final report

Project code: P.MDC.0034

Prepared by: THE CENTRE FOR INTERNATIONAL ECONOMICS AND OLIVER & DOAM PTY LTD

Date published June 2015

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 1961
NORTH SYDNEY NSW 2059

Stage 2 enhancements of 'Payoffs from R&D along the Australian food value chain' relating to the CIE and other models

This is an MLA Donor Company funded project.

Meat & Livestock Australia and the MLA Donor Company acknowledge the matching funds provided by the Australian Government to support the research and development detailed in this publication.

DRAFT REPORT

Distribution of Benefits Along the Value Chain from MLA Activities

Project No. P.MDC.0034

Prepared for
Meat and Livestock Australia

SEPTEMBER 2016

THE CENTRE FOR INTERNATIONAL ECONOMICS AND OLIVER & DOAM PTY LTD

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Executive Summary

In this report a suite of economic models known as the Global Meat Industry / Integrated Framework (GMI/IF) is used to explore the overall industry level of benefits, and distribution of benefits between industry sectors, of various types of project work that may be undertaken by MLA.

Seven scenarios are used to explore the overall level and distribution of benefits from MLA's work. Broadly the seven scenarios involve improvements in export and domestic demand for Australian red meat, improvements in Australian meat processing and livestock raising productivity, a reduction in waste in the processing sector and increases in transport, wholesaling and retailing efficiencies both for agricultural outputs and processed products.

Using the GMI/IF model it is found that improvements in export demand produce the greatest benefits for the industry as a whole and for all sectors within the industry. At the other end of the spectrum, increases in transport, wholesaling and retailing efficiencies produce the least benefits.

The seven scenarios used in this report are the same as scenarios previously analysed by MLA using the CIE Food Model, enabling comparisons to be made between the two sets of model results. Although, for the seven scenarios analysed, the overall level of correlation between the two sets of model results is found to be high, significant differences are also noted. Analysis in this report attributes the differences in model results mainly to the way the Australian meat industry is represented in the two models and elasticities of demand and supply used.

In addition to the seven scenarios described above, this report also contains analyses for two scenarios involving increased sheepmeat sales into China. The first of these scenarios entails the development of a trade into China for chilled Australian lamb; the second entails the development of a new sheepmeat product for China based on MSA pathways. Although, in many respects, the initial impact of both these Chinese sheepmeat scenarios is similar, the final level of industry benefits is vastly different. A conclusion from this observation is that there is potentially significant value from ex-ante economic modelling in aiding project selection.

1. Introduction

Although MLA undertakes work along the complete livestock / meat value chain, MLA's primary purpose is to benefit Australian cattle, sheep and goat producers. It is important, therefore, to ensure that wherever along the value chain work is conducted by MLA that producer and other sector benefits from the work can be clearly articulated and measured.

MLA recognizes that significant differences may exist between those that may initially benefit from the work it undertakes ('first round' beneficiaries) and final beneficiaries. For example, MLA promotions designed to increase demand for Australian beef may initially benefit retailers selling the beef and the Australian processors from whom the beef is purchased. Over time, however, through increasing the demand for Australian cattle, Australian cattle producers should also benefit.

Economic models can be used to analyse the long term distribution of benefits across the value chain arising from initiatives of a particular type at any point in the value chain. MLA wishes to use economic models of the meat industry to understand how benefits from particular projects it has undertaken or may undertake are likely to be distributed across the different sectors of the industry.

The number of MLA projects is large, and these projects are diverse in nature. However, the economic impact[1] from MLA's work can be generally classified into just a few areas:

- to expand domestic demand by:
  - improving the quality, features or information about a product;
  - finding a new use for an agricultural product or by-product of processing;
  - to expand international demand using similar mechanisms to those above and also through reducing economic or technical barriers to trade;
- to increase the productivity of resource use on farm - for example, through livestock genetic improvement or through better feeds;
- to increase the productivity of resource use in processing — for example, through the introduction of new technology in processing plants that raises levels of efficiency;
- to increase through chain productivity – for example by improving road or rail transport efficiency or by better information flows resulting in greater collaboration, decision synchronisation and product more aligned with customer requirements.

In this report a suite of economic models known as the Global Meat Industry / Integrated Framework (GMI/IF) is used to explore the overall industry level of benefits, and distribution of benefits between industry sectors, of various types of project work undertaken by MLA. The overall level and distribution of benefits is explored using seven scenarios of the impact from MLA's work:

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1 Of course, MLA's work may also have environmental and social impacts – but only economic impacts are considered in this report.

- a 1 per cent improvement in export demand;
- a 1 per cent improvement in domestic demand;
- a 1 per cent improvement in processing productivity arising from greater efficiencies in non-livestock cost areas;
- a 1 per cent reduction in transport, wholesaling, marketing and retailing costs for processed products;
- a 1 per cent improvement in processing productivity arising from extracting more saleable meat from the livestock carcase;
- a 1 per cent improvement in on-farm productivity, such as might arise from MLA research and extension activities into livestock genetics or the feedbase; and
- a 1 per cent reduction in transport, wholesaling, marketing and retailing costs of agricultural outputs.

These seven scenarios were chosen because they replicate scenarios previously analysed by MLA using a different suite of models, the CIE Food Model. One of the aims of this project is to compare results produced using the GMI/IF framework with the previous results presented to MLA using the Food Model.

In particular, the aims of this project are to:

- Demonstrate using the GMI/IF framework how different levels of industry benefits arise from MLA projects with different economic impacts and how the distribution of benefits along the value chain will change depending on the economic impact.
  - Demonstration will be by way of examples (the seven scenarios) with overall industry benefits and sector benefits (in $ and percentage changes) calculated using these examples.
- Compare results from the GMI/IF framework with results previously generated using the Food Model, providing a rationale for major differences.
- Demonstrate the overall level of benefits and distributional impact of benefits that might accrue from increasing demand for Australian sheepmeat in China. This would involve developing in detail one or two scenarios in addition to the seven above.

This report is organised as follows:

- in Chapter 2 some background is provided on the GMI/IF model;
- in Chapter 3 results from analysis of the seven scenarios using the GMI/IF model are presented;
- in Chapter 4 results from the GMI/IF model are compared with those previously generated using the Food Model and an explanation provided for major differences;
- in Chapter 5 results from analysing the potential impact of MLA demand enhancing activities for Australian sheepmeat in China are presented; and
- Chapter 6 contains a short conclusion.

2. The GMI/IF model

The suite of models used in this report, namely the Global Meat Industry (GMI) model and Integrated Framework (IF), have been purpose built for the Australian meat industry. The models provide a comprehensive capacity to analyse the economic impacts of various industry developments or interventions that might be under consideration by the industry or Government. Moreover, this capacity to analyse economic impacts can be done separately by meat industry sector or by market.

The detail of the GMI/IF model allows for a breadth of analysis not possible with other models. To provide just a few examples, the GMI/IF model can estimate the impact on the Australian livestock and meat industry of:

- An increase in demand Australian beef or sheepmeat in just one market or numerous markets
- An increase in competitor activity in just one market of numerous markets – e.g. the entry of Indian buffalo into Indonesia or Brazilian beef into the US.
- An increase in productivity affecting just the northern extensive cattle industry or both the northern and southern industries.
- An improvement in productivity in the feedlot sector and the flow on impacts to other sectors (the producing and the processing sectors)
- New technology that lowers costs for sheepmeat processors, but not beef processors.

Similarly, impact can be measured along numerous dimensions, such as gross value of industry production, value added by the industry, livestock or meat prices, total meat sales and so on.

The GMI/IF model was originally developed for the Meat Research Corporation in 1991, but since 1991 has undergone annual updates or, from time to time, more complete overhauls. For example, the model was updated in response to the emergence of the live trade to Indonesia. From the time of its creation the model has been used for many critical industry functions. Their latest uses have included providing the economic underpinning for the Meat Industry Strategic Plan 2020 and Impact Assessment of MLA Expenditure 2010-11 to 2014-15[2].

It makes sense that, as far as possible, the models used by the wider industry for investment planning are also used by MLA for more detailed planning purposes and for program assessment.

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2 Centre for International Economics, 2015, *Meat Industry Strategic Plan 2015-20: Quantifying the payoffs from collaborative investments by the red meat industry*, Report prepared for the Red Meat Industry Council, Canberra and Agstrat Associates Pty Ltd, Centre for International Economics and ISJ Investments Pty Ltd, 2016, *Impact Assessment of MLA Expenditure 2010-11 to 2014-15*, Final Report, Project F.EVA.1601, Meat & Livestock Australia, February.

In this Chapter the structure of the GMI/IF model is outlined. At the end of the Chapter some examples are provided on how these models can be used for "what if" analysis.

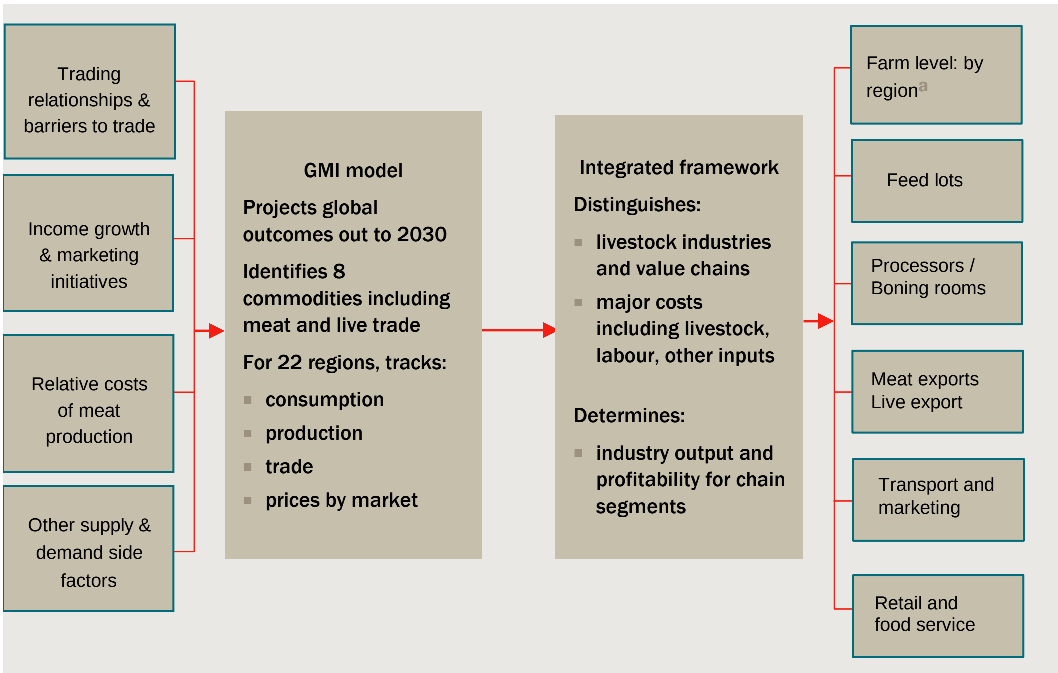
Overall structure of the GMI/IF modelling framework

The GMI/IF modelling framework consists of two separate economic models:

- the GMI model — that models global meat demand and supply
- the IF model — that has a detailed representation of the domestic red meat value chain.

The overall relationship between the GMI and IF models is described in Chart **2.1**.

