# 1 Modelling approach

The terms of reference for this inquiry asked the Productivity Commission to report on, amongst other things, any significant transition issues or adjustment costs that may arise from alternative assistance mechanisms or policy changes and how they might be best managed. The Commission was also asked to quantify the economywide and regional costs and benefits of existing and alternative assistance mechanisms.

At the outset of the inquiry, quantitative analysis may have appropriately focused on alternative industry-specific assistance mechanisms and the economywide, industry and regional impacts of further assistance, notwithstanding that Ford Motor Company of Australia (Ford) had announced it would cease local vehicle manufacturing by October 2016. However, during the course of the inquiry, General Motors Holden (Holden) and Toyota Motor Corporation Australia (Toyota) also announced that they would cease motor vehicle and engine manufacturing in Australia by the end of 2017.

In view of these developments, the Commission has focused its quantitative analysis on the potential implications of the impending motor vehicle manufacturing plant closures in Australia. Quantitative analysis can shed light on the broad order of magnitude of the adjustment task.

In the Commission’s modelling, the passenger motor vehicle manufacturing industry[[1]](#footnote-1) workforce is assumed to decline by 80 per cent from current levels as a consequence of plant closures. This assumes that a number of jobs in design and engineering (consistent with the announcements of both Ford and Holden), head office, sales and marketing functions are retained. These latter services and the associated employment of labour and capital are reclassified (for the purpose of this analysis) to become part of the ‘business services’ sector in the Victorian economy — the current location of the head offices of Ford, Holden and Toyota.

Employment is also assumed to decline by 40 per cent from prevailing levels in the automotive components manufacturing industry as a result of the cessation of large-scale passenger motor vehicle manufacturing. Virtually all of this reduction is assumed to occur in component manufacturing in Victoria and South Australia.

The Commission’s approach also allows for the operation of a small-scale motor vehicle manufacturing industry for specialist and bespoke vehicles — an allowance for this of around 2 per cent of current industry production has been included in this illustrative analysis. Accordingly, the exit of the major vehicle manufacturers is assumed to result in a 98 per cent decline in the Australian output of passenger motor vehicles.

With the closure of the major passenger motor vehicle manufacturing plants occurring by the end of 2017, industry-specific budgetary assistance to the automotive manufacturing industry is modelled as ending at that time.

It is important to note that the statistics quoted in this supplementary report follow the ABS classifications of the different segments of the automotive industry. These ABS classifications do not line up exactly with the boundaries commonly thought of within the automotive manufacturing industry or relevant to the administration of government assistance programs to the industry and its suppliers. In particular, ‘*automotive components manufacturing*’ that forms part of the ABS motor vehicle and motor vehicle part manufacturing industry is defined more narrowly than what is regarded as automotive component manufacturing by the industry (which also covers a range of chemical, plastic, metal and glass products).[[2]](#footnote-2) The Commission’s analysis takes account of the industry’s broader definition of automotive components manufacturing by capturing the broader range of manufacturing activities that support passenger motor vehicle manufacturing, and a system of input-output linkages between the passenger motor vehicle manufacturing industry and other industries.

The exit scenario modelled is outlined in table 1.1. To illustrate a range of possible adjustment implications following the closure of the major passenger motor vehicle manufacturing plants, the Commission has undertaken tests to highlight the sensitivity of possible changes and adjustment paths associated with these closures (chapter 4).

Table 1.1 Illustrative scenarios modelled

|  |  |  |
| --- | --- | --- |
| Scenario | Passenger motor vehicle and automotive components production | Budgetary assistance — motor vehicle manufacturing and automotive components |
| ***Exit scenario modelled*** | | |
| Closure of motor vehicle manufacturing plants in Australia | All large-scale passenger motor vehicle manufacturing in Australia ceases by the end of 2017,a but some ongoing head office, design and engineering and marketing functions in Australia are maintained. Automotive component manufacture equivalent to 40 per cent of employment in the Australian components industry assumed to cease concurrently with the cessation of passenger motor vehicle manufacturing. | The profile for ATS funding incorporates reductions announced in the 2013-14 Mid-Year Economic and Fiscal Outlook.b No assistance allocated once large‑scale passenger motor vehicle manufacturing ceases. |
| In estimating the timescale over which the economy adjusts to plant closures, aggregate unemployment is modelled as increasing in the short term as displaced automotive employees take time to find re-employment, but unemployment returns to base levels in the long term. Two job loss scenarios are considered based on the number of people currently employed in passenger motor vehicle manufacturing and the automotive supply chain and duration analysis of the unemployment experience of manufacturing industry workers. | | |
| **Alternative modelling assumptions examined and sensitivity testing** | | |
| * Alternative assumptions about the rate of adjustment in labour markets, with respect to the interstate mobility of the workforce. | | |
| * Alternative assumptions about the rate of adjustment of investment in new capital. | | |
| * Alternative assumptions about the effect of increased import substitution possibilities (Armington elasticities) across products by industry. | | |

