# A The MMRF model

This appendix provides an overview of the MMRF-Auto14 model used in this inquiry to assess the economywide and regional effects of impending and possible changes in the automotive industry. MMRF-Auto14 is based on the Monash Multi-Regional Forecasting (MMRF) model that has been used widely by the Commission and others to analyse the effects of public policy in Australia, and is well suited to examining policies with a regional focus and the effects of industry adjustment.

## A.1 An overview of the MMRF model

The MMRF model is a ‘bottom-up’ model that treats each state and territory as a separate economy. The benchmark model from which MMRF-Auto14 was adapted includes:

* 64 industries and commodities in each state, and the inter-linkages between these contained in the input-output tables
* state labour markets, comprised of eight occupations, with the supply of labour moving between states to equate changes across states in occupational-specific real wages
* eight state-specific household sectors, which supply domestic factors of production (labour and capital), consume goods and services, and pay income and commodity taxes
* eight state and territory governments
* the Australian Government.

Important elements of the theoretical structure of the version of MMRF used in this project include the following:

* households change their consumption bundles in response to changes in aggregate expenditure and relative prices
* producers adapt their output and their relative use of labour, capital and agricultural land in response to changes in relative prices
* foreign demand for Australian exports responds to the export price of Australian products, and exporters can accrue short-term returns in response to price changes.

The model is documented in more detail in CoPS (forthcoming).

### Database

The MMRF database is composed of:

1. a production core, comprised of eight input-output tables (one for each state and territory) that are linked through interstate trade
2. fiscal accounts for the nine governments
3. cohort-based population and demographic accounting.

The production core of the database shows how each industry in each state and territory economy is linked to other industries within that state and in other states. It is based on input‑output tables prepared by the ABS, complemented by various ABS national and state publications. It provides a detailed description of the structure of production according to a constant returns to scale production technology and demand for industry outputs and imports, in each state and territory. Within this framework, it shows:

1. the flow of industry outputs to other industries (termed ‘intermediate inputs’), final demands by households (consumption), government, investment (for capital formation purposes) and exports
2. the transport and distribution costs associated with transferring products from the producer (or the port of entry in the case of imports) to final consumers and other users, as well as product taxes and subsidies pertaining to product flows (including the GST, import duties and excise taxes)
3. the cost structure of industries in terms of intermediate inputs of commodities (goods and services supplied by domestic industries and by imports), primary factors of production (labour, capital and agricultural land), other costs to production and indirect taxes and subsidies not elsewhere classified (such as payroll taxes).

The initial database includes 64 industries, of which there are: 6 agricultural and related industries; 6 mining industries; 21 manufacturing industries; 8 utility industries; 2 construction industries; 4 trade, repair and food and accommodation industries; 8 transport industries; and 9 finance, government and other service industries.

For the purpose of the current study, the ‘motor vehicles and parts’ industry in the standard classification has been disaggregated into three components:

* passenger motor vehicle manufacturing
* automotive components manufacturing
* a residual other automotive manufacturing.

The disaggregation of the motor vehicles and parts industry was based on detailed product information that underpins the ABS *Input-Output Tables* (described in Appendix B).

The fiscal accounts detail revenue and expenditure for the nine state, territory and Australian governments and align with the ABS *Government Financial Statistics*. The accounts include a range of:

* government revenue sources, such as income tax, payroll tax, the GST, excise duties and other commodity taxes and tariffs
* government expenditure, including operating expenses, welfare payments and government grants.

The fiscal accounts for each state and territory government also include, where relevant, those for local government.

The cohort-based population and demographic module supports the modelling of the population over time in the dynamic version of the model. The demographic module models population change for age and gender-specific subsets, or cohorts using a ‘stock-flow’ approach, and determines labour supply by applying age, gender and state-specific participation rates to the number of people in each cohort. The module also allows for people to move between states in response to changes in labour demand by state industries.

## A.2 The economic environment (model closure[[1]](#footnote-1))

The primary focus of this study is on the likely impacts on the Australian economy and regional economies from the closure of the major passenger motor vehicle manufacturing plants in Australia. More specifically, the study asks the question ‘how might the Australian economy differ with the closure of the major passenger motor vehicle manufacturing plants?’.