2.1 Linked GMI and Integrated Framework



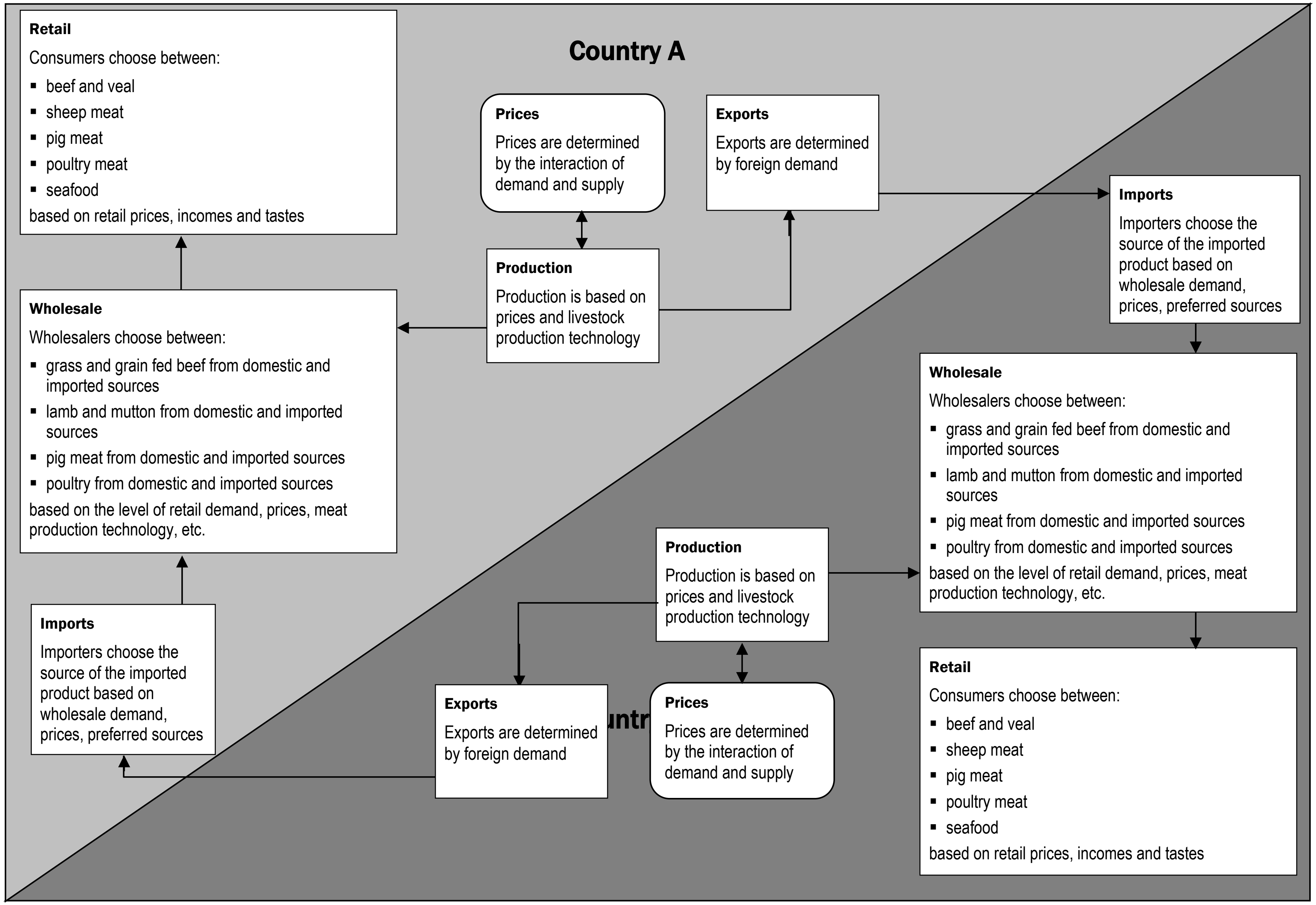
[a] Includes identification of northern and southern industries for cattle.

Data source: CIE.

The GMI model

A schematic of the GMI model is shown in Chart **2.2**. The GMI model contains both demand and supply equations for various types of proteins (meats and seafood) in 22 defined global countries / regions. The countries and regions covered in the GMI model are shown in Chart **2.3**.

2.2 Schematic representation of the GMI model



2.3 Data and country coverage of the GMI model and database

Country	*Beef and veal*			*Poultry meat*	*Sheep meat*		*Seafood*	*Live sheep*	*Live cattle*
	Grain	*Grass*	*Diaph-ragm*[a]		*Mutton including goat*	*Lamb*			
Australia	✓	✓	✓	✓	✓	✓		✓	✓
USA	✓	✓	✓	✓	✓				
Japan	✓	✓	✓	✓	✓		✓		
Canada	✓	✓	✓	✓	✓				
Chinese Taipei		✓		✓	✓		✓		
South Korea	✓	✓		✓	✓		✓		
New Zealand		✓		✓	✓	✓			
Mexico		✓	✓	✓	✓				
Argentina		✓		✓	✓				
Uruguay		✓		✓	✓				
Paraguay		✓		✓	✓				
Brazil		✓		✓	✓				
China		✓		✓	✓		✓		
Malaysia		✓		✓	✓		✓		✓
Indonesia		✓		✓	✓		✓		✓
Thailand		✓		✓	✓		✓		
Philippines		✓		✓	✓		✓		✓
European Union		✓	✓	✓	✓				
Hong Kong		✓		✓	✓		✓		
Singapore		✓		✓	✓		✓		
India		✓		✓	✓				
Other countries		✓		✓	✓			✓	✓

[a] Diaphragm beef comes from the inner lining of the rib cage. It is usually classified as offal. We keep it separate because, in Japan, it receives a special tariff treatment (15 per cent compared with 38.5 per cent for beef in general).

Source: CIE.

GMI protein demand representation by country

In the GMI model the level of protein demand in a country by type of protein is dependent upon:

- consumer preferences — which are influenced by customs and perhaps also religious beliefs and the age structure of the population;
- relative prices between meat and other proteins and between different types of meats - which are influenced by the cost and availability of substitute meats in each country including 'the effects of barriers to imports;
- income level and perhaps distribution; and
- population.

GMI protein supply representation by country

Similar to the demand equations, in the GMI model exist a series of economic relationships that measure the supply of proteins by country. Supply is dependent of the following factors:

- the initial inventory of stocks (that is, cow herd numbers);
- livestock prices (which, in turn, are influenced by protein prices);
- producers can choose between different types of production based on relative prices (for example . grain or grassfed beef or, in the case of Japan, between Wagyu and dairy beef production).

Other features of the GMI model

Some other features of the GMI model are that it:

- treats meat commodities produced in different countries as different products — for example, Australian grass fed beef is a different product from South Korean Hanwoo and dairy beef;
- treats all bilateral trade flows for a particular commodity as trade in different products — for example, South Korean grain fed beef imports from Australia are distinguished from South Korean imports of grain fed beef from the United States;
- allows importing countries to choose the source of their meat imports on the basis of trade policies, relative prices and their preferences for meat from particular sources;
- explicitly incorporates the major trade policies affecting world meat trade flows such as tariffs, variable levies, quotas, voluntary restraint agreements, foot and mouth disease trade bans and export subsidies;
- is supported by the GMI database — an extremely detailed time series database covering production, consumption, trade and price statistics for each type of meat for each of the countries and regions represented in the model.

The GMI model is dynamic and produces results on an annual basis. For MISP2020 forecasts were included on annual basis out to 2030.

The Integrated Framework (IF)

Originally, the Integrated Framework (IF) was a model of the Australian economy that contained a detailed representation of all livestock sectors focusing on the red meat industries. It captured interactions between the red meat value chain and other sectors of the economy. These interactions include purchased input use at the farm level and value adding factors such as capital and labour.

In terms of red meat sector coverage, the existing IF includes farm production, feedlots, processing, wholesaling, retailing, domestic consumption and exports. The IF measures the effect of changes on each industry (in terms of output, prices, profitability etc.) and the economy as a whole (in terms of GDP, employment, consumption, trade balance etc.). This original model was a one-period or static model.

As part of the RMAC MISP2020 Strategic Planning process[3], the IF was heavily modified and updated to focus on the red meat value chains with additional commodity and industry detail that directly supported the analysis of MISP2020 and later the evaluation of MLA investments over the period 2010-11 to 2014-15.

Livestock and meat sectors represented in the IF are shown in Chart 2.4. Each sector and step of the value chain has its own representation. This makes it possible to observe how change prices and profitability are distributed along the value chain in response to changes in economic drivers. In the IF:

- Each farm level beef industry can produce finished grass fed cattle, feeders for entry into feedlots and cattle for live export — the industry can change their production mix to each of these markets in response to economic drivers. The IF allows for differences between the northern and southern cattle production on the basis of their respective:
  - exposure to lot feeding, live exports and domestic and export processing sectors;
  - potential for productivity gains (for example, pasture productivity and genetic gain) from RD&E;
  - potential for improving eating quality performance through changes in transport and treatment use.

2.4 Commodities and industries identified by the IF

Red meat outputs	Red meat industry
Farm level	
Grass fed cattle	Northern beef Southern Beef
Feeders	
Cattle for live export	
Grain fed cattle	Feedlots
Lambs	Sheep
Sheep	
Sheep for live export	
Goats	Goats
Goats for export	
Processing sector	
Grass fed beef and co-products	Grass fed beef processing
Grain fed beef and co-products	Grain fed beef processing
Lamb and coproducts	Lamb processing
Mutton and coproducts	Sheepmeat processing

3 Centre for International Economics, 2015, Meat Industry Strategic Plan 2015-20: Quantifying the payoffs from collaborative investments by the red meat industry, Report prepared for the Red Meat Industry Council, Canberra.

Red meat outputs	Red meat industry
Goatmeat and coproducts	Goat meat processing
Live exporters	
Live cattle exported	Live cattle exporters
Live sheep exported	Live sheep exporters
Live goats exported	Live goat exporters

Source: MLA Integrated Framework.

- The sheep industry produces lambs and sheep — in this case these outputs are produced in fixed proportions as the turnoff of sheep moves in line with the overall flock.
- Each of the processing segments produce meat (grass fed beef, grain fed beef etc) and a co-product bundle comprised of hides/skins , offal and meat and bone meal:
  – Meat and co-products are produced in fixed proportions, but relative yields can be changed through the model's structure.

In additional to extra detail on red meat supply chain, the updated IF also takes a dynamic view over time permitting the analysis of developments where timing of impacts is critical.

'What if' analysis

The design of the GMI/IF model means that economic answers can be provided to many "what if" questions relevant to MLA and the Australian meat industry.

The GMI/IF model was used, for instance, as part of the effort to encourage McDonald's to buy Australian beef for their operations in the United States. McDonald's were, of course, interested in the potential for Australian beef to lower the cost of their hamburger patties produced in the United States. However, they were also concerned that purchasing Australian beef for their United States operations would raise the price of Australian beef generally, affecting purchasing costs elsewhere in the world, so in global terms the gains may be marginal or non-existent. The GMI/IF model was used at the time to show that, indeed, Australian grinding beef prices would rise, but not to the extent that some in McDonald's believed and that in global terms McDonald's would obtain cost efficiencies by purchasing Australian beef for their United States operations.

The GMI/IF model has also been used extensively for trade policy prioritisation and planning — addressing questions such as: if a Free Trade Agreement reduced beef and sheepmeat tariffs, what impact would that have on cattle and sheepmeat prices and the gross value of production by the industry.

The list of 'what if' questions that could be posed is, in fact, almost limitless, examples being:

- if MLA beef promotional funds were switched from Japan to China, resulting in a reduction in demand for Australian beef in Japan, but boosting demand in China, what impact would this have on Australian cattle prices and industry profitability?

- if MLA research into the feedbase increased the productivity of adopting southern producers by 1 per cent per annum, what impact would this have on the profitability of southern producers, northern producers, feedlotters and processors?
- if, through MLA research, better feedback was provided to producers on the true value of meat obtained from their animals and payments based on this value, encouraging greater efficiencies from supply chain integration, what would be the impact on producer and processor profitability and the gross value of production of the Australian meat and livestock industries?

It must be emphasized in analysing these 'what if' questions often the most difficult task is in producing the input data to feed into the GMI/IF model. To use just the first of the examples provided above, data would be required on the impact on beef demand in Japan and China, from switching, say, $2 million of MLA promotional expenditure. Well founded input data to answer 'what if' questions of relevance to MLA has often been lacking in the past. If MLA is to optimise its expenditure across programs and projects, however, the existence of such data is a prerequisite. If such data does not exist, how else does MLA come to a view of how much to spend on meat promotion in Japan versus China?

3. Model results from seven 'typical' simulations

In this chapter the first of the major objectives of this Project, as listed in Chapter 1, is addressed. In particular this Chapter will:

- demonstrate using the GMI/IF framework how different levels of industry benefits arise from MLA projects with different economic impacts and how the distribution of benefits along the value chain will change depending on the economic impact.

This Chapter contains three substantive sections:

- in the first section details on the scenarios to be modelled are provided;
- second, summary results are presented from the GMI/IF framework for the scenarios modelled; and
- third, the results for each scenario are explained in more detail.

Modelled scenarios

A major objective of the current project is to compare results from the GMI/IF framework with those generated for MLA in a previous project using the Food Model – this comparison is undertaken in Chapter 4. The scenarios used in the current work, therefore, mirror, as far as possible the scenarios used in the previous work.

To address the terms of reference, the scenarios to be tested using the GMI/IF model are shown below in table 3.1.

3.1 Scenarios used in the modelling

	Scenario	Description
1	Export demand	This has been simulated in the GMI/IF model by a 1 per cent increase in export prices for all processing red meats including co-products (noting that meat and co-products are aggregated in the Food Model).
2	Domestic demand	This has been simulated in the GMI/IF model by a 1 per cent increase in domestic consumption for all red meats excluding co-products. (In the GM/IF model, it is assumed that all co-products are exported.)
3	Processing production productivity	This has been simulated by a 1 per cent increase in processing productivity for all factors, excluding agricultural inputs, used in processing.
4	Transport and handling efficiency of processed products	This has been simulated by a 1 per cent increase in productivity for transport, wholesaling, marketing and retailing for processed products. ▪ In the GMI/IF model cost savings in transport and distribution are conditional on the base period transport costs, which in turn, are based on GHD estimates.

	Scenario	Description
5	Waste reduction in processing	This has been simulated by a 1 per cent increase in productivity of the use of agricultural inputs in processing
6	Farm production efficiency	This has been simulated by a 1 per cent increase in productivity for all on-farm variable cost factors. This has been applied as a 1 per cent reduction in the costs of all variable inputs into production excluding hired labour, payments to capital and land.
7	Transport and handling efficiency of farm products	This has been simulated by a 1 per cent increase in productivity in transport, wholesaling, marketing and retailing of agricultural output. This is equivalent to a one per cent reduction in the cost of these services.

