref. S2ND3000S3100) and (3) and an adjustment to match the Institutional Sector Accounts to the Use Table account. In a similar manner the indirect taxes received by local government are derived from the total taxes on production and imports (including a timing adjustment) listed within the Income and Outlay Account for the sector (Table 9, Series Refs. S2ND2000S3200, S2ND2010S3200), less the value of subsidies paid (Table 9, Series Ref. S2ND3000S3200). The direct taxes received as income by central government are made up of income tax (Table 8, Series Ref. S2ND5100S3100) and other current taxes received (Table 8, Series Ref. S2ND5900S3100), while for local government the direct taxes received are all classed within other current taxes (Table 9, Series Ref. S2ND5900S3200).

On the expenditures side, central and local government make use of their income in the consumption of commodities (G_C), as transfers to households (g_H), as taxes (G_T), in savings and investments (g_S), and as transfers to the rest of the world (g_W). Given that the first two accounts are covered above, we shall start with the Government Taxes account. The value of indirect taxes paid by central government is taken directly from the National Use Table under ‘taxes on products’. The payment of direct taxes by central government equates to the income tax paid by different government agencies. This can be found under the Income and Outlay account for central government (Table 8, Series Ref. S2ND5100S3100). Note that no tax payments are listed for local government.

The total value of central government savings and investment, or central government investment in final consumption i.e., $s_{C,central\ gov}$, is derived by summing: (1) savings (Table 8, Series Ref. S2NB8000S3100), (2) consumption of fixed capital (Table 8, Series Ref. S2NK1000S3100), (3) net capital taxes received (Table 8, Series Ref. S3ND9100S3100), and (4) net capital transfers received (Table 8, Series Ref. S3ND9900S3100). An adjustment is then made to the savings and investment account to ensure that total income for central government equals total expenditure. The total value savings and investment for local government ($s_{C,local\ gov}$) is similarly made up of the sum of savings (Table 9, Series Ref. S3NB8000S3200), consumption of fixed capital (Table 9, Series Ref. S3NK1000S3200), net capital taxes received (Table 9, Series Ref. S3ND9100S3200) and net capital transfers receivable (Table 9, Series Ref. S3ND9900S3200).

Finally, the value of central government transfers to the rest of the world are derived by summing: (1) balance between imports and exports of goods and services for the nation, (Table 12, Series Ref. S2NB1100S6000), (2) the differences between miscellaneous current transfers paid to the rest of the world by the nation and miscellaneous current transfers received (Table 12, Series Refs. S2ND7500S6000, S2ND7501S6000), and (3) the differences between property interest paid and property interest received for central government (Table 8, Series Refs. S2ND4100S3100, S2ND4101S3100).

- *Taxes Accounts* ($T_G, P_T, e_T, h_T, G_T, s_T, w_T$) – The only tax accounts not already covered above are investment taxes (s_T) and rest of world taxes (w_T). The indirect component of both investment and rest of world taxes are again taken directly from the National Use Table under ‘taxes on products’ (final demand columns ‘gross fixed capital formation’ and ‘international exports’, respectively). No direct taxes are included within the investment taxes account. The direct tax component of rest of world taxes are derived by taking the difference between income tax paid and income tax received for the rest of world sector (Table 12. Series Refs. S2ND5120S6000, S2ND5100S6000).
- *Savings and Investments Accounts* ($s_C, s_T, e_S, h_S, g_S, w_S$) – The only savings and investments account not already described above is foreign savings (w_S). This scalar is derived by taking the sum of savings and net capital transfers receivable within the Rest of World Sector Accounts (Table 12, Series Refs. S3NB8000S6000, S3ND9900S6000).
- *Rest of World Accounts* ($w_C, w_E, w_H, w_T, w_S, y, l_W, e_W, h_W, g_W$) – All accounts are calculated as described above.

3.3 REGIONALISATION OF NATIONAL SUPPLY USE TABLE

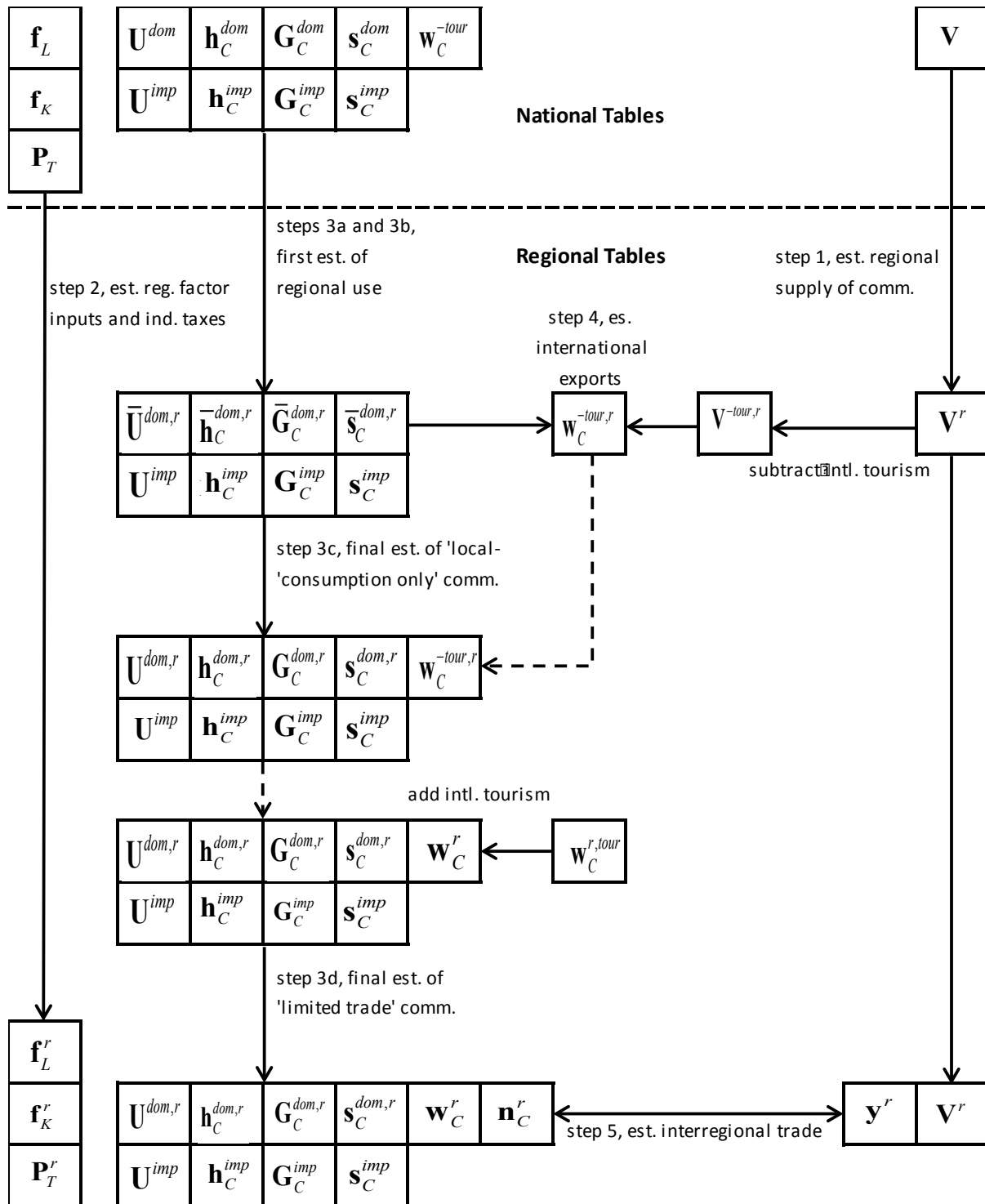
Regional supply use tables were constructed as a prerequisite to the regional SAM. Due to the lack of regional information, the tables could not be constructed directly from regional level data. Instead, the national Supply Use Table for 2006–07 was regionalised, by utilising various methods depending on the account under investigation. This included development of a number of regionalisation scalars and coefficients, as set out in Table 2. An overview of the matrices and vectors generated in the regionalisation the Supply Use Tables is provided in Figure 3, followed by a detailed explanation of these steps below.

Table 2 Scalars and Coefficients for Regionalising 2006–07 Supply Use Tables

Symbol	Name	Formula	Definitions	Data Source
$DOMUSE_{i,j}$	Domestic use coefficient	$\frac{u_{i,j}^{imp}}{\beta_j' - VA_j}$	$u_{i,j}^{dom}$ = total NZ use of domestic commodity i by industry j β_j = total NZ input for industry j VA_j = total NZ value added for industry j	National Supply and Use Tables
$DTCSH_{\psi}$	Domestic tourism consumption share	$\frac{domtour_{\psi}}{inttour_{\psi}}$	$domtour_{\psi}$ = total domestic tourist demand for commodity ψ $inttour_{\psi}$ = international tourist demand for commodity ψ	Statistics New Zealand's Tourism Satellite Accounts
	Domestic tourism distribution share		m = day visits by tourists from region s within region r M = visitor nights by tourists from region s within region r $vis_{day}^{r,s}$ = day visits by tourists from region s within region r $vis_{night}^{r,s}$ = visitor nights by tourists from region s within region r n_i = boolean for whether commodity i is consumed for overnight trips W_{is} = commodity weighting factor to allow for relative differences in value and accessibility of commodities between regions	Ministry of Business, Innovation and Employment's Regional Tourism Estimates
$DTRSMDISTSH_i^{r,s}$	Domestic tourism distribution share	$\frac{\left(vis_{day}^{r,s} \cdot n_i + vis_{night}^{r,s} \right) W_{is}}{\sum_{s=1}^{\phi} \left(vis_{day}^{r,s} \cdot n_i + vis_{night}^{r,s} \right) W_{is}}$ $\frac{\sum_{s=1}^{\phi} vis_{day}^{r,s} + vis_{night}^{r,s}}{\sum_{r=1}^{\theta} \sum_{s=1}^{\phi} vis_{day}^{r,s} + vis_{night}^{r,s}}$		Ministry of Business, Innovation and Employment's Regional Tourism Estimates
FTE_{ϕ}^r	ANZSIC06 Employment Scalar	$\frac{Emp_{\phi}^r}{\sum_r Emp_{\phi}^r}$	Emp_{ϕ}^r = Employment (measured in 'modified employee counts') within region r in industry ϕ	Employee count (EC) data is obtained from SNZ's Business Frame. ECs are a head count of all salary and wage earners for a reference period. This includes most employees but does not capture all working proprietors – individuals who pay themselves a salary or wage. The modified employment count or MEC measure is based on ECs but includes an adjustment to incorporate an estimate of the number of working proprietors.
$GDP SH_{\tau}^r$	Regional GDP Share	$\frac{GDP_{\tau}^r}{\sum_r GDP_{\tau}^r}$	GDP_{τ}^r = GDP for industry τ (16 industries in total) in region r	Statistics New Zealand's Regional Gross Domestic Product Series
HET_i	Product heterogeneity coefficient	$\frac{exp_i + imp_i + exp_i - imp_i }{tsup_i + tuse_i}$	exp_i = national exports of commodity i imp_i = national imports of commodity i $tsup_i$ = total national supply of commodity i $tuse_i$ = total national use of commodity i	National Supply and Use Tables
$HHLDSH_i$	Household final demand share	$\frac{h_{Ci}}{\sum_{i=1}^B h_{Ci}}$	h_{Ci} = household final demand consumption of commodity i	National Supply and Use Tables
$IISH_j$	Intermediate input share	$\frac{\sum_{i=1}^B u_{i,j}}{\beta_j}$	$u_{i,j}$ = total national inputs of commodity i into industry j β_j = total national output of industry j	National Supply and Use Tables

Table 2 Scalars and Coefficients for Regionalising 2006–07 Supply Use Tables (continued)

Symbol	Name	Formula	Definitions	Data Source
$IMPUSE_{i,j}$	Imports use coefficient	$\frac{u_{i,j}^{dom}}{\beta'_j - VA_j}$	$u_{i,j}^{imp}$ = total NZ use of imported commodity i by industry j β'_j = total NZ input for industry j VA_j = total NZ value added for industry j	National Supply and Use Tables
$INCOMESH^r$	Regional household income share	$\frac{hhldincome^r}{\sum_r hhldincome^r}$	$hhldincome^r$ = total household income for region r	Statistics New Zealand's New Zealand Income Survey
$ITRSM SH^r$	Regional international tourism share	$\frac{idayv^r + inightv^r}{\sum_r (idayv^r + inightv^r)}$	$idayv^r$ = international tourist day visits to region r $inightv^r$ = international tourist visitor nights in region r	Ministry of Business, Innovation and Employment's Regional Tourism Estimates
$POPSH^r$	Regional population share	$\frac{pop^r}{\sum_r pop^r}$	pop^r = total population of region r	Statistics New Zealand's Sub-national Population Projections
$PROD_j^r$	Regional Industry Productivity Scalar	$\frac{Mincome_j^r}{Mincome_j^n}$	$Mincome_j^r$ = mean income of persons employed in industry j within region r . $Mincome_j^n$ = mean income of persons employed in industry j within the nation.	Statistics New Zealand's 2006 Census of Population and Dwellings
$TRDSH^{r,s}$	Trade share coefficients	$\frac{sales^{r,s}}{\sum_s sales^{r,s}} \quad s \neq r$	$sales^{r,s}$ = totals sales by agents within region r to agents within region s	Market View Data
$VARATIO_j^r$	Value Added (GDP) to Output Ratio	$\frac{VA_j}{\beta_j}$	VA_j = total NZ value added for industry j β_j = total NZ output of industry j	National Supply and Use Tables



Notes: f_K = capital inputs to production vector, f_L = labour inputs to production vector, G_C = government final consumption matrix, h_C = household final consumption vector, n_C = interregional exports vector, s_C = investment consumption vector, U_C = intermediate consumption matrix, V = supply matrix, w_C = international exports vector, y_C = international imports vector, subscript r denotes for region r , subscript dom denotes for commodities produced within NZ, subscript imp denotes for commodities produced outside of NZ, overline denotes a first estimate of a matrix/vector

Figure 3 Regionalisation Process for the National Supply Use Tables

3.3.1 Step 1 Estimation of Regional Supply of Commodities (V^r)

Over a decade ago, Jackson (1998) noted that subnational output data is rare to find at any significant level of disaggregation, and that industry-based employment data is often the only major form of regional-specific data available to the regional modeller. Although this is predominantly still the case for New Zealand, and our method consequently draws heavily on employment data in producing estimates of regional output/supply, it has also been possible to supplement these estimates with superior data on regional production for a number of physical commodities. We have also used the regional GDP series recently released by SNZ to constrain the estimates of regional supply, ensuring consistency with official GDP figures.