To examine the longer-term impacts, a longer-term modelling environment is used for the comparative-static modelling. In this environment, the estimated effects reflect those that are likely to occur once there has been a complete adjustment in capital and labour use across jurisdictions and industries.

The study also examines the timescale over which adjustments may occur, or the transition path, using a dynamic, or year-to-year, modelling environment.

### Comparative-static modelling environment

The comparative-static modelling undertaken in this study follows the long-run environment used in the Commission’s previous modelling of the economywide effects of future automotive assistance arrangements (PC 2008) and in its modelling of the impacts of COAG reforms (PC 2012b). The key elements of the long-run economic environment used in this study are as follows.

* The model index of consumer prices is the numeraire. That is, changes in domestic prices in the model can be interpreted as changes relative to the general level of prices in the economy. In all simulations, the nominal exchange rate is flexible.
* National employment by occupational group responds to differences in real pre‑tax wages for that occupational group compared to the average across all occupational groups, as does state employment in each occupational group. The population and number of households in each state are assumed to change in line with state employment, with the unemployment rate in each state held fixed. The national population is held fixed.
* Each industry adjusts its capital stocks in order to equate its expected and actual rates of return on capital. The base-line expected rates of return are determined by values in the MMRF database. Industries’ demands for investment goods are linked to changes in industry-specific capital stocks by an exogenous investment/capital ratio.
* Nominal household consumption is determined by post-tax household disposable income, while the balance of trade as a ratio of gross domestic product (GDP) in local currency prices is allowed to vary.

Government tax rates are assumed fixed, so that revenue moves in line with the various tax bases. In the model core, the level of real public consumption expenditure is assumed to move in proportion with the level of real aggregate household consumption expenditure. In the fiscal module, nominal government expenditure (including government consumption and other outlays) changes in line with the underlying drivers of economic activity in the MMRF model (such as population, unemployment, aggregate economic activity and prices). The budget position is held fixed as a share of GDP or GSP through the use of lump-sum transfers to, or from, households.

It is assumed that the closure of the major passenger motor vehicle manufacturing plants will not influence the national supply of labour — that is, after the economy has adjusted to the closure of the passenger motor vehicle manufacturing industry, national labour supply will be the same as it would otherwise have been. Higher national and regional output therefore depends on higher productivity of labour and the relocation of labour between regional industries. In the MMRF model, the base levels of national labour supply and employment by eight occupational groups are represented by their levels in 2005‑06.

These closure settings align with those used in PC (2008). They differ from those adopted in PC (2012b) with respect to the treatment of government expenditure. In that study, changes in real government expenditure were assumed to be discretionary to enable the Commission to report on the ‘fiscal implications’ of COAG reforms assessed.

### Recursive-dynamic modelling environment

As it involves running the model through time in one-year steps, the modelling environment used in the ‘recursive-dynamic’ modelling is different from that used in the long-run comparative-static modelling discussed previously. Each step in the recursive-dynamic modelling is similar to a short-run comparative-static simulation, but with gradual adjustment in capital and labour markets. The model database is updated at each annual step (collectively referred to as the ‘reference case’).

#### The dynamic modelling environment

The modelling environment used for the reference case assumes that:

* Population growth and the aggregate supply of labour are determined by the demographic module outlined in the Productivity Commission paper *Economy-wide Modelling of the Impacts of COAG Reforms* (PC 2012b).
* Investment, and with it the capital stock, in each industry gradually responds to differences between the expected and actual rates of return on capital. The base-line expected rates of return are determined by values in the MMRF database. The adjustment process is outlined in CoPS (forthcoming).
* Nominal government expenditure (including government consumption and other outlays) moves in line with the underlying drivers of economic activity in MMRF (such as population, unemployment, aggregate economic activity and prices).[[2]](#footnote-2)
* The budget position is held fixed as a share of GDP or gross state product (GSP) through the use of lump-sum transfers to, or from, households.

In common with the comparative-static modelling:

* Nominal household consumption is determined by post-tax household disposable income, while the balance of trade as a ratio of GDP in local currency prices is allowed to vary. Regional household consumption is determined by regional post-tax household disposable income.
* Government tax rates are assumed to remain fixed so that revenue moves in line with the various tax bases.

#### The exit scenario modelling environment

The modelling environment used for the policy scenario is aligned to that used for the reference case, except for closure switches required to model the closure of the major passenger motor vehicle manufacturing plants in Australia (appendix C).