Source: The CIE.

GMI/IF model results

Table 3.2 presents results from the GMI/IF model for the seven scenarios outlined above.

To provide consistency with the previous work undertaken for MLA using the Food Model:

- The simulations used in this report cover both the beef and sheepmeat sectors and involve applying simultaneous 1 per cent changes to both commodities. It is important to realise that if the 1 per cent changes were to be applied to the beef and sheepmeat industries *separately* then *different* outcomes would result due to interactions between the supply chains and cross relationships between sheepmeat and beef demand[4].
- Similarly, the 1 per cent change has been applied simultaneously to all relevant sectors. For example, the 1 per cent improvement in on-farm productivity has been applied simultaneously to the northern cattle, southern cattle, sheepmeat and feedlot sectors. Again, different results would be produced by separately applying 1 per cent productivity improvements to each sector.
- The simulations have been conducted using the 2009-10 financial year data for the GMI/IF model (even though this model has later data available) to start from the same base as the Food Model

Two measures have been used for the 'industry impact' resulting from each scenario. One measure is industry real Gross Value of Production (GVP). The other measure is industry 'value added'. Both sets of measures have been used in the past to assess the merit of alternative projects and both measures were used in the previous work commissioned by MLA using the Food Model. The GVP measure effectively measures industry size. The value added measure may be thought of as 'industry income'. In past program and

4 As an example of the interaction: if a productivity improvement in the sheepmeat industry occurred in isolation of the beef industry, the cost of sheepmeat products would drop and sheepmeat would steal market share not only from pork and chicken, but also beef — this will not occur if the productivity improvement occurs for both beef and sheepmeat.

project evaluations GVP has been the more commonly used measure, but in the recent MLA evaluation[5] and in the MISP2020 value added was the primary measure used.

Table 3.2 shows the GMI/IF model results for change in GVP and change in value added by sector for each of the seven scenarios.

In table 3.2 estimates of GVP have not be added together to avoid double counting (the GVP of livestock feeds into the GVP of the processing sector). It is possible, however, to directly add and compare "value-added" over sectors because, as the name implies, 'value added' is the additional value contributed by each sector — it is the difference between GVP and key variable inputs such as livestock. As a result of these considerations in table 3.2 a red meat industry total is shown for the 'value added' measures for each scenario, but not for the GVP measures (effectively the red meat total for GVP is the GVP shown against the processing sector).

3.2 GMI/IF model results: 1% change to relevant variable for seven scenarios

Industry variables/ scenario	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
	$m	$m	$m	$m	$m	$m	$m
Change in GVP							
Farming	109.5	17.0	13.0	6.2	48.7	15.6	0.9
Processing	144.0	23.9	5.5	2.6	92.9	36.2	1.7
Change in value added							
Farming	65.1	11.3	7.6	3.7	26.3	36.7	2.5
Processing	23.1	3.2	2.7	1.3	34.5	17.7	0.8
Total red meat	88.2	14.5	10.3	5.0	60.8	54.4	3.3

Table 3.3 shows the relative distribution of benefits from the GMI/IF model, corresponding to table 3.2.

3.3 GMI/IF model results: Relative distribution of benefits for each scenario

Industry variables/ scenario	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
	%	%	%	%	%	%	%
Change in value-added							
Farming	73.8	78.1	73.7	74.0	43.3	67.5	75.7
Processing	26.2	21.9	26.3	26.0	56.7	32.5	24.3

5 Agstrat Associates Pty Ltd, Centre for International Economics and ISJ Investments Pty Ltd, 2016, Impact Assessment of MLA Expenditure 2010-11 to 2014-15, Final Report, Project F.EVA.1601, Meat & Livestock Australia, February.

Industry variables/ scenario	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
	%	%	%	%	%	%	%
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Further explanation of the GMI/IF model results

For each scenario, this section provides a further explanation of the GMI/IF model results.

Scenario 1: a one per cent increase in export demand

The 'export demand' scenario provides considerably greater benefits than any other scenario for the industry as a whole and for every industry sector — both in terms of increase in GVP and increase in industry value added.

If export demand were to increase by 1 per cent, industry GVP would increase by $144 million (noting earlier remarks about the processing sector GVP being equivalent to industry GVP) and value added would increase by $88.2 million. The increase in GVP is almost 2½ times greater than for any other scenario modelled and in terms of value added is more than 1.6 times greater than for any other scenario.

That a 1 per cent increase in export demand has such an impact on both industry GVP and value added is hardly surprising given that exports account for about 75 per cent of Australian beef and veal production and about 65 per cent of Australian lamb and mutton production[6].

The demand and supply situation facing the Australian beef and sheepmeat industry, and the model result from this scenario, can be explained by reference to Chart **3.4**. The supply curve for Australian beef and sheepmeat is relatively inelastic (the steeper the supply curve, the more inelastic) — similar to that shown in Chart **3.4**.

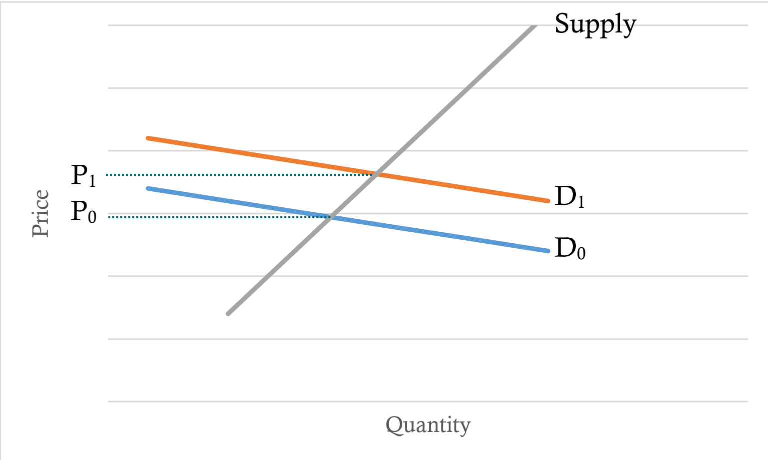
- This inelasticity arises from the fact that the supply of livestock is constrained by available land and capital and limits on the reproductive capacity of livestock.

The inelasticity of supply means that when the demand curve shifts outward, from D_0 to D_1 in Chart **3.4**, as it would with a 1 per cent increase in export demand, prices for beef and sheepmeat rise reasonably significantly (from P_0 to P_1 in Chart **3.4**). The GMI/IF

6 See, for instance, production and export statistics for 2015 contained in MLA cattle and sheepmeat industry projections – MLA, 2016, Cattle Industry Projections: July Update, http://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/cattle-projections/july-update_australian-cattle-industry-projections-2016.pdf and MLA, 2016, Sheep Industry Projections: July Update, http://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/sheep-projections/july-update_australian-sheep-industry-projections-2016.pdf.

model results show that, as a result of a 1 per cent increase in beef and sheepmeat export demand, grassfed cattle, grainfed cattle lamb and sheep prices increase by 0.77 per cent, 0.64 per cent, 0.45 per cent and 1.03per cent respectively. At the same time the improvement in demand and higher prices also encourages producers and processors to increase grassfed beef, grainfed beef lamb and mutton production - by 0.86 per cent, 0.54 per cent, 0.41 per cent and 0.28 per cent, respectively. The supply response may be viewed as higher than perhaps initial thinking would suggest, particularly for grassfed beef, but:

3.4 Shift in demand with relatively inelastic supply



- this is because grassfed cattle are diverted from the live cattle trade into processing (in this scenario only beef and sheep export demand was increased, not live cattle export demand) and, to a lesser extent, from the feeder trade directly into processing.

Because of the more constrained factors of production (for example, land, water) in livestock raising, relative to processing, a larger slice of the benefits is captured by the producing sector — 74 per cent of the value added benefits are captured by producers versus 26 per cent by processors.

Scenario 2: a one per cent increase in domestic demand (quantity consumed on the domestic market)

In many ways the domestic demand scenario, Scenario 2, is similar to the export demand scenario (Scenario 1). There are some important differences, however.

One important difference is that the increase in domestic demand was simulated by a 1 per cent increase in *quantity* consumed (domestic disappearance). This contrasts to the export demand scenario which was simulated by initially increasing export beef and sheepmeat *prices* by 1 per cent (of course, the final increase in prices is less than this because there is a supply response).

The increase in domestic demand was simulated in quantity terms because it is almost impossible to sustain any domestic market price increase in the absence of a rise also in export prices. Once domestic prices rise, in the absence of any accompanying rise in export prices, product is quickly redirected from export markets to the domestic market, supressing the rise in domestic prices. If the domestic demand expansion could have been modelled as 1 per cent *price* change (rather than a 1 per cent *quantity* change), the results would be less than half of the reported amount.

Even with the favourable, quantity based, simulation scenario for the domestic market, benefits from a rise in domestic demand are estimated to be a fraction of those for a 1 per cent rise in export demand.

- As can be seen from table 3.2, a 1 per cent rise in domestic demand results in only a $24 million expansion in industry output (real GVP) compared to a $144 million expansion for a similar rise in export demand — that is, the rise in domestic demand provides little more than 15 per cent of the benefits of a rise in export demand.
- Similarly, in 'value added' terms a one percent rise in domestic demand results in a $14.5 million expansion in value added compared to an $88.2 million expansion for export demand—again, the rise in domestic demand provides little more than 15 per cent of the benefits of a rise in export demand.

The lower benefits from the domestic demand scenario, compared to the export demand scenario, stem from the lower share of sales into the domestic market (hence, the 1 per cent increase applies to a lower number), the greater inelasticity of demand domestically compared to exports and the easier re-diversion of product from export markets back to the domestic market.

It can be seen from table 3.3 that a slightly higher percentage of total benefits are captured by the farm sector under the domestic demand increase than under the export demand increase (78.1 per cent versus 73.8 per cent). This again reflects the nature of the domestic demand simulation (being in quantity terms) and also the different grass / grain fed split in domestic and export markets. Notwithstanding the production sector capturing a slightly higher *proportion* of the benefits, because of the different level of *total* benefits, farmers are vastly better off through export demand increasing by 1 per cent, than domestic demand increasing by 1 per cent.

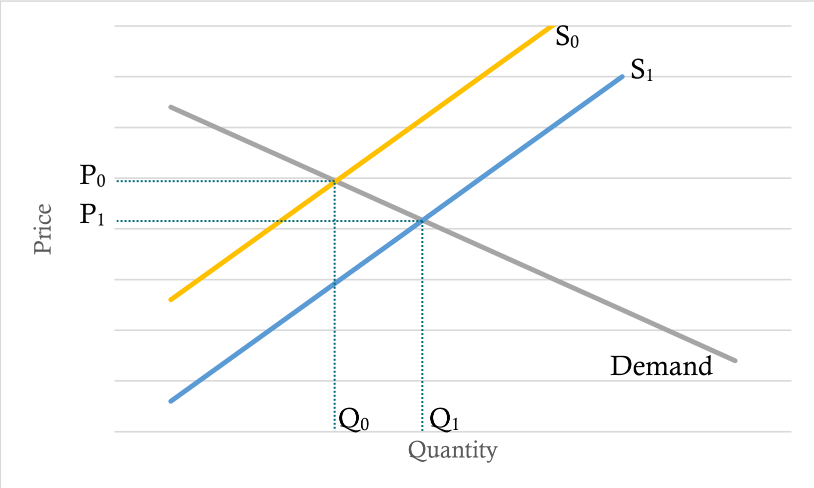
Scenario 3: a one per cent increase in processing productivity for all processing factors excluding agricultural inputs

An improvement in processing productivity for non-agricultural processing inputs (that might be achieved, for example, through the introduction of new labour saving technology) shifts the supply curve for beef and sheepmeat downward to the right. As a result of the productivity improvement the cost of producing beef and sheepmeat falls which, in turn, results in lower beef and sheepmeat prices. Both domestic and export consumers, particularly those in price sensitive markets, respond to the lower prices by increasing consumption of beef and sheepmeat.

The situation in similar to that depicted in Chart **3.5** with an outward shift in the supply curve for processed beef and sheepmeat (from S_0 to S_1). As a result of this outward shift in the supply curve, beef and sheepmeat prices fall from P_0 to P_1, with this fall in prices stimulating an increase in consumption from Q_0 to Q_1.

- The GMI/IF model estimates, for instance, that a 1 per cent improvement in processing productivity for non-agricultural inputs would result in grassfed *beef* prices falling by 0.02 per cent and consumption increasing by 0.1 per cent.

3.5 Shift in meat supply curve from improvement in processing productivity



The expansion in beef and sheepmeat demand increases the demand by processors for cattle, sheep and lambs —- the derived demand for cattle and sheep shifts outward to the right (increases). Without a productivity gain in cattle and sheep production on farm, the price of livestock on farm must increase to induce more supply. This passes benefits to the farming sector. The GMI/IF model estimates that grassfed *cattle* prices would increase by 0.1 per cent from a 1 per cent processing productivity improvement in non-agricultural inputs.