Step 1a: Generating First Estimates of Regional Output Shares for each Economic Industry

We begin the process of generating regional supply matrices, V^r , by creating a set of coefficients that describe, for a given economic industry, the share of total national output produced within each region. We term this coefficient for a given region r and industry j OSH_j^r . The first best estimate of this coefficient, termed \overline{OSH}_j^r , is calculated as,

$$\overline{OSH}_j^r = \frac{EOS_j^r \times PROD_j^r}{\sum_{r=1}^R (EOS_j^r \times PROD_j^r)} \quad \text{Equation 3.1}$$

where EOS_j^r represents the share of national output for industry j that can be allocated to region r , based on the region's share of employment in that industry. So as to ensure that regional differences in sub-industry composition are taken into account, the calculations for EOS_j^r are performed at the 6-digit ANZSIC (sub) industry level, rather than by the 106 industries defined within the SUTs. Thus,

$$EOS_j^r = \frac{\sum_{\phi=1}^{\Phi} (\beta_{\phi} \times FTE_{\phi}^r)}{\sum_{\phi=1}^{\Phi} \beta_{\phi}} \quad \text{Equation 3.2}$$

The subscript ϕ in Eq. 3.2 is used to denote an ANZSIC06 (sub) industry that falls under IO industry j . The term β_{ϕ} refers to the value (\$mil) of industry output for the ANZSIC06 industry ϕ , as derived from the SNZ's Annual Enterprise Survey.⁸ The inclusion of these output values in Eq. 3.2 provides a means of weighting the different ANZSIC06 industries that come together to form industry j . The term FTE_{ϕ}^r refers to an employment scalar for ANZSIC06 industry ϕ in region r , as set out in Table 2 above.

⁸ Due to data suppression, a number of confidential items within the data are estimated via a variety of ad hoc methods.

Note that a productivity scalar, $PROD_j^r$, is further added to Eq. 3.1, to account for possible differences in productivity between regions (i.e., the ratio of output per worker may vary from the national average). Given the lack of regional productivity information available, it has been necessary to draw on relative differences in the incomes received by employees as a proxy for such productivity differences (refer to Table 2 for details of the calculation of the $PROD_j^r$ scalars).

Step 1b: Improving first estimates using Physical Production Data

For some commodities there exists superior information on regional production. We use this data to improve our first estimates of regional production. For example, data on milk solid production by region can be used to provide improved estimates of the share of total raw milk produced by each region, and similarly regional shares of total land planted in kiwifruit can be used to estimate regional shares of kiwifruit production. Table 3 below provides a summary of the specific cells within the regional supply matrices that are estimated via superior data sources. Note that the first four rows of Table 3 provide 2-dimensional (commodity type and industry) identifiers for each of the cells considered. The remaining rows within the table describe the data and assumptions employed.

We note that for some production activities, the sites at which physical production of commodities occurs can be quite different from the sites at which management, administrative and various other staff are located. For example, although crude oil and gas is produced only within the Taranaki region, the oil and gas extraction industry also employs a number of people within the Wellington region. So as to ensure that some responsibility for the commodities produced by the oil and gas industry is attributed to Wellington as well as Taranaki, only a proportion of the relevant cells within the Supply Table are regionalised based on the data described in Table 3 to generate first estimates of regional production. That proportion is set equal to the intermediate input share, $IISH_j$ (refer to Table 2). All cells for which this approach is taken are identified by note 14 within Table 3.

Step 1c: Generating second estimates of Regional Output Shares for each Economic Industry

The purpose of this sub-step is to ensure that the estimates of regional output by economic industry are consistent with this GDP data, for the year ending March 2007. A least-squares optimisation is utilised for this purpose. In June 2013, Statistics New Zealand released the Regional Gross Domestic Production series, the first official measure of New Zealand's regional economies,⁹ covering 15 NZ regions, 16 industries, and the period 2007–10. The objective of the optimisation is to find a set of second estimates of the regional output shares, OSH_j^r , that are as close as possible to the first estimates, subject to the constraint that regional GDP shares calculated from these regional output shares are the same as the SNZ data. The least-squares optimisation is thus undertaken separately for each of the 16 industries covered by the GDP series. Letting τ denote any of these 16 industries, and j^τ an element of the sub-set of IO106 industries that aggregate to form industry τ , the optimisation for τ requires finding values for each $OSH_{j^\tau}^r$ according to the function

⁹ http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/RegionalGDP_MRYeMar0710.aspx

$$\begin{aligned}
& \text{minimize} \sum_{j^\tau} \sum_r^R \left(\frac{OSH_{j^\tau}^r \times \beta_{j^\tau} - \overline{OSH}_{j^\tau}^r \times (\beta_{j^\tau} - \beta_{pj^\tau}^r) + \beta_{pj^\tau}^r}{\overline{OSH}_{j^\tau}^r \times (\beta_{j^\tau} - \beta_{pj^\tau}^r) + \beta_{pj^\tau}^r} \right)^2 \\
& \text{s.t.} \quad \frac{\sum_{j^\tau} (\beta_{j^\tau} \times OSH_{j^\tau}^r \times VARATIO_{j^\tau}^r)}{\sum_r^R \sum_{j^\tau} (\beta_{j^\tau} \times OSH_{j^\tau}^r \times VARATIO_{j^\tau}^r)} = GDPSH_\tau^r \\
& \quad \sum_r^R OSH_j^r = 1
\end{aligned}
\tag{Equation 3.3}$$

The term $\beta_{pj^\tau}^r$ denotes the regional output of commodities determined from the physical production data (Step 1a). The term $GDPSH_\tau^r$ on the right-hand-side of the constraint denotes the regional GDP share for region r and industry τ , as defined from the SNZ data (see Table 2 above). The other term thus far unexplained is $VARATIO_{j^\tau}^r$, which specifies the value added (GDP) to output ratio for industry j^τ within region r . With no data upon which to assume otherwise, these ratios are derived simply from national-level data (refer to Table 2).

Step 1d: Generate Regional Supply Matrices

Having determined the share of industry output for each region, $OSH_{j^\tau}^r$, estimates for the cells of the regional supply matrices, $v_{i,j}^r$, can be calculated according to a simple equation,

$$v_{i,j}^r = OSH_j^r \times v_{i,j}$$
Equation 3.4

Where $v_{i,j}$ is the supply of commodity i by industry j within the nation, as obtained from the national supply matrix.

Table 3 Details of Regionalisation of Specific Cells in Supply Matrix

205IOC Commodity Code	5	6	10	11	15	18, 23
205IOC Commodity Name	Kiwifruit	Pome fruit (apples, pears)	Sheep	Cattle	Raw milk	Wood and non-wood forest products/ support services to forestry and logging
106IOI Industry Code	1-5,7	1-5,7	1-5,7	1-5,7	3	5
106IOI Name	Horticulture and fruit growing/ sheep, beef and grain farming/ poultry, deer and other livestock farming/ forestry and logging	Horticulture and fruit growing/ sheep, beef and grain farming/ poultry, deer and other livestock farming/ forestry and logging	Horticulture and fruit growing/ sheep, beef and grain farming/ poultry, deer and other livestock farming/ forestry and logging	Horticulture and fruit growing/ sheep, beef and grain farming/ poultry, deer and other livestock farming/ forestry and logging	Dairy cattle farming	Forestry and logging
Variable for Regional Scalar	Area of planted kiwifruit (ha)	Area of planted pomme fruit (ha)	Sheep population (head)	Cattle population (head)	Milk solids production (kg)	Exotic forest harvested (ha)
Assumptions	Output per ha and price spatially invariant	Output per ha and price spatially invariant	Commodity production directly proportional to and function only of population	Commodity production directly proportional to and function only of population	Milk price spatially invariant	Commodity production per ha harvested spatially invariant
Data	SNZ's 2007 Agriculture Census: area of planted kiwifruit (ha) by region and farmtype group	SNZ's 2007 Agriculture Census: area of planted pipfruit (ha) by region and farmtype group	SNZ's Agriculture Census: sheep numbers (head) by region and farmtype group	SNZ's Agriculture Census: beef numbers (head) by region and farmtype group	LIC NZ Dairy Statistics: herds, cattle population (head) and effective land area (ha) by sub-region, average kg milkfat per herd, per head and per effective land area by sub-region	SNZ's Forestry Dataset: total exotic timber harvested (ha) by region
Notes	(1)	(1)	(1)	(1)	(2)	(3), (14)

Table 3 Details of Regionalisation of Specific Cells in Supply Matrix (continued)

205IOC Commodity Code	30	31	32	34	87	118
205IOC Commodity Name	Sands, pebbles, gravel, clays, stone and bitumen	Chemical and fertilizer minerals and salt	Precious metals and stones	Meat and offal	Articles of concrete and stone	Electricity
106IOI Industry Code	10	10	10	12	27	35
106IOI Name	Metal ore and non-metallic mineral mining and quarrying	Metal ore and non-metallic mineral mining and quarrying	Metal ore and non-metallic mineral mining and quarrying	Meat and meat product manufacturing	Non-metallic mineral product manufacturing	Electricity generation and on-selling
Variable for Regional Scalar	Relative mineral production (\$)	Relative mineral production (\$)	Relative mineral production (\$)	Carcass production (\$)	Volume of ready mixed concrete (m ³)	Energy production (GWh)
Assumptions	Equal relative differences between domestic mineral prices as for export mineral prices	Equal relative differences between domestic mineral prices as for export mineral prices	Domestic price for serpentine equal to export price	Aggregate regions split into 16 region groupings using regional gross output estimates. Assume relative differences in domestic prices of meat the same as relative differences in export prices	Concrete constitutes the bulk of this commodity group	Electricity price is spatially invariant
Data	MBIE petroleum and mineral data: amorphous silica, bentonite, clay, decorative pebbles, rock, sand and gravel production by location (tonnes). HS and UN Comtrade data: export data for minerals (kg, \$)	MBIE petroleum and mineral data: dolomite for agriculture, dolomite for industry and zeolite production by location (tonnes). HS and UN Comtrade data: export data for minerals (kg, \$)	MBIE petroleum and mineral data: gold and silver production by location (\$), serpentine production by location (tonnes). HS and UN Comtrade data: export data for minerals (kg, \$)	SNZ Livestock Slaughtering data: Regional kills by animal type. HS trade data: meat exports (kg, \$)	SNZ Ready Mixed Concrete data: production (m ³) by region	Electricity Authority electricity generation by plant (GWh)
Notes	(4), (5), (6), (14)	(4), (5), (6), (14)	(4), (5), (6), (14)	(6), (9)	(10)	(11), (14)

Table 3 Details of Regionalisation of Specific Cells in Supply Matrix (continued)

205IOC Commodity Code	19	25	26	27	28	29
205IOC Commodity Name	Standing timber	Coal, coke and tar products	Crude petroleum	Natural gas	Iron ores, non-ferrous metal ores and concentrates	Gypsum, limestone, cement and building stone
106IOI Industry Code	5	8	9	9	10	10
IO106_name	Forestry and logging	Coal mining	Oil and gas extraction	Oil and gas extraction	Metal ore and non-metallic mineral mining and quarrying	Metal ore and non-metallic mineral mining and quarrying
Variable for Regional Scalar	Net change in standing volumes	Coal production (\$)	All crude petroleum produced in Taranaki	All natural gas produced in Taranaki	Ironsand production (tonnes)	Relative mineral production (\$)
Assumptions	Territorial authority areas split to match regional boundaries using planted forest area (m ²)	-	-	-	-	Equal relative differences between domestic mineral prices as for export mineral prices
Data	National Exotic Forest Description: standing timber volumes (m ³) by territorial authority, LCDB2: planted forest area, category 31 (m ²) (7), (8)	MBIE petroleum and mineral data: coal mass production (kg) by region and coal type. Covc (2009): coal prices (\$/kg) by coal type and location of production (4)	-	-	MBIE petroleum and mineral data: ironsand production by location (4)	MBIE petroleum and mineral data: building and dimension stone, diatomite, limestone for agriculture, limestone for industry, limestone and marl for cement, perlite and pumice production by location (tonnes). HS and UN Comtrade data: export data for minerals (kg, \$) (4), (5), (6)
Notes	(7), (8)	(4), (14)	(14)	(14)	(4), (14)	(4), (5), (6), (14)

Table 3 Details of Regionalisation of Specific Cells in Supply Matrix (continued)

205IOC Commodity Code	123	124	125	169	172
205IOC Commodity Name	Residential building construction	Non-residential building construction	Civil engineering services	Leased residential property services	Owner - occupied dwellings
106IOI Industry Code	41	42	43	78	81
IO106_name	Residential building construction	Non-residential building construction	Heavy and civil engineering construction	Residential property operation	Owner-occupied property operation
Regional Share Scalar / Method	Value of new and altered residential buildings (\$)	Value of new and altered non-residential buildings (\$)	Value of non-building construction (\$)	Rental income (\$)	Imputed rent for owner occupied dwellings (\$)
Assumptions	-	-	Regional share of civil engineering services is equivalent to the regional share of non-building construction	Gross output is directly proportional to rent income	Equal relative differences between regions for imputed rent of owner-occupied dwellings as for rent of rented dwellings
Data	SNZ construction data: value of building work put in place (\$) by type and region (12)	SNZ construction data: value of building work put in place (\$) by type and region (12)	SNZ construction data: value of building work put in place (\$) by type and region (12)	SNZ 2006 Census data: Number of households by type of tenure and region. SNZ HES data: average weekly rent by territorial authority (13)	SNZ 2006 Census data: Number of households by type of tenure and region. SNZ HES data: average weekly rent by territorial authority (13)
Notes	(12)	(12)	(12)	(13)	(13)

Notes

- (1) Statistics New Zealand (SNZ) 2007 Agricultural Census data obtained via a special data request from SNZ
(2) Livestock Improvement Corporation (LIC) NZ Dairy Statistics accessed from http://www.lic.co.nz/lic_Publications.cfm
(3) Statistics New Zealand (SNZ) forestry data accessed from <http://nzdotstat.stats.govt.nz/wbos/>
(4) Ministry of Business Innovation and Employment (MBIE) petroleum and mineral data accessed from <http://www.nzpm.govt.nz/cms>
(5) United Nations (UN) Comtrade data accessed from <http://comtrade.un.org>
(6) Harmonised System export data accessed from <http://www.stats.govt.nz/infoshare/>
(7) Land Cover Database 2 (LCDB2) accessed from <https://koordinates.com/>
(8) National Exotic Forest Description accessed from <http://www.mpi.govt.nz/>
(9) Statistics New Zealand (SNZ) livestock slaughtering statistics accessed from <http://www.stats.govt.nz/infoshare/>
(10) Statistics New Zealand (SNZ) ready mixed concrete data derived from the Ready-Mix Concrete Survey, accessed from <http://www.stats.govt.nz/infoshare/>
(11) Electricity Authority (EA) generation by plant accessed from <http://www.ea.govt.nz/>
(12) Statistics New Zealand (SNZ) construction data derived from the Quarterly Building Activity Survey, accessed from <http://www.stats.govt.nz/infoshare/>
(13) Statistics New Zealand (SNZ) Household Economic Survey (HES) accessed from www.stats.govt.nz
(14) Only a proportion of this cell (equal to the intermediate input share, $IISHARE_j$) is regionalised via this data

3.3.2 Step 2 Estimation of Factor Inputs and Industry Taxes ($\mathbf{f}_L^r, \mathbf{f}_K^r, \mathbf{P}_T^r$)

In Equation 3.3 above, estimates of value added (GDP) by industry and region ($\beta_{j^r} \times OSH_{j^r} \times VARATIO_{j^r}$) are used as part of the constraints on the optimisation function.

