NZIER
NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH

Workforce in Red Meat and Wool

Results from supplemental modelling

NZIER report to the Ministry for Primary Industries

October 2023

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Key points

We provide results from modelling the Red Meat and Wool sector

- We modelled eight scenarios of the future development of the Red Meat and Wool sector, using an economy-wide model. The scenarios included changes to all the food and fibre sectors and different assumptions about the Red Meat and Wool sector.
- Initial scenarios were based on past trends, and then we added increased use of technology and growth in export demand. Additional scenarios examined the impact of higher growth and lower growth in the Red Meat and Wool sector.

Productivity and export demand both affect future workforce needs

- Under all the scenarios, the Red Meat and Wool sector workforce grows. That is, the macroeconomic conditions regarding population and food demand create growth in the sector, which consequently needs a larger workforce.
- Higher export demand – growth in overseas markets, whether in terms in volume or price – leads to a larger sector and larger workforce.
- Productivity changes are complex. First, the sector grows even in the lower productivity scenarios. Export demand supports a larger workforce.
- Second, increased productivity allows the sector to grow faster and larger. The modelling assumes that there is a market for meat and wool, so New Zealand can sell as much as it produces.
- Third, the Core production and Core processing parts of the sector are in tension with each other. They both have to operate at the same volume – on-farm production flows into processing – so they balance the workforce required across both parts. When the Core processing part has relatively low productivity, it pulls in more labour because that is required to process the output from the on-farm part. However, its low productivity limits somewhat the size of the whole sector.
- When its productivity is higher, Core processing can have greater throughput. The on-farm workforce therefore grows to support higher production in Core production.

The sector is large enough to affect the whole economy

- The Red Meat and Wool sector is large enough that the New Zealand workforce and economy could be one to two percent larger if the sector does well. Improving the productivity of the sector increases New Zealand's GDP.
- The workforce grows more in higher-productivity scenarios. In those cases, the sector is able to attract workers with higher pay and grow sector value.
- The sector is competing with other food and fibre sectors and the rest of the economy for investment capital and workforce. When it grows more and sells more, it competes better, offers higher wages, and supports a larger workforce. In lower-productivity scenarios, it has a smaller future workforce on lower wages. Instead, workers find jobs in other parts of the economy.

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1 Introduction

1.1 Scope of the work

The Ministry for Primary Industries (MPI) commissioned NZIER to undertake modelling to help understand future workforce needs in the food and fibre sectors. One key sector is the Red Meat and Wool sector. It produced $12 billion in exports in 2022/23,[1] making it the second-largest part of the food and fibre sectors. The future trajectory of the sector and its workforce needs will be influenced by several drivers, including competition from other land uses, recruiting sufficient labour, and investment in automation and innovation.

To understand potential workforce requirements for the sector, NZIER modelled the possible impacts of productivity growth in Core production and Core processing in the Red Meat and Wool sector, alongside different market scenarios. The model used for the work, a computable general equilibrium (CGE) model, included all other sectors in the food and fibre sectors as well as the rest of the economy. The modelling therefore captured the interactions between the Red Meat and Wool sector with other sectors and the rest of the economy, in particular the competition for resources.

The modelling was based on information gathered from a review of dozens of industry and government reports and many interviews with key informants from the food and fibre sectors. However, the modelling does not represent any specific government policy or industry strategy. Instead, we modelled a set of scenarios that together provide an indication of the range of possible futures that the Red Meat and Wool sector could face. These are 'what-if' scenarios: what if this or that were to happen? What would be the impact on industry output and workforce needs?

1.2 We modelled eight scenarios for the future of Red Meat and Wool

For this work, the Red Meat and Wool sector has been divided into a few different parts, based on the idea of a supply or value chain. Core production includes sheep and beef farms, and Core processing includes various types of meat processing and food manufacturing. Further discussion of the modelling approach and scenarios are contained in other sections of this report.

A summary of the eight scenarios is provided in Table 1.