The GMI/IF model estimates that, as a result of a 1 per cent improvement in processing productivity for non-agricultural inputs, value added by the industry would increase by $10.3 million. The processing sector manages to capture 26 per cent of the industry value added, but, because of the increase need for livestock, farmers also benefit substantially, capturing 74 per cent of the total industry value added.

In industry output terms the GMI/IF estimates that real GVP for the farm sector would increase by $13.0 million and for the processing sector by $5.5 million. Since the GVP of the farm sector feeds into the GVP of the processing sector this means that the GVP *added* by the processing sector is negative ($5.5 million less $13.0 million = -$7.5 million). This simply reflects the fact that cost savings have been made in the processing sector.

Scenarios 4 and 7: a one per cent increase in productivity for transport, wholesaling, marketing and retailing for processed products and for agricultural outputs, respectively

The two transport, wholesaling, marketing and retailing scenarios, Scenario 4 being related to processed products and Scenario 7 being related to agricultural outputs, provide the least benefits of all scenarios. The GMI/IF model estimates that Scenario 4 will provide value added benefits of $5.0 million and Scenario 7 benefits of $3.3 million (compared to, for example, an $88.2 million industry benefit in value added terms from a

1 per cent improvement in export demand, and $54.4 million benefit from a 1 per cent improvement in on-farm productivity).

The major reason for the small level of benefits is that transport, wholesaling and retailing margins, although important, are insignificant compared to the level of export demand and the level of on farm costs. To be specific transport, wholesaling, and marketing margins for processed products accounts for between 5 and 7 per cent of the total value of output, while transport, wholesaling, marketing. and retailing margins for agricultural outputs account for 3 per cent.

In terms of the proportional distribution of benefits along the meat industry supply chain, as would be anticipated, the split of benefits for a productivity improvement in transport and handling for processed meat products (that is, beef and sheepmeat) and for agricultural outputs is virtually equivalent to that for an improvement in processing efficiency (scenario 3) — the logic is identical.

Scenario 5: a one per cent increase in productivity for use of agricultural inputs in processing (waste reduction in processing)

In modelling Simulation 5, reduction in waste, the method used was equivalent to assuming an improvement in saleable meat yield, or more correctly, meat yield that can be sold into a higher value category.

- For the current application using the GMI/IF model and for the previous work completed for MLA using the Food Model, the reduction in waste has been simulated by a per unit reduction requirement in the livestock input (cattle and sheep) for the processing sector. That is, the same level of processing output *value* can be produced with 1 per cent less livestock input *costs* with no change in other inputs *costs*.[7]

In the GMI/IF model livestock costs represent the vast proportion of total processing costs — about 70 per cent of total processing costs. A 1 per cent drop in these costs causes the price of processed beef and sheepmeat to drop significantly. In the GMI/IF model export market consumers are very sensitive to meat prices — the price level of Australian meat very significantly influences the amount of Australian meat consumed, especially in price sensitive markets. For grass fed beef, for instance, the export demand elasticity in the GMI/IF model is -6.4. This means that for each 1 per cent fall in the Australian grass fed beef price export demand will rise by 6.4 per cent.

The significance of livestock costs in total processing costs and the relatively elastic meat demand curves in the GMI/IF model means that the farming sector, as well as the processing sector, benefits under this scenario. The result can be explained by reference to the grass fed beef sector. As a result of greater efficiency in the processing sector (less waste), the price of Australian grass fed beef drops, causing demand to expand. The expansion in demand means that, even though 1 per cent less grass fed cattle was initially required under this scenario, after the consumer response more Australian cattle are

7 Noting that output in this case applies to both meat and co-products, which cannot be separated in the Food Model.

needed. Effectively under this scenario the Australian processing sector has become more efficient, meaning that Australian beef is able to compete more effectively in export markets — and consumer demand for Australian beef expands.

Similarly to Scenario 3, the need for processors to acquire more cattle and sheep drives the price of livestock higher. This passes the benefits of efficiency gains in the processing sector to the farming sector. The GMI/IF model estimates that grassfed *cattle* prices would increase by 0.55 per cent:

- This means that the efficiency gains under this scenario are shared. Per unit of production, the processing sector needs 1 per cent less cattle but, as a result of the expansion in demand, cattle prices rise by 0.55 per cent. The per unit cattle input cost saving for the processing sector, therefore, is 0.45 per cent (the 1 per cent increase in saleable meat yield less the 0.55 per cent cattle price rise).

The total industry benefit under this scenario ranks amongst the highest of all scenarios — in GVP terms it ranks second and in value added terms it ranks third. Because the scenario involves more efficient use of livestock by the processing sector, in relative terms the processing sector captures more of the benefits than for any other scenario (specifically, the processing sector capture 44 per cent of the total benefits) and the farming sector less of the benefits (only 56 per cent of the total benefits). Notwithstanding the fact that the farming sector proportionately captures less benefits than for any other scenario, because total benefits are high, this scenario remains attractive for the farming sector (resulting in farming value added benefits of $21.7 million, the third highest of all scenarios).

Scenario 6: a one per cent productivity increase in all on-farm variable factors

A 1 per cent productivity increase in all on-farm variable factors, shifts the supply curve for livestock (cattle, lamb and sheep) downward to the right. Effectively the cost of producing livestock under this scenario drops, meaning that farmers will increase output which, in turn, leads to a fall in prices.

In the GMI/IF framework the impact of the productivity improvement is most evident for grass fed cattle. Grassfed cattle production expands by 0.62 per cent, resulting in a 0.30 per cent fall in grassfed cattle prices. Equivalent information for grain fed cattle, sheep and lambs is shown in table 3.6.

3.6 GMI/IF model results: Output and price changes from a 1 per cent improvement in on-farm productivity

Livestock category	Output change	Price change
	%	%
Grass fed cattle	0.62	-0.30
Grain fed cattle	0.51	-0.39
Lambs	0.28	-0.30
Sheep	0.34	-0.22

Because of the efficiency improvement in that part of the industry where most of the costs lie, and given the highly elastic demand curves in the GMI/IF model as previously referenced, total industry benefits from this scenario are high. Under this scenario GVP for the industry increases by $36.2 million and value added by $54.4 million.

Benefit 'multipliers'

To make the results from the GMI/IF model more accessible, simple relationships or 'multipliers' can be calculated for each scenario. The first step is to calculate the 'shock' or the first-round value that has been applied to the model. This first-round value is equal to 1 per cent of the database values listed (see table 3.7).

3.7 First-round value base for each scenario

Scenario	First-round value base component	1% of value base
Export demand	▪ Export sales at wholesale prices	▪ $80.6m
Domestic demand	▪ Domestic sales at wholesale prices	▪ $45.2m
Processing cost reduction	▪ Non-livestock inputs including chemicals, consumables and packaging, energy and water, hired labour and other inputs	▪ $27.1m
Transport and handling efficiency of processed products	▪ Off-farm transport	▪ $5.5m
Processing waste reduction	▪ Livestock input into processing	▪ $106.5m
On-farm productivity	▪ Fertilisers and chemicals, energy and water, transport, hired labour and other inputs	▪ $68.9m
Transport and handling efficiency of farm products	▪ On-farm transport	▪ $3.7m

The next step is to calculate the ratio between the benefits in table 3.2 and the values in table 3.7 to estimate the 'multipliers' in table 3.8.

3.8 Benefit multipliers for every $1 of first round improvement

Industry variables/ scenario	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
Change in GVP							
Farming	1.4	0.4	0.5	1.1	0.5	0.2	0.2
Processing	1.8	0.5	0.2	0.5	0.9	0.5	0.4
Change in value added							
Farming	0.8	0.3	0.3	0.7	0.2	0.5	0.7
Processing	0.3	0.1	0.1	0.2	0.3	0.3	0.2
Total red meat	1.1	0.3	0.4	0.9	0.6	0.8	0.9

For example, for scenario 1: $1 improvement in the value of export demand will result in additional value added of $1.10 across the industry recalling that these results are the aggregation across beef, sheep and goat meat segments of the industry.

In the practical application of the GMI/IF to investments in the industry, the higher-level results in table 3.8 should identify the key differences:

- between each of the commodities and industries underlying the aggregate result
- over time to better reflect market conditions.

For example, across these scenarios, the way in which benefits are shared along the chain depend on:

- the strength (or price sensitivity) of export demand of each commodity — which is important between beef and lamb
- capacity utilisation across each of the processing sectors.

Concluding comments on the GMI/IF model results

In terms of industry impact and benefits, the GMI/IF model results for a 1 per cent increase in export demand far exceed impact and benefits of any other scenario. The industry gains more in GVP from a 1 per cent increase in export demand than from all the other six scenarios added together — and this holds true for farm GVP and processing GVP considered separately. At the other end of the spectrum the scenarios addressing changes in industry transport, wholesaling and retailing margins have least impact.

A broadly similar ranking of impacts from the seven scenarios was obtained from the previous work using the Food Model. However, there are also substantial differences evident between results from the GMI/IF model and those from the Food Model. Similarities and differences between the two sets of model results are explored further in the next chapter.

4. Comparing results from the GMI/IF model and the Food Model

In this chapter the second major objective listed in Chapter 1, is addressed. In particular this Chapter will:

- Compare results from the GMI/IF framework with results previously generated using the Food Model, providing a rationale for major differences.

This Chapter contains three substantive sections:

- first, key differences in the structure of the GMI/IF model and Food Model are noted;
- second, simulation results are presented using the GMI/IF model and the Food Model; and
- third, comments are made on results using the two frameworks, focusing especially on major differences.

Key differences between the Food Model and GMI/IF model

Table **4.1** identifies the *key* differences between the Food Model and GMI/IF model — to list *all* differences would be almost an impossible task.

4.1 Key differences between the Food Model and GMI/IF model

Issue	Food model	GMI/IF
General		
Model type	▪ Comparative static, one period general equilibrium model.	▪ 'Comparative dynamic', red meat sector specific model.
Base year and baseline of analysis	▪ 2009-10 base year.	▪ 2009-10 based used for comparisons, but the GMI/IF is updated annually
Model uses within red meat industry	▪ Used to produce results for 6 simulations for MLA. ▪ Used for certain activities by CSIRO.	▪ Used extensively in the meat industry over many years in numerous areas. ▪ Used to provide the economic underpinning for MISP2020.

Issue	Food model	GMI/IF
Commodity details and linkages		
Commodity and industry detail	▪ The Food Model only identifies: – At the farm level cattle and sheep and at the processing level beef and sheep meat. – There are no separate live trade or lot feeding sectors (these are aggregated with farm level industries). – Co-products have been aggregated with meat for domestic consumption and exports. ▪ The farm level sheep industry includes the production and export of wool. ▪ The value of processed beef and sheepmeat also contains an estimated value for smallgoods.	▪ The GMI/IF identifies 15 outputs covering 3 species across farm, feedlots, live trade and processing sectors. – Explicit activities are included for feedlots and for the live export sector. – All processing industries explicitly produce 'co-products' which is an aggregate of hides/skins, offal, tallow meat and bone meal. ▪ Separate demand and supply curves exist for 22 major export regions for 8 meat and livestock related commodities. ▪ Consumption of 'meat' by households, food service and further processing, includes consumption of smallgoods – all are included in 'domestic disappearance' category.
Links with the rest of the economy	▪ The Food Model contains a full representation of the Australian economy adding-up to gross domestic product. ▪ The Food Model produces information on changes in *aggregate* real household consumption which is often used as a proxy for welfare. ▪ The Food Model includes interaction with other meats in household and other consumption. ▪ The Food Model can simulate the impact of a wide range of external tax and other policy measures on the economy generally, including on the red meat sector.	▪ No aggregate measures for GDP or aggregate consumption. – Focuses on linkages within red meat industry. ▪ No formal linkages outside of red meat sector. ▪ If required, the impact of external tax changes can be introduced by model 'shocks' or by assumed supply relationships.
Regional detail	▪ The Food Model allows separate analysis for states and territories. The national results represent aggregated information from identical shocks made at the state / territory level.	▪ Principally a national model with regional detail (northern, southern) for the on-farm beef sector.
Transport and trade sectors	▪ One of the strengths of the economy wide model is the representation of other sectors in the economy, especially transport and trade. ▪ The treatment of transport and trade is complex where supply of these services can move freely between the red meat and other sectors.	▪ Transport costs are included in the GMI/IF to get product to export or domestic markets. ▪ Changes in domestic transport and trade margins are imposed from outside of the model.
Economic environment		
Employment and wages	▪ The standard Food Model assumptions involve adjustments in real wages to ensure no change in aggregate employment.	▪ The standard GMI/IF model assumptions involve real wages growing at CPI and assumed to be set in the rest of the economy (rather than being influenced by

Issue	Food model	GMI/IF
	▪ Red meat processing industries remain a small part of economy wide employment, but can have a small influence on wages.	the economic state of the red meat industry). ▪ Red meat processing industries can hire as much labour as they require at the current wage. ▪ A supply function for processing labour could be included.
Variables reported		
Change in real production	▪ The change in the value of industry gross value of production is deflated by information on economy wide price levels endogenously produced by the model.	▪ Reported as change in nominal gross value of production (GVP) – These nominal prices can be deflated using exogenous CPI forecasts.
Measure of industry income	▪ Value-added – payment to labour, capital and land.	▪ Value-added. – payment to labour, capital and land.
Measure of baseline contribution to GDP	▪ Income and taxes generated. – Equivalent to GDP: changes in industry value-added plus changes in commodity and indirect taxes.	▪ Cannot be estimated in GMI/IF and, therefore, not reported.