Step 2 involves using these derived figures of value added by industry and region to disaggregate the components of the Use Table, covering value added inputs to industry production (factor inputs to production, \mathbf{f}_L^r and \mathbf{f}_K^r , as well as the components of industry

taxes, \mathbf{P}_T^r , covering ‘other taxes on production’ and ‘subsidies’). Under this step it is assumed, for each industry, that the ratio of a particular value added input to total value added inputs is uniform across New Zealand. For example labour inputs to production for industry j within region r are calculated as

$$f_{Lj}^r = \beta_{j^r} \times OSH_{j^r} \times VARATIO_{j^r} \times \frac{f_{Lj}}{VA_j} \quad \text{Equation 3.5}$$

Where f_{Lj} is the total value of labour inputs into production for industry j within NZ and VA_j is the total value added inputs for industry j within NZ, with both sets of data derived from the National Use Table. The other value added inputs to production are also calculated in an analogous manner.

The national accounts item ‘taxes on products’ are included within the industry taxes matrix, \mathbf{P}_T^r , but are not an item conventionally included within industry GDP totals. We thus regionalise the row of data for taxes on products within the National Use Table in the same manner as the intermediate consumption matrix \mathbf{U} (see below).

3.3.3 Step 3 Estimation of Intermediate Consumption, Household Final Consumption, Government Final Consumption, Investment Final Consumption and International Imports (\mathbf{U}^r , \mathbf{h}_C^r , \mathbf{G}_C^r , \mathbf{s}_C^r and \mathbf{y}_W^r)

Step 3a: Generate First Estimates of Regional Intermediate Consumption

Conceptually, the regional intermediate consumption matrices can each be split into two matrices describing the use of commodities produced within NZ industries (referred to hereafter as ‘domestic commodities’), and the use of commodities imported from other nations (‘imported commodities’). We can term these matrices, respectively, $\mathbf{U}^{dom,r}$ and $\mathbf{U}^{imp,r}$. The regionalisation of the national intermediate consumption matrix begins with the generation of first estimates for the domestic commodity use matrix, i.e., $\bar{\mathbf{U}}^{dom,r}$. As no further adjustments are required to the imported commodity use matrix, our first estimates for this matrix also constitute the final estimates. To generate these estimates it is assumed that industry use profiles are homogenous across New Zealand. Thus for a given commodity, industry and region,

$$\bar{u}_{i,j}^{dom,r} = DOMUSE_{i,j} \times (\beta_j^{rr} - VA_j^r) \quad \text{Equation 3.6}$$

$$u_{i,j}^{imp,r} = IMPUSE_{i,j} \times (\beta_j^{rr} - VA_j^r) \quad \text{Equation 3.7}$$

The two terms $DOMUSE_{i,j}$ and $IMPUSE_{i,j}$ are, respectively, national use coefficients for domestic and international commodity i by industry j as defined in Table 2 above, while VA_j^r refers to the total value added for industry j in region r as derived under Step 2. Now, given that the inputs to an industry should equal the total outputs from that industry, the total use or inputs to an industry j in region r , β_j^{rr} , can be determined by summing all of the commodities supplied by that industry as recorded in the regional supply matrices calculated above, i.e.,

$$\beta_j^{rr} = \sum_{i=1}^B v_{i,j} \quad \text{Equation 3.8}$$

where column industry j in the vector β^{rr} is equal to row industry i in matrix V .

Step 3b: Generate First Estimates of Regional Final Demand Consumption

The first estimates of the final demand accounts, \bar{h}_C^r , \bar{G}_C^r and \bar{s}_C^r , are derived by apportioning the national final demand matrices among the NZ regions through application of a set of scalars. For example, household j final consumption of domestic commodity i within region r , $h_{Ci,j}^{dom,r}$, is determined through application of regional household income shares, $INCOMESH^r$ (see Table 2 above).

$$\bar{h}_{Ci,j}^{dom,r} = INCOMESH^r \times h_{Ci,j}^{dom} \quad \text{Equation 3.9}$$

where $h_{Ci,j}^{dom}$ is the national consumption of domestic commodity i by household category j , as determined from the National Use Table. First estimates of household consumption of international commodities are also determined in an analogous manner. The regional household income shares are further used to generate first estimates of regional investment final consumption, while regional population shares, $POPSH^r$, are used to generate first estimates of regional government final consumption.

Step 3c: Generate Final Estimates of Regional Consumption for 'Local-Consumption Only' Commodities

For most domestically produced commodities, the supply of that commodity by a particular region need not equal the use of that commodity within the region, as interregional trade enables regions to balance-out differences between supply and demand. When creating regional supply and use matrices it is, however, common to assume that there are some commodities for which trade between regions is negligible. Most often this approach is applied to service commodities which, because of their very nature, need to be consumed at their location of production and the agents responsible for the consumption are predominantly local agents. For example Piispala (2000), when creating regional supply and use tables for Finland, assumed services such as hairdressing and education involved no trade between regions. This assumption is applied to just a small number of commodities in our study, including certain utility services (water, sewerage, waste disposal), education services and personal services (e.g., accommodation for the aged, child care services). The full list of these commodities is provided in Table A.2 of Appendix A (column 1).

To ensure balance between supply and demand for commodities deemed to be used entirely within their region of supply, we scale the first estimates of intermediate consumption and final demand for those commodities, until total regional use equals total commodity production. For example, when column commodity j in the Industry accounts is equal to row commodity i in the Commodity accounts, the use of domestic commodity i by industry j within region r is calculated as,

$$u_{i,j}^{dom,r} = \frac{\bar{u}_{i,j}^{dom,r}}{\sum_{j=1}^{\Gamma} \bar{u}_{i,j}^{dom,r} + \sum_{j=1}^{\Lambda} \bar{h}_{i,j}^{dom,r} + \sum_{j=1}^{\Theta} \bar{g}_{i,j}^{dom,r} + \bar{s}_{i,j}^{dom,r} + w_{Ci}^r} \times \sum_{i=1}^{\Gamma} v_{i,j}^r \quad \text{Equation 3.10}$$

The term w_{Ci}^r in Eq 3.10 refers to international exports of commodity i from region r . For the commodities considered under this step, these values are typically very small or equal to zero. But in any case, the methods used to estimate international exports by region are described further below.

Step 3d: Generate Final Estimates of Regional Consumption for 'Limited Trade' Commodities

In addition to the set of commodities addressed under Step 3c, a further set of commodities is identified for special treatment due to the limited ability of these commodities to be traded between regions. Essentially these are types of services which, by their nature, are also usually consumed at the site of production. Interregional trade in the services is therefore likely to be confined primarily to situations of persons/employees undertaking personal or business travel (that is tourists or regional visitors). We refer to this set of services as 'Limited Trade' commodities, and in this study these comprise of different types of passenger transport services, as well as the commodity group 'libraries, museums and art'.

We set the total use of a (domestically produced) Limited Trade commodity within a given region r , $\alpha_i^{dom,r}$, as equal to: (1) the total supply of that commodity within the region, less the value of that commodity supplied as either international exports or to visitors from other regions, plus (2) the value of that commodity consumed by agents from region r while visiting other regions. Thus when row commodity i in the Commodity Accounts is equal to column commodity j in the Industry Accounts,

$$\alpha_i^{dom,r} = \sum_{j=1}^{\Gamma} v_{i,j}^r - \left(w_{Ci}^r + \sum_{s=1}^{\Phi} n_i^{r,s} \right) + \sum_{s=1}^{\Phi} n_i^{s,r} \quad \text{Equation 3.11}$$

where $n_i^{r,s}$ is the supply of commodity i by the subject region r to another region s ($r, s \in \{1 \dots \Phi\}$), and conversely $n_i^{s,r}$ is the supply of commodity i by another region s to subject region r . The methods used to estimate international exports and interregional trade are described further below.

Having now determined the total use within a region of each Limited Trade commodity, these values are apportioned among the relevant components of the Commodity Accounts (i.e., \mathbf{U} , \mathbf{h}_C^r , \mathbf{G}_C^r , \mathbf{s}_C^r) in a similar manner to the Local Consumption Only commodities. For example, the final estimate for use of Limited Trade (domestic) commodity i by industry j is calculated as,

$$u_{i,j}^{dom,r} = \frac{\bar{u}_{i,j}^{dom,r}}{\sum_{j=1}^{\Gamma} \bar{u}_{i,j}^{dom,r} + \sum_{j=1}^{\Delta} \bar{h}_{i,j}^{dom,r} + \sum_{j=1}^{\Theta} \bar{g}_{i,j}^{dom,r} + \bar{s}_{i,j}^{dom,r}} \times \alpha_i^{dom,r} \quad \text{Equation 3.12}$$

Step 3e: Generate International Imports Vector

The vector of international imports into a given region r can be calculated by summing elements from the various import sub-matrices and vectors calculated above, i.e.,

$$y_{Wj}^r = \sum_{j=1}^{\Gamma} u_{i,j}^{imp,r} + \sum_{j=1}^{\Delta} h_{i,j}^{imp,r} + \sum_{j=1}^{\Theta} g_{i,j}^{imp,r} + s_{Ci}^{imp,r} \quad \text{Equation 3.13}$$

where column commodity j in the International Imports vector is the same as row commodity i within the Commodity Accounts.

Step 3f: Generate Final Estimates for Regional Consumption

The final step involved in calculating these accounts involves bringing back together the domestic commodity and international commodity components of the accounts. The final intermediate consumption matrix, is calculated simply as,

$$\mathbf{U}^r = \mathbf{U}^{dom,r} + \mathbf{U}^{imp,r} \quad \text{Equation 3.14}$$

3.3.4 Step 4 Estimation of International Exports (\mathbf{W}_C^r)

Step 4a: Generate Estimates of Regional Exports of Tourism Commodities

The tourism satellite accounts produced by Statistics New Zealand provide data on the supply and use of tourism-related goods and services (Statistics New Zealand, 2010). In generating estimates of international exports by regions, we are particularly interested in the data pertaining to international demand for tourism products. These tourism products are grouped into two types under the accounts, 'tourism-characteristic' and 'tourism-related'. The former covers products for which at least 25 percent of production is purchased by tourists, while for the latter up to 25 percent is consumed by tourists. Nine different tourism-characteristic products are identified in the accounts (including accommodation services, food and beverage serving services and others) and 14 tourism-related products (e.g., different types of retail sales, gambling services, education services).

The first task is to match the tourism-characteristic and tourism-related products from the satellite accounts as best as possible to the 205IOC commodity categories of the Supply Use Tables. Where one tourism product matches to a number of 205IOC commodities, the household final demand share, $HHLDSH_i$ (see Table 2), is used as the basis for apportioning data among the relevant commodities. Another complication is that transactions within the Use Table are recorded in basic prices, while tourism expenditure is measured in

purchaser prices in the satellite accounts. This means, for example, that only the margin component of an expenditure classified as ‘retail – food, beverages, tobacco and other groceries’ under the satellite accounts is classed as a retail commodity within the 205IOC classification, and the remainder of the expenditure is allocated to various food, beverage and other commodities. Data on total supply of commodities at both purchasers’ prices and basic prices from the National Supply Table is taken as the basis for estimating the margin component of tourist expenditures.

Having determined international tourism expenditure for each 205IOC commodity, the final task is to allocate this expenditure among the different New Zealand regions. The regional international tourism share coefficients, $ITRSMH_r$,¹⁰ are used for this purpose.

Step 4b: Generate Estimates of Remaining International Exports

A type of supply-demand pool method is used as the basis for distributing the remainder of the international exports vector among New Zealand regions. The approach is based on the supposition that for any particular commodity, both the larger the positive difference between supply and use of that commodity in a given region, and the larger the magnitude of total supply from that region, the larger the quantum of international exports of that commodity from the region. Thus, the exports of commodity i from region r , excluding the tourism component already calculated under step 4a above (i.e., $w_{Ci}^r - w_{Ci}^{tour,r}$), is calculated as,

$$w_{Ci}^r - w_{Ci}^{tour,r} = \frac{\sum_{j=1}^B v_{i,j}^r - w_{Ci}^{tour,r} + \chi_i^r}{\sum_r \left(\sum_{j=1}^B v_{i,j}^r - w_{Ci}^{tour,r} + \chi_i^r \right)} \times (w_{Ci} - w_{Ci}^{tour}) \quad \text{Equation 3.15}$$

where the row commodity i in the exports matrix is equal to column commodity j in the supply matrix. The term χ_i^r represents the balance between local supply and local demand for commodity i in region r , and is calculated as,

$$\chi_i^r = \sum_{j=1}^B v_{i,j}^r - w_{Ci}^{tour,r} - \sum_{i=1}^B (\bar{h}_{Ci}^r + \bar{g}_{Ci}^r + \bar{s}_{Ci}^r) \quad \text{Equation 3.16}$$

3.3.5 Step 5 Estimation of Interregional Trade in Commodities (\mathbf{n}_C^r and \mathbf{y}_N^r)

The final task in the regionalisation of the Supply and Use Table components of the SAM is to generate the vectors of interregional exports and imports of commodities. Note that our SAM framework (see Figure 2 above) only requires us to determine, for any particular region r , the total value of interregional exports and imports of each commodity. However, to ensure that our regional SAMs are in balance, and that all of the regional SAMs added together

¹⁰ However, for the specific commodity accommodation services, international tourist day visits are excluded from both the numerator and denominator of the regional international tourism share coefficient.

equate to the national SAM, our regionalisation process involves the development of a full specification of interregional trade between NZ regions. In other words, for each possible pair of NZ regions, a vector of commodity imports and exports is determined.¹¹

The generation of these interregional trade vectors begins through the identification of five alternative regionalisation methods, and then the allocation of each commodity to one of these methods. Table B.1 provides full details on the allocation of commodities to regionalisation methods, while a full explanation of each of these methods is provided in the sub-steps below.