## A.3 Model parameters

In such models such as MMRF, the key parameters are mediate the responsiveness of trade volumes to changes in the competitiveness of local industry and the use of labour and capital between activities and across regions. These include:

* export demand elasticities
* import substitution elasticities
* primary factor substitution elasticities, and occupational transformation (supply-side) and substitution (demand-side) elasticities.

The elasticities used in the comparative‑static modelling are more representative of a longer-run modelling environment in which greater flexibility exists for the economy to adjust to changes in relative prices, rates of return and other factors than in the year-to-year dynamic modelling. Reflecting the more limited scope for adjustment year-on-year relative to the longer term, the year-to-year elasticities generally take a smaller value than the longer-run elasticities. The standard benchmark MMRF parameter values have been used in the year-to-year modelling.

### Export demand elasticities

Export demand elasticities govern the extent to which greater export volumes come at the expense of price declines — the greater the elasticities, the smaller the price declines required. The central results in this supplement assume a value of -10 for all export demand elasticities in comparative‑static long-run simulations, a value which is considered more appropriate for the long-run nature of the projections presented in this study. This setting assumes that in the longer run Australian producers have little influence over world prices of the products they sell. The export demand elasticity of -10 was adopted by the Commission in its previous modelling of the effects of future automotive assistance (PC 2008).[[3]](#footnote-3)

In year-to-year simulations, the reference value of -5 adopted by the Centre of Policy Studies is applied. This value assumes that Australia has a somewhat greater influence over prices in the short term than in long term. For example, Australian producers might be able to increase prices in the short term by withholding supply of commodity exports, but would be expected to have less effect on global prices in the long term. This is because other commodity exporters may respond to higher prices by increasing their own supply, or major importers may turn to domestic production. The year-to-year export demand elasticity value of -5 was adopted by the Commission in its assessment of the impacts of COAG reforms (PC 2012b).

### Domestic‑import substitution elasticities

Domestic-import substitution elasticities determine the degree of substitutability between domestically produced and imported products (Armington elasticities). More specifically, the elasticities determine the sensitivity of:

* domestic demand for imports to changes in the price of imports relative to domestic production
* domestic demand for domestic production to changes in the price of domestic demand relative to imports.

The values adopted in this study are the standard values incorporated by the Centre of Policy Studies in the MMRF model. These values are being applied in both the longer-run comparative‑static and year-to-year simulations. The values range between 0 (for products with little or no imports) and 10 (for products with a high degree of flexibility). Elasticity values of 5.2 are set for passenger motor vehicles and other automotive manufacturing (PC 2008) and, reflecting its status as an input into production, 2 for automotive components.

To examine the implications of greater responsiveness of imports in the longer term to relative price changes, a sensitivity test that doubles the year-to-year value of the elasticities is undertaken (chapter 4).[[4]](#footnote-4)

The standard values of the import substitution elasticities and the values used in the sensitivity test are listed in table A.1.

### Primary factor substitution and occupational mobility parameters

On the demand side, substitution elasticities determine the degree to which labour and capital inputs can be substituted for each other in production. The benchmark values for year-to-year simulations in the MMRF model are 0.5 for all industries and regions. Reference values in the longer-term comparative‑static simulations are 1.25.[[5]](#footnote-5)

MMRF also includes elasticities governing the degree of substitutability in use of the eight different occupations in production. The benchmark values for year-to-year simulations are 0.35. The selection of these values reflects an assumption that employers have limited flexibility to alter the occupational mix used in production on a year-to-year basis. The values being applied in the longer-term comparative‑static simulations are 1 to reflect higher substitution prospects over the longer run.[[6]](#footnote-6)

On the supply side, transformation elasticities determine the extent to which the supply of labour can move between the eight occupational groups. The benchmark value for year-to-year simulations is set at 0.1. The selection of this value reflects an assumption that, on a year-to-year basis, employees have limited potential to change their occupation. The value in the longer-term comparative‑static simulations is 1 to reflect higher transformation prospects over the longer run.[[7]](#footnote-7)