In addition to the differences and approaches as shown in table **4.1**, the underlying data sources are also different. The Food Model is based on the 2009-10 input-output tables prepared by the ABS whereas the GMI/IF database has been built 'bottoms-up' from industry data as part of a MLA funded project.

Table **4.2** shows the high-level differences in base level industry GVP estimated by the two models. After consideration of the different approaches[8], the total value of the industry at farm and processing level provided by the two models is remarkably similar.

4.2 Reconciliation of value of production in the red meat sector 2009-10

	Farm	Processing[b]		
		Meat	Coproducts	Total
	$m	$m	$m	$m
GMI/IF (valued at export or wholesale level)				
Beef	9 044	7 309	1 024	8 333
Sheepmeat (excluding wool)	2 977	2 826	546	3 372
Total	12 021	10 135	1 570	11 706

8 The differences in approaches include different points of valuing product along the supply chain and even differences in the components included in the valuation. For example, the valuation of beef and sheepmeat in the GMI/IF framework is at export or wholesale level, whereas for the Food Model it is ex-factory. We would usually expect that the difference in valuations between factory gate and export fob to be less than 10 per cent. Another significant difference is the inclusion of wool production in the Food Model and its exclusion in the GMI/IF model.

	Farm	Processing[b]		
		Meat	Coproducts	Total
Food model				
Beef	9 066			9 624[d]
Sheep	2 766[c]			1 782[d]
Total	11 832			11 406[d]

[a] Includes adjustment for feedlots and live exports valuation to be equivalent with the Food Model. [b] Processing is valued at export or wholesale level for the GMI/IF and at factory gate for the Food Model. [c] Includes wool production at farm level. [d] Includes value of production of smallgoods which is not included in the IF.

Source: CIE.

Whereas the GMI/IF model has domestic and export markets, the input-output structure behind the Food model is significantly more complex as shown in table **4.3**. Take the farm level category, for instance, in table **4.3**, and observe that cattle can be sold to meat products for processing, to farmers for herd breeding and replacement, for household consumption (imputed from on-farm consumption by households), or for exports and other uses by industry.[9] For the GMI/IF, selling options are significantly simplified — with available options being sales to feedlots, the processing sector and for live export.

4.3 Sales structure of the Food Model

	Cattle	Beef	Sheep	Sheepmeat
	$m	$m	$m	$m
Industry total sales	9 066	9 624	4 224	1 782
Sales category				
Meat products	5 307	393	958	106
Household consumption	336	3 760	122	707
Exports	422	2 169	1 412	401
Other use by industry[a]	3 000	3 302	1 732	567

[a] Includes sales to investment in the ABS methodology which includes the purchase of livestock for herd replacement.

Source: Food Model.

A key component of these models are the domestic/export shares. Table **4.4** shows that differences in structure and methodology between the models result in very different estimates of the significance of exports. Because the data behind the GMI/IF model has been estimated based on meat production and exports, the significance of export market sales is much higher than for the Food Model which is based on a more complex input-output approach.

9 The Food Model database is based on the ABS input-output tables. These table are internally consistent estimates of GVP and value added by industry that add to national gross domestic product. The strength of this approach is the coverage and consistency across all sectors of the economy using the same methodology. The tradeoff is that at this level of detail, for some industries, ABS methodology does not stand up against detailed industry data and knowledge. This is part of the rationale for moving the IF away from the ABS input-output tables.

4.4 Export shares for each model[a]

	Food model	GMI/IF
	%	%
Live cattle (on-farm level cattle)	4.7	9.3
Live sheep (on-farm level sheep)	33.4[b]	9.9
Grass fed	Beef = 22.5	76.1
Grain fed		41.4
Lamb	Sheepmeat = 22.5	49.7
Mutton		86.5

[a] The proportion of the value of exports in the total value of sales by the industry [b] Calculation of export share includes wool with live sheep.

Source: CIE.

In producing model comparisons, in addition to use of common database values, the estimates of demand and supply elasticities used in the models are vitally important.

Table **4.5** compares the key export demand elasticities for beef and sheepmeat between the models, noting that beef and sheepmeat elasticities for the Food Model should be equal to the share weighted sum of the equivalent components from the GMI/IF[10]. To put these in perspective, NZIER recently estimated the export demand elasticity for NZ meat and meat products (beef and sheepmeat) was -5.14[11] which closely aligns with the GMI/IF estimated export demand elasticity[12].

4.5 Export demand elasticities for each model

	Food model	IF/GMI
Live cattle	-0.48	-0.41
Live sheep	-1.0 [a]	-1.01
Grass fed	Beef = -6.5	-6.38
Grain fed		-7.98
Lamb	Sheepmeat = -2.67	-2.04
Mutton		-3.63

[a] Food model Includes wool with live sheep. *Source:* CIE.

As shown in table **4.3**, the Food Model has a number of other demand categories — such as domestic demand, on-farm consumption and 'other uses by industry'. Averaging across these categories, the total demand elasticities are significantly different as shown in table **4.6**. The lower overall demand elasticity in the Food Model is not only the result of the elasticities for the other demand categories, but only the much lower proportion of product in the Food Model sold to export markets (see table **4.4**). In both the Food

10 For instance, given that the split in the value of lamb and mutton exports in 2010 was 67%/33% the weighted average GMI/IF sheepmeat elasticity can be calculated as: 0.67*-2.04 + 0.33*-3.63=-2.56.

11 NZ Institute of Economic Research, 2011, Review of export elasticities, Working Paper 2011/4, October.

12 The GMI/IF weighted average elasticity for all red meat products and live exports is -5.18.

Model and the GMI/IF model the export demand elasticity is significantly higher than the domestic demand elasticity.

4.6 Average demand elasticities (domestic and export) for each model[a]

	Food model	GMI/IF
Grass fed	Beef = -1.3	-5.46
Grain fed		-3.97
Lamb	Sheepmeat = -0.66	-1.74
Mutton		-3.44

[a] Share weighted sum across all categories. *Source:* CIE.

In addition to demand parameters, the linkage between the farm and processing sectors is also crucial in both models, especially for simulations 3 to 5 which involve changes in processing costs. Table **4.7** shows that a key difference between the models, especially for simulations 3 to 5, is the contribution of livestock to the total costs — with the GMI/IF having a higher proportion of livestock costs in total processing costs across all categories. The GMI/IF database was assembled using industry data, most particularly the GHD study and ABS/MLA data. [13]

4.7 Comparing the cost structures for the processing sector [a]

	Food model		IF				
	Beef	Sheepmeat	Grass fed	Grain fed	Lamb	Sheep	Goats
	%	%	%	%	%	%	%
Livestock	55.1	53.8	68.5	74.0	73.4	65.4	57.6
Beef and sheepmeat processing[b]	4.6	6.7	0.0	0.0	0.0	0.0	0.0
Transport	5.1	5.1	2.6	2.1	1.9	2.2	3.2
Other inputs	10.8	20.0	13.4	11.0	12.5	16.5	3.7
Total inputs	75.7	80.4	81.8	85.0	85.9	81.9	77.2
Labour	6.8	3.6	13.6	11.3	10.8	12.8	18.7
Capital[b]	2.8	1.5	4.6	3.8	3.3	5.3	4.1
Total output	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] As presented by the share of total costs by sector. Data based on GHD (2009) and MLA data. [b] The beef and sheep processing includes intra-industry usage such as meat input into the manufacture of smallgoods. [c] In the IF, the payment to capital involves a cost of capital component plus a margin. *Source:* CIE.

13 GHD 2010 Study of the Australian Red Neat Processing Sector and its Contribution to National and Regional Economics. Prepared for MLA and AMPC, Project A.CIS.0016, June.

Simulation results using the two frameworks

Tables **4.8** and **4.9** compare results in dollar terms from the Food Model and GMI/IF model for the seven simulations.

Total outcomes for the red meat sector

Table **4.8** shows the original outcomes from the Food model – the data in this table represents data extracted from Table 2 in the original report [14].

4.8 Food model: 1% change to relevant variable for seven scenarios

Industry sector / impact measure	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
	$m	$m	$m	$m	$m	$m	$m
Change in real production							
Farming	90.3	36.3	18.2	7.4	-38.6	34.5	3.4
Processing	85.5	45.6	28.3	12.6	56.5	26.1	2.6
Transporting– Direct meat	20.8	9.8	-1.6	-8.9	-0.8	2.6	0.0
Trading– Direct meat	39.0	23.1	5.0	-11.6	6.5	2.8	-6.8
Change in value-added							
Farming	46.4	18.4	9.3	3.9	-19.4	46.5	1.2
Processing	9.3	4.6	-1.6	1.0	12.4	2.2	0.2
Total red meat	*55.6*	*23.0*	*7.7*	*4.9*	*-14.9*	*18.0*	*1.4*
Transporting– Direct meat	6.2	2.6	-0.5	-2.8	-0.2	-0.8	-0.5
Trading – Direct meat	21.0	11.5	2.5	-5.2	3.3	1.4	-3.3

[a] In 2009-10 dollars.

Source: The CIE Food Processing Model.

The results presented should be understood in the context of the model's database structure (outlined above). For instance, in table **4.8**, for simulation 1 farming GVP is found to increase by $90.3 million, whereas the GVP for processing increases by $85.5 million. This does not imply that there is a 'loss' of GVP between the farm and processing levels. Instead, it reflects that in the Food Model database, less than 60 per cent of 'livestock' is sold to processing, and that the increase in price of 'livestock' applies to the larger base of all sales, not just sales to the processing sector.

Table **4.9** shows corresponding benefits calculated from the GMI/IF —information from table 3.2 is simply repeated here for the convenience of the reader.

14 Centre for International Economics, 2015, Addendum to Payoffs from Research and Development along the Australian Food Value Chain – The Specific Case of Beef and Sheepmeat, Report prepared for MLA, June, p7.

4.9 GMI/IF model: 1% change to relevant variable for seven scenarios

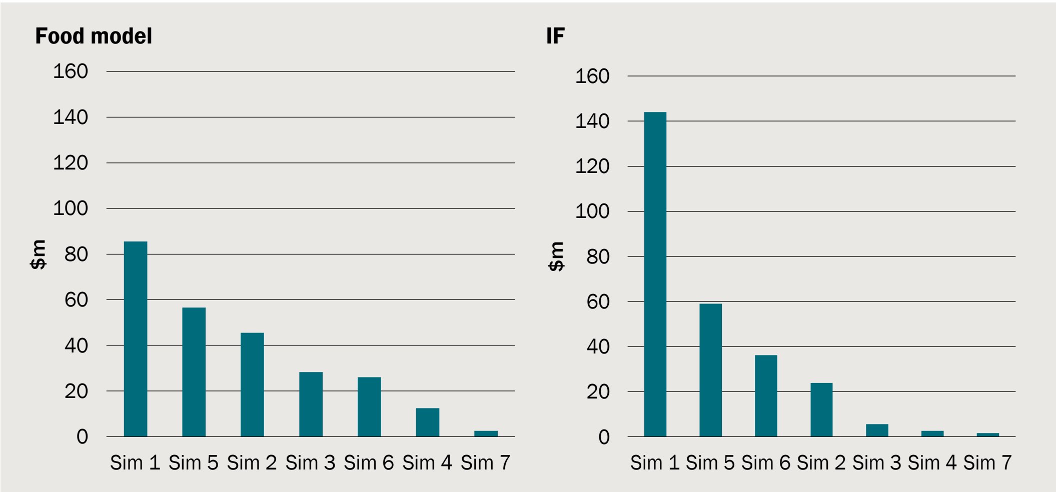
Industry sector / impact measure	1 Export Demand	2 Domestic Demand	3 Processing Productivity	4 Transport, etc Processing	5 Reduce Waste	6 On farm Productivity	7 Transport, etc Agriculture
	$m	$m	$m	$m	$m	$m	$m
Change in GVP							
Farming	109.5	17.0	13.0	6.2	43.8	15.6	0.9
Processing	144.0	23.9	5.5	2.6	59.0	36.2	1.7
Change in value added							
Farming	65.1	11.3	7.6	3.7	21.7	36.7	2.5
Processing	23.1	3.2	2.7	1.3	16.9	17.7	0.8
Total red meat	88.2	14.5	10.3	5.0	38.6	54.4	3.3

[a] In 2009-10 dollars.

Source: GMI/IF.

Chart **4.10** and **4.11** compares and ranks the benefits measured by GVP and value-added between models by simulation.