- Scenarios 1 to 3 start with past trends in productivity growth, and build onto them using information gathered from industry reports and interviews with key informants about technology and export markets. On past trends, on-farm productivity would grow well and processing productivity would grow very little.
- Scenarios 4 to 6 test the impact of assuming lower productivity growth in the Red Meat and Wool sector compared to the earlier scenarios. For the rest of the food and fibre sectors, the scenarios use the earlier inputs. The lower-productivity scenarios use the same assumptions that were applied to the Dairy sector in Scenarios 1 to 3, which assumed constraints on growing the sector. These assumptions limit the growth of the sector in the model, especially relative to food and fibre sectors.

[1] Ministry for Primary Industries. 2023. Situation and outlook for primary industries. Wellington, June.

- Scenarios 7 and 8 then test the impact of higher productivity in Red Meat and Wool. On-farm productivity returns to the levels in Scenarios 2 and 3, while meat processing productivity is increased.

Table 1 Summary of the eight scenarios

Scenarios used as the basis for economic modelling of the future workforce

Scenario		Focus	Other food and fibre sectors	Red Meat and Wool sector
1.	Business as usual (BAU)	Baseline for the project; continuation of past trends	Trend productivity growth continues Technology adoption occurs but is slow Export profile remains roughly the same as now	Trend productivity growth: higher in Core production and lower in Core processing
2.	Increased use of technology	Current and near-future technologies are widely adopted	High labour productivity Export profile is affected by supply-side factors	Higher productivity growth in Core production but not Core processing
3.	Transformed sector	A virtuous cycle of technology, sustainability and responding to consumer demands	High-value export market High productivity sectors and industries	Productivity as in Scenario 2 Large growth in the value of exports (quantity and price)
4.	Lower-productivity Business as usual (BAU)	Continuation of past trends, **except** Red Meat and Wool	Other food and fibre sectors as in Scenario 1	No productivity growth in Core production or Core processing
5.	Lower-productivity Increased use of technology	Strong technology adoption, **except** Red Meat and Wool	Other food and fibre sectors as in Scenario 2	No productivity growth in Core production or Core processing
6.	Lower-productivity Transformed sector	Strong technology adoption and export growth, **except** Red Meat and Wool	Other food and fibre sectors as in Scenario 3	No productivity growth in Core production or Core processing Somewhat higher export demand
7.	Higher-productivity Increased use of technology	Strong technology adoption, **including** Red Meat and Wool	Other food and fibre sectors as in Scenario 2	Trend productivity growth in Core production and higher productivity growth in Core processing
8.	Higher-productivity Transformed sector	Technology and export growth, **including** Red Meat and Wool	Other food and fibre sectors as in Scenario 3	Productivity growth as in Scenario 7 Higher export demand as in Scenario 3

Source: NZIER

1.3 This report supplements analysis of all the food and fibre sectors workforce

In 2022, MPI, in conjunction with the Primary Sector Workforce Dataset and Forecasting Working Group (the Working Group), commissioned NZIER to investigate future scenarios in the food and fibre sectors and the potential ramifications for the future workforce. The work analysed the food and fibre sectors workforce in detail: by sector, region and role, for 2020 and 2032.

NZIER produced four reports for the project:

- *The food and fibre workforce: Data on its size and composition*.
- *Proposed scenarios for estimating the future food and fibre workforce*.
- *Economic forecasts for the food and fibre sectors: CGE analysis of the three scenarios*.
- *Workforce forecasts for 2032: based on three future scenarios*.

The prior work considered three scenarios for the future development of the food and fibre sectors. *Business as usual* (BAU) projected future development based on past performance. *Increased use of technology* largely focused on productivity gains from automation and innovation. The *Transformed sector* assessed the impact of adopting lots of new technology and achieving good export prices by targeting high-value markets. These are Scenarios 1 to 3 in Table 1 and Table 2. As part of that project, we also modelled higher-productivity futures for Red Meat and Wool, Scenarios 7 and 8 in Table 1 and Table 2. MPI then commissioned further analysis of the Red Meat and Wool sector considering lower productivity scenarios, Scenarios 4 to 6 in Table 1 and Table 2. The results of all eight scenarios have been pulled together into the present report.