Table A.1 Domestic-import substitution elasticities in the MMRF model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | MMRF industry | | Standard elasticity | Higher elasticity used in sensitivity test | Import share in domestic use |
|  |  | |  |  | Per cent |
| 1 | Livestock | | 1.45 | 2.90 | .. |
| 2 | Crops | | 0.50 | 1.00 | 1 |
| 3 | Dairy cattle | | 2.00 | 4.00 | .. |
| 4 | Other agriculture | | 1.97 | 3.94 | 6 |
| 5 | Forestry and logging | | 2.00 | 4.00 | 3 |
| 6 | Fishing | | 0.50 | 1.00 | 5 |
| 7 | Coal mining | | 0.50 | 1.00 | .. |
| 8 | Oil mining | | 10.00 | 20.00 | 77 |
| 9 | Gas mining | | 10.00 | 20.00 | .. |
| 10 | Iron ore mining | | 0.50 | 1.00 | 18 |
| 11 | Other metal ore mining | | 0.50 | 1.00 | 21 |
| 12 | Other mining | | 2.00 | 4.00 | 3 |
| 13 | Meat products | | 0.50 | 1.00 | 4 |
| 14 | Dairy products | | 1.60 | 3.20 | 10 |
| 15 | Other food beverages and tobacco | | 1.49 | 2.98 | 21 |
| 16 | Textiles, clothing and footwear | | 2.91 | 5.82 | 66 |
| 17 | Wood and wood products | | 1.99 | 3.98 | 17 |
| 18 | Paper and paper products | | 1.10 | 2.20 | 37 |
| 19 | Printing, publishing and recorded media | | 2.00 | 4.00 | 12 |
| 20 | | Petrol | 0.40 | 0.80 | 25 |
| 21 | | Other petroleum and coal products | 0.40 | 0.80 | 35 |
| 22 | | Chemical products | 1.94 | 3.88 | 51 |
| 23 | | Rubber and plastic products | 1.50 | 3.00 | 38 |
| 24 | | Other non-metallic minerals products | 1.18 | 2.36 | 23 |
| 25 | | Cement and lime | 0.26 | 0.52 | 2 |
| 26 | | Iron and steel | 0.82 | 1.64 | 28 |
| 27 | | Alumina | 1.00 | 2.00 | 4 |
| 28 | | Aluminium | 1.00 | 2.00 | 25 |
| 29 | | Other non-ferrous metals | 1.00 | 2.00 | 23 |
| 30 | | Metal products | 1.89 | 3.78 | 22 |
| **31** | | **Passenger motor vehicle manufacturing** | **5.20** | **10.40** | **59** |
| **32** | | **Automotive components manufacturing**a | **2.50** | **5.00** | **44** |
| **33** | | **Other automotive manufacturing** | **5.20** | **10.40** | **51** |
| 34 | | Other equipment | 1.31 | 2.62 | 63 |

(Continued next page)

Table A.1 (continued)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | MMRF industry | Standard elasticity | Higher elasticity | Import share in domestic use |
|  |  |  |  | Per cent |
| 35 | Other manufacturing | 0.92 | 1.84 | 56 |
| 36 | Electricity generation – coal | 0 | 0 | .. |
| 37 | Electricity generation – gas | 0 | 0 | .. |
| 38 | Electricity generation – oil | 0 | 0 | .. |
| 39 | Electricity generation – hydro | 0 | 0 | .. |
| 40 | Electricity generation – other | 0 | 0 | .. |
| 41 | Electricity supply | 0 | 0 | .. |
| 42 | Gas supply | 0 | 0 | .. |
| 43 | Water and sewage services | 0 | 0 | .. |
| 44 | Residential construction | 0 | 0 | .. |
| 45 | Non-residential construction | 0 | 0 | .. |
| 46 | Wholesale trade | 0 | 0 | .. |
| 47 | Retail trade | 0 | 0 | 1 |
| 48 | Mechanical repairs | 0 | 0 | .. |
| 49 | Hotels, cafes and restaurants | 0 | 0 | 9 |
| 50 | Road freight transport | 0 | 0 | 1 |
| 51 | Road passenger transport | 0 | 0 | 18 |
| 52 | Rail freight transport | 0 | 0 | 1 |
| 53 | Rail passenger transport | 0 | 0 | 23 |
| 54 | Pipeline and other transport | 0 | 0 | .. |
| 55 | Water transport | 2.00 | 4.00 | 39 |
| 56 | Air transport | 2.00 | 4.00 | 51 |
| 57 | Services to transport | 0 | 0 | 1 |
| 58 | Communication services | 0 | 0 | 3 |
| 59 | Financial services | 0 | 0 | 2 |
| 60 | Ownership of dwellings | 0 | 0 | 1 |
| 61 | Business services | 0 | 0 | 3 |
| 62 | Government administration and defence | 0 | 0 | .. |
| 63 | Education | 0 | 0 | 3 |
| 64 | Health services | 0 | 0 | 1 |
| 65 | Community services | 0 | 0 | 4 |
| 66 | Other services | 0 | 0 | 1 |