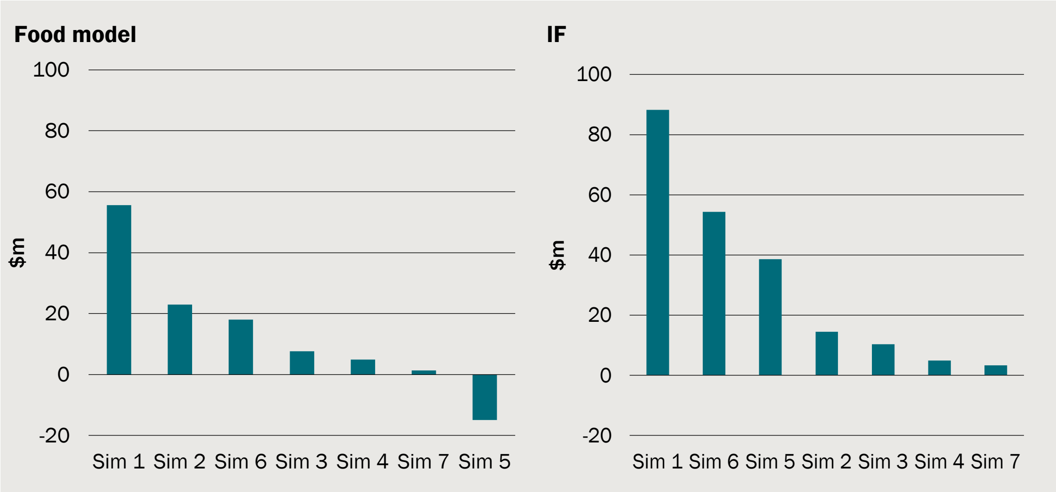
4.10 Comparison of GVP benefits across red meat value chain



[a] In 2009-10 dollars, GVP for the red meat processing sector only (to avoid double counting) but also excludes estimated benefits to the trade and transport sectors to make comparison with the IF results.

Data source: CIE.

4.11 Comparison of value-added benefits across red meat value chain



[a] In 2009-10 dollars, includes the benefits to the red meat farm and processing sector but excludes estimated benefits to the trade and transport sectors to make comparison with the IF results.

Data source: CIE.

Comments on results using the two frameworks

A number of observations can be made on the results presented in the previous section from use of the Food Model and GMI/IF model.

General 'take away' observations from a comparison of the model results

The following general observations may be made:

- Despite the Food Model and GMI/IF model being built on very different frameworks, the model results are reasonably similar. In terms of overall change in industry GVP predicted by the two model frameworks using the seven simulations, the correlation between results is 0.91. In terms of value added the correlation is 0.72. The consistency in results extends to sector benefit analysis, particularly on farm. If Scenario 5 is ignored (waste) for on-farm GVP benefits the correlation is 0.95 and for value added the correlation is 0.90.[15]
- Under both sets of models the scenario which consistently attracts most benefits is Scenario 1, export marketing. Conversely, the scenarios which consistently attract the least benefits under both sets of models are Scenarios 4 and 7 (the two scenarios related to transport and handling).
- In terms of the ranking of scenarios in terms of GVP and value added benefits generated under both model frameworks in most cases:

15 The correlation results are significantly influenced by the export demand and two transport scenarios.

  - Either the ranking afforded to a scenario is the same under both model frameworks (as is the case for Export Marketing which ranks first in terms of benefits under both frameworks)
  - Or the ranking is similar (mostly a maximum of only one rank difference).
- The dollar size of benefits is consistently higher for the GMI/IF than for the Food model for both GVP and value-added.
  - Table **4.4** shows that the share of exports in total sales for processing is significantly higher in the GMI/IF model than the Food model.
  - This is also true for household consumption where the GMI/IF tracks 'domestic disappearance' and the Food Model tracks an estimate of 'household consumption'.
  - Because the 1 per cent applies to a smaller base relative to total sales, for these key simulations, the outcome for the Food Model will be smaller.

  Also of critical importance in the higher benefits generated by the GMI/IF model is the higher elasticities used in this model. For positive interventions, such as improvements in productivity or increases in demand, these higher elasticities will generate greater benefits (they will also, of course, result in greater negative industry impacts when adverse developments occur).
- The most notable inconsistency between the two sets of models is for simulation 5 (reduction in waste), particularly when calculating value added. Under the Food Model the industry *looses* overall by a 1 per cent reduction in waste in the processing sector, with a $14.9 million reduction in value added. The losses in value added in the farm sector are particularly heavy, amounting to $19.4 million in the Food Model, compensated by a small gain ($4.5 million) in the processing sector. In contrast, under the GMI/IF framework the industry gains overall from the reduction in waste, by $38.6 million, comprising a gain of $21.7 million on farm and a gain of $16.9 million in the processing sector.
- Differences in results also exist between the two model frameworks for the other processing related simulation, Scenario 3 (1 per cent improvement in processing productivity), but to a considerably lesser degree. The reasons behind the differences in the processing waste and processing cost simulations are further explored below.

Processing cost / waste simulations

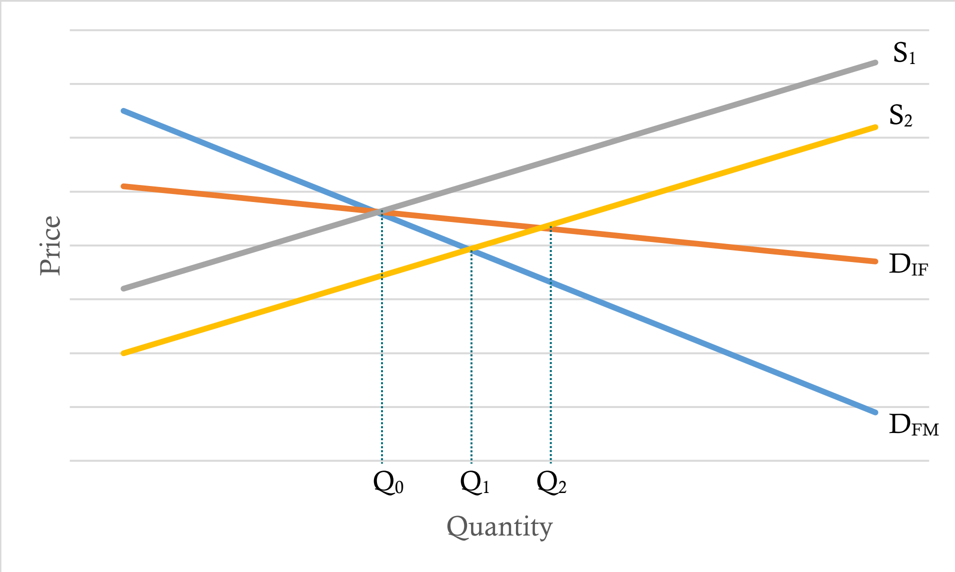
The analysis above identified that there were some differences in estimated GVP and value added outputs from the two model frameworks, especially for simulation 5 and, to a lesser extent, simulation 3. These differences can be attributed to two factors:

- the differences in processing cost structures between the two models (see table **4.7**) especially the share of livestock in processing costs.
- the aggregate demand elasticity facing the processing sector under the two model frameworks (see table **4.6**).

The lower aggregate demand elasticity for meat in the Food Model is especially important in limiting benefits from cost improvements in Australian meat processing. The situation is similar to that depicted in Chart **4.12**. The demand curve used in the

GMI/IF model is more elastic than in the Food Model — just as the demand curve D_{IF} in Chart **4.12** is more elastic than the demand curve D_{FM}.

4.12: The impact of demand elasticities on the calculation of cost reduction benefits



When the supply curve shifts outwards, say from S_1 to S_2, as it would, for instance, if waste were to reduced in Australian meat processing:

- Under the GMI/IF model, because of the more elastic demand curve, demand expands rapidly, (in Chart **4.12** from Q_0 to Q_2) which limits any price fall.
- Under the Food Model demand only expands a little (in Chart **4.12** from Q_0 to Q_1) which means that the price fall is significant.

In modelling Simulation 5, reduction in waste, the method used was equivalent to assuming an improvement in saleable meat yield, or more correctly, meat yield that can be sold into a higher value category.

- For both models, the reduction in waste has been simulated by a per unit reduction requirement in the livestock input (cattle and sheep) for the processing sector. That is, the same level of processing output *value* can be produced with 1 per cent less livestock input *costs* with no change in other inputs *costs*. [16]

Because the GMI/IF model has a higher aggregate demand elasticity (that is, a more elastic demand curve) and a higher proportion of processing costs attributed to livestock, the benefits of an improvement in yield are significant — under the GMI/IF the benefits, in value added terms, from the 'reduction in processing waste' simulation rank 3rd overall (behind 'export marketing' and only marginally behind an improvement in 'on-farm productivity').

16 Noting that output in this case applies to both meat and co-products, which cannot be separated in the Food Model.

Farm cost simulations

Consistent with the narrative above, the benefits from the GMI/IF model of an improvement in on-farm productivity are significantly higher than for the Food Model because of the expansion in demand which limits price falls.

Concluding remarks on the two model frameworks

The Food Model and the GMI/IF model have largely been developed for different purposes and this is reflected in the framework structures and results.

- The GMI/IF framework has been developed for the Australian meat industry. It is based on specific industry data and knowledge. However, some the relationships in the model are less sophisticated and, therefore, less data intensive that the Food Model.
- The Food Model has evolved from economy wide input-output tables and models. The data and economic relationships are more generic across industries and so are suited to the analysis of wider economic issues and problems. In some areas information from the Food Model does not appear to align closely with generally accepted information on the Australian meat industry (for example, share of exports in total sales, cost share of livestock in total processing costs, level of on-farm meat consumption, elasticities of demand).
- The inputs and the outputs of each of the models remain significantly different. This highlights that models should be used on fit-for-purpose basis.

5. Case study: value adding sheepmeat into China

In this chapter the third major objective of MLA Project P.MDC.0034 is addressed. In particular this chapter will

- Demonstrate the overall level of benefits and distributional impact of benefits that might accrue from increasing demand for Australian sheepmeat in China using two scenarios.

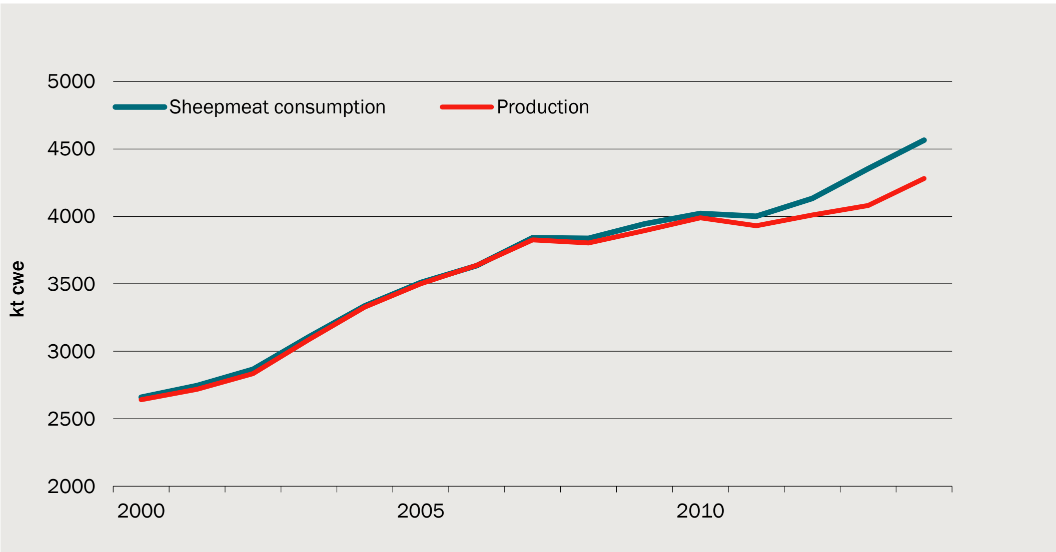
This chapter is divided into three major sections.

- First, some background is provided on Australian sheepmeat exports into China.
- Second, two scenarios are developed for the Australia/China trade involving an increase in demand for Australian sheepmeat.
- Third, results from these scenarios are presented and explained.

Background on Australian sheepmeat exports to China

China is both the world's largest producer of sheepmeat and the largest consumer. Since 2005 sheepmeat production has grown at the rate of 1.8 per cent per annum, while sheepmeat consumption has grown at the rate of 2.3 per cent per annum (see chart **5.1**).

5.1 Sheepmeat consumption and production in China



Data source: GMI database and China Agriculture Yearbook, 2015.

Sheepmeat consumption in China

Sheepmeat in China is principally consumed by higher income consumers in the main urban areas. Per person consumption in urban areas is twice that of rural areas and is mainly concentrated in the north and north west of China, in the winter months. The top income groups are known to consume at least 50 per cent more sheepmeat than the lowest income groups.

Despite sheepmeat being consumed by the top income groups, the incomes of these groups is still low compared to Australia. The majority of consumers have limited purchasing power, hence demand for lamb mainly comprises cheaper cuts. There is also a lack of ovens in the home, so cooking is focussed on stovetop dishes.

Table **5.2** lists common Chinese meals prepared with sheepmeat.

