3 Modelling the assistance scenarios

In this chapter, the choice of model and how it is used are briefly outlined. The chapter begins with a discussion of how economic modelling informs policy decisions, and the relative advantages of the Monash Multi-Regional Forecasting (MMRF) model for this study (section 3.1). The structure, underlying assumptions and modifications to this model and its database are outlined (section 3.2). The simulation approach is then discussed, along with a description of how the necessary shocks have been designed and implemented. The chapter ends with an outline of key outputs of the model. Results from the simulations are given in chapter 4.

3.1 The choice of a model

Economic modelling enables the policy analyst to consider, in a systematic and transparent way, various ramifications of policy changes throughout the economy, to the extent that these can be specified in the model. In the absence of such a tool, judgement or guesses would be needed. That said, modelling is a selective abstraction of the real world, and its complex interactions, and cannot be expected to replicate reality except in simple exercises. It is therefore best used in conjunction with other analysis and, ultimately, a degree of judgement will still be called for.

A good economic model should abstract from aspects that are not relevant to the issue under scrutiny, capturing to the extent possible only those that are likely to influence the outcome. This study focuses on estimating the economy-wide implications of changing some of the policies that affect the automotive industry. Therefore, an appropriate model for the task is one that can account for:

- the economy-wide impacts of changes that affect primarily the automotive industry
- the linkages between the automotive industry, the rest of the Australian economy and the outside world
- the specific relationship between car assembly and component manufacturing in Australia.

Three main aspects of a model in turn influence the simulation results and how well the above aims can be achieved.

1. Assumptions about the economic behaviour of automotive and other producers, investors, households and the foreign sector, reflected in equations and parameter values that determine the degree to which they respond to changes in relative prices and other market conditions.
2. The database, which is a representation of input–output linkages and other features of the economy.
3. The model 'closure', which describes the economic environment in which the simulations are conducted, incorporating factors that influence results but which are taken as given.

The model used in this study

The Commission chose to use the comparative-static version of the MMRF model for this study. The MMRF model is a multi-regional applied general equilibrium model developed by the Centre of Policy Studies (CoPS) at Monash University. This model is different from the recursive dynamic MONASH model of the Australian economy used in the Industry Commission's 1997 report on *The Automotive Industry* (IC 1997) and the Commission's 2002 *Review of Automotive Assistance* (PC 2002). Despite the differences between the MONASH and the MMRF models, long-term results from both versions can be compared (chapter 5).

The MMRF model was chosen because, like the MONASH model, it is a well-documented model with a proven track record. It could also be relatively easily updated with recent information, and modified to reflect this study's focus on the automotive industry. It was used by the Commission in its recent study for COAG, *Potential Benefits of the National Reform Agenda* (PC 2006).

Two other key factors were considered in choosing the MMRF model — the time and spatial dimensions.

The time dimension

Using the comparative-static version of MMRF means that its simulation results do not relate to a particular year, and no adjustment paths can be inferred. Strictly, results must be interpreted as the difference between two situations: 'with' and 'without' the policy change.

These results are counterfactual *projections* of the effect of the specific change

modelled, not *forecasts* of what the economy will actually look like at a future point in time.

The obvious disadvantage of a comparative-static approach is that it cannot be used to analyse the effects of the precise timing of policy changes, or the time-path of adjustment costs. While these temporal considerations may be important in some cases, a comparative-static model was seen as preferable in this study for two reasons:

- the focus is on evaluating the long-term implications of changing industry policy — once firms and households have fully adapted to the changes — so that the spatial aspects of the model are more important
- particularly given the time constraints in this study, a comparative-static model obviates the need to make forecasting assumptions about the future economy and automotive industry, which is fraught with difficulties and inevitably controversial.

The spatial dimension

Unlike other economic models, such as single-industry or sectoral models, the MMRF model is designed to capture the economy-wide impacts of policy changes. Yet by representing the Australian economy as a combination of the economies (and industries) of all jurisdictions, the MMRF model also allows an analysis of the effects of policy at the jurisdictional and industry levels. This is especially useful given the geographic concentration of the Australian automotive industry.

The Commission has further developed the spatial and industry dimensions of the model to meet the specific needs of this study. How this was done is outlined in the following section.

3.2 Key features of the MMRF model

As noted, three main aspects of a model determine its simulation results — the behavioural assumptions as reflected in the equation structure and parameter settings, its database, and its closure. This section discusses how each of these is represented in the MMRF model, and the changes that were made for this study.

Structure and parameters

The MMRF model accounts for the links between different parts of the economy. It includes a representation of the behaviour of:

- domestic producers and investors, classified by industry and eight domestic regions (that is, the six States and two Territories, collectively referred to as 'jurisdictions' in this report)
- domestic consumers and suppliers of labour and capital, provided by eight region-specific household sectors
- an aggregate foreign purchaser of Australia's exports, seller of imports and supplier of foreign capital
- the Australian Government and eight State and Territory Government accounts.