Step 5a: Local-Consumption Commodities Method

As already explained above, there are a small set of commodities for which trade between regions is likely to be negligible. No estimation of interregional exports and imports are therefore required for these commodities.

Step 5b: Tourism-Commodities Method

Tourism commodities have already been introduced above. The only interregional trade incorporated into the SAM for these commodities is that which is associated with interregional visitors/tourists. We thus calculate interregional tourism trade as

$$n_{Ci,tourism}^{r,s} = V_{i,tourism}^{dom} \times DTRSMDISTSH_i^{r,s} \quad \text{Equation 3.17}$$

where $V_{i,tourism}^{dom}$ is the tourism spend from the Tourism Satellite Accounts and $DTRSMDISTSH_i^{r,s}$ is the domestic tourism distribution share for origin region r , destination region s and commodity i .

Step 5c: Supply Share Method

Under the supply share method it is assumed that all producers of a given commodity i supply that commodity on a pro-rata basis to each and every user. For each user therefore, the proportion of commodity i that is supplied from a particular region r , is the same as that region's share of total national production of the commodity.

As this method takes no account of the relative distances and other types of 'impedance factors' existing between regions, it is suitable for application to only a select few commodities. The electricity commodity is an obvious example. As electricity producers within New Zealand supply their product to a national grid network, we view users of the commodity as being supplied by all national producers. It is also worth noting that in New Zealand we have only one major petroleum refinery plant, located in the Northland region, although various administration and other parts of the operation of petrochemical supply are located elsewhere within the country. So as to ensure that all users of petrochemicals receive both the 'physical' and 'other' components of the commodities, the

¹¹ In the steps below we concentrate only on describing the generation of the interregional *exports* vectors between pairs of regions, $\mathbf{n}_C^{r,s}$. Of course, once the interregional export vectors are generated we also have the interregional *import* vectors, as the exports from a given region r to another region s are the same as the imports to region s from region r .

supply share method is also applied to the ‘petrol’, ‘diesel’ and ‘other petroleum products’ commodities. The service commodity ‘central government and administration services’ is another commodity to which the supply share method is applied.

Step 5d: Gravity Model Method

Commodity trade estimated under this method actually involves two steps: (1) application of a gravity model to generate first estimates of interregional trade in commodities, and (2) application of a least squares optimisation to balance the trade matrices, ensuring that total regional supply and use of each commodity, as estimated in the steps above, is satisfied.

Generation of First Estimates Using Gravity Model

Gravity-type models have played a key role in modelling trade flows for approximately 50 years, stemming from the work of Tinbergen (1962) who was the first to use a gravity model to analyse international trade flows, Poyhonen (1963) and Linneman (1966). Not surprisingly, this approach was also quickly transferred to the estimation of input-output and supply-use matrices (Leontief and Strout, 1963; Uribe et al., 1966; Theil, 1967). It has been recognised that where regional trade and input-output data is too expensive and time consuming to obtain via survey methods, gravity-model based approaches are most likely, (compared to other non-survey methods), used in the estimation of these data (Riddington *et al.*, 2006).

Although there are a number of variations in the way in which gravity models are formulated, the general idea is that the flow of goods between two locations is a function of the supply or production at the origin location, the demand or consumption at the destination location, and some measure of the impedance factors, usually distance, existing between the two locations. In this study, the first estimates of interregional commodity trade flows between an exporting region r and importing region s , $\bar{n}_{Ci}^{r,s}$, are based on the following function (assuming row commodity i in the Commodity Accounts is equal to column commodity j in the Industry Accounts):

$$\bar{n}_i^{r,s} = \frac{\left(\sum_{j=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r \right) + \left(\sum_{j=1}^{\Gamma} u_{i,j}^{dom,s} + h_i^{dom,s} + \sum_{j=1}^{\Theta} g_{i,j}^{dom,s} + s_i^{dom,s} \right) \times q_i^{r,s}}{\sum_{r=1}^R \sum_{s=1}^S \left(\left(\sum_{j=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r \right) + \left(\sum_{j=1}^{\Gamma} u_{i,j}^{dom,s} + h_i^{dom,s} + \sum_{j=1}^{\Theta} g_{i,j}^{dom,s} + s_i^{dom,s} \right) \times q_i^{r,s} \right)} \times \left(\sum_{j=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r \right) \quad \text{Equation 3.18}$$

The first bracketed component on the top of the fraction within equation 3.18 specifies the total supply of commodity i to the domestic market by region r . The similar component to the right of the multiplication sign (shown on bottom line, due to space restrictions) specifies the total supply of commodity i to the domestic market by all New Zealand regions. The other bracketed component on the top of the fraction gives the total use of domestic commodity i within the importing region s . The parameter $q_i^{r,s}$, referred to as the ‘impedance-coefficient’ or ‘q-coefficient’, determines the extent to which commodity i will be traded between the origin and destination regions, given predetermined estimates of supply and use of this commodity.

For the majority of the physical commodities, the q-coefficients were derived out of detailed work undertaken within the National Freight Demands Study (Richard Paling Consulting, 2008) and Upper North Island Freight Study (Richard Paling Consulting, 2008). These studies contain quite comprehensive data on region-to-region freight transport flows, derived from in-depth industry analysis and surveys. Conveniently this research is based on a 2006–07 study year, thus matching the available Supply and Use Tables. Although a number of different commodity types are identified in the studies, the commodity classification is of less detail than the classification within the Supply and Use tables. Altogether 105 different physical commodities from the Supply and Use Table classification (IO205C) are matched to 15 different commodity types used within the freight studies. Letting ζ denote a commodity from the freight studies to which IO205 commodity i is matched, the q-coefficient for interregional trade in commodity i between region r and s is calculated as,

$$q_i^{r,s} = \frac{freight_{\zeta}^{r,s}}{\sum_s freight_{\zeta}^{r,s} + \sum_r freight_{\zeta}^{r,s}} \quad \text{Equation 3.19}$$

where $freight_{\zeta}^{r,s}$ is the freight (tonnes) of commodity ζ from region r to region s .¹²

The q-coefficients for the remaining commodities are derived out of the Marketview data collected and published by a major New Zealand bank, BNZ.¹³ The Marketview data is created from credit and debit card transactions by all BNZ customers, with BNZ holding about a 16–18% market share of all credit and debit card banking within New Zealand. Every transaction is recorded according to the postal address of the card holder (purchaser), and the location and type of merchant involved in the transaction. The Marketview data is thus particularly suitable for analysing trade flows between regions for commodities often sold through credit and debit card transactions (e.g., retail services, accommodation services, food and beverage services), and for which the number of merchants in each region is sufficiently large so as to enable the BNZ to publish the data while preserving confidentiality.

In this study we requested Marketview data from the BNZ containing the sum of transactions coded by (regional) location of merchants, industry classification of merchants and (regional) location of cardholders. Altogether data for 11 different industry types were obtained. As the gravity model is commodity based, it was then necessary to select commodities for which these data were considered to adequately represent. For example, data obtained on sales by merchants grouped within the NZIOI industry ‘accommodation’ were deemed representative of the sales patterns for the NZIOC commodity ‘accommodation’. Full details of this matching process between industries and commodities are provided in Appendix B, Table B.2. The q-coefficients for each commodity were then calculated simply according to the equation,

$$q_i^{r,s} = \frac{cardtrans_j^{r,s}}{\sum_s cardtrans_j^{r,s} + \sum_r cardtrans_j^{r,s}}, \quad \text{Equation 3.20}$$

where $cardtrans_j^{r,s}$ is the total value of card transactions (\$) by merchants within region r to cardholders within region s , for all merchants classed within an industry j that is matched to commodity i .

¹² Due to aggregation of some regions within the National Freight Demands Study, some region-to-region freight flows must first be estimated.

¹³ <http://www.bnz.co.nz/business-banking/cards-and-payments/marketview>

Generation of Final Estimates Using Least-Squares Optimisation

Having generated first estimates for the value of interregional trade in each commodity, $\bar{n}_{Ci}^{r,s}$, these are translated into final estimates through application of a least-squares optimisation. The task is to find values for each unknown variable, $n_{Ci}^{r,s}$, while minimizing the difference between these final estimates and the first estimates. Thus in mathematical notation the optimisation for commodity i is:

$$\begin{aligned} & \text{Minimize} \sum_r \sum_s \left(\frac{n_{Ci}^{r,s} - \bar{n}_{Ci}^{r,s}}{\bar{n}_{Ci}^{r,s}} \right)^2 \\ & \text{s.t.} \quad \sum_s n_{Ci}^{r,s} = \sum_{i=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r, \\ & \quad \sum_r n_{Ci}^{r,s} = \sum_{j=1}^{\Gamma} u_i^{dom,s} + h_{Ci}^{dom,s} + \sum_{j=1}^{\Theta} g_{Ci}^{dom,s} + s_{Ci}^{dom,s} \end{aligned} \quad \text{Equation 3.21}$$

The first of the constraints ensures that the total trade in commodity i from a given region matches the already estimated total production of commodity i within that region, while the second constraint ensures that the total trade of a commodity i into a region matches the already determined total use within that region of domestic commodity i .

Step 5e: Kronenberg Regionalisation Method

Our final method for generating estimates of interregional trade in commodities is labelled as the 'Kronenberg' method and is applied to the set of residual (mainly service) commodities. In the same manner as the methods described in Step 5d above, the Kronenberg method requires the generation of a set of first estimates of interregional trade for each commodity. Once these are generated, a least squares optimisation is then applied to generate the set of final estimates that, while being as close as possible to the first estimates, ensure that total production and use of commodities within each region matches values already calculated for these constraints.

The primary difference, however, is that this time the method for generating first estimates of interregional trade is based on an approach presented by Kronenberg (2009), in that case for constructing non-survey based regional input-output tables. Unlike many other traditional methods for estimating interregional trade flows when survey data is unavailable, an important feature of the Kronenberg approach is that it allows for cross-hauling of commodities (i.e., the simultaneous import and export of one and the same type of commodity). The rationale behind the method is that, while interregional trade in commodities may be attributed to the need to balance out differences between supply and demand of commodities at a local level, the extent of such trade cannot be determined simply by using the commodity definitions provided within national accounts. This is because the types of commodities produced within one region may be quite different from the types produced in another region, even when these commodities are grouped within the same commodity definition. For example, while all New Zealand regions may produce the commodity 'legal services', some regions may have an undersupply of firms providing certain types of specialist services, and conversely an oversupply in the provision of other specialist legal services. The extent to which a particular commodity is subject to cross-hauling thus relates to the level of 'heterogeneity' among all of the products that are grouped within that commodity's definition.

Following Kronenberg (2009), we assume that the level of cross-hauling for a given commodity i , denoted x_i^r , is proportional to the sum of the total domestic supply of the commodity within the region and the total domestic use within the region. The factor of proportion is then given by the degree of product heterogeneity for commodity i , HET_i . Thus, when commodity i in the Commodity Accounts equals commodity j in the industry accounts, our estimates of x_i^r are calculated as,

$$x_i^r = HET_i \times \left(\sum_{i=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r + \sum_{j=1}^{\Gamma} u_{i,j}^{dom,r} + h_{Ci}^{dom,r} + \sum_{j=1}^{\Theta} g_{Ci}^{dom,r} + s_{Ci}^{dom,r} \right) \quad \text{Equation 3.22}$$

This functional form implies that a ‘scaling up’ of the economy through an increase in both production and consumption will cause a proportional increase in x_i^r . However, when only production increases, the increase in cross-hauling is less than proportional. Similarly, a less than proportional increase in cross-hauling occurs when only consumption increases (Kronenberg, 2009).

Note that the product heterogeneity coefficients, HET_i , are derived from national level data on international import and export of commodities, relative to national use and supply of those commodities (see Table 2). It is thus assumed that the heterogeneity coefficients at a regional level are the same as at the national level.

Having determined the value of cross-hauling for each commodity, first estimates of the total interregional imports and exports for a given region r and commodity i can be calculated as,

$$\bar{y}_{Ni}^r = \frac{trdvol_i^r - srprod_i^r}{2}, \quad \text{Equation 3.23}$$

and

$$\bar{n}_{Ci}^r = \frac{trdvol_i^r + srprod_i^r}{2}. \quad \text{Equation 3.24}$$

The term $srprod_i^r$ refers to the net surplus in production of commodity i within region r , or in other words total regional supply of commodity i to the domestic market, less regional use of that domestic commodity, i.e.,

$$srprod_i^r = \left(\sum_{i=1}^{\Gamma} v_{i,j}^r - w_{Ci}^r \right) - \left(\sum_{j=1}^{\Gamma} u_{i,j}^{dom,r} + h_{Ci}^{dom,r} + \sum_{j=1}^{\Theta} g_{Ci}^{dom,r} + s_{Ci}^{dom,r} \right). \quad \text{Equation 3.25}$$

The term $trdvol_i^r$ denotes the total value of interregional trade in commodity i for region r and is calculated as,

$$trdvol_i^r = |srprod_i^r| + x_i^r \quad \text{Equation 3.26}$$

The final step in the calculation of first estimates of the trade in commodities is, for each region, to share total interregional exports of each commodity among all of the possible destination regions. Thus,

$$\bar{n}_{Ci}^{r,s} = \bar{n}_{Ci}^r \times TRDSH^{r,s} \quad \text{Equation 3.27}$$

where $TRDSH^{r,s}$ is a general trade share coefficient applied to all commodities within region r . It denotes, of the total commodities exported from region r as interregional trade, the proportion that is sold to region s . We base the derivation of these trade share coefficients on all of the available Market View data (refer to Table 2).