1.4 This report focuses on Red Meat and Wool sector results

Our modelling included all the food and fibre sectors, as well as the rest of the New Zealand economy. Most of the modelling parameters or inputs were taken from the 2022 work, described in the reports referenced above, while the shocks applied to the Red Meat and Wool sector are shown in Table 2. Changes in one sector will affect results throughout the economy, so model results for all sectors may be affected. However, the focus for this modelling was the impacts on the Red Meat and Wool sector. The report therefore focuses on those results.

The balance of this report presents the modelling method and results. Section 2 is focused on the method, including the model used and the scenarios modelled. Section 3 presents the results for the Red Meat and Wool sector. Next, section 4 moves to the food and fibre sectors as a whole, while section 5 provides economy-wide results. Section 6 provides some conclusions based on the scenarios. Detailed results are contained in the appendices.

2 Method

2.1 Summary of the project

The size, skills, and location of the workforce for the food and fibre sectors are an important focus for MPI and the Working Group. The workforce is a key part of a vibrant and productive food and fibre sector and having the right people and skills in the right

places allows industries to be productive and achieve their potential growth paths. The Red Meat and Wool sector is an important part of the economy and its workforce is large. Therefore, MPI is interested in understanding its potential size in detail.

For the project, the workforce in 2020 was estimated from ANZSIC06 codes based on research from Stats NZ's Integrated Data Infrastructure (IDI). Workforce counts are the average of the monthly counts of distinct individuals associated with each ANZSIC06 class, or sector.

Using this base, we used a mixed methods approach to estimate the approximate possible workforce futures. First, we conducted industry interviews to determine the skill mix of the current workforce. The skill mix of the current workforce is used as the basis of our forecast in the subsequent analysis.

Second, we estimated the performance of the food and fibre sector using a computable general equilibrium (CGE) model. The model links together all the industries that make up the food and fibre sectors and connects them to the whole economy. We examine the performance of the sectors in different scenarios with assumptions about productivity and export markets.

Third, we use the CGE forecasts about labour demand to calculate the size of the workforce in each scenario. We can disaggregate the workforce in several ways, as discussed below, to provide detailed forecasts of the workforce by sector and location, as well as skill-level requirements.

2.2 CGE modelling

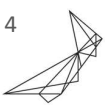
2.2.1 Structure of the model

NZIER maintains a CGE model of the New Zealand economy and its key sub-national regions. The model, TERM-NZ, is a static bottom-up regional model of the economy. Its structure is based on the TERM model of Australia. The data are based on Statistics NZ's interindustry transactions for the year ended March 2020, reflecting the supply and demand among industries in the economy. The model details economic linkages within the economy, i.e., how commodities produced by industries are either used as the intermediate input by other industries or for final consumption by households, government, investment and exports.

The TERM model for this project examined 15 regional economies: Northland, Auckland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay, Taranaki, Manawatu Wanganui, Wellington, Tasman Nelson, Marlborough, West Coast, Canterbury, Otago, and Southland. It also considered 54 industries in the food and fibre sectors and an additional 5 industries containing aggregated data for the rest of the economy. Because TERM is a CGE model, it links the productive industries to the household sector (via the labour market), government, capital markets, the rest of New Zealand (via inter-regional trade), and the global economy (via imports and exports).

2.2.2 Key parameters

To model a scenario, we change input parameters (numbers) in the model, run a simulation, and report output variables. This process is referred to as 'shocking the model'. We can then compare the output variables 'before' (i.e., pre-shock) and 'after' (i.e., post-



shock) to quantify the impacts on the economy. Because TERM-NZ is a static model, we capture the snapshots of two years: 2020 and 2032. The 2020 economy draws on our latest database, and we update the Business-as-Usual (BAU) scenario for 2032 by applying forecasted GDP figures provided by NZIER's *Quarterly Predictions*, The Treasury's Long-term Fiscal Position, and the OECD-FAO Agricultural Outlook.

Working with MPI, we designed several shocks to the overall productivity growth and the export demand under each scenario. The shocks are designed to simulate a 'what if?' situation: what if there are significant changes to the overall efficiency and export demand? Understanding these shocks helps us understand the extent to which the food and fibre sectors may change. The shocks include percentage changes in productivity and export price parameters over the years 2020 to 2032.