The assumptions underlying the behaviour of these participants in the MMRF model include that:

- producers are subject to constant returns to scale technology,[1] which determines how they respond to changes in input and output prices by changing their output and their use of labour, produced capital, land and purchased inputs
- households vary their consumption of commodities in response to changes in their income from labour and capital, and the relative prices of goods consumed
- labour responds to regional employment opportunities as signalled by changes in relative wages (that is, labour moves to regions with relatively high wages)
- domestic and foreign investors respond to changes in industry-specific rates of return
- demand for Australian exports responds to changes in the world price of exports
- demand for imports responds to changes in the import price of foreign products relative to the price of domestically-produced products.

These assumptions are widely accepted as reasonable representations of observed behaviour in an economy and are used in most industry or sectoral, as well as economy-wide, models. (For example, most are present in Econtech's MM 600+ model (Econtech 2002)).

The model's equations and parameters, outlined briefly below, reflect these assumptions.

Equations

The equations of the MMRF model define the determinants of demand and supply (documented in Adams et al. 2002). Two additional sets of equations were incorporated in the model for this study. Specifically:

1 See chapter 5 for a discussion of the influence of this assumption on model results.

- equations required to handle the inter-regional mobility of occupations (as in the version of MMRF used in PC (2006)) and the 'single national labour market' closure
- an equation that ties uncapped ACIS credits to the value of production and the tariff rate (chapter 2).

Parameter settings

Numerous parameters — mostly elasticities, combined with database values — determine the degree to which changes in particular variables, such as prices, lead to changes in quantities demanded and supplied.

Especially important in this study are:

- export demand elasticities — that is, the responsiveness of demand for Australia's exports to changes in world export prices; these have been set to 10 (and at 5 in a sensitivity analysis) across all commodities (box 3.1)
- substitution elasticities between domestically-produced and imported commodities, which determine the sensitivity of imports to changes in the duty-paid prices of imports; these vary between 0 and 10 across commodities,[2] and are set at 5.2 for cars and their components (appendix C)[3]
- substitution elasticities between labour and capital — which determine the degree to which these factors can be substituted for each other in production; these are set at 0.5 for all industries.[4]

2 Zero for non-traded products.

3 The substitution elasticities are the same across users in MMRF — that is, households (private and government consumption) and firms (intermediate inputs and investment goods). They are the values used in the MONASH model, and are consistent with those used in the GTAP model which suggests that domestic import substitution elasticities are about half the value of the elasticities of substitution among different foreign sources, the latter providing an upper bound on export demand elasticities (Hertel 1997; PC 2002; Shomos 2005).

4 These are based on estimation work conducted in the context of the IMPACT project in the 1970s (Caddy 1976). These magnitudes are commonly used in the context of models such as MMRF.

Box 3.1 Export demand elasticities and terms of trade effects

Export demand elasticities indicate the responsiveness of exports to a change in the corresponding world prices — or vice versa. Similar elasticities operate on the import side. The values assigned to these elasticities depend on views about the share of an economy in international trade. In the context of this study, export demand elasticities are an important determinant of overall results.

On the export side, large elasticity values imply that Australian producers are assumed to be 'price takers' — that is, Australian export levels are assumed not to affect world prices much. Alternatively, small elasticity values imply that a modelled increase in Australian exports will reduce the price received by exporters. This is referred to as a terms of trade loss, and is the inevitable result of combining low export demand elasticities with improvements in the international competitiveness of Australian exporters.

Low values of export demand elasticities are often used in economic models to constrain the ability of the modelled economy to expand in response to an increase in factor inputs or competitiveness. Economic models do not account for many of the rigidities which actually limit the expansion of an economy. Export demand elasticities are one way of reducing the ability of a (constant returns to scale) economy to expand and, therefore, dealing with model 'flip-flop' (Dixon et al. 1997).

Models of the Australian economy (such as the MONASH and MMRF models) often use the 'almost small economy assumption' (Tyers 2004), in which world prices of imports are assumed to be fixed, and world prices of exports are assumed to be somewhat sensitive to the volume of Australian exports.

The standard value for export demand elasticities in MMRF is 5. This is based on values used in the MONASH model, which were informed by the results of econometric studies undertaken in the 1970s during the IMPACT Project (Parmenter 1982), as well as experience with the ORANI and MONASH models.

The Commission has argued in the past that the standard MONASH values are too low and, for at least some products, should be doubled (PC 2000, 2002). This is because:

- the basis on which the estimations were carried out in the econometric studies differs from that on which the parameters are defined in MMRF
- although low values might be appropriate for short-run, year-to-year modelling purposes, they are likely to overstate the extent to which Australian firms can differentiate their products from those of foreign competitors in the longer term.

The export demand elasticities for all goods in this study are set at 10. This is close to the values of 12 used in the MM 600+ model (PC 2002). A sensitivity analysis with a value of 5 was also conducted.