3.4 REGIONALISED SOCIAL ACCOUNTING MATRIX

This section describes the process for breaking down a national SAM into a regional SAM. As shown by Figures 1 and 2 above, for the most part the regional SAMs consist of the same matrices and vectors as the national SAM. An additional superscript, r , is however used to denote the particular study region under consideration. The subscript $ronz$ also appears in this report to denote the sum of all New Zealand regions excluding the study region r (i.e., the rest of New Zealand). The regional SAM further contains an extra row and column that records transfers occurring between the study region and the rest of New Zealand.

A number of the accounts in the regional SAM are derived directly from the 2006–07 regional supply use tables and require no further explanation (i.e., \mathbf{U}^r , \mathbf{h}_C^r , \mathbf{G}_C^r , \mathbf{s}_C^r , \mathbf{n}_C^r , \mathbf{w}_C^r , \mathbf{V}_C^r , \mathbf{P}_G^r , \mathbf{s}_T^r , \mathbf{y}_N^r and \mathbf{y}_W^r). The remaining accounts in the regional SAM are determined via a combination of regional scalars and interregional transfer coefficients. Table 4 presents a summary of the calculation of these coefficients, while the remainder of this section provides a thorough description of their calculation.

Table 4 Regional SAM Scalars

Symbol	Name	Formula	Definitions	Data Source
$COFCSH^r$	Consumption of Fixed Capital Share	$\frac{\sum COFC_i^r - (COFC_{rpo}^r + COFC_{oopo}^r)}{\sum COFC_i^{NZ} - (COFC_{rpo}^{NZ} + COFC_{oopo}^{NZ})}$	$COFC_i^r$ = Consumption of Fixed Capital of Region i $COFC_{rpo}^r$ = Consumption of Fixed Capital of Residential Property Operation $COFC_{oopo}^r$ = Consumption of Fixed Capital of Owner-occupied Property Operation	Regional Use Table
$COMUTSH^{r,s}$	Commuter share	$\frac{COMUT^{r,s}}{\sum_r COMUT^{r,s}}$	$COMUT^{r,s}$ = number of people who live in region r and travel to region s to work	Statistics New Zealand 2006 Census, Usual Residence Areas (2006) and Workplace Address (2006 Areas) by Main Means of Travel to Work
$EKOWNSH^r$	Enterprise Capital Ownership Share	$\frac{\sum_{k=1\%}^{100\%} \left(\sum_{EC=1}^{100\%} GU_{EC,k}^r \times \left(\frac{EC}{GU} \right)_k^r \times \left(\frac{GDP}{EC} \right)_k^r \right) \times k}{\sum_{k=1\%}^{100\%} \sum_{EC=1}^{100\%} GU_{EC,k}^r \times \left(\frac{EC}{GU} \right)_k^r \times \left(\frac{GDP}{EC} \right)_k^r}$	EC = employment count (employees) GU = geographical business units GDP = gross domestic product k = NZ enterprise ownership share r = region r	Statistics New Zealand Enterprises and Full-time Equivalent Persons Engaged by Degree of Overseas Equity and ANZSIC Statistics New Zealand Geographic Unit and Employment Data
$ENTINCSH^r$	Enterprise Income Share	$\frac{\mu^r}{\mu^{NZ}}$	μ^r = total enterprise income for region r	Regional Social Accounting Matrix
$FORYSH^r$	Regional Foreign Income Share	$\frac{Y_{OPen}^r + Y_{OlnDiv}^r + Y_{OPSB}^r + Y_{OOth}^r}{Y_{OPen}^{NZ} + Y_{OlnDiv}^{NZ} + Y_{OPSB}^{NZ} + Y_{OOth}^{NZ}}$	Y_{OPen}^r = overseas pension income of region r Y_{OlnDiv}^r = interest and dividends from overseas Y_{OPSB}^r = private superannuation and benefits from overseas Y_{OOth}^r = trust, maintenance and irregular overseas income	Statistics New Zealand Household Economic Survey
$GDPSSH^r$	Regional GDP share	$\frac{GDP^r}{\sum_r GDP^r}$	GDP^r = GDP for region r	Statistics New Zealand's Regional Gross Domestic Product Series
$GOVBENSH^r$	Government Benefit Share	$\frac{ACC^r + SocWel^r}{ACC^{NZ} + SocWel^{NZ}}$	ACC^r = ACC payments payments received by households in region r $SocWel^r$ = social welfare payments received by households in region r	Statistics New Zealand Household Economic Survey
$GOVCOFCSAVSH^r$	Government Consumption of Fixed Capital and Savings Share	$\left(\frac{COFC_{gov}^{NZ}}{COFC_{gov}^{NZ} + GOVSAV^{NZ}} \right) \left(\frac{COFC_{gov}^r}{COFC_{gov}^{NZ}} \right) + \left(\frac{GOVSAV^{NZ}}{COFC_{gov}^{NZ} + GOVSAV^{NZ}} \right) \times GDPSSH^r$	$COFC_{gov}^r$ = consumption of fixed capital of government for region r $GOVSAV^{NZ}$ = government savings for New Zealand $GDPSSH^r$ = regional GDP share for region r	Regional Use Table Statistics New Zealand's Regional Gross Domestic Product Series
$GOVCONSH^r$	Household Contribution to Government Share	$\frac{E_{ssc}^r + E_{pfc}^r + E_{mct}^r}{E_{ssc}^{NZ} + E_{pfc}^{NZ} + E_{mct}^{NZ}}$	E_{ssc}^r = household social security contributions for region r E_{pfc}^r = household pension fund contributions for region r E_{mct}^r = household miscellaneous current transfers for region r	Statistics New Zealand Household Economic Survey (HES)
$HHCOFCSAVSH^r$	Household Consumption of Fixed Capital and Household Savings Share	$\frac{COFC_{ood}^{NZ}}{COFC_{ood}^{NZ} + HHSAY^{NZ}} \times \frac{COFC_{ood}^r}{COFC_{ood}^{NZ}} + \frac{HHSAY^{NZ}}{COFC_{ood}^{NZ} + HHSAY^{NZ}} \times \frac{HESSAY^r}{HESSAY^{NZ}}$	$COFC_{ood}^r$ = consumption of fixed capital of owner-occupied dwellings for region r $HHSAY^r$ = household savings for region r (ISA) $HESSAY^r$ = households savings for region r (HES)	Regional Use Table Statistics New Zealand Household Economic Survey (HES) Statistics New Zealand Institutional Sector Accounts (ISA)
$HHINVINC^r$	Regional Investment Income	$\frac{Y_{ent}^r + Y_{prdiv}^r + Y_{proi}^r}{Y_{ent}^{NZ} + Y_{prdiv}^{NZ} + Y_{proi}^{NZ}}$	Y_{ent}^r = entrepreneurial income from self-employment or casual and hobby income Y_{prdiv}^r = property income receivable from dividends Y_{proi}^r = property income receivable from other investment and PIE income	Statistics New Zealand Household Economic Survey
$HHTAXSH^r$	Household Tax Share	$\frac{E_{tax}^r + E_{oatx}^r}{E_{tax}^{NZ} + E_{oatx}^{NZ}}$	E_{tax}^r = household income tax for region r E_{oatx}^r = household other tax for region r	Statistics New Zealand Household Economic Survey

Table 4 Regional SAM Scalars (continued)

Symbol	Name	Formula	Definitions	Data Source
$INCOODSH^r$	Income from Owner-occupied Dwellings Share	$\frac{OS_{ood}^r + COFC_{ood}^r}{OS_{ood}^{NZ} + COFC_{ood}^{NZ}}$	OS_{ood}^r = Gross Operating Surplus of Owner-occupied Dwellings of region r $COFC_{ood}^r$ = Consumption of Fixed Capital of Owner-occupied Dwellings of region r	Regional Use Table
$INGOVSH^r$	Income to Government Share i	$\frac{OS_i^r + COFC_i^r}{OS_i^{NZ} + COFC_i^{NZ}}$	OS_i^r = Government Industry i Gross Operating Surplus of region r $COFC_i^r$ = Government Industry i Consumption of Fixed Capital of region r	Regional Use Table
$MORTINSH^r$	Mortgage and Insurance Payment Share	$\frac{E_{prop}^r + E_{ins}^r + E_{CTO}^r - Y_{prop}^r}{E_{prop}^{NZ} + E_{ins}^{NZ} + E_{CTO}^{NZ} - Y_{prop}^{NZ}}$	E_{prop}^r = household interest payments on mortgage for primary property for region r E_{ins}^r = household payments on non-life insurance premiums for region r E_{CTO}^r = household current transfers to overseas for region r Y_{prop}^r = household interest income for region r	Statistics New Zealand Household Economic Survey
$ODOCCSH^{r,s}$	Owner-occupied dwelling occupancy share	$RESNIGHTS^{r,s} \times OODRESSH^{r,s} + TOURNIGHTS^{r,s} \times OODTOURSH$	$RESNIGHTS^{r,s}$ = nights residents spend in their usual dwelling of residence where $r = s$ $OODRESSH^{r,s}$ = owner-occupied dwellings share of all dwellings $TOURNIGHTS^{r,s}$ = nights tourists from region r spend in region s $OODTOURSH$ = share of tourist nights spent in private dwellings	Ministry of Business, Employment and Innovation's Domestic Tourism Survey (DTS) Statistics New Zealand Population Data
$PENFSH^r$	Regional Pension Fund Contribution Fund Share	$\frac{PENF^r}{PENF^{NZ}}$	$PENF^r$ = contribution to private pension funds or region r	Statistics New Zealand Household Economic Survey
$POPSH^r$	Regional Population Scalar	$\frac{Pop^r}{Pop^{NZ}}$	POP^r = population in region r	Statistics New Zealand Population Estimates

3.4.1 Labour Accounts ($n_L^r, l_H^r, l_N^r, l_W^r$)

- n_L^r – We use data on commuting, derived from the Statistics New Zealand census, as the basis for estimating interregional transfers of labour income. The value of labour income received from the rest of New Zealand, n_L^r , is calculated as,

$$n_L^r = (f_L^{ronz} - l_W^{ronz}) \times COMUTSH^{ronz,r} \quad \text{Equation 3.28}$$

where f_L^{ronz} is the total payment of labour income by industries within the rest of New Zealand, l_W^{ronz} is the value of labour income from industries in the rest of New Zealand that is paid to other nations (see calculation below), and $COMUTSH^{ronz,r}$ is the commuter share coefficient denoting the proportion of people working in the rest of New Zealand who live in the subject region.

- l_H^r – Domestic labour factor income, l_H^r , is calculated as,

$$l_H^r = (f_L^r - l_W^r) \times COMUTSH^{r,r} + n_L^r, \quad \text{Equation 3.29}$$

where f_L^r is the total labour payment by all industries within the subject region, l_W^r is the labour income paid by the subject region industries to the rest of the world, n_L^r is as defined above and $COMUTSH^{r,r}$ is the share of workers who commute within the same region between locations of employment and residence.

- l_N^r – Labour factor income to the rest of New Zealand, l_N^r , measures labour used within the subject region from residents of other regions and is calculated as,

$$l_N^r = (f_L^r - l_W^r) \times COMUTSH^{ronz,r}, \quad \text{Equation 3.30}$$

where $COMUTSH^{ronz,r}$ represents the proportion of total workers who live in the rest of New Zealand and work in the study region.

- l_W^r – Finally, the labour factor income to the rest of the world was allocated from the national figure, l_W , using a regional GDP scalar. This is represented by,

$$l_W^r = l_W \times GDPSH^r, \quad \text{Equation 3.31}$$

where $GDPSH^r$ is the regional share of GDP over the nation's total GDP.

3.4.2 Capital Accounts ($n_K^r, k_E^r, k_H^r, k_{Gi}^r, k_N^r$)

- n_K^r – The gross operating surplus from the rest of New Zealand, n_K^r , shows the value of capital income from other New Zealand regions to the subject region. This identity reveals the geographical ownership of capital, or the amount of capital, registered in a particular region, that is used outside that region. It is calculated by multiplying the rest of New Zealand capital factor payments to enterprises by $EKOWNSH^{r,ronz}$, the share of study region ownership of rest of New Zealand enterprises. Thus,

$$n_K^r = (f_K - f_K^r - k_H \times (1 - INCOOD^r) - (k_G - k_G^r)) \times EKOWNSH^{r,ronz}, \quad \text{Equation 3.32}$$

where $INCOODSH^r$ is a regional scalar for apportioning the income from owner occupied dwellings in each region. As data for regional business ownership is not available we assume $EKOWNSH$ is approximate to the shares of international ownership of businesses in the study region.

- k_E^r – Regional enterprise gross operating surplus, k_E^r , denotes the transfer of capital income to enterprises in the subject region from capital as a factor of production. It is calculated by taking the capital inputs to production for the region from the regionalized SAM, f_K^r (or the sum of the region's operating surplus and the region's consumption of fixed capital for all industries), adding any international capital transfers, and taking out the government and household transfers such that,

$$k_E^r = f_K^r - k_H \times INCOODSH^r - k_G^r - n_K^{ronz} + n_K^r, \quad \text{Equation 3.33}$$

where n_K^{ronz} represents the region's capital that is used in other regions of NZ.

- n_K^{ronz} – This is set equal to the region's total capital payment, multiplied by the share of study region businesses owned by entities in the rest of New Zealand, $EKOWNSH^{ronz,r}$, so that

$$n_K^{ronz} = (f_K^r - k_H \times INCOODSH^r - k_G^r) \times EKOWNSH^{ronz,r}. \quad \text{Equation 3.34}$$

- k_H^r – The regional value of gross operating surplus to households, k_H^r , is calculated by allocating the national value of household gross operating surplus from capital, k_H , according to the value of imputed rent on owner occupied dwellings in each region. Thus,

$$k_H^r = k_H \times INCOODSH \times OODOCCSH^{r,r} \quad \text{Equation 3.35}$$

where $OODOCCSH^{r,r}$ is a scalar denoting the share of imputed rent from housing capital within the study region allocated to usually resident population in the study region.¹⁴

- k_G^r – The regional value of government gross operating surplus, k_G^r , is calculated by summing central government and local government capital income in each region. Both the central and local government's share of the national gross operating surplus are apportioned according to the regional scalar:

$$k_{Gi}^r = k_{Gi} \times INGOVSH_i. \quad \text{Equation 3.36}$$

- k_N^r – The gross operating surplus to the rest of New Zealand, k_N^r , shows the income from capital that is distributed from the subject region to the rest of New Zealand. It is made up of two components – income that goes to enterprises and income that goes to households. This interregional transfer is calculated by allocating a portion of capital income that is used in other regions, less capital income to households and governments, and adding to it a portion of the imputed rent value from owner occupied dwellings. This is represented as:

$$k_N^r = n_K^{ronz} + k_H \times INCOODSH^r \times (1 - LOCINSH^r) \quad \text{Equation 3.37}$$

where $1 - LOCINSH^r$ is a scalar denoting the share of capital income for occupancy of dwellings in the study region, by owners usually resident in the rest of New Zealand.