Across the eight scenarios, we are investigating the impact of productivity in Core production and Core processing alongside changes in export demand, with a focus on Red Meat and Wool. We do this by changing a few model inputs and observing the impact on model outputs. The model inputs that we varied are provided in Table 2. The outputs of interest were production, income and workforce counts. Those outputs will be presented in later sections of the report.

Table 2 Productivity and export shocks, Red Meat and Wool sector

Scenario		Core production productivity increase	Core processing productivity increase	Export demand increase
1.	Business as usual (BAU)	27%	1%	10%
2.	Increased use of technology	37%	1%	10%
3.	Transformed sector	37%	1%	50%
4.	Lower-productivity Business as usual (BAU)	0%	0%	10%
5.	Lower-productivity Increased use of technology	0%	0%	10%
6.	Lower-productivity Transformed sector	0%	0%	20%
7.	Higher-productivity Increased use of technology	37%	11%	10%
8.	Higher-productivity Transformed sector	37%	11%	50%

Source: NZIER

For each scenario, we report results in real dollars as opposed to nominal dollars. Real GDP is an inflation-adjusted measure and shows the actual value of goods and services produced in the economy. Using NZIER's Quarterly Predictions and then extending the forecast, we estimate real GDP at $441 billion in the year 2032. Compared with the base year 2020, the average annual growth rate is 2.7 percent over the period.

3 Results for the Red Meat and Wool sector

3.1 Production and exports for eight 2032 scenarios

3.1.1 Results from the modelling

We modelled the eight scenarios using the TERM-NZ model. Results for just the Red Meat and Wool sector are presented in Table 3. The table provides figures for the 2020 baseline as well as the eight scenarios. Table 3 focuses on two economic indicators: the value of production and the value of exports. Because they are value measures, they account for differences in both quantities and prices among the scenarios.

For all scenarios, production and exports are larger in the final year (2032) than in the base year (2020). That is, the Red Meat and Wool sector grows under every set of assumptions used in the modelling. These figures represent real growth: they are in real (inflation-adjusted) dollars, not nominal dollars. The lowest levels of growth are seen in Scenarios 4 and 5, which assumed the lowest growth in productivity and export demand. The highest levels of growth result from the largest assumed growth in productivity and export demand, Scenarios 3 and 8.

Table 3 Production and exports by scenario, Red Meat and Wool sector
Results from CGE modelling for all scenarios

Scenario	Production ($m)	Exports ($m)
0. 2020 baseline	$23,463	$10,701
1. BAU	$35,094	$17,944
2. Increased use of technology	$36,327	$19,237
3. Transformed sector	$42,093	$23,451
4. Lower-productivity BAU	$31,995	$14,527
5. Lower-productivity Increased use of technology	$31,933	$14,327
6. Lower-productivity Transformed sector	$32,891	$14,931
7. Higher-productivity Increased use of technology	$38,300	$20,615
8. Higher-productivity Transformed sector	$44,391	$25,029

Source: NZIER
Note: Figure are in real (inflation-adjusted) dollars.

3.1.2 Key messages

A few key messages can be distilled from the set of scenarios:

- The sector can expect to grow. The BAU – a continuation of past trends – shows clear growth, and even lower-productivity scenarios lead to growth.
- The sector benefits from both growth in demand and improvements in productivity. Where both occur, the model estimates substantial growth (e.g., doubling of export value).

- There is a large potential upside to export growth and productivity growth. If the sector is able to achieve the growth rates modelled, the results in 2032 are significant for sector revenue.

3.2 Workforce for eight 2032 scenarios

3.2.1 Results from the modelling

Table 4 provides the estimated workforce for the Red Meat and Wool sector under each scenario. The total workforce is shown, as is the workforce for Core production, Core processing and other parts of the sector.