Updating and modifying the database

The current economic and policy environment provides a starting point from which future policy options can be assessed. Thus, having laid out the structure of the model, the next step is to set up the database to reflect the latest-available information. The database is similar to that used for PC (2006), but it was modified in three ways, by:

- updating the base year from 2001-02 to 2005-06
- disaggregating the automotive industry
- incorporating specifics of automotive assistance arrangements.

Updating the base year

The MMRF database was updated to 2005-06, using the latest-available consistent data from the ABS.[5] Doing this was important, given the changes that have occurred in the Australian economy in recent years (for example, the increasing share of mining in economic activity and in exports). The updating was undertaken by CoPS. Appendix D provides an outline of the process used.

Disaggregating the automotive industry

For this study, the Commission contracted CoPS to separate the 'motor vehicles and parts' (MVP) industry from the broader 'transport equipment' industry that was included in the MMRF model used in PC (2006).

The motor vehicle and parts industry is composed of distinct sub-sectors with their own characteristics. These sectors differ in terms of their:

- location in the supply chain
- geographical location (assemblers, for example, are concentrated in South Australia and Victoria, while component makers are spread across most jurisdictions)
- levels of industry assistance, especially tariffs and ACIS funding, the focus of

[5] The database was not updated with more recent information to 2008 to reflect, for example, the closure of Mitsubishi. There are three reasons for this. First, the direct effects of the changes over the past 18 months are uncertain, so including them would introduce more uncertainty in the modelling. Second, excluding this information is unlikely to affect results significantly, since the changes seem to have been small relative to the size of the automotive industry. Third, more recent automotive industry data would be inconsistent with the data describing the rest of the economy.

this study.

Therefore, the motor vehicles and parts industry itself was disaggregated by the Commission to identify separately:

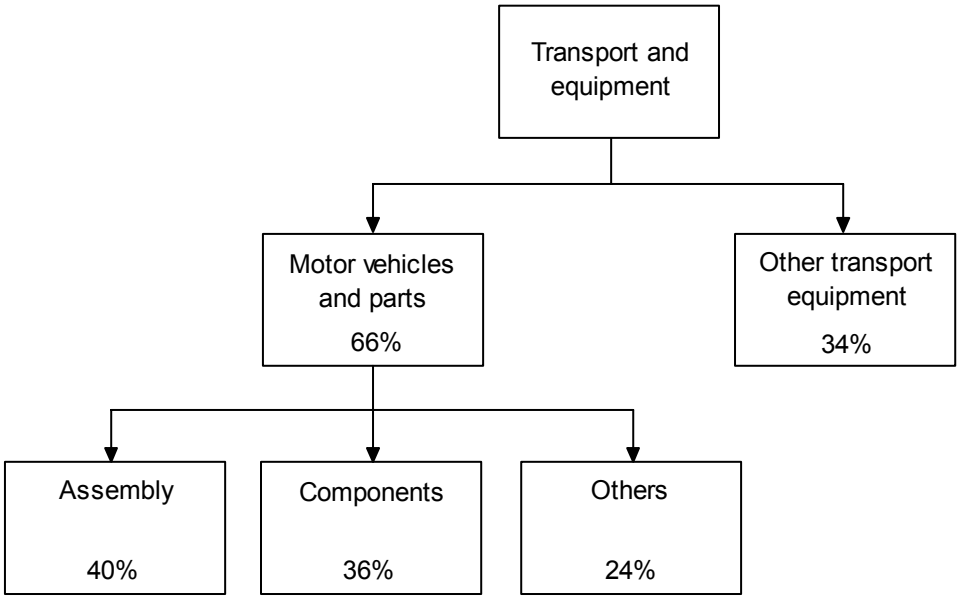
- car assembly
- car components
- other motor vehicles and components (called 'others'), which includes (but is not confined to) trucks, utilities, semi-trailers, motor cycles and engines.

The criterion used for this disaggregation was to allocate those items not directly affected by the headline Most-Favoured-Nation (MFN) automotive tariff rate of 10 per cent into the 'others' category.[6] Appendix D outlines how this disaggregation was performed and the outcome for the database.

The structure imposed on the MMRF database is consistent with that described in figure 3.1 — car assembly and components account for about three-quarters of automotive industry output in the database. Various checks were performed to ensure that the disaggregated database was robust (appendix D). Table 3.1 shows how sectoral value-added at the jurisdictional level in the MMRF database is consistent with the latest-available ABS data.

6 ACIS assistance applies more broadly than tariff assistance. Therefore, a small part of the 'others' sector might be affected by modelled changes to ACIS funding.

Figure 3.1 **Industry structure in MMRF[a]**
Shares of value-added



[a] Shares for assembly, components and others reflect those obtained when the Commission's definitions of these sectors are applied directly to ABS 4-digit ANZSIC data on industry value-added. They are similar to the sector shares in the MMRF database after it is disaggregated.

Data sources: Commission estimates; ABS (2007a).