a Ford has announced it will cease vehicle and engine manufacturing in Australia by October 2016 and Holden and Toyota have announced they will cease vehicle and engine manufacturing in Australia by the end of 2017. b Based on estimates provided by the Department of Industry.

In view of the Commission’s conclusion that the case for providing industry-specific assistance to the automotive manufacturing industry is weak, the analysis does *not* seek to answer the questions: ‘What are the cost disadvantages of manufacturing motor vehicles in Australia and what would be the likely level of government subsidies required to retain production in Australia?’ Nor does it seek to answer the question: ‘How might such a subsidy vary over time with changing consumer tastes and demand for local offerings, industry costs and changes in the terms of trade and other general economic conditions?’ It follows that the modelling does not estimate the potential efficiency costs of continuing to provide assistance to the industry.

## 1.1 The modelling framework

To assess the economywide and regional impacts of changes in the automotive manufacturing industry, it is necessary to examine changes in the industry itself and flow-on effects to different sectors and groups within the economy. These impacts will depend on, among other factors, changes in resource use by different sectors of the economy, changes in Australia’s terms of trade with the rest of the world and other relative prices effects.

The Commission and its predecessors have made extensive use of economywide computable general equilibrium models to assess the impacts of changes in industry assistance on economic activity and the impacts of economic policy reforms. In 2008, the Commission used a computable general equilibrium framework to model the effects of future automotive assistance arrangements (PC 2008) and in 2012, it used a similar (but updated and extended) framework to assess the impacts of Council of Australian Government’s (COAG) policy reforms (PC 2012a). The particular model adopted in each of these studies, and a number of earlier studies, is the Monash Multi-Regional Forecasting (MMRF) model.

The version of the model being used in this study — termed the MMRF‑Auto14 model — follows that used in the Commission’s 2012 study on the impacts of COAG reforms. This model treats each state and territory as a separate economy linked by inter-regional trade. Production in each jurisdiction is disaggregated into 66 industries. The model also includes a regional equation system that applies a ‘top-down’ approach to project state and territory results to 58 statistical divisions on the basis of relative employment by industry in each division.

In the model, the automotive manufacturing industry is disaggregated into three segments:

* passenger motor vehicle manufacturing
* automotive component manufacturing, including among other things, the production of panels, fuel pumps, transmission systems, instrumentation, seatbelts, lights, windscreen wipers and air conditioners
* other automotive manufacturing, including other vehicle production (production of trucks, buses, motor bikes and motor scooters) and motor vehicle body and trailer production (which does not include the large-scale manufacture of passenger motor vehicles, but relates to the manufacture of bus and truck bodies, caravans and trailers, and modification of finished vehicles).

Separate identification of the passenger motor vehicle manufacturing segment in the model allows the model database to capture input-output linkages between the passenger motor vehicle manufacturing industry and all other industries included in the model, including other manufacturing industries that are part of the automotive supply chain.

Based on ABS statistical information, inquiry information received through submissions and consultations, and the model database, it is estimated that:

* the passenger motor vehicle manufacturing industry accounts for about 0.1 per cent of both value added and employment in Australia, while the automotive components manufacturing industry (as defined by the ABS) accounts for just under a further 0.2 per cent
* over half of Australian-manufactured passenger motor vehicles by value is purchased by individuals and households for personal use, around 20 per cent is exported and 25 per cent is used as inputs into the creation of physical capital (investment)
* Australian-produced components and other manufactures make up around 30 and 25 per cent, respectively, of the costs of domestic inputs used in manufacturing passenger motor vehicles in Australia, with the remainder comprised of services
* Australian-sourced inputs account for almost 70 per cent of the cost of Australian-produced passenger motor vehicles, with the remainder being comprised of value adding inputs of labour and capital and imported components
* while the links between automotive components suppliers and passenger motor vehicle manufacturers differ substantially between firms, overall, just over 20 per cent of the Australian-manufactured output of automotive components (as defined by the ABS) are used directly in the manufacture of passenger motor vehicles
* around 70 per cent of automotive components produced in Australia are then used by other industries and consumers as aftermarket sales[[3]](#footnote-3) with the balance being exported or for own use
* less than 1 per cent of other Australian-produced manufactures, such as metal and chemical products, are used in the manufacture of passenger motor vehicles
* the manufacture of passenger motor vehicles, including engines, is centred in the statistical divisions of Melbourne and Barwon (covering Geelong, where Ford’s engine plant is located) in Victoria and Adelaide in South Australia (covering Elizabeth), with employment split between these divisions in the proportions around 70, 10 and 20 per cent, respectively
* production of automotive components is located mainly in the capital city areas of Victoria and South Australia, with smaller contributions from New South Wales, Queensland and Western Australia (with the capital cities accounting in total for around 82 per cent of employment in components production).

The MMRF model is applied in *comparative-static* mode to project the longer-run effects of change and in *dynamic* mode to explore the timescale over which changes may occur and possible adjustment implications. Under the dynamic approach, the modelling scenario focuses on the path of the economy with the modelled closure of passenger motor vehicle manufacturing plants by the end of 2017.

The broad growth path of the economy adopted for this study follows that adopted for the Commission’s 2012 report on the impacts of COAG reforms and is based on assumptions about changes in population, terms of trade and labour productivity (PC 2012). Modelled changes in labour productivity and other variables are based on historical data at the sectoral level. Changes in population are estimated using a cohort-based demographic model. It includes sector-specific changes for the motor vehicle manufacturing industries (appendix B).

The MMRF‑Auto14 model as applied in this study is outlined in appendix A and the model database and its construction is outlined in appendix B. A detailed description of the theoretical structure of the model is provided in *A Dynamic Multi-Regional Applied General Equilibrium Model of the Australian Economy* (CoPS forthcoming). A draft of this manuscript is available on request to the Commission.

## 1.2 The modelling in context

No model can fully replicate the economy and all of its complex interactions. The economywide approach adopted in this inquiry seeks to capture many of the relationships relevant to modelling the closure of passenger motor vehicle manufacturing plants in Australia. The motor vehicle manufacturing closure scenario seeks to reflect the direct effects on industry of corporate decisions concerning the location of production facilities around the globe — decision-making processes which are determined outside of the model. In model simulations, the direct effects of decisions to establish or close plants are imposed on the model as exogenous ‘shocks’ or a model ‘scenario’ and the flow-on economic effects are estimated.

As the scenario modelled reflects production decisions imposed on the model, it should *not* be interpreted as a quantification of the effects of government policy decisions. As discussed in the inquiry report, the cost of maintaining a motor vehicle manufacturing industry in Australia would likely be significant and would need to increase over time through import tariffs or budgetary assistance if current trends continue (inquiry report, box 3.8, p. 103). However, the precise level of assistance that would be required is uncertain and accordingly the efficiency and welfare effects of continued assistance have not been modelled.

While the economywide approach of the MMRF model supports the analysis of a range of changes affecting industry, regions and the national economy, there are some real-world processes that are not included. For example, the model does not capture the emergence of new activities and products or productivity improving changes in the use of resources. The model also does not capture factors such as economies of scale or scope that change the commercial viability of production units or lead firms to concentrate new production at a particular plant or in a particular location.

The dynamic modelling of the possible timescale of effects is based on a framework of ‘adaptive’ expectations where industry adjusts gradually to economic change. Under this approach, capital progressively depreciates and accumulates to equilibrate actual return on capital with the expected rate, based on the historical average. The possible implications of alternative rates of capital accumulation are investigated in this modelling exercise through sensitivity testing. More broadly, the economic adjustments that are realised may differ from those modelled to the extent that firms anticipate changes and, in so doing, adjust investment, output and employment decisions according to their expectations of the industry and economywide effects of the closure of passenger motor vehicle manufacturing plants in Australia.