Table 4 Workforce in the Red Meat and Wool sector by scenario

Workforce counts in each scenario, disaggregated by part of sector

Scenario		Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Total
0.	2020 baseline	48,450	23,847	5,041	371	77,709
1.	BAU	48,099	31,235	5,517	377	85,227
2.	Increased use of technology	45,767	34,315	5,772	382	86,236
3.	Transformed sector	54,080	39,972	6,120	382	100,553
4.	Lower-productivity BAU	53,188	25,392	5,195	377	84,152
5.	Lower-productivity Increased use of technology	53,866	25,632	5,295	382	85,174
6.	Lower-productivity Transformed sector	55,922	26,496	5,381	382	88,181
7.	Higher-productivity Increased use of technology	48,881	33,191	5,772	382	88,042
8.	Higher-productivity Transformed sector	57,764	38,635	5,926	383	102,708

Source: NZIER

A few patterns are evident in the results in Table 4.

- The Red Meat and Wool sector workforce grows in all future scenarios. Even under BAU – a continuation of current trends – the workforce is forecast to grow by between 7,000 and 8,000 workers.
- Both increased productivity and increased export demand lead to larger workforces than BAU.
- Core production and Core processing workforce counts are affected by each other's productivity changes. Scenario 5 has lower Core production productivity than Scenario 2. The workforce appears to shift from Core processing in Scenario 2 to Core production in Scenario 5. That is, production is solved jointly by the two parts of the sector, with workforce flowing to the part that needs it.

- Higher export earnings also grow the sector and its workforce. Scenarios 3 and 6 have larger workforces than other scenarios with the same productivity assumptions. More demand leads to higher production and requires a large workforce.
- Comparing Scenario 7 and Scenario 2 suggests that higher productivity in Core processing relieves a supply chain bottleneck. The workforce in Core production grows from Scenario 2 to Scenario 7, suggesting that on-farm production grows, leading to more stock to be processed by Core processing.

3.2.2 Key messages

The workforce estimates from the different scenarios suggest a few key messages:

- When export demand increases, a larger workforce is required.
- Both Core Production and Core Processing are part of the supply chain and work together. Workers shift between the two activities to whichever has the greater need for labour and lower productivity.
- Another way to think about the relationship is that freeing up labour in processing makes it available for production, and the whole sector grows.
- Lower productivity leads to lower production and fewer workers. By contrast, relieving the processing bottleneck leads on-farm production to increase. The Core processing workforce is pushed lower by the productivity improvements but higher by the increase in throughput. The final result is a larger overall workforce, weighted more towards Core production but still with a sizeable Core processing workforce.

4 Results for the food and fibre sectors

4.1 Production and exports for eight 2032 scenarios

4.1.1 Results from the modelling

The Red Meat and Wool sector is part of the wider food and fibre sectors, and represents about one quarter of its production and exports. When the one sector grows, it can produce growth in the total for all the sectors. However, the sectors are also competing among themselves for resources, such as workers. Growth in one sector can dampen growth in other sectors. The size of the net effect is a combination of those two effects, one growing the total of the sectors and the other shrinking the total. By using modelling, we can estimate the net effect.

Results for the food and fibre sectors in the baseline and the eight scenarios are provided in Table 5. In all scenarios, the sectors as a whole are expected to grow. Some are expected to encounter constraints on growth, in particular the dairy sector, either through limits on land-use change or through environmental regulation. Other industries and sectors are expected to experience conditions more favourable to growth. The extent of the modelled growth depends on expected growth in productivity and export demand.

Table 5 Production and exports by scenario, food and fibre sectors

Results from CGE modelling for all scenarios

Scenario		Production ($m)	Exports ($m)
0.	2020 baseline	$93,268	$45,329
1.	BAU	$135,673	$72,418
2.	Increased use of technology	$141,279	$77,519
3.	Transformed sector	$150,243	$84,218
4.	Lower-productivity BAU	$133,417	$69,844
5.	Lower-productivity Increased use of technology	$138,063	$73,834
6.	Lower-productivity Transformed sector	$143,198	$77,870
7.	Higher-productivity Increased use of technology	$143,089	$78,650
8.	Higher-productivity Transformed sector	$152,344	$85,511

Source: NZIER
Note: Figure are in real (inflation-adjusted) dollars.