Table 3.1 **State sectoral shares of value-added**

	ABS			*MMRF*		
	2001-02			*2005-06*		
	Cars	*Components*	*Others*	*Cars*	*Components*	*Others*
	%	%	%	%	%	%
New South Wales	3	19	15	0	21	16
Victoria	63	53	51	73	48	48
Queensland	4	6	14	0	11	16
South Australia	28	19	14	27	14	12
Western Australia	2	1	5	0	5	7
Tasmania	0	1	1	0	1	0
Northern Territory	0	0	0	0	0	0
ACT	0	0	0	0	0	0
Total[a]	**100**	**100**	**100**	**100**	**100**	**100**

[a] Columns may not add to total due to rounding.

Data sources: Commission estimates; ABS (2005a-f, unpublished data).

Incorporating assistance

Automotive assistance is embedded in the standard MMRF model. However, changes to the database were needed to identify and account explicitly for ACIS and its interaction with the tariff. Further, as requested of the Commission (appendix A), the Green Car Innovation Fund (GCIF) was incorporated in the database.

Tariffs

The ABS input–output table on which the MMRF database is based contains tariff revenues and import values for each commodity. These can be used to derive a trade-weighted average tariff rate for each commodity. The rates obtained for the car assembly and car components sectors are 5.7 per cent and 4.2 per cent respectively. These figures are much lower than 10 per cent because they include the negative effect that ACIS import duty credits have on tariff revenue (table 3.2).

When adjusted, the ACIS-exclusive tariff rates of around 8 per cent for cars and components reflect the average tariff rates that would be faced if the ACIS scheme did not exist. They are still lower than the headline MFN rate of 10 per cent for three reasons.

1. As outlined in chapter 2, a range of preferential agreements with Australia's trading partners reduces the average tariff rate.
2. Concessional arrangements exempt some imports from duty.[7]
3. Some imports subject to duties of less than 10 per cent were included in the car and components sectors, due to the complexity of aligning trade and input–output classifications (table 3.3; appendix D).

Table 3.2 **Tariff rates implied in the MMRF database**

	Including ACIS[a]	Excluding ACIS[b]
	%	%
Cars	5.7	8.4
Components	4.2	7.6

a Tariff rates implied by tariff revenues and value of imports in the MMRF database. **b** Tariff rates consistent with the value of duty that would have been paid, had ACIS not been in place.

Source: Commission estimates based on MMRF database.

7 *Customs Tariff Act 1995* (Cwlth), Schedule 4.

Table 3.3 **Sectoral distribution of headline MFN tariff rates**
Share of value of imports

	10 per cent	*5 per cent*	*0 per cent*
Cars	66	34	0
Components	60	31	8

Source: Commission estimates based on WITS (World Integrated Trade Solution).

ACIS

ACIS funding was only implicitly reflected in the original database — by the lower level of tariff revenue that arises from the use of ACIS credits to offset the duty payable on eligible automotive products. To model the policy scenarios for this study, ACIS funding needed to be accounted for explicitly.

To do this, the total estimated ACIS funding of $537 million (chapter 2) was allocated across jurisdictions (table 3.4), using information:

- from the MMRF database on the relative proportion of car and component manufacturers in each jurisdiction
- on how credits are allocated nationally (chapter 2).[8]

Table 3.4 **ACIS funding by jurisdiction**

	Shares[a]		*ACIS funding*[b]	
	Of total costs (car assembly and components)	*Of ACIS*	*Capped*	*Uncapped*
	%	%	$ m	$ m
New South Wales	13	8	45	0
Victoria	56	63	235	102
Queensland	8	5	29	0
South Australia	18	21	76	35
Western Australia	4	2	13	0
Tasmania	1	0	2	0
Northern Territory	0	0	0	0
ACT	0	0	1	0
Total	**100**	**100**	**400**	**137**

[a] Columns may not add to 100 due to rounding. [b] For 2006-07.

Data sources: Commission estimates (appendix D); ABS (2005a-f, unpublished data).

There were several options for including ACIS funding in the database (box 3.2).

8 Jurisdiction-based ACIS data are not otherwise available.

Box 3.2 Modelling ACIS — a subsidy for what?

The nature of ACIS means that it could be seen as part research and development (R&D) subsidy, part subsidy on imported inputs, and/or part general production subsidy.

An R&D subsidy?

Although some ACIS funding is allocated on the basis of R&D expenditure, ACIS could only be seen as an R&D subsidy if it increased R&D expenditure (by lowering the cost to producers of R&D) *at the margin*. However, ACIS expenditure (which is lower than total R&D expenditure) appears to be 'infra-marginal' and, therefore, would not act as an R&D subsidy. Even if this were not the case, the broad definition of R&D under ACIS, and the nature of R&D in the industry (chapter 5), mean that it would be unlikely to generate spillovers associated with R&D.

An import subsidy?