5.2 Common sheepmeat meals in China

	Where	Preparation
Red-cooked and curried lamb stew	In-home	▪ Lamb breast, is chopped into 1-inch cubes ▪ Blanched before cooking, then stewed
Sliced lamb hot pot	In-home and out-of-home	▪ Sliced lamb or mutton ▪ NZ is selling retail packs of mutton into China
Stir-fry Scallion Lamb, Iron Platter Lamb, Szechuan Lamb, Oyster Sauce Lamb	In-home and out-of-home	▪ Sheepmeat chopped into small cubes or slices ▪ Typically lean meat for these dishes
Sheepmeat kebab	Out-of-home	▪ Sheepmeat chopped into small cubes
Sliced boiled lamb	In-home and out-of-home	▪ Served as a cold dish, but less common than other uses ▪ Low cost cuts used
Dried Sheepmeat Snacks	In-home and out-of-home	▪ Sliced or diced sheepmeat, sticks and kebabs

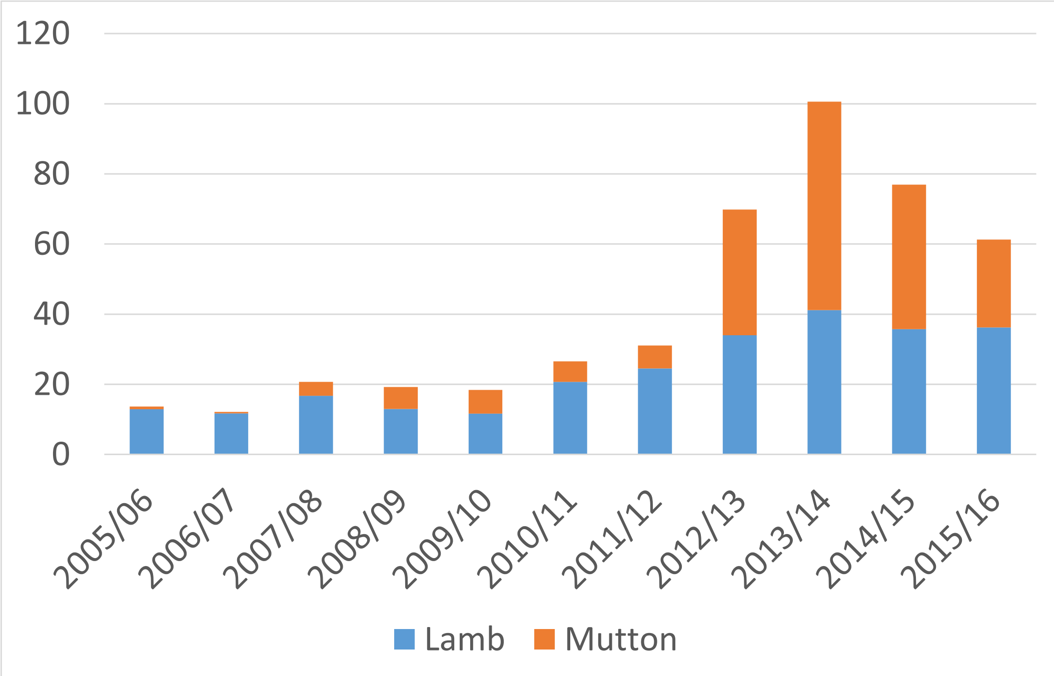
Traditionally sheepmeat in China was a by product of wool production, with consumption comprising mostly mutton, although this is now changing with lamb being consumed in greater quantities. Sheepmeat in China is known as ‘yang rou’, covering both lamb and mutton. It is likely that, given the sheepmeat dishes traditionally prepared in China, the range of cuts used in these dishes, and at the relevant price points, that lamb, mutton and goat meat are highly substitutable (many consumers cannot distinguish between them).

Sheepmeat trade into China

The difference between the rates of growth of sheepmeat consumption and sheepmeat production in China over the last ten years has been made up by increasing volumes of sheepmeat imports.

The overwhelming majority of the trade in sheepmeats into China is sourced from Australia and New Zealand, with New Zealand dominating the imported trade (on average over the last five years 57 per cent of China's imported sheepmeat has been sourced from New Zealand, with Australia supplying 40 per cent). Notwithstanding the dominance of New Zealand, however, Australian sheepmeat imports have grown strongly since 2005, increasing about 4.5 times between 2005-06 and 2015-16 (see chart **5.3**).

5.3 Australian sheepmeat exports to China



The bulk of Australia's lamb and mutton trade into China has comprised front end, low value, cuts — last calendar year the main lamb cuts exported to China were breast and flap (69 per cent of all exports), rack cap (15 per cent) and neck (11 per cent). Current lamb exports to China are exclusively frozen and over 90 per cent bone-in. The China market has proved a valuable outlet for forequarter, frozen, low valued cuts (which were previously sent to markets like South Africa and Papua New Guinea). Due to the nature of cut composition, the China trade has complemented other higher valued markets such as the domestic and United States markets.

It is to be noted from chart **5.3** that recently Australia's sheepmeat trade to China has turned down. After many years of rising prices, since mid 2014 prices for sheep and lambs in China have fallen, resulting in producers culling sheep, thus placing further pressure on prices. However, the culling that is occurring now, in the medium term, will constrain China's capacity to increase sheepmeat production.

Forecast future developments with sheepmeat consumption and trade into China

Looking to the medium term, MLA notes that although China's sheepmeat production is expected to increase slightly (2-2.5 per cent) every year up to 2020, this will not keep up with demand, which is expected to grow 3.4 per cent per annum. The main drivers for the increase in demand are increasing incomes and, to a lesser extent, increasing populations. China's population growth is slowing, with the population expected to increase by 2.2 per cent to 2021, but this is still an additional 30 million people [17]. Over the same period (between 2015 and 2021) per person incomes in China are expected to grow by 31 per cent[18]. The growth in incomes in China is especially important for future levels of sheepmeat consumption since sheepmeat demand in China is income elastic. The GMI/IF model uses an income elasticity of demand in China for sheepmeat of 1.2 With all other things held constant this means that if incomes grow by 31 per cent in China over the next five years, sheepmeat demand should grow by about 37 per cent.

As previously noted, current and past trade in sheepmeats to China has predominantly consisted of lower valued cuts. These cuts will continue to dominate the trade into the foreseeable future — these cuts are more affordable and suit the cooking requirements of many Chinese sheepmeat dishes. There are now signs, however, that a premium sheepmeat market is beginning to emerge, supplementing the much larger lower value one. As indications of this, middle class consumers are increasingly prepared to pay more for imported food items. Moreover, there are small volumes of domestic lamb now being marketed as organic – again reflecting the tastes of the upper middle class and wealthy population segments.

The growth in modern retail and the hotel restaurant (HR) sector will also assist the emergence of a premium sheepmeat segment. Such outlets place more emphasis on western foods. The HR sector is expected to grow by around 10 per cent per annum through to 2020, implying the market will double in size every eight years. Also by 2020, China could well have become the world's most popular destination for international tourists, according to the World Tourist Organisation, with annual visitors amounting to 130 million.

Also growing at unprecedented speed in China is the online economy. Based on McKinsey research[19], in 2011, China's e-tailing sales reached US$120 billion, which was just behind the United States - despite the low broadband penetration rate in China of only 30 per cent. Today, the majority of young people living in big cities regularly shop online, including for food.

China — Australia Free Trade Agreement

Assisting with the growth of Australia's total sheepmeat trade to China, and a growth in premium sheepmeat sales, will be the China-Australia Free Trade Agreement (ChAFTA). Until the entry into force of this agreement in late 2015, the average tariff for Australian frozen sheepmeat cuts into China was about 12 per cent and for chilled

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17 United Nations, Department of Economic and Social Affairs, Population Division, 2015, World Population Prospects: The 2015 Revision, https://esa.un.org/unpd/wpp/.

18 International Monetary Fund, 2016, World Economic Outlook, October 2016, https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx.

19 Dobbs, R., Y Chen, G Orr, J. Manyika, M. Chui and E. Change, 2013, China's e-tail revolution: online shopping as a catalyst for growth, McKinsey Global Institute, McKinsey & Company, March.

sheepmeat was about 15 per cent. Furthermore, tariffs imposed on New Zealand's sheepmeat imports into China were considerably lower due to the 2008 New Zealand — China Free Trade Agreement.

ChAFTA not only provides an opportunity in equalising access conditions with New Zealand but also to capitalise on Chinese high regard for Australian food and meat products. Under ChAFTA all tariffs on Australian sheepmeat will be reduced to zero by 2023.

The fact that tariffs on chilled product fall more than frozen product under ChAFTA provides opportunities in the development of a premium trade. Even more important, one Australian processor has recently been granted access to supply chilled sheepmeat to China[20]. It is hoped that in the near future access will be granted to additional processors.

Scenarios for adding value to the sheepmeat trade into China

Given the background provided above two scenarios were developed for adding value to Australia's existing sheepmeat trade into China.

Scenario 1: development of a chilled lamb trade into China

This scenario picks up on the possibility of developing a premium lamb trade into China involving the development a small chilled lamb trade, set at 6 300 tonnes by 2020 (that is, equivalent to 20 per cent of 2015 calendar year lamb shipments to China).

It has been assumed that:

- The growth in the chilled trade would occur in equal increments over the period 2015 to 2020.
- The chilled trade would be added trade — it would not simply involve some of the existing trade being replaced.
- That New Zealand would not respond to the Australian initiative.
- A 50 per cent premium for chilled over frozen product is assumed. This premium would appear to be conservative, provided the move to chilled also involves shipment of higher value cuts. The premium, when applied, results in a per unit value for chilled lamb into China of $4.74 per kilogram. This compares to a per unit price for Australian chilled lamb to all export markets in 2015 of $9.01 per kilogram. Even so to achieve a $4.74 for chilled lamb into China would involve a value uplift - moving from forequarter to higher-value hindquarter and loin cuts.

Realising this scenario would require a series of actions in the areas of market access and marketing.

20 Australian Broadcasting Corporation – Rural, 2016, WA meat processor makes historic move to enter Chinese chilled lamb market, ABC Online, http://www.abc.net.au/news/2016-03-18/first-chilled-lamb-shipment-to-china/7256440.

Details of the scenario are provided in table **5.4**.

5.4 Estimation of model shocks for scenario 1

	Exports	Return	Value
	kt	Ac/kg shipped	$000s
Baseline (based on calendar year 2015 shipments)			
Fresh or chilled lamb	0.0	na	0.0
Frozen lamb	31.3	3.16	99.0
Lamb	31.3	3.16	99.0
— % fresh or chilled quantity	0.0		
— % premium chilled over frozen	na		
Additional product in scenario 1 (20% chilled trade attracting a 50% price premium)			
Fresh or chilled lamb	6.3	4.74	29.7
Frozen lamb	0.0	na	0
Additional lamb	6.2	4.74	29.4
Total lamb shipments to China under Scenario 1			
Fresh or chilled lamb	6.3	4.74	29.7
Frozen lamb	31.3	3.16	99.0
Lamb	37.6	3.42	128.6
— % fresh or chilled quantity	17		
— % premium chilled over frozen	50		
% increase in total	20	8	30

Source: Oliver & Doam and CIE assumptions

Scenario 2: development of a yearling sheepmeat trade into China

The second scenario involves the development of a new sheepmeat product for China based on MSA pathways that could be eventually extended to other markets particularly those in the Middle East.

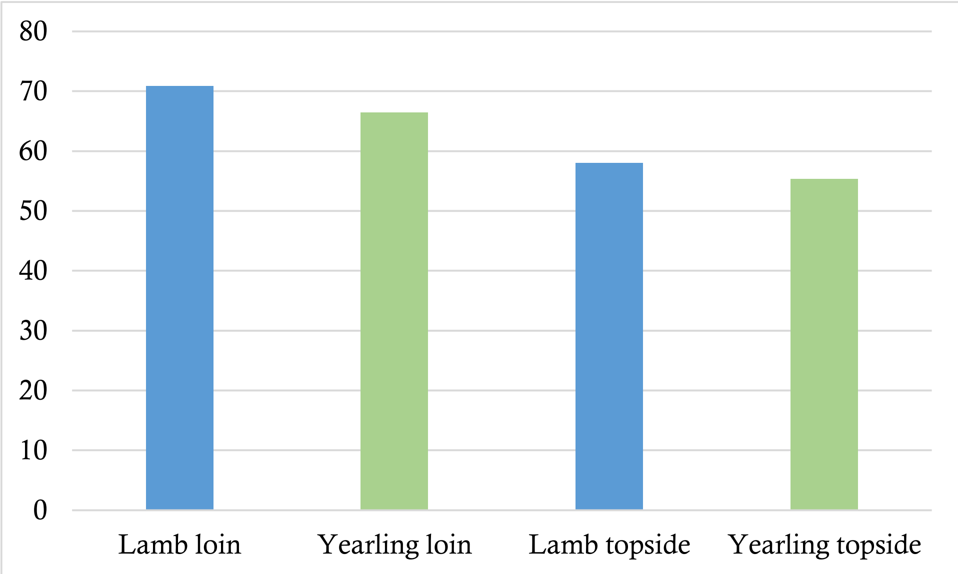
The development of this scenario was based on the following:

- many in China do not distinguish between lamb and mutton (see the Background section).
- recent MSA testing in China shows MSA yearling sheepmeat product rates well amongst Chinese consumers in terms of acceptability.