¹⁴ For example, people usually resident in Christchurch going on holiday to holiday homes in Marlborough would represent a transfer of imputed rent from Marlborough to Canterbury. The remainder of the time they spend occupying their usual residence in Christchurch would represent an imputed rent transfer occurring within the Canterbury region.

3.4.3 Enterprise Accounts ($h_E^r, n_E^r, w_E^r, e_H^r, e_{Gi}^r, e_T^r, e_S^r, e_N^r, e_W^r$)

- h_E^r – Household transfers to enterprise for the study region, h_E^r are calculated as

$$h_E^r = h_E \times PENFSH^r \times \sum_{r=1}^{\theta} PENFSRVSH^{r,s} \quad \text{Equation 3.38}$$

where $PENFSH^r$ equals the subject region's share of contributions to private pension funds, according to the Household Economic Survey and, $\sum_{r=1}^{\theta} PENFSRVSH^{r,s}$ is the regional share of household income from investments in enterprises which we assume are equal to the interregional trade shares of superannuation and individual pension services to destination region s as calculated from the interregional trade calculations.

- n_E^r – The transfers to study region enterprises from RoNZ Households is calculated by distributing components of the national household transfers to enterprise, h_E , according to the regional pension fund share and investment in enterprise share. Formally, it is calculated by,

$$n_E^r = h_E \times (1 - PENFSH^r) \times (1 - \sum_{r=1}^{\theta} PENFSRVSH^{r,s}). \quad \text{Equation 3.39}$$

- w_E^r – National foreign transfers to enterprises are assumed to be distributed among the regions according to their relative economic activity:

$$w_E^r = w_E \times GDPSH^r. \quad \text{Equation 3.40}$$

- e_H^r – To calculate the enterprise transfers to households in each region, e_H^r , the NZ total of household income from enterprises for the subject region is apportioned according to the share of pension fund services received by region r , $\sum_{s=1}^{\theta} PENFSRVSH^{r,s}$. The NZ total of household income from enterprises for the subject region is calculated by apportioning the total national figure, e_H , according to a regional scalar of household investment income, $HHINVINC^r$:

$$e_H^r = e_H \times HHINVINC^r \times \sum_{s=1}^{\theta} PENFSRVSH^{r,s}. \quad \text{Equation 3.41}$$

- e_{Gi}^r – The regional values for enterprise transfers to government sector i , e_{Gi}^r , are allocated according to regional GDP share:

$$e_{Gi}^r = e_{Gi} \times GDPSH^r. \quad \text{Equation 3.42}$$

- e_T^r – Enterprise taxes are regionalised using an enterprise income scalar, according to the regional proportion of enterprise income in that region compared to the national figure (taken from the supply use tables). This is represented as:

$$e_T^r = e_T \times ENTINCSH^r. \quad \text{Equation 3.43}$$

- e_S^r – Enterprise savings are apportioned to the regions from the National SAM using a consumption of fixed capital (within industry) scalar, obtained from the Use Tables. Note that two industries are excluded from this calculation, namely ‘Residential Property Operation’ and ‘Owner-Occupied Property Occupation’, as these relate to households, rather than enterprises. Thus,

$$e_S^r = e_S \times COFCSH^r. \quad \text{Equation 3.44}$$

- e_N^r – Enterprise transfers to RoNZ, e_N^r , are calculated according to,

$$e_N^r = e_H \times (1 - HHINVINC^r) \left(1 - \sum_{s=1}^9 PENFSRVSH^{r,s} \right). \quad \text{Equation 3.45}$$

- e_W^r – Finally, the enterprise transfers to the rest of the world are allocated from the national figure using a regional GDP scalar. Thus,

$$e_W^r = e_W \times GDPSH^r. \quad \text{Equation 3.46}$$

3.4.4 Households Accounts (g_{Hj}^r , n_H^r , w_H^r , h_{Gi}^r , h_{Ti}^r , h_S^r , h_N^r , h_W^r)

- g_{Hj}^r – Transfers from government sector j to households, in each region are calculated by apportioning g_{Hj} , as calculated in the national SAM, according to a regional government scalar, taken from data in the Household Economic Survey. Thus,

$$g_{Hj}^r = g_{Hj} \times GOVBENSH^r. \quad \text{Equation 3.47}$$

- n_H^r – Household income for region r from the rest of New Zealand is made up of two components, namely (1) the value of imputed rent from owner occupied dwellings from the rest of NZ and (2) the transfers to households from enterprises in the rest of NZ. Thus, the total transfers to households from RoNZ is calculated as,

$$n_H^r = k_H \times (1 - INCOODSH^r) \times (1 - OODOCCSH^{ronz}) + e_H \times HHINVINC^r \times \left(1 - \sum_{s=1}^9 PENFSRVSH^{r,s} \right) \quad \text{Equation 3.48}$$

- w_H^r – National foreign transfers to households is apportioned regionally by an overseas transfer scalar. This is based on income received in the regions from overseas, as detailed in the Household Economic Survey, Income Account. Thus,

$$w_H^r = w_H \times FORYSH^r, \quad \text{Equation 3.49}$$

where $FORYSH^r$ is the regional foreign income scalar.

- h_{Gi}^r – The regional values for household transfers to government sector i are calculated using a household contributions to government scalar:

$$h_{Gi}^r = h_{Gi} \times GOVCONSH^r \quad \text{Equation 3.50}$$

- h_{Ti}^r – Household taxes are comprised of the sum of taxes on products purchased by households, as derived from the Regional Use table, plus the income tax paid by households from the National Social Accounting Matrix. The latter component is apportioned regionally using household tax payment data from Statistics New Zealand's Household Economic Survey. Thus,

$$h_{G,direct}^r = h_{G,direct} \times HHTAXSH^r \quad \text{Equation 3.51}$$

- h_S^r – Household savings are regionalised from the National SAM using a weighted average scalar made up of two data sources, namely the Household Economic Survey and the Use Tables. Formally, this is represented by

$$h_S^r = h_S \times HHCOFCSAVSH^r \quad \text{Equation 3.52}$$

where $HHCOFCSAVSH^r$ is the consumption of fixed capital and household savings scalar.

- h_N^r – Household transfers to the rest of New Zealand are comprised of household transfers to enterprises outside of the region. It is calculated according to

$$h_N^r = (h_E \times PENFSH^r) \times \left(1 - \sum_{s=1}^g PENFSRVSH^{r,s}\right) \quad \text{Equation 3.53}$$

- h_W^r – Regional household transfers to the rest of the world are divided amongst the regions using a household property cost scalar, relating to the region's share of mortgage and (property) insurance payments:

$$h_W^r = h_W \times MORTINSH^r. \quad \text{Equation 3.54}$$

3.4.5 Government Accounts (T_G^r , G_T^r , g_S^r)

Regional government indirect tax income, T_G^r , is the sum of the various regional indirect tax accounts; industry, enterprise, household, government, investment and rest of the world. We apply the share between local and central government at the national level to apportion these taxes to local and central government at the regional level. Thus,

$$t_{Gi,indirect}^r = \left(p_{T,indirect}^r + e_{T,indirect}^r + h_{T,indirect}^r + g_{T,indirect}^r + s_{T,indirect}^r + w_{T,indirect}^r \right) \times \frac{t_{Gi,indirect}^{NZ}}{t_{G,indirect}^{NZ}} \quad \text{Equation 3.55}$$

Similarly, government direct tax income is the sum of direct taxes on enterprises, households, government and the rest of the world:

$$t_{Gi,direct}^r = \left(e_{T,direct}^r + h_{T,direct}^r + g_{T,direct}^r + w_{T,direct}^r \right) \times \frac{t_{Gi,direct}^{NZ}}{t_{G,direct}^{NZ}}. \quad \text{Equation 3.56}$$

Government indirect taxes, G_T^r are taken directly from taxes on products from the regional use tables. Government direct taxes equate with direct taxes from the National SAM, regionalised by a GDP scalar. This is represented by,

$$g_{T,direct,central}^r = DIRTAX_{central}^{NZ} \times GDPSH^r.^{15} \quad \text{Equation 3.57}$$

Government savings, g_S^r , are allocated across the regions using a weighted average of government savings and consumption of fixed capital (in the government industry) across the regions, i.e.,

$$g_{Sj}^r = g_{Sj}^{NZ} \times GOVCOFCSAVSH^r. \quad \text{Equation 3.58}$$

Government transfers to the rest of the world are allocated from the national figure, g_W^{NZ} , using a regional GDP scalar:

$$g_{Wj}^r = g_{Wj}^{NZ} \times GDPSH^r. \quad \text{Equation 3.59}$$

¹⁵ Note that local government does not pay direct taxes.

3.4.6 Taxes (s_T^r , w_T^r)

Investment taxes for each region, s_T^r , are taken straight from the Regional Use Table. They are indirect taxes, and comprised of the sum of the values of taxes on products on gross fixed capital formation plus change in inventories. As with the national SAM, no direct taxes are included in the savings and investment taxes account. Rest of world taxes for each region, w_T^r , are made up of two components; taxes on products on international exports from Regional Use Table and a portion of the rest of world taxes from the National SAM. This is represented as

$$w_T^r = TAPEX^r + (w_T \times GDP SH^r). \quad \text{Equation 3.60}$$

3.4.7 Savings (n_S^r , w_S^r)

Once all other transfers between the study region and the rest of New Zealand are calculated we assume the remaining difference is transfers of capital, which goes into the interregional savings account, n_S^r . Foreign savings are regionalised according to relative economic activity:

$$w_S^r = w_S^{NZ} \times GDP SH^r. \quad \text{Equation 3.61}$$

3.4.8 Rest of New Zealand and Rest of World Accounts

All of the accounts for the rest of New Zealand and rest of world are described already above.

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APPENDICES

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APPENDIX A: CONCORDANCES

Table A.1 106IO Industry to ANZSIC Concordance

Industry Description	ANZSIC Codes
1 Horticulture and fruit growing	A011100-A011500, A012100-A012300, A013100-A013700, A013900
2 Sheep, beef cattle and grain farming	A014100-A014600, A014900, A015100-A015200, A015900
3 Dairy cattle farming	A016000
4 Poultry, deer and other livestock farming	A017100-A017200, A018000, A019100-A019300, A019900
5 Forestry and logging	A030100-A030200
6 Fishing and aquaculture	A020100-A020300, A041100-A041400, A041900
7 Agriculture, forestry and fishing support services	A042000, A051000, A052100-A052200, A052900
8 Coal mining	B060000
9 Oil and gas extraction	B070000
10 Metal ore and non-metallic mineral mining and quarrying	B080100-B080700, B080900, B091100, B091900, B099000
11 Exploration and other mining support services	B101100-B101200, B109000
12 Meat and meat product manufacturing	C111100-C111300
13 Seafood processing	C112000
14 Dairy product manufacturing	C113100-C113300
15 Fruit, oil, cereal and other food product manufacturing	C114000, C115000, C116100-C116200, C117100-C117400, C118100-C118200, C119100-C119200, C119900
16 Beverage and tobacco product manufacturing	C121100-C121400, C122000
17 Textile and leather manufacturing	C131100-C131300, C132000, C133100-C133400
18 Clothing, knitted products and footwear manufacturing	C134000, C135100-C135200
19 Wood product manufacturing	C141100-C141300, C149100-C149400, C149900
20 Pulp, paper and converted paper product manufacturing	C151000, C152100-C152400, C152900
21 Printing	C161100-C161200, C162000
22 Petroleum and coal product manufacturing	C170100, C170900
23 Basic chemical and basic polymer manufacturing	C181100-C181300, C182100, C182900
24 Fertiliser and pesticide manufacturing	C183100-C183200
25 Pharmaceutical, cleaning and other chemical manufacturing	C184100-C184200, C185100-C185200, C189100-C189200, C189900
26 Polymer product and rubber product manufacturing	C191100-C191600, C191900-C192000
27 Non-metallic mineral product manufacturing	C201000, C202100, C202900, C203100-C203400, C209000
28 Primary metal and metal product manufacturing	C211000, C212100-C212200, C213100-C213300, C213900, C214100-C214200, C214900
29 Fabricated metal product manufacturing	C221000, C222100-C222400, C222900, C223100, C223900-C224000, C229100-C229300, C229900
30 Transport equipment manufacturing	C231100-C231300, C231900, C239100-C239400, C239900
31 Electronic and electrical equipment manufacturing	C241100-C241200, C241900, C242100-C242200, C242900, C243100-C243200, C243900, C244100, C244900
32 Machinery manufacturing	C245100-C245200, C246100-C246300, C246900, C249100, C249900
33 Furniture manufacturing	C251100-C251300, C251900

Table A.1 106IO Industry to ANZSIC Concordance(continued)

Industry Description	ANZSIC Codes
34 Other manufacturing	C259100-C259200, C259900
35 Electricity generation and on-selling	D261100-D261200, D261900, D264000
36 Electricity transmission and distribution	D262000, D263000
37 Gas supply	D270000
38 Water supply	D281100
39 Sewerage and drainage services	D281200
40 Waste collection, treatment and disposal services	D291100, D291900, D292100-D292200
41 Residential building construction	E301100, E301900,
42 Non-residential building construction	E302000
43 Heavy and civil engineering construction	E310100, E310900
44 Construction services	E321100-E321200, E322100-E322400, E323100-E323400, E323900, E324100-E324500, E329100-E329200, E329900
45 Basic material wholesaling	F331100-F331200, F331900, F332100-F332300, F333100-F333200, F333900
46 Machinery and equipment wholesaling	F341100, F341900, F349100-F349400, F349900
47 Motor vehicle and motor vehicle parts wholesaling	F350100-F350500
48 Grocery, liquor and tobacco product wholesaling	F360100-F360600, F360900
49 Other goods and commission based wholesaling	F371100-F371200, F372000, F373100-F373600, F373900, F380000
50 Motor vehicle and parts retailing	G391100-G391300, G392100-G392200
51 Fuel retailing	G400000
52 Supermarket and grocery stores	G411000
53 Specialised food retailing	G412100-G412300, G412900
54 Furniture, electrical and hardware retailing	G421100-G421400, G422100-G422200, G422900, G423100-G423200
55 Recreational, clothing, footwear and personal accessory retailing	G424100-G424500, G425100-G425300, G425900
56 Department stores	G426000
57 Other store based retailing; non-store and commission based retail	G427100-G427400, G427900, G431000, G432000
58 Accommodation	H440000
59 Food and beverage services	H451100-H451300, H452000, H453000
60 Road transport	I461000, I462100-I462300
61 Rail transport	I471000, I472000
62 Other transport	I481000, I482000, I501000, I502100, I502900
63 Air and space transport	I490000
64 Postal and courier pick up and delivery services	I510100-I510200
65 Transport support services	I521100-I521200, I521900-I522000, I529100-I529200, I529900
66 Warehousing and storage services	I530100, I530900
67 Publishing (except internet and music publishing)	J541100-J541400, J541900-J542000
68 Motion picture and sound recording activities	J551100-J551400, J552100-J552200
69 Broadcasting and internet publishing	J561000, J562100-J562200, J570000
70 Telecommunications services including internet service providers	J580100-J580200, J580900, J591000, J592100-J592200
71 Library and other information services	J601000, J602000