Being delivered as import duty credits, ACIS lowers the prices of eligible automotive imports (as would an import subsidy). In this case, it could create a bias towards the use of imported rather than domestically-produced inputs (partly offsetting the initial distortionary effects of the tariff on input choice). This assumes that industry participants first use credits to offset duty payable on eligible imports, a reasonable assumption since they lose about 3–5 cents for every one dollar of credits traded. It is also consistent with evidence as to how credits seem to be used by eligible importers of eligible automotive products. However, ACIS may not act entirely as a subsidy on imports, because:

- the value of tariffs on the imports of automotive products that are eligible for the use of ACIS credits exceeds the value of the relevant credits
- the credits are tradeable.

A production subsidy?

Because most ACIS funding is allocated on the basis of production levels and credits are fully tradeable, it can be seen as equivalent to a pure cash payment and therefore acts, at least in part, as a production subsidy. Given this, ACIS may:

- enable producers to sell their output below the cost of production — that is, drive a wedge between sales revenue and production costs of car and component producers, so that the price to users changes but resource costs are not lower
- promote higher levels of production than otherwise
- result in lower imports than would be the case if it were a pure import subsidy.

Other effects of ACIS

Compliance costs — record keeping, reporting and administration requirements — are incurred by businesses which register for ACIS. For example, employers need to report the amount of time spent by employees on automotive R&D and other activities. There are also costs for the Government associated with administration and monitoring.

ACIS was incorporated as follows:

- uncapped funding was included as an import subsidy
- capped funding was treated as a production subsidy.

Although it is recognised that this is not precisely how the scheme operates, it is a reasonable approximation and provides insights into the interaction between the tariff and ACIS.[9] More information on the treatment of ACIS is provided in appendices B and D.

Moreover, in line with the task requested of the Commission, ACIS was also modelled as a pure production subsidy in one scenario.

The Green Car Innovation Fund

The Commission has not been asked to evaluate the effects of the GCIF, but has been asked to include it in the 'base case'.[10] As noted in chapter 2, however, most details of the Fund are yet to be determined.

The design features of the GCIF are relevant to how it is incorporated in the database (box 3.3). Those features influence, for example, the effects on automotive production, and environmental and innovation spillovers (box 3.4).

Box 3.3 Considerations in designing the GCIF

Issues (highlighted by car producers) that will arise in designing the GCIF include:

- how the funding is delivered — for example, whether through upfront cash grants, tax breaks or production credits
- which firms are eligible to receive funding, for example:
  - whether there will be a cap on the amount individual companies can receive
  - whether funds are allocated to Australian operations or parent companies
- whether funding will be additional to current programs
- whether one technology or a range of technologies will be funded
- the total amount of the funding.

Source: Murphy and Porter (2008).

9 This facilitated the modelling; given the way uncapped funding depends on the value of production and on the tariff rate, the formula used to calculate its amount was incorporated into the model structure to allow any changes in output to affect ACIS endogenously.

10 This was clarified at the workshop. As a result, the GCIF was included in the MMRF database, consistent with the workshop discussion.

Box 3.4 **Possible effects of the Green Car Innovation Fund**

Likely impacts on automotive production

The GCIF essentially is a subsidy for the development and production of hybrid or other 'green'-type vehicles in Australia. Subsidies reduce unit costs to producers of the activity to which the funding applies, but not the real resource costs to the Australian economy. The GCIF will expand development and production of green cars (over and above the level that producers would have undertaken without the additional support) to the extent it compensates producers for the additional costs they incur in excess of potential market returns.

The extent to which the GCIF encourages a net increase in industry output will depend on the rate of subsidy — if producers are just compensated for higher costs of producing green cars (including forgone profits from producing other models), there will be a change in the mix but not the overall level of production. If the subsidy is more generous, there could be a change in the vehicle mix as well as a net expansion in production and investment.

To the extent that the GCIF subsidises production of a model that would otherwise have been uncommercial, it would have negative effects on productivity in the industry, and impose an economic loss on the economy overall.

Potential environmental spillover effects

The GCIF appears geared to encouraging the production of environmentally-friendly cars, rather than supporting environmentally-friendly production methods. Thus, any environmental benefits of the GCIF relate to increased purchases of green vehicles. However, with the local retail price still determined by the tariff-inclusive price, it is unlikely that overall sales of green vehicles would increase markedly, although there would be a switch towards those produced locally. Moreover, the Government has announced the introduction of an Emissions Trading Scheme (ETS). This scheme, by setting a price for carbon emissions, will induce cost-effective responses to emissions abatement across the economy. In this context, policies that target use of particular abatement technologies become redundant, and will only impose additional, unnecessary costs.

Potential innovation spillover effects

The GCIF may encourage some development of green car technology in Australia. However, it is likely that this technology would be 'owned' and patented by vehicle makers who could then sell it incorporated in their vehicles, or directly to other manufacturers. It can be argued that in the absence of a price for carbon emissions, there is little incentive for firms to develop abatement technologies because the market undervalues abatement. Again, however, unlike the GCIF, an ETS will provide this signal in a way that does not attempt to pick technology 'winners'.

