

Infometrics Consulting

The ESSAM General Equilibrium Model

The ESSAM (Energy Substitution, Social Accounting Matrix) model is a general equilibrium model of the New Zealand economy. It takes into account all of the main inter-dependencies found in the economy, such as the flow of goods from one industry to another and the passing on of changes in costs in one industry into prices and, thence, the costs of other industries.

The ESSAM model has previously been used to analyse the economy-wide and industry specific effects of a wide range of issues. For example:

- Investment in energy generation and energy pricing (Contact Energy and Meridian Solutions)
- Investment in roading and funding regimes for roading (New Zealand Automobile Association and Road Advisory Group)
- Policies to reduce carbon dioxide emissions (Ministry for the Environment and Fletcher Energy)
- Release of genetically modified organisms (Life Sciences Network NZ)
- Changes in import tariffs (Ministry of Economic Development)
- Impacts of climate change (Foundation for Research, Science and Technology)

Some of the model's features are:

- 49 industry groups (currently), as detailed in the table below.
- Substitution between inputs into production - labour, capital, materials, energy.
- 4 energy types: coal, oil, gas and electricity, between which substitution is also allowed.
- Substitution between goods and services used by households.
- Social accounting matrix (SAM) for complete tracking of financial flows between households, government, business and the rest of the world.

The model's output is extremely comprehensive, covering the standard collection of macroeconomic and industry variables:

- GDP, private consumption, exports and imports, employment, etc.
- Demand for goods and services by industry, government, households and the rest of the world.
- Industry data on output, employment, exports etc.
- Import-domestic shares.
- Fiscal effects.

An additional advantage of using the ESSAM model is that its assumptions and input parameters are clear. All are open to amendment by the client. Transparency, the judicious use of sensitivity analysis, and careful interpretation of results, ensure that the model does not appear as a total black box.

Production Functions

These equations determine how much output can be produced with given amounts of inputs. A two-level standard translog specification is used which distinguishes four factors of production – capital, labour, materials and energy, with energy split into coal, oil, natural gas and electricity.

Intermediate Demand

A composite commodity is defined by the model. This is made up of imperfectly substitutable domestic and imported components - where relevant. The share of each of these components is determined by the elasticity of substitution between them and by relative prices.

Price Determination

The price of industry output is determined by the cost of factor inputs (labour and capital), domestic and imported intermediate inputs, and tax payments (including tariffs). World prices are not affected by New Zealand purchases or sales abroad.

Consumption Expenditure

This is divided into Government Consumption and Private Consumption. For the latter, eight household commodity categories are identified, and spending on these is modelled using price and income elasticities in an AIDS framework. An industry by commodity conversion matrix translates the demand for commodities into industry output requirements and also allows import-domestic substitution.

Government Consumption is usually either a fixed proportion of GDP or it is set exogenously. Where the budget balance is exogenous, either tax rates or transfer payments are assumed to be endogenous.

Stocks

Owing to a lack of information on stock change, this is exogenously set as a proportion of GDP, domestic absorption or some similar macroeconomic aggregate. The industry composition of stock change is set at the base year mix, although variation is permitted in the import-domestic composition.

Investment

Industry investment is related to the rate of capital accumulation over the model's projection period as revealed by demand for capital in the horizon year. Allowance is made for depreciation. Rental rates or the service price of capital (analogous to wage rates for labour) also affect capital formation. Investment by industry of demand is converted into investment by industry of supply using a capital input-output table. Again, import-domestic substitution is possible between sources of supply.

Exports

These are determined from overseas export demand functions in relation to world prices and domestic prices inclusive of possible export subsidies, adjusted by the exchange rate. It is also possible to set export quantities exogenously.

Supply-Demand Identities

Supply-demand balances are required to clear all product markets. Domestic output must equate to the demand stemming from consumption, investment, stocks, exports and intermediate requirements.

Balance of Payments

Receipts from exports plus net capital inflows (or borrowing) must be equal to payments for imports; each item being measured in a domestic currency net of subsidies or tariffs.

Factor Market Balance

In cases where total employment of a factor is exogenous, factor price relativities (for wages and rental rates) are usually fixed so that all factor prices adjust equiproportionally to achieve the set target.

Income-Expenditure Identity

Total expenditure on domestically consumed final demand must be equal to the income generated by labour, capital, taxation, tariffs, and net capital inflows. Similarly, income and expenditure flows must balance between the five sectors identified in the model – business, household, government, foreign parties and capital.

Industry Classification

The 49 industries identified in the ESSAM model are defined below. These definitions are according to Australian and New Zealand Standard Industrial Classification (ANZSIC).

Industry	
1 HFRG	Horticulture and fruit growing
2 MLVC	Mixed livestock and cropping
3 SHBF	Sheep and beef cattle farming
4 DAIF	Dairy cattle farming
5 OAGR	Other farming and services to agr, hunting & trapping
6 LOGG	Forestry & logging
7 FISH	Commercial fishing
8 COAL	Coal mining
9 OILG	Oil & gas extraction and exploration
10 OMIN	Other mining & quarrying and services to mining
11 MEAT	Meat processing
12 DAIR	Dairy product manufacturing
13 OFOD	Other food processing & mfg
14 TCFL	Textiles, clothing, footwear & leather mfg
15 WOOD	Log sawmilling, timber dressing & oth wood product mfg
16 PAPER	Paper and paper product mfg
17 PPRM	Printing, publishing & recorded media
18 PETR	Petroleum
19 CHEM	Chemical and chemical product mfg
20 RBPL	Rubber and plastic product mfg
21 NMMP	Non-metallic mineral product mfg
22 BASM	Basic metal manufacturing
23 FABM	Structural, sheet and fab metal prod mfg
24 MACH	Machinery and equipment mfg
25 OMFG	Other manufacturing
26 EGEN	Electricity generation
27 EDIS	Electricity transmission & supply
28 GASS	Gas supply
29 WATS	Water supply

30	BLDG	Construction
31	TRDE	Wholesale & retail trade
32	ACCR	Accommodation, cafes & restaurants
33	ROAD	Road transport
34	WRAI	Water and rail transport
35	AIRS	Air transport, services to transport, storage
36	COMM	Communication services
37	FIIN	Finance and Insurance
38	OWND	Ownership of owner-occupied dwellings
39	OPRS	Other property services
40	SCIT	Scientific research & technical services
41	COMP	Computer services
42	LAOB	Legal, accounting & other business services
43	GOVD	Govt administration & defence
44	SCHL	Pre-school, primary, secondary & other education
45	OEDU	Post-school education
46	HOSP	Hospitals, nursing homes, aged accom & other comm care
47	OHLT	Medical, dental and other health services
48	MPRT	Cultural and recreational services
49	PERS	Personal and other services, waste disposal & sewerage svcs