The behavioural parameters included in the MMRF‑Auto14 model determine the responsiveness of producers and consumers to changes in relative prices and are based on benchmark model values. To the extent that behavioural responses by producers and consumers differ (such as in purchasing local and imported supplies, the substitution between labour and capital in production or the relocation of labour between regions) from these benchmark values, results could under- or overstate outcomes.

Similarly, the compilation of the model database is based on many simplifying assumptions needed to translate and calibrate available statistical information into a balanced database representing the complex interactions in the economy. Deviations in the model data from actual economic flows could lead to under- or overstatement of aggregate results, or variation in the distributional effects of change from likely outcomes. As described in appendix B, the Commission has sought to reflect the main features of the automotive manufacturing industry in the model database, including the observed declines in the level of output and employment in passenger vehicle manufacturing and the associated decline in this activity relative to other activities in the economy over the past decade.

## 1.3 Refereeing and consultation

In accordance with the requirements of the Productivity Commission Act, the Commission appointed two referees — Professor Peter Robertson, Head of Discipline/Winthrop Professor of Economics, University of Western Australia and Dr Ashley Winston, Chief Economist, KPMG Australia to assess its modelling approach and preliminary results. The Commission also held a modelling roundtable on 4 March 2014 to consider its preliminary results. Both referees attended the roundtable, as did representatives of Australian and state government agencies, the automotive industry and the Australian Manufacturing Workers Union (AMWU), as well as academics (inquiry report, appendix A). The consultations assisted the Commission to subsequently refine and improve the database construction, the modelling and presentation of results.

The modelling roundtable also allowed for discussion of modelling work provided by participants to the inquiry, in particular modelling provided by the Federal Chamber of Automotive Industries (FCAI) (sub. 30). As detailed in chapter 6 of the inquiry report, the modelling provided by the FCAI did not disaggregate the automotive manufacturing industry as in this report, but modelled a more than 90 per cent reduction in output of the entire industry. Their estimate of around 50 000 job losses is larger than the Commission’s estimates.

In the Commission’s assessment, a more appropriate upper bound estimate is 40 000 job losses, with plausible estimates of likely job losses (based on current industry employment) falling within this bound (chapter 3). This estimate takes account of the closure of passenger motor vehicle manufacturers and the flow on effects to component and other suppliers. It makes allowance for the significant extent to which manufacturers of aftermarket components, producers of buses and trucks and their component suppliers, and motor vehicle body and trailer manufacturers[[4]](#footnote-4) will continue production following the closure of passenger motor vehicle manufacturing plants.

## 1.4 Structure of reporting on the modelling

Chapter 2 of this supplement presents the longer-run modelled impacts of the closure of the major passenger motor vehicle manufacturing plants in Australia at the national, state and regional levels. Chapter 3 reports on the possible timescale of impacts. Chapter 4 examines the sensitivity of results to alternative assumptions about labour and capital market adjustment and the extent to which imports can substitute for domestic production.

As noted, appendix A provides a description of the MMRF‑Auto14 model, modelling assumptions and key model parameter values. Appendix B describes the database adopted, the disaggregation of the motor vehicle and parts industry and key cost and sales shares for the industry. Appendix C provides details of the specification of the modelling scenarios.

1. Passenger motor vehicle manufacturing is defined in this supplement as the manufacture of passenger motor vehicles, light commercial vehicles (including sports utility vehicles) and associate engine production. It excludes manufacture of heavy commercial vehicles, including buses and trucks, caravans and trailers. [↑](#footnote-ref-1)
2. Automotive component manufacturing in this supplement refers to automotive electrical component manufacturing and other vehicle parts manufacturing (as classified to ABS Australian and New Zealand Standard Industry Classification (ANZSIC) 1993 classes 2813 and 2819 and the equivalent classes, 2313 and 2319, in ANZSIC 2006). These activities are separately enumerated in the Commission’s modelling database (see below). [↑](#footnote-ref-2)
3. Supply of accessories and parts for motor vehicles fitted after a new vehicle has been sold, such as for mechanical repairs. [↑](#footnote-ref-3)
4. The ABS category 'motor vehicle body and trailer manufacturing' does not include the large-scale manufacture of motor vehicles, but relates to the manufacture of motor vehicle bodies (including bus and truck bodies), caravans and trailers, and modification of finished vehicles. [↑](#footnote-ref-4)