In the absence of more information, the following assumptions about the Fund were made when incorporating it in the MMRF database:

- it is allocated evenly over the five years — $100 million per year (which is in line with the Government's Budget allocations for 2011-12 (chapter 2))
- it is delivered as a cash payment and therefore represented in the database as a production subsidy, with no account for any other possible effects (box 3.4)
- it is allocated to car assemblers only, according to the shares of car production in Victoria and South Australia.

The model's closure

The following 'central' model closure was adopted for the main simulations.

In the aggregate economy:

- labour supply by occupation is fixed nationally (being determined independently of the policies under investigation), so all adjustments in the national labour market translate into changes in real wages for each occupation
- the after tax rate of return on capital is fixed, and the capital stock adjusts to keep that rate constant
- investment moves in proportion with changes in the capital stock, and is funded by Australian savings and foreign inflows of capital
- private savings and consumption change in line with household disposable income
- the trade balance is endogenous, and adjusts to keep additional investment fully funded
- the level of real public current expenditure moves in proportion with the level of real aggregate private consumption expenditure
- the Australian Government surplus is a fixed proportion of GDP — consistent with the assumption that budgetary policy should not be influenced by changes in automotive industry policy — and a tax on factor incomes adjusts to maintain this ratio.

At the jurisdiction level:

- labour is mobile across jurisdictions, responding to 'short-term' changes in relative wages, and changes in occupational wages equate across jurisdictions
- in a similar way, capital is reallocated across jurisdictions in response to 'short-term' changes in its after tax returns.

At the industry level:

- policy changes do not alter the technology available to producers, however producers may change the capital–labour ratio of their production processes in response to changes in relative factor prices
- capital and labour are reallocated across industries, in response to changes in their respective returns.

These closure settings are broadly consistent with those used in PC (2007) and many other Monash and MMRF trade simulations (for example, IC (1997) and PC (2002, 2003)).

The settings for labour and capital reflect what is often referred to as a long-run closure. Although there is no time dimension in a comparative-static model, this 'long run' is generally interpreted to be about seven to ten years (enough time for adjustments to policy changes to be completed). A result of these settings for labour and capital is that the relative size of the State/Territory economies is likely to change in response to changes in assistance, as resources are reallocated from the automotive industry to other industries, and from automotive-intensive jurisdictions to other jurisdictions. Further, if the capital stock increases, then both the size of the economy and its capital intensity will increase.

Three alternative closure settings were used to analyse the sensitivity of results to the assumptions of flexibility in movements of labour and capital outlined above.

Alternative closures

As the flexibility of the economy to respond to policy changes is constrained, the size of gains can be reduced or sometimes turn negative. Three sensitivity simulations were run with the following alternative closures to illustrate this point.

- The 'decomposition closure' fixes the national stock of capital, and the rate of return of capital adjusts. This closure is designed to isolate the reallocation effects of movements in labour and capital across industries and jurisdictions in response to a policy shock, as well as their associated terms of trade effects.
- The 'variable rate of return' closure allows some flexibility in the supply of capital from abroad, but less than in the central closure. This closure assumes that, as Australia increases its borrowings from abroad, lenders require a risk premium, which leads to a rise in the required rate of return and reduces the amount of additional capital.
- The 'short-run' closure fixes capital at the national, jurisdictional and industry levels, and restricts labour movements to within jurisdictions. This closure

represents a very short-run economic environment, represented by restricted factor movements.

3.3 Implementing shocks to the model

With the structure and database of the MMRF model modified to suit the needs of this study, the model was ready to simulate the alternative policy scenarios. These scenarios involve changes in the combination and level of assistance requested through tariffs and ACIS, under different assumptions. The simulations were grouped into three categories (table 3.5):

- reference scenarios (labelled R1 through R4) designed to provide a detailed analysis of the effects of tariffs and of ACIS — these scenarios include some of the options described in the task requested of the Commission (appendix A)
- options scenarios (labelled O1 through O8), which cover the options described in the task requested of the Commission
- sensitivity scenarios (labelled S1 through S5).

Table 3.5 **List of scenarios for modelling automotive assistance**[a]

Scenario	*Description*
	Reference scenarios
R1	Tariff reduced from 10% to 5% and ACIS discontinued (=R2+R3) (current plan)
R2	Tariff reduced from 10% to 5% and ACIS maintained at Stage 2 (equivalent to O2)
R3	Tariff maintained at 10% and ACIS discontinued (equivalent to O6)
R4	Scenario R1 with 'decomposition' closure
	Options outlined in appendix A[b]
O1	Tariff reduced from 10% to 5% and ACIS reduced to Stage 3
O3	Tariff reduced from 10% to 5% and ACIS maintained at Stage 2 delivered as grants
O4	Tariff maintained at 10% and ACIS reduced to Stage 3
O5[c]	Tariff maintained at 10% and ACIS maintained at Stage 2 (equivalent to database)
O7	Tariff reduced from 10% to 0% and ACIS discontinued
O8	Scenario O1, with 10% increase in mining commodity prices
	Sensitivity analyses[d]
S1	Scenario O7 with general tariff to 0%
S2	Scenario R1 with export demand elasticity of 5
S3	Scenario R1 with endogenous budget surplus
S4	Scenario R1 with 'variable rate of return' closure
S5	Scenario R1 with 'short-run' closure

