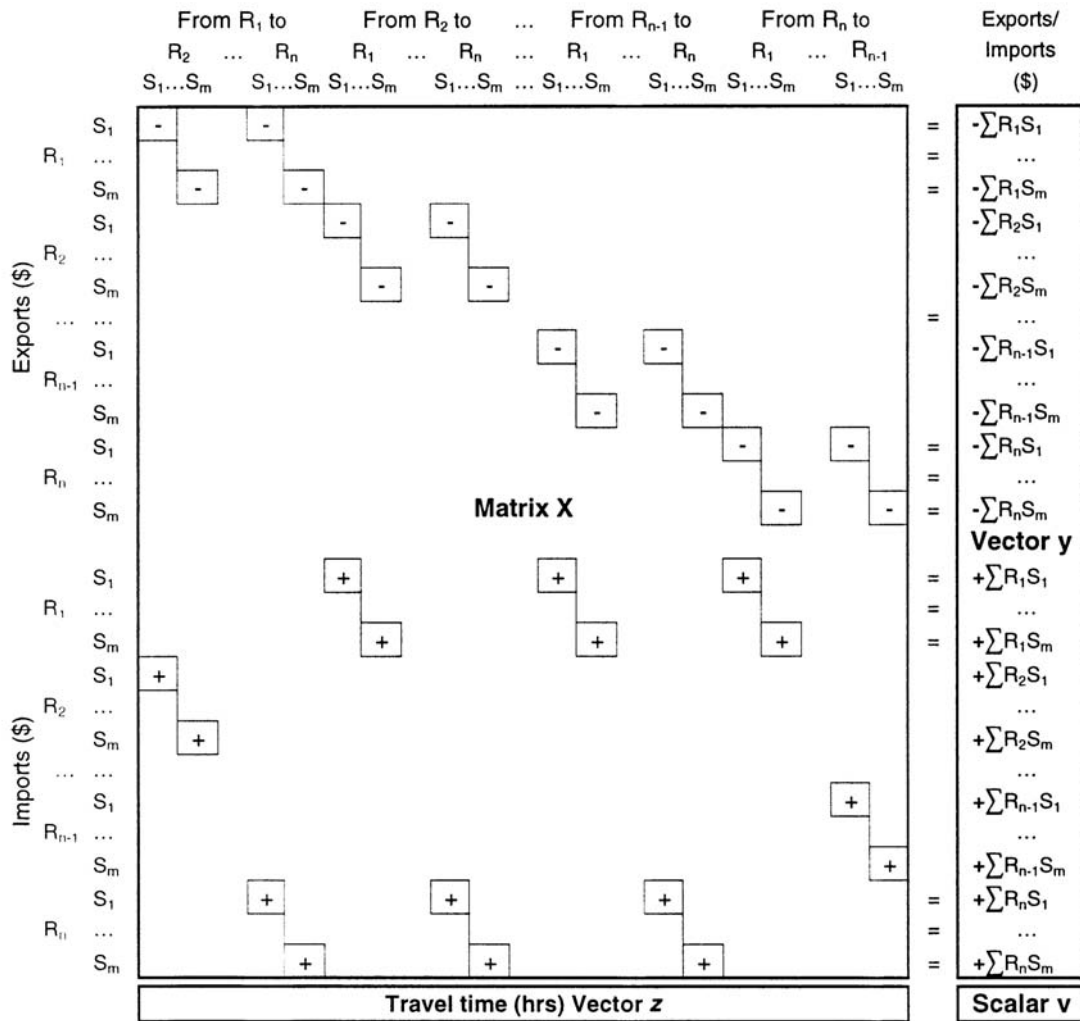


Appendix A: Description of the Interregional Flows Optimisation

This appendix describes the optimisation approach used in this report to define the level of interregional trade between the study region and its trading partners. The optimisation problem is portrayed diagrammatically in Figure A.1 and described mathematically below.

Figure A.1 Structure of the interregional trade flows optimisation problem



The capital letters R and S are used to respectively denote regions and sectors (ie. $R_1 S_1$ denotes sector 1 in region 1). The letter n represents the number of regions, while the letter m represents the number of sectors. A total of 16 regions (Auckland inclusive), covering all 16 regional councils in New Zealand, were used in the Auckland region empirical analysis. This analysis was performed for all 23 sectors.

Matrix **X** ($n \times m \times 2, (n \times n - n) \times m$). This matrix describes the flow of trade between regions. A negative sign (-) denotes exports, while a positive sign (+) denotes imports. Column 1, for example, describes the trade flows between region 1, R_1 , and region 2, R_2 .

Vector \mathbf{y} ($n \times m \times 2, 1$). This column vector describes imports to, and exports from, each region by sector. The element in row 1, for example, represents the sum of all sector 1 exports originating from region 1, $-\sum R_1 S_1$. The elements in this vector are used as binding constraints in the optimisation. This information is taken directly from the input–output tables generated by the GRIT system.

Vector \mathbf{z} ($1, (n \times n - n) \times m$). This row vector denotes ‘freight haulage times’ between regions per dollar of trade flow. Freight haulage times were calculated using an origin/destination matrix. The major city/town in each region was used as the point of origin/destination. Haulage times between the North and South Islands were adjusted for the Cook Strait crossing.

Scalar \mathbf{v} ($1, 1$). This scalar is the sum of row vector \mathbf{z} . It represents the total freight travel time needed to move goods and services between all permutations of regions and sectors. Minimisation of this scalar is the objective function.

The optimisation is solved as follows:

$$\begin{array}{ll} \text{Min:} & \mathbf{z}\mathbf{w} = \mathbf{v} \\ \text{subject to:} & \mathbf{X}\mathbf{w} = \mathbf{y} \\ & \mathbf{w} \geq \mathbf{0} \end{array}$$

where: \mathbf{w} = column vector ($(n \times n - n) \times m, 1$) describing the flow (\$) of m sector commodities between n regions, to be solved for.

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About the Ministry for the Environment

The Ministry for the Environment works with others to identify New Zealand's environmental problems and get action on solutions. Our focus is on the effects people's everyday activities have on the environment, so our work programmes cover both the natural world and the places where people live and work.

We advise the Government on New Zealand's environmental laws, policies, standards and guidelines, monitor how they are working in practice and take any action needed to improve them. Through reporting on the state of our environment, we help raise community awareness and provide the information needed by decision makers. We also play our part in international action on global environmental issues.

On behalf of the Minister for the Environment, who has duties under various laws, we report on local government performance on environmental matters and on the work of the Environmental Risk Management Authority and the Energy Efficiency and Conservation Authority.

Besides the Environment Act 1986 under which it was set up, the Ministry is responsible for administering the Soil Conservation and Rivers Control Act 1941, the Resource Management Act 1991, the Ozone Layer Protection Act 1996, and the Hazardous Substances and New Organisms Act 1996.

Head Office

Grand Annexe Building
84 Boulcott Street
PO Box 10-362
Wellington, New Zealand
Phone (04) 917 7400, fax (04) 917 7523
Internet www.mfe.govt.nz

Northern Regions Office

8–10 Whitaker Place
PO Box 8270
Auckland
Phone (09) 913 1640, fax (09) 913 1649

South Island Office

Level 4
Price Waterhouse Centre
119 Armagh Street
PO Box 1345
Christchurch
Phone (03) 963 0940; fax (03) 963 2050