Table A.1 106IO Industry to ANZSIC Concordance(continued)

Industry Description	ANZSIC Codes
72 Banking and financing; financial asset investing	K621000, K622100-K622300, K622900-K623000, K624000
73 Life insurance	K631000
74 Health and general insurance	K632100-K632200
75 Superannuation funds	K633000
76 Auxiliary finance and insurance services	K641100, K641900-K642000
77 Rental and hiring services (except real estate); non-financial asset	L661100, L661900-L662000, L663100-L663200, L663900-L664000
78 Residential property operation	L671100
79 Non-residential property operation	L671200
80 Real estate services	L672000
81 Owner-occupied property operation	
82 Scientific, architectural and engineering services	M691000, M692100-M692500
83 Legal and accounting services	M693100-M693200
84 Advertising, market research and management services	M694000, M695000, M696100-M696200
85 Veterinary and other professional services	M697000, M699100, M699900
86 Computer system design and related services	M700000
87 Travel agency and tour arrangement services	N722000
88 Employment and other administrative services	N721100-N721200, N729100-N729400, N729900
89 Building cleaning, pest control and other support services	N731100-N731300, N732000
90 Local government administration	O753000
91 Central government administration and justice	O751000, O752000, O754000, O755100-O755200
92 Defence	O760000
93 Public order, safety and regulatory services	O771100-O771400, O771900-O772000
94 Preschool education	P801000
95 School education	P802100-P802400
96 Tertiary education	P810100-P810200
97 Adult, community and other education	P821100-P821200, P821900-P822000
98 Hospitals	Q840100-Q840200
99 Medical and other health care services	Q851100-Q851200, Q852000, Q853100-Q853400, Q853900, Q859100, Q859900
100 Residential care services and social assistance	Q860100, Q860900, Q871000, Q879000
101 Heritage and artistic activities	R891000, R892100-R892200, R900100-R900300
102 Sport and recreation activities	R911100-R911400, R912100, R912900, R913100, R913900
103 Gambling activities	R920100-R920200, R920900
104 Repair and maintenance	S941100-S941200, S941900, S942100-S942200, S942900, S949100, S949900
105 Personal services; domestic household staff	S951100-S951200, S952000, S953100-S953400, S953900, S960100-S960300
106 Religious services; civil, professional and other interest groups	S954000, S955100-S955200, S955900

Table A.2 203IOC to CPC Codes Commodity Concordance

IOC203 Commodity Description	CPC Codes
1 Living plants, buds, seeds, spice and aromatic crops	1610, 1620, 1630, 1640, 1651-1659, 1690, 1961-1963
2 Vegetables	1211-1216, 1219, 1221, 1229, 1231-1235, 1239, 1241-1242, 1249, 1251-1254, 1259-1260, 1270, 1290, 1510, 1591-1593, 1599, 1701-1705, 1709
3 Kiwifruit	1342
4 Pome fruit (apples, pears)	1351-1352
5 Other fruit and nuts	1311-1319, 1321-1324, 1329-1330, 1341, 1343-1344, 1349, 1353-1356, 1359-1360, 1371-1377, 1379, 1391, 1399, 1411-1412, 1421-1422, 1431-1432, 1441-1446, 1449-1450, 1460, 1491, 1499
6 Forage products, fibres, sugar crops, unmanufactured tobacco	1801-1803, 1809, 1911-1913, 1919, 1921-1922, 1929-1930, 1940, 1950, 1970, 1990, 21600
7 Cereals	1111-1112, 1121-1122, 1131-1132, 1141-1142, 1151-1152, 1161-1162, 1171-1172, 1181-1182, 1190
8 Sheep	2122
9 Cattle	2111
10 Other livestock	2112, 2121, 2123, 2130, 2151-2155, 2191-2196, 2199
11 Deer	2129
12 Pigs	2140
13 Raw milk	2211-2212, 2291-2293, 2299
14 Wool	2941-2944
15 Other animal products	2310, 2320, 2330, 2411, 2419-2420, 2910, 2920, 2930, 2960
16 Wood and non-wood forest products	3110, 3120, 3130, 3211, 3219-3220, 3230, 3241, 3249-3250
18 Fish	4111, 4119-4120
19 Crustaceans	4210, 4220, 4291, 4299, 4910, 4920, 4930
20 Support services to agriculture (including animal husbandry)	86111-86112, 86119, 86121, 86129
21 Support services to forestry and logging	86140
22 Fishing services	86130, 86150
23 Coal, coke and tar products	11010, 11020, 11030, 11040, 11050, 33100, 33200
24 Crude petroleum	12010, 12030
25 Natural gas	12020
26 Iron ores, non-ferrous metal ores and concentrates	13000, 14100, 14210, 14220, 14230, 14240, 14290
27 Gypsum, limestone, cement and building stone	15110, 15120, 15130, 15200
28 Sands, pebbles, gravel, clays, stone and bitumen	15310, 15320, 15330, 15400
29 Chemical and fertilizer minerals and salt	16110, 16120, 16190, 16200
30 Precious metals and stones	16310, 16320, 16330, 16390, 41310, 41320, 41330, 41340, 41350
31 Services incidental to mining	86211, 86219
32 Meat and offal	21111-21119, 21121-21125, 21131-21139, 21141-21145, 21151-21153, 21155-21156, 21159-21160
33 Bacon, ham and smallgood products	21171-21176, 21179-21180, 21190

Table A.2 203IOC to CPC Codes Commodity Concordance (continued)

IOC203 Commodity Description	CPC Codes
34 Hides and skins	2951-2955, 2959
35 Prepared fish	21210, 21221-21227, 21231-21233, 21241-21243, 21250, 21261, 21269-21270, 21280, 21291, 21299
36 Milk and cream in solid or processed liquid form	22110, 22120, 22130, 22211-22212, 22219, 22221-22222, 22229
37 Other dairy products	22230, 22241-22242, 22249, 22251-22254, 22259-22260, 22270, 22290
38 Prepared vegetables	21311-21313, 21319, 21321, 21329-21330, 21340, 21391-21397, 21399
39 Fruit juices	21431-21435, 21439
40 Prepared fruit and nuts	21411-21412, 21419, 21421-21424, 21429, 21491-21496, 21499
41 Basic chemicals; other paper and paperboard products	21511-21515, 21519, 21521-21526, 21529, 21531-21539, 21541-21550, 21590, 21710, 21720, 21731-21732, 32121-32122, 32129, 32131-32137, 32141-32143, 32149, 32191-32195, 32197-32199, 34110, 34120, 34131, 34140, 34150, 34160, 34170, 34180, 34210, 34220, 34231-34233, 34240, 34250, 34260, 34270, 34280, 34290
42 Grain products	23110, 23120, 23130, 23140, 23161-23162, 23170, 23180
43 Starches	23210, 23220, 23230
44 Animal feed	23311, 23319-23320
45 Bakery products	23410, 23420, 23430, 23490
46 Sugar and confectionery products	23511-23512, 23520, 23530, 23540, 23610, 23620, 23630, 23640, 23650, 23660, 23670
47 Macaroni and noodles	23710, 23721-23722
48 Food products	22300, 23911-23914, 23921-23928, 23991-23997, 23999
49 Soft drinks; bottled mineral waters	24410, 24490
50 Spirits and tobacco products	24110, 24131, 24139, 25010, 25020, 25090
51 Malt liquors and malt (includes beer made from malt)	24310, 24320
52 Wines	24211-24212, 24220, 24230
53 Natural and man-made textile fibres	26110, 26130, 26140, 26150, 26160, 26170, 26190, 26210, 26220
54 Yarn and thread	26310, 26320, 26330, 26340, 26350, 26360, 26370, 26380, 26410, 26420, 26430, 26440, 26450, 26460
55 Woven fabrics	26510, 26520, 26530, 26540, 26550, 26560, 26570, 26590, 26610, 26620, 26630, 26690, 26710, 26720, 26730, 26740, 26750, 26760, 26770, 26790, 26810, 26820, 26830, 26840, 26850, 26860, 26880, 26890
56 Other textiles	27110, 27120, 27130, 27140, 27150, 27160, 27170, 27180, 27190, 27310, 27320, 27911-27913, 27921-27922, 27991-27999
57 Tanned skins and leather; handbags and articles of leather	28310, 28320, 28330, 29110, 29120, 29130, 29210, 29220, 29230, 29290
58 Carpets	27210, 27220, 27230, 27290
59 Clothing and knitted fabrics	28110, 28190, 28210, 28221-28229, 28231-28238, 28241-28243, 28250, 28261-28262, 28269

Table A.2 203IOC to CPC Codes Commodity Concordance (continued)

IOC203 Commodity Description	CPC Codes
60 Footwear	29310, 29320, 29330, 29340, 29410, 29420, 29490, 29510, 29520, 29600
61 Wood	31100, 31210, 31220, 31230, 31310, 31320, 31330
62 Panels, boards, veneer sheets and plywood	31410, 31420, 31430, 31440, 31450, 31510, 31520
63 Building joinery	31600
64 Wood containers and other wood products	31700, 31911-31914, 31921-31923
65 Pulp, paper and paperboard	32111-32113, 32151-32153
66 Books and other printed material	32210, 32220, 32230, 32291-32292, 32299, 32511-32512, 32520, 32530, 32540, 32550, 32610, 32620, 32630, 32690, 32700, 32800
67 Newspapers and journals	32300, 32410, 32420, 32490
68 Petrol	33310, 33350
69 Diesel	33360
70 Other petroleum products	33320, 33330, 33341-33342, 33370, 33380, 33410, 33420, 33500, 33610, 33620, 33630, 33690, 33710, 33720
71 Other chemical products and man-made fibres	34139, 34310, 34320, 34330, 34340, 34400, 34510, 34520, 34530, 34540, 34550, 34560, 34570, 35410, 35420, 35430, 35440, 35450, 35460, 35470, 35490, 35510, 35520, 35530, 35540, 35550, 35560
72 Fertilisers pesticides and other chemical products	34611-34615, 34619, 34621, 34629, 34631-34632, 34639, 34641-34646, 34649, 34651-34654, 34659, 34661-34664, 34666, 34669
73 Plastics in primary forms	34710, 34720, 34730, 34740, 34790
74 Pharmaceutical products	35210, 35220, 35230, 35240, 35250, 35260, 35270, 35290
75 Soap and perfumes	35310, 35321-35323, 35331-35334
76 Paints	35110, 35120, 35130, 35140
77 Rubber tyres and tubes	36111-36115, 36120
78 Rubber	34800, 36210, 36220, 36230, 36240, 36250, 36260, 36270
79 Semi-manufactures of plastics	36310, 36320, 36330, 36390
80 Packaging products of plastics	36410, 36490
81 Other plastics products	36910, 36920, 36930, 36940, 36950, 36960, 36971-36972, 36980, 36990
82 Glass and glass products	37111-37117, 37121, 37129, 37191-37197, 37199
83 Non-structural ceramic ware and clay products	37210, 37221-37222, 37291-37292, 37299, 37310, 37320, 37330, 37340, 37350, 37360, 37370
84 Plaster, lime and cement	37410, 37420, 37430, 37440, 37450
85 Articles of concrete and stone	37510, 37520, 37530, 37540, 37550, 37560, 37570, 37610, 37690, 37910, 37920, 37930, 37940, 37950, 37960, 37990
86 Wastes and scraps	39110, 39120, 39130, 39140, 39150, 39160, 39170, 39180, 39211-39218, 39220, 39230, 39240, 39250, 39260, 39270, 39280, 39290, 39310, 39320, 39331-39333, 39340, 39350, 39361-39368, 39370, 39380, 39910, 39920, 39931, 39939-39940, 39950, 39990, 41601-41604

Table A.2 203IOC to CPC Codes Commodity Concordance (continued)