[a] All non-sensitivity analysis simulations assume a fixed Australian Government budget to GDP ratio, and an export elasticity of 10. [b] In translating these options into simulated scenarios, the Commission has interpreted an increase in ACIS as retaining Stage 2, because current arrangements' in those options are referred to as Stage 3. [c] Scenario O5 (interpreting an increase in ACIS as retaining Stage 2) is reflected in the database and all scenarios are compared with this situation. [d] Scenarios S2 to S5 model alternative assumptions about the model settings and parameters.

Table C.3 in appendix C outlines the initial budgetary impacts of a range of these scenarios. The remainder of this section outlines how the shocks to the tariff rate, ACIS and the exchange rate were implemented across the three scenario categories.

Modelling tariff changes

The tariff shocks outlined above included changes to the automotive tariff rate and the general tariff rate.

Automotive tariffs

Tariff shocks are implemented by reducing the tariff rates in the MMRF model (table 3.2) by a percentage amount consistent with a reduction in the headline MFN rate from 10 to 5 per cent.[11] This amount is obtained using detailed HS 8-digit level data, with the percentage changes given in table 3.6. In performing this calculation, it is assumed that the MFN rates give the closest approximation to the price wedge created by tariffs and, therefore, preferential tariff rates are abstracted from in this calculation (chapter 2).

Table 3.6 **Percentage change in trade-weighted average tariff rate**
Associated with a change in the headline MFN rate from 10 to 5 per cent

Cars	38
Components	43

Source: Commission estimates, using WITS (World Integrated Trade Solution).

General tariff

One of the options (labelled scenario O7) was to model an elimination of the automotive tariff (as well as all ACIS funding). An alternative way of simulating this is to model it in conjunction with an elimination of the general tariff rate (scenario S1). This alternative avoids the allocative distortions associated with uneven tariff rates across sectors.

Modelling ACIS

The ACIS options were modelled as follows.

- The scheduled reduction in ACIS from Stage 2 to Stage 3 was modelled as a

[11] Eliminating the automotive tariff rate is modelled as a 100 per cent reduction.

reduction in capped credits only — from $2 billion to $1 billion. This is because formulas for calculating uncapped credits are set to remain unchanged in Stage 3 (chapter 2).

- However, given the way uncapped credits are allocated, the value of uncapped credits was modelled to change in line with any change to production levels or the modelled tariff rate.
- Winding up ACIS was modelled as the elimination of both capped and uncapped credits.

Modelling $A appreciation as a commodity price shock

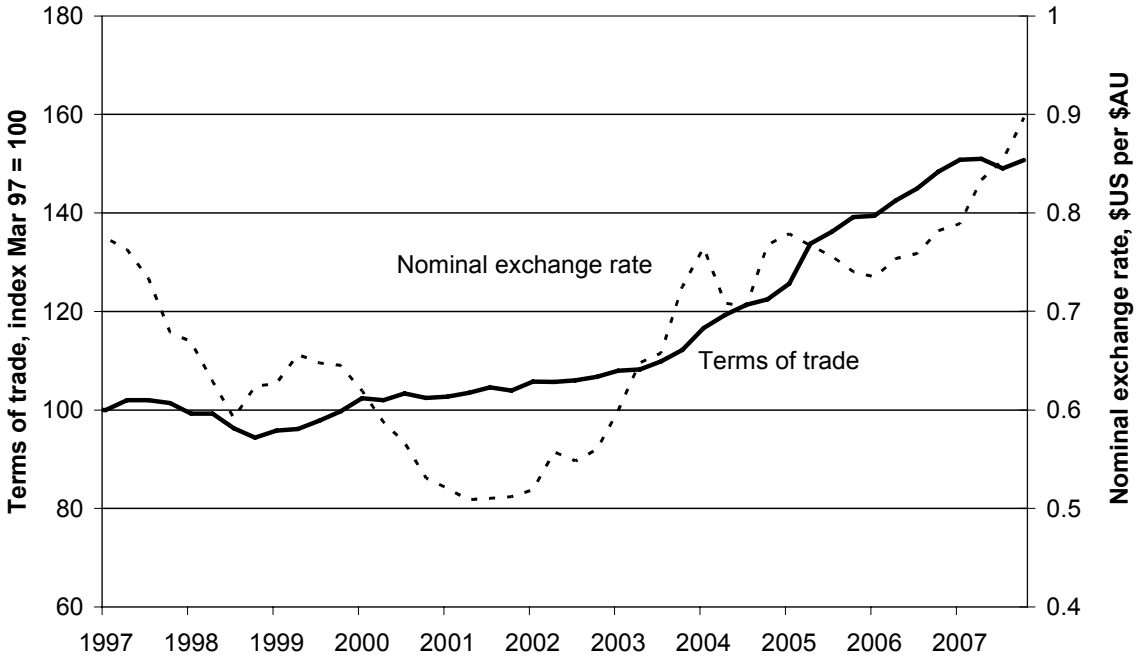
The MMRF model does not include nominal bilateral exchange rates, affecting how the Commission could address the request to simulate the effects of a further appreciation of the Australian dollar to achieve parity with the US dollar. (It contains just one exchange rate — that is, a real exchange rate between Australia and the 'rest of the world'.) The scenario requested would have to be modelled indirectly in the model — that is, by implementing a change in the real economy that would lead to a change in the real exchange rate.