MSA testing recently completed in China was especially important in the development of Scenario 2. The testing involved 720 Chinese consumers rating grilled lamb and yearling loin and topside products for tenderness, juiciness, flavour and overall liking. Product was rated as unsatisfactory, good every day, better than every day and premium.

Results for overall liking for lamb loins and yearling loins and for lamb topsides and yearling topsides are shown in Chart **5.5**. It can be seen that yearling sheep product scores lower than lamb, but only slightly so — by 6.6 per cent for loin and by 4.9 per cent for topside. Research will now proceed to isolate yearling sheepmeat product that performs equally with lamb in the eyes of Chinese consumers. Research is also planned on cooking methods more commonly applied to sheepmeat in China (rather than the grill method used in the recently completed study).

5.5 Overall liking of lamb and yearling sheepmeat products by Chinese consumers



Source: David Pethick, personal communication and LambEx talk, August, 2016.

The key assumptions in the development of scenario 2 are:

- Product that was previously exported as mutton to China can now be classified as a new product that has similar eating quality characteristics to lamb.
- Recent research indicates that eating quality of yearling sheepmeat in the eyes of Chinese consumers is only 6.6 per cent eating quality points or 4.9 per cent lower than lamb (based on loin and topside cuts and the grill cooking method).
- The same research also indicated that willingness to pay by Chinese consumers would be $12.52 per kilogram for 3 star quality, $18.46 for 4 star and $26.50 for 5 star (retail level prices):
  – noting that cuts that grade 4 and 5 star product are already higher-quality cuts, the key metric is the premium for yearling sheepmeat that is paid over the equivalent mutton price on a like-for-like basis.

Additional assumptions include:

- the increase in demand and supply is for chilled yearling product and would not be at the expense of existing market segments;
- the premium for yearling sheepmeat product over mutton could be obtained by attribution of part of the value differential between mutton and lamb; and
- all of these animals would be drawn from the pool that is eligible through existing MSA pathways.

CIE (2012) estimated that the pool from which eligible animals could be drawn was considerable – of the 3.1 million yearling sheep potentially available annually that could meet MSA requirements, CIE estimated that producers might find it financially attractive to send 1.6 million to slaughter (at 23kg cwe per animal providing 36.8kt cwe of production). Not all of the product from these yearling sheep, however, would be marketed as MSA. CIE estimated that in total 12.5kt cwe might be available for marketing.

More critical than the amount of product potentially available is information on the likely market penetration of this product. The 'willingness to pay' data provides some clues here, but to satisfactorily come to a conclusion regarding market penetration would require a channel survey or expert market knowledge.

For the purpose of this exercise it has simply been assumed that 6 kt cwe of yearling sheepmeat product could be sold into China. Furthermore, it has been assumed that the yearling sheepmeat products sold fresh, could achieve 80 per cent of the fresh lamb price from simulation 1.[21]

Table **5.6** shows how the assumptions are put together.

5.6 Estimation of model shocks for scenario 2

	Exports	Return	Value
	kt	Ac/kg shipped	$000s
Baseline (based on calendar year 2015 shipments)			
Fresh or chilled mutton (and goatmeat)	0.0	na	0.0
Frozen mutton (and goat meat)	30.7	3.05	93.6
Mutton (and goat meat)	30.7	3.05	93.6
- % fresh or chilled quantity	0.0		
- % premium chilled over frozen	na		
Additional product in scenario 2 (6kt of chilled MSA yearling sheep product sold at a discount of 20% to the chilled lamb in scenario 1)			
Fresh or chilled mutton	6.0	3.79	22.8
Frozen mutton	0.0	0.00	0.0
Additional mutton	6.0	3.79	22.8
Total mutton/yearling sheepmeat shipments to China under Scenario 2 (including goat meat)			
Fresh or chilled mutton / yearling sheepmeat	6.0	3.79	22.8
Frozen mutton	30.7	3.05	93.6
Total Mutton/yearling sheepmeat	36.7	3.17	116.4

21 Like the assumption for chilled lamb, the price assumption for chilled yearling sheepmeat is probably conservative. Globally the price achieved for chilled mutton exports in 2015 was $7.61 per kilogram. The price assumption for chilled yearling sheepmeat product into China is $3.79 per kilogram.

- % fresh or chilled quantity	16		
- % premium chilled over frozen	24		
% increase in total	20	4	24

Source: Oliver&Doam and CIE assumptions

In total, this scenario would result in mutton/yearling sheepmeat exports to China increasing in volume terms by 20 per cent and 24 per cent in value terms. These are the 'shocks' for the GMI model. It is assumed that the developments occur in equal increments over five years.

Results from the GMI/IF model for China using the two scenarios

Results from the two simulations for China are summarised in table **5.7**. Results shown in this table pertain to 2020.

5.7 Calendar year 2020 results from the GMI/IF model for China scenarios 1 & 2

Outcome measure	Scenario 1 Chilled Lamb	Scenario 2 Yearling sheepmeat
Change in industry GVP		
Farming	$87.1 million	$21.4 million
Processing	$108.5 million	$24.4 million
Change in industry value added		
Farming	$53.4 million	$16.7 million
Processing	$10.2 million	$1.6 million
Total	$63.6 million	$18.3 million
Change in the value of sheepmeat exports		
To China	$72.2 million	$54.0 million
Total exports	$84.3 million	$38.6 million
Change in producer prices		
Sheep	-10c/kg cwe	18c/kg cwe
Lambs	13c/kg cwe	-1c/kg cwe

It can be seen from table **5.7** that both the chilled lamb and yearling sheepmeat scenarios are estimated to provide considerable benefits to the Australian industry. The chilled lamb scenario would increase processing sector GVP by $108.5 million and industry value added by $63.6 million. Corresponding figures for the yearling sheepmeat scenario are $24.4 million and $18.3 million, respectively.

Industry benefits from the chilled lamb scenario are surprisingly high, being almost as great as those estimated from a 1 per cent increase in overall beef and sheepmeat export demand (see Chapter 3, Scenario 1). The China chilled lamb scenario involves an initial model shock of a 30% increase in the value of lamb shipments to China. This equates to an increase in the value of lamb shipments to China of $29.6 million (i.e. $128.6 million less $99.0 million – see table **5.4**). This compares to an initial shock of $55 million in terms of an increase in beef and sheepmeat export demand under Chapter 3 Scenario 1 (equating to 1 per cent of the value of beef and sheepmeat exports in 2009/10 of $5.497 billion). That is, the initial model shock in the China chilled lamb scenario is slightly over half that of the 1 per cent increase in export demand scenario, yet the China lamb scenario provides 75 per cent of the GVP benefits of Chapter 3, Scenario 1 and 72 per cent of the valued added benefits.

The fact that there is "more bang from the buck" for the China chilled lamb scenario, than from the 1 per cent increase in general export demand scenario, can be attributed to elasticities of demand and supply. In the China chilled lamb scenario both the elasticity of demand and elasticity of supply are higher than the elasticities applying to a 1 per cent increase in overall exports. The elasticity of demand is higher because consumers in China, living in a developing country, are more price responsive than consumers in all markets. The elasticity of supply is higher because demand for beef is not also increasing at the same time (meaning more resources will be diverted to sheepmeat production), nor is demand in export markets generally increasing – demand is only increasing in China (meaning exports can be transferred from other markets to China[22]). The net effect of the differences in demand and supply elasticities is that, relative to the initial shock, the industry impact is greater from chilled lamb penetration into China than it is from a general increase in export demand.

Another noticeable feature from table **5.7** is that the payoffs from the chilled lamb scenario are significantly higher at all stages of the value chain than for the yearling sheepmeat scenario – in GVP terms the benefits from the chilled lamb scenario are 3.7 times greater than the yearling sheepmeat scenario and in value added terms are 2.9 times greater. This result stems from the fact that the model estimates that the boost to *total* sheepmeat exports under the chilled lamb scenario will significantly greater than under the yearling sheepmeat scenario.

- Under the chilled lamb scenario there is a $72.2 million boost in exports to China and a $84.3 million boost in total sheepmeat exports – the boost in total exports exceeds that in China. This is despite the fact that some product is diverted away from other markets to China. The reason is that the additional demand for chilled lamb in China increases prices in all export markets – because demand for lamb in inelastic in these export markets.
- Under the yearling sheepmeat proposal there is a $54.1 million boost in exports to China, but only a $36.9 million boost in total sheepmeat exports. Mutton exports in other markets drop to accommodate the increased demand in China – because the elasticity of demand for mutton in these other markets is high, mutton is easily diverted from these other export markets into China and export prices overall do not increase by all that much.

22 It is to be noted, however, that the demand for sheepmeat in major markets such as the United States, the Middle East and Europe is price inelastic – so diversion will be limited.

Concluding comments on adding value to the sheepmeat trade into China

It has been shown in this report, using the GMI/IF model, that there is the potential to add considerable value to Australia's sheepmeat trade to China. If the trade in Australia's chilled lamb trade to China could be increased by 6,300 tonnes over the next 5 years, this would increase the value added for the Australian industry by $63.6 million. Similarly, if a trade in yearling sheepmeat could be developed the value added for the Australian industry could rise by $18.3 million.

The value of economic modelling in ex ante project evaluation has been demonstrated with clarity in the China simulations presented in this Chapter. On the face of things the yearling sheepmeat proposal might have been expected to provide reasonably similar benefits to the chilled lamb proposal[23]. After all:

- the current (2015) levels of mutton and lamb exports to China are very similar (31.3 kt for lamb and 30.7kt for mutton);
- the demand boost modelled was reasonably similar also (30 per cent in the case of lamb, 24 per cent in the case of mutton); and
- the current value of mutton and lamb exports to China, though different, is not massively different, with the value of mutton exports to China being 24 per cent below the value of lamb exports.

Despite these similarities, however, the economic analysis strongly supported proceeding with the chilled lamb proposal above the yearling sheepmeat proposal (if a choice needed to be made). The chilled lamb proposal provided industry benefits 3.5 to 4.4 times greater than those which accrue from the yearling sheepmeat proposal (depending on whether change in GVP or change in value added is used as the industry benefit measure). Industry would receive considerably more gross benefits from MLA focussing on the development of a chilled lamb trade into China than it would from focussing on developing a yearling sheepmeat trade.

One final point needs to be made. It must be emphasised that the figures above are indicative of gross benefits. Of course, realisation of either scenario is likely to involve additional costs – both at an industry level and enterprise level. At an industry level there would potentially be expenditure on both market access ((securing favourable conditions of entry for chilled lamb and chilled yearling sheepmeat product) and, particularly, marketing activities (a range of business development initiatives, including promoting the benefits of the product). At an enterprise level there would be additional costs in servicing the chilled trade as well as in establishing sheepmeat MSA systems for the trade to China. In a full evaluation of the two scenarios these costs (as well as the gross benefits) would need to be taken into account.

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23 Indeed, without undertaking the analysis some might have been tempted to believe that the yearling sheepmeat proposal would have produced greater benefits - by adding value to this lower value product.

6. Conclusion

This report has demonstrated how the GMI/IF model can be used to measure overall industry impact and the distribution of this impact across sectors arising from seven scenarios previously analysed by MLA through application of the Food Model. In addition the GMI/IF model was used to estimate the industry impact of two further scenarios related to adding value to Australian sheepmeat sales into China.

A large part of this report involved comparing results from the GMI/IF model and the Food Model using the seven scenarios. While differences were evident between the two sets of model results, in many areas the results were reasonably similar. This is a remarkable result considering that the GMI/IF model and the Food Model have been designed for very different purposes and have been built on very different frameworks.

It is the experience of the authors of this report that what matters more than the particular model used, whether this be the GMI/IF model, the Food Model or some other model, is the inputs into that model. These inputs are critical in ex ante and ex post evaluations of projects that MLA may be considering or has undertaken.

This report has focussed on the analysis of seven relatively straightforward scenarios, involving demand or supply shifts. In ex ante and ex post evaluations often the most significant source of error, and the greatest area of uncertainty, is how much a particular (MLA) project or program will / has shifted industry demand or supply. This goes to questions such as the probability of success of an R&D program, levels of adoption, the degree to which risk has been averted, the impact of marketing programs and attribution.

Improved performance measurement was one of the major recommendations to emerge from the recent evaluation of activities undertaken by MLA between 2010/11 and 2014/15. Although the refinement and maintenance of economic models has a role to play in improved performance measurement, the greater need in project / program evaluation is to more precisely define the inputs into the model – the so called "model shocks" (corresponding to the scenarios in the current study). This entails more precisely defining the outcomes that have been achieved, or will be achieved, through a set of projects or programs. These outcomes must be justifiable, being based on sound evidence and logic.

Once evidence based, justifiable, outcomes from project work have been defined economic models can be used to estimate overall industry impact and the spread of this impact across the supply chain.

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