IOC203 Commodity Description	CPC Codes
87 Basic iron, steel and other metals	41111-41117, 41121-41122, 41411-41413, 41421-41422, 41431-41432, 41441-41443, 41211-41214, 41221-41224, 41231-41234, 41239, 41241-41244, 41251-41253, 41261-41267, 41271-41273, 41281-41289, 41291-41293, 41511-41516, 41521-41524, 41531-41536, 41542, 41544-41545, 41547
88 Steel products, semi-finished metal products	42110, 42120, 42190, 87310
89 Structural metal products	38701-38704
90 Prefabricated buildings	42210, 42220, 42310, 42320, 42330, 42341-42342
91 Metal containers and steam generators	42911-42916, 42921-42922, 42931-42932, 42941-42946, 42950, 42991-42999
92 Other fabricated metal products	44710, 44720, 44730, 44740, 44750, 44760, 46410, 46420, 46430
93 Weapons and ammunition; accumulators, primary cells and batteries	49111-49116, 49119, 49121, 49129, 49210, 49221-49222, 49229, 49231-49232
94 Motor vehicles, trailers and semi-trailers; bodies (coachwork)	49311-49316, 49319-49320, 49390, 49410, 49490
95 Ships, pleasure and sporting boats	49511-49512, 49519-49520, 49531-49533, 49540, 49911-49913, 49921-49922, 49930, 49941-49942
96 Other transport equipment and parts	49610, 49621-49623, 49630, 49640
97 Aircraft and spacecraft,	44811-44818, 44821-44826, 44831-44833, 87390
98 Domestic appliances	45110, 45130, 45141-45142, 45150, 45160, 45170, 45180, 45221-45222, 45230, 45240, 45250, 45261-45266, 45269, 45271-45272, 45281, 45289-45290, 47530, 47540, 47550, 47590, 47910, 47920, 87331-87333
99 Computers, parts and office machinery	46111-46113, 46121-46122, 46131-46132, 46211-46215, 46220, 87360
100 Electric motors, generators and transformers	46310, 46320, 46330, 46340, 46350, 46360, 46510, 46531-46532, 46539, 46541-46542, 46910, 46921, 46929, 46931-46932, 46939-46940, 46950, 46960, 47110, 47120, 47130, 47140, 47150, 47160, 47171-47173
101 Other electrical equipment and parts thereof	47211-47215, 47221-47223, 47311-47315, 47321, 47323, 47330, 47401-47403, 87340
102 Television, cameras and other electronic goods	48110, 48121-48122, 48130, 48140, 48150, 48160, 48171-48172, 48180, 87350
103 Medical equipment	48211-48212, 48219-48220, 48231-48233, 48241-48244, 48249, 48251-48253, 48261-48264, 48266, 48269, 48281-48285, 48311-48315, 48321-48324, 48330, 48341-48342, 48351-48354
104 Photographic and scientific equipment	43110, 43121-43123, 43131-43134, 43141-43143, 43151-43156, 87320
105 Engines	43211, 43219-43220, 43230, 43240, 43251-43254, 43310, 43320, 43331-43332, 43410, 43420, 43430, 43510, 43520, 43530, 43540, 43550, 43560, 43570, 43580, 43911-43915, 43921-43924, 43931-43935, 43941-43944, 43949, 44211-44218, 44221-44222, 44231-44232, 44241-44242, 44251-44253, 44255-44256
106 General industrial machinery	

Table A.2 203IOC to CPC Codes Commodity Concordance (continued)

IOC203 Commodity Description	CPC Codes
107 Agricultural and forestry equipment	44111-44115, 44119, 44121-44129, 44131-44132, 44139, 44141-44142, 44149-44150, 44160, 44191-44194, 44198-44199
108 Other special-purpose machinery	44310, 44320, 44611-44614, 44621-44622, 44629-44630, 44640, 44911-44919, 44921-44923, 44929
109 Machinery for mining	44411-44412, 44421-44430, 44440, 44461-44462
110 Machinery for food production	44511, 44513, 44515-44518, 44522-44523
111 Furniture	38111-38112, 38119, 38121-38122, 38130, 38140, 38150, 38160
112 Jewellery	38210, 38220, 38230, 38240, 38250
113 Sports goods	38410, 38420, 38430, 38440, 38450
114 Games and toys	38310, 38320, 38330, 38340, 38350, 38360, 38510, 38520, 38530, 38540, 38550, 38560, 38570, 38581-38582, 38590, 38600, 38911-38912, 38921-38924, 38930, 38941-38942, 38950, 38961-38963, 38971-38972, 38991-38999, 48410, 48420, 48430, 48440, 48490
115 Services incidental to manufacturing	88110, 88120, 88130, 88140, 88150, 88161-88167, 88169-88170, 88181-88184, 88190, 88211-88217, 88219, 88221-88223, 88231-88233, 88311-88314, 88319, 88321-88322, 88329, 88411-88412, 88421-88427, 88429-88430, 88511-88512, 88520, 88531-88537, 88539, 88601-88602, 88711-88713, 88720, 88731-88733, 88739, 88741-88749, 88751-88757, 88759, 88761-88769, 88771-88776, 88779, 88811-88813, 88821-88827, 88829, 88901-88907, 88909, 89200, 89310, 89320, 89330
116 Electricity	69111-69112, 86311-86312
117 Gas	17200, 69120, 86320
118 Water	17300, 17400, 18000, 69210, 69220, 69230, 86330, 86340, 86350
119 Sewerage services	94110, 94120
120 Waste disposal, recycling and environmental protection services	89410, 89420, 94211-94212, 94219, 94221, 94229, 94231, 94239, 94311-94313, 94319, 94321-94322, 94331-94333, 94339, 94411-94413, 94420, 94430, 94490, 94510, 94590, 94900
121 Residential building construction	53111-53112, 54111-54112, 54400
122 Non-residential building construction	53121-53122, 53129, 54121-54122, 54129
123 Civil engineering services	53211-53213, 53221-53222, 53231-53234, 53241-53242, 53251-53253, 53261-53262, 53269-53270, 53290, 54211-54213, 54221-54222, 54231-54234, 54241-54242, 54251-54253, 54261-54262, 54269-54270, 54290
124 Pre-erection work	54310, 54320, 54330, 54341-54342
125 Other installation work	54511-54512, 54521-54522, 54530, 54540, 54550, 54560, 54570, 54590
126 Electrical installation work	54611-54614, 54619, 54631-54632
127 Plumbing and other installation services	54621-54622, 54640, 54650, 54691, 54699
128 Building completion work	54710, 54720, 54730, 54740, 54750, 54760, 54770, 54790

APPENDIX B: INTERREGIONAL TRADE ESTIMATION METHODS

Table B.1 Interregional Trade Regionalisation Method by IOC203 Commodity

IOC203 Commodity Description	Gravity Model (Market View)	Gravity Model (Freight Flows)	Limited Trade	Kronenberg	Local- Consumption Only	Supply Share
1 Retail margin	x					
2 Wholesale margin	x					
3 Living plants, buds, seeds, spice and aromatic crops		x				
4 Vegetables		x				
5 Kiwifruit		x				
6 Pome fruit (apples, pears)		x				
7 Other fruit and nuts		x				
8 Forage products, fibres, sugar crops, unmanufactured tobacco		x				
9 Cereals		x				
10 Sheep		x				
11 Cattle		x				
12 Other livestock		x				
13 Deer		x				
14 Pigs		x				
15 Raw milk		x				
16 Wool		x				
17 Other animal products		x				
18 Wood and non-wood forest products		x				
19 Standing timber					x	
20 Fish		x				
21 Crustaceans		x				
22 Support services to agriculture (including animal husbandry)				x		
23 Support services to forestry and logging				x		
24 Fishing services				x		
25 Coal, coke and tar products		x				
26 Crude petroleum		x				
27 Natural gas				x		
28 Iron ores, non-ferrous metal ores and concentrates		x				
29 Gypsum, limestone, cement and building stone		x				
30 Sands, pebbles, gravel, clays, stone and bitumen		x				
31 Chemical and fertilizer minerals and salt		x				
32 Precious metals and stones		x				
33 Services incidental to mining				x		
34 Meat and offal		x				
35 Bacon, ham and smallgoods products		x				
36 Hides and skins		x				
37 Prepared fish		x				
38 Milk and cream in solid or processed liquid form		x				
39 Other dairy products		x				
40 Prepared vegetables		x				
41 Fruit juices		x				
42 Prepared fruit and nuts		x				
43 Basic chemicals; other paper and paperboard products		x				
44 Grain products		x				
45 Starches		x				
46 Animal feed		x				
47 Bakery products		x				
48 Sugar and confectionery products		x				
49 Macaroni and noodles		x				
50 Food products		x				
51 Soft drinks; bottled mineral waters		x				
52 Spirits and tobacco products		x				
53 Malt liquors and malt (includes beer made from malt)		x				
54 Wines		x				
55 Natural and man-made textile fibres		x				
56 Yarn and thread		x				
57 Woven fabrics		x				
58 Other textiles		x				
59 Tanned skins and leather; handbags and articles of leather		x				
60 Carpets		x				
61 Clothing and knitted fabrics		x				
62 Footwear		x				
63 Wood		x				
64 Panels, boards, veneer sheets and plywood		x				
65 Building joinery		x				
66 Wood containers and other wood products		x				
67 Pulp, paper and paperboard		x				
68 Books and other printed material		x				
69 Newspapers and journals		x				

Table B.1 Interregional Trade Regionalisation Method by IOC203 Commodity (continued)

IOC203 Commodity Description	Gravity Model (Market View)	Gravity Model (Freight Flows)	Limited Trade	Kronenberg	Local- Consumption Only	Supply Share
70 Petrol						x
71 Diesel						x
72 Other petroleum products						x
73 Other chemical products and man-made fibres		x				
74 Fertilisers pesticides and other chemical products		x				
75 Plastics in primary forms		x				
76 Pharmaceutical products		x				
77 Soap and perfumes		x				
78 Paints		x				
79 Rubber tyres and tubes		x				
80 Rubber		x				
81 Semi-manufactures of plastics		x				
82 Packaging products of plastics		x				
83 Other plastics products		x				
84 Glass and glass products		x				
85 Non-structural ceramic ware and clay products		x				
86 Plaster, lime and cement		x				
87 Articles of concrete and stone		x				
88 Wastes and scraps		x				
89 Basic iron, steel and other metals		x				
90 Steel products, semi-finished metal products		x				
91 Structural metal products		x				
92 Prefabricated buildings		x				
93 Metal containers and steam generators		x				
94 Other fabricated metal products		x				
95 Weapons and ammunition; accumulators, primary cells and batterie		x				
96 Motor vehicles, trailers and semi-trailers; bodies (coachwork)		x				
97 Ships, pleasure and sporting boats		x				
98 Other transport equipment and parts		x				
99 Aircraft and spacecraft,		x				
100 Domestic appliances		x				
101 Computers, parts and office machinery		x				
102 Electric motors, generators and transformers		x				
103 Other electrical equipment and parts thereof		x				
104 Television, cameras and other electronic goods		x				
105 Medical equipment		x				
106 Photographic and scientific equipment		x				
107 Engines		x				
108 General industrial machinery		x				
109 Agricultural and forestry equipment		x				
110 Other special-purpose machinery		x				
111 Machinery for mining		x				
112 Machinery for food production		x				
113 Furniture		x				
114 Jewellery		x				
115 Sports goods		x				
116 Games and toys		x				
117 Services incidental to manufacturing				x		
118 Electricity						x
119 Gas						x
120 Water					x	
121 Sewerage services					x	
122 Waste disposal, recycling and environmental protection services					x	
123 Residential building construction					x	
124 Non-residential building construction				x		
125 Civil engineering services				x		
126 Pre-erection work					x	
127 Other installation work					x	
128 Electrical installation work					x	
129 Plumbing and other installation services					x	
130 Building completion work					x	
131 Land and land improvements				x		
132 Wholesale trade	x					
133 Accommodation	x					
134 Meal services	x					
135 Takeaways	x					
136 Beverage services	x					
137 Road transport freight services				x		

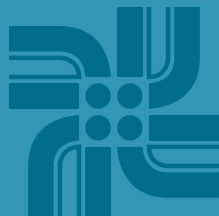
Table B.1 Interregional Trade Regionalisation Method by IOC203 Commodity (continued)

IOC203 Commodity Description	Gravity Model (Market View)	Gravity Model (Freight Flows)	Limited Trade	Kronenberg	Local- Consumption Only	Supply Share
138 Road passenger transport			x			
139 Railway transport freight services				x		
140 Railway passenger transport			x			
141 Sea transport freight services				x		
142 Passenger transportation by waterborne vessels				x		
143 Air transport freight services				x		
144 Air passenger transport			x			
145 Travel arrangement and sightseeing transportation services	x					
146 Postal and courier services	x					
147 Cargo handling services				x		
148 Supporting services for road and rail transport				x		
149 Supporting services for water transport				x		
150 Supporting services for air transport				x		
151 Freight transport agencies and other supporting transport services				x		
152 Storage and warehousing services				x		
153 Publishing, printing and reproduction services				x		
154 Packaged software, tapes, audio and video records				x		
155 Motion picture, radio, tv services				x		
156 Broadcasting, programming and programme distribution services				x		
157 Telecommunications services				x		
158 Internet telecommunications services and online content				x		
159 News agency, library and archive services				x		
160 Financial intermediation services				x		
161 Life insurance				x		
162 Other insurance services				x		
163 Superannuation and individual pension services				x		
164 Services auxiliary to financial services				x		
165 Equipment hire services	x					
166 Computer software and services				x		
167 Intellectual property licensing services				x		
168 Capitalised exploration				x		
169 Leased residential property services				x		
170 Leased commercial property services				x		
171 Other real estate services				x		
172 Owner - occupied dwellings					x	
173 Research and development				x		
174 Architectural and engineering services				x		
175 Other business services				x		
176 Legal services				x		
177 Accounting and taxation services				x		
178 Advertising and marketing services				x		
179 Management consultancy				x		
180 Placement and supply of personnel				x		
181 Cleaning					x	
182 Other support services				x		
183 Local government administration services					x	
184 Central government administration services						x
185 Investigation and security services				x		
186 Preschool education					x	
187 Primary education					x	
188 Secondary education					x	
189 Higher education				x		
190 Other education services					x	
191 Hospital and nursing care					x	
192 Medical, dental and other health services	x					
193 Accommodation for the aged					x	
194 Child care services					x	
195 Other social services					x	
196 Libraries, museums and art			x			
197 Sport and recreation services				x		
198 Casino-based gambling services	x					
199 Lottery services	x					
200 Racing and sports betting services	x					
201 Other gambling services, including online gambling	x					
202 Maintenance of domestic and office equipment	x					
203 Maintenance of transport machinery and equipment	x					
204 Maintenance of other equipment	x					
205 Other personal and community services	x					

Table B.2 NZIO to MarketView Commodity Concordance

NZIO Commodity Category	NZIO Industry (MarketView) Category
1 Retail margin	2 Retailing
2 Wholesale margin	1 Wholesaling
132 Wholesale trade	1 Wholesaling
133 Accommodation	11 Accommodation
134 Meal services	12 Food and beverage services
135 Takeaways	12 Food and beverage services
136 Beverage services	12 Food and beverage services
145 Travel arrangement and sightseeing transportation services	15 Travel agency and tour arrangement services
146 Postal and courier services	13 Postal and courier pick up and delivery services
165 Equipment hire services	14 Rental and hiring services (except real estate); non-financial asset leasing
192 Medical, dental and other health services	16 Medical and other health care services
198 Casino-based gambling services	17 Gambling activities
199 Lottery services	17 Gambling activities
200 Racing and sports betting services	17 Gambling activities
201 Other gambling services, including online gambling	17 Gambling activities
202 Maintenance of domestic and office equipment	18 Repair and maintenance
203 Maintenance of transport machinery and equipment	18 Repair and maintenance
204 Maintenance of other equipment	18 Repair and maintenance
205 Other personal and community services	19 Personal services; domestic household staff

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