The nominal exchange rate is the price of a foreign currency in terms of the Australian dollar. It is determined by the demand and supply of two currencies for international and domestic transactions and is affected by the stock of currency and, therefore, inflation in both economies. The *real* exchange rate is adjusted for inflation. In MMRF, it is the ratio of the domestic price of imports and domestic producer prices (as measured by the GDP deflator).

While exchange rate changes can be caused by a wide range of circumstances, the key driver of the real and nominal appreciation over recent years has been the rising terms of trade, driven by strong increases in foreign demand for, and therefore export prices of, base metals and minerals (figure 3.2). It is this cause of the exchange rate appreciation that has been modelled, in line with comments of referees and participants at the Commission's technical workshop (appendix B). Demand for Australia's exports of base metals and mineral commodities was increased sufficiently to produce a 10 per cent rise in the export price of these goods, which causes an appreciation in the exchange rate.

An approximation of the effect of the exchange rate appreciation on the automotive industry can be obtained by scaling the simulation results. For example, to analyse the effect of an appreciation to parity with the US dollar, the change in automotive output would be multiplied by a ratio of the change in the exchange rate required to reach parity to the change in the exchange rate given by the modelling results.

Figure 3.2 **Australia's terms of trade and the nominal exchange rate**



Data sources: ABS (2008b); RBA (2008).

3.4 Key outputs

The results of MMRF simulations are interpreted as long-run effects — that is, changes in the economy once all adjustments in goods and factor markets have occurred.[12] These effects are described by the following key outcome variables generated by the model:

- national and jurisdiction outputs (measured by GDP and gross state products)
- sectoral output, value-added and employment by jurisdiction
- employment by occupational group, in each jurisdiction, and by industry
- exports and imports by commodity, nationally and by jurisdiction
- revenues and expenditures for the State/Territory and Australian Governments.

The change in real gross national expenditure (GNE), adjusted for the share of additional investment funded by foreign sources, has been used as the key measure of economic 'welfare' changes in this study (box 3.5).

[12] Some of the sensitivity or decomposition closures are defined as short run, and adaptation is limited, as discussed earlier in this chapter.

Box 3.5 **Measuring changes in economic welfare in the MMRF model**

A measure of economic welfare is an attempt at capturing the effect of a policy change on the well being of Australians derived through additional consumption. This study uses changes in real gross national expenditure (GNE) adjusted for foreign investment as the principal indicator of changes in aggregate welfare resulting from changes in automotive policy settings. GNE is defined as the sum of private and public consumption and investment. In interpreting GNE as a measure of welfare, investment is interpreted as the present value of the future consumption that it generates. To the extent that part of that investment is financed by foreigners, they have claims on a proportionate amount of future income, which is excluded.

The following provides an outline of the rationale for this approach.

Private and public consumption expenditure

Traditionally, economists use combined changes in consumer and producer surplus, together with changes in taxes, as the indicator of economic welfare. In the case of private consumption, 'equivalent variation' is often used to estimate consumer surplus. This is a measure of the amount of income that would offset the benefits to the consumer that arise from the changes modelled (for example, a reduction in the price of cars). This measure is related to the change in consumption expenditure deflated by the change in prices — that is, real consumption. A similar logic is applied to changes in spending on government services, which form part of the wellbeing of households.

In the MMRF model, households receive the incomes from all factors (so a separate calculation is not required for producer surplus) and taxes adjust households' disposable income. Real consumption provides, therefore, a good proxy for the traditional measures of welfare for this part of GNE.

Private and public investment

In a dynamic model that accounts properly for the implications of changes in foreign debt, changes in real private and public consumption are measured accurately. In a comparative-static model, it is difficult to account for the implications of changes in the capital stock that underlie the results. In this study, investment is interpreted as claims against future consumption. The additional capital requires an increase in investment. To the extent that some of this investment is financed by foreigners, only the part of investment relevant to Australian investors should be included in calculating the part of GNE that is relevant to measuring a change in the welfare of Australian residents. In the MMRF database, 80 per cent of capital is assumed to be Australian owned. Australian-owned investment is funded by domestic savings while foreign-owned investment is funded by the trade deficit and foreign income flows (the current account deficit).