**..** Zero or less than 0.5 per cent. a A lower elasticity is adopted for the use of automotive components in production than for manufactured motor vehicles to better align with the elasticities used for other manufactured intermediate products. Reflecting the aftermarket nature of their sales, the import substitution elasticities for household and investment demand are set to the same as for manufactured passenger motor vehicles.

*Sources*: MMRF‑Auto14 database; Commission estimates.

The model also includes an elasticity governing the extent of mobility in the labour supply between states. Previous versions of the MMRF model did not explicitly include this transformation behaviour, but implicitly assumed infinite transformation possibilities or imposed interstate migration exogenously. Consistent with earlier practice, a high transformation parameter value of 20 has been adopted. Under this approach, the mobility of labour between regional industries is influenced by other factors (such as the primary factor substitution and occupational mobility parameters). For the purposes of illustrating the sensitivity of results to alternative assumptions about interstate labour mobility, an alternative parameter value representing ‘sticky’ interstate labour markets of 1 is adopted (chapter 4).[[8]](#footnote-8)

### Capital market adjustment parameters

Capital market adjustment (or investment) parameters in MMRF determine the rate at which industries accumulate new capital on the basis of changes in relative competitiveness and what this implies for returns to capital. Broadly, the benchmark investment parameter values in MMRF are set at 0.5 to ensure that, from an economic shock, capital accumulation will occur so that the industry rate of return on capital returns to ‘normal’ after a period of around seven years, all other things remaining equal.

Because the rate of economic adjustment to the closure of the major passenger motor vehicle manufacturing plants in Australia is likely to be sensitive to the responses of other industries to the announced changes, a ‘more rapid’ adjustment scenario is modelled using parameter values of 0.4 (a lower value implying more rapid adjustment) in a range of greater than zero to less than 1.[[9]](#footnote-9) Under this scenario, returns on capital would return to normal levels after around four to five years, other things being equal (chapter 4). The impact of possible slower adjustment is also modelled using a parameter value of 0.6. Under this scenario, returns on capital would return to normal levels after around ten years, other things being equal. Although the choice of parameters in general equilibrium modelling is uncertain and often subject to judgment, Dixon and Rimmer noted in the documentation for the MONASH model that parameters are typically chosen so that ‘employment effects of a shock to the economy are largely eliminated after 5 years’ (Dixon and Rimmer 2002, p. 205).

1. The term ‘model closure’ is used to refer to the assignment of the model’s variables between those determined outside the model (exogenous variables) and those determined by the model (endogenous variables). [↑](#footnote-ref-1)
2. In the current implementation of the MMRF model, real regional government investment is modelled as moving in line with total real regional investment. [↑](#footnote-ref-2)
3. This involved changing the MMRF parameters SIGMAEXP (traditional exports) and SIGMAEXPNTR (non-traditional exports) for all commodities. [↑](#footnote-ref-3)
4. This involved changing the MMRF parameters SIGMA1O (industry demand), SIGMA2O (investment demand) and SIGMA3O (household demand) for all commodities. [↑](#footnote-ref-4)
5. This involved changing the MMRF parameter SIGMA1FAC for all industries and regions. [↑](#footnote-ref-5)
6. This involved changing the MMRF parameter SIGMA1LAB for all industries and regions. [↑](#footnote-ref-6)
7. This involved changing the MMRF parameter SIGMALABO. [↑](#footnote-ref-7)
8. This involved changing the MMRF parameter SIGMALABS. [↑](#footnote-ref-8)
9. This involved changing the MMRF parameter ADJ\_COEFF. [↑](#footnote-ref-9)