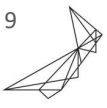
There are three groups of scenarios that can be compared:

- Scenarios 1 and 4 provide two different assumptions regarding business as usual. The difference is the productivity growth in the Red Meat and Wool sector. Lower productivity in that sector reduces total production by about $2 billion. This is smaller than the difference shown between the two scenarios in Table 3, because other parts of the food and fibre sectors grow more when growth in the Red Meat and Wool sector is reduced.
- Scenarios 2, 5, and 7 are scenarios with high rates of technology adoption across the food and fibre sectors. The differences across the scenarios arise from the assumptions about rate of adoption in Red Meat and Wool. Higher or lower productivity growth can add or remove billions of dollars of production and exports from the food and fibre sectors. Again, however, the impact on the Red Meat and Wool sector is offset somewhat by changes in other sectors.
- Scenarios 3, 6, and 8 include technology adoption and strong export market growth. The differences in the modelling assumptions are again in the Red Meat and Wool sector. The results in Table 5 indicate that the performance of that sector translates into impacts on the food and fibre sectors as a whole. However, competition for workers and investment capital among the sectors dampens the impact.

4.1.2 Key messages

The results across the food and fibre sectors suggest the following:

- Lower productivity growth in the Red Meat and Wool sector leads to lower overall output from the food and fibre sectors. Lower productivity can occur because of lack of access to labour with the right skills, lack of capital investment, or regulations that increase uncertainty or reduce innovation. Higher productivity growth through technology and market development in the one sector leads to higher overall output across the sectors.



- If the Red Meat and Wool sector grows faster or slower, other parts of the food and fibre sectors respond to some extent. If, for example, Red Meat and Wool grows more slowly, then other sectors grow more quickly. They outcompete Red Meat and Wool for resources and increase their shares of the food and fibre sectors. This adjustment reduces the positive or negative primary impact by about one quarter. Observing this effect and estimating its size shows the benefit of using an economy-wide model rather than an industry-specific model.

4.2 Workforce for eight 2032 scenarios

4.2.1 Results from the modelling

The analysis also produced workforce counts for the total of the food and fibre sectors. They are provided in Table 6.

Table 6 Workforce in the food and fibre sectors by scenario

Workforce counts in each scenario, disaggregated by part of sector

Scenario		Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Total[a]
0.	2020 baseline	182,333	84,256	67,988	22,402	363,160
1.	BAU	192,727	97,425	71,115	23,451	391,184
2.	Increased use of technology	192,534	101,650	71,657	24,023	396,470
3.	Transformed sector	205,946	110,284	73,306	24,389	420,615
4.	Lower-productivity BAU	196,718	90,153	70,358	23,275	386,929
5.	Lower-productivity Increased use of technology	199,271	90,896	70,545	23,769	391,026
6.	Lower-productivity Transformed sector	206,714	94,192	71,841	24,005	403,348
7.	Higher-productivity Increased use of technology	195,820	100,413	71,664	24,130	398,659
8.	Higher-productivity Transformed sector	209,821	108,779	73,346	24,509	423,177

Source: NZIER

[a] The totals also include between 6,000 and 7,000 workers from industries categorised as 'Other' in the analysis. These are industries in which a small percentage of workers contribute to the food and fibre sectors.

4.2.2 Key messages

The results from the workforce analysis for all the food and fibre sectors suggest the following:

- The impacts on the Red Meat and Wool sector are large enough that they affect total workforce counts across all the food and fibre sectors. Limits on the one sector or gains in the one sector have wider impacts.

- The workforce impacts are magnified. For example, the difference in the Red Meat and Wool workforce between Scenario 6 and Scenario 8 is about 15,000 workers, while the difference across all the food and fibre sectors is about 20,000 workers. We can compare this result to the production and export figures, where the impacts on Red Meat and Wool were dampened or offset by other sectors. The fact that these two metrics – jobs and production – move in opposite directions suggests that labour productivity in the Red Meat and Wool sector is better than average labour productivity across the food and fibre sectors. We investigated the quantitative modelling and found that the Cross-sector industries are particularly affected by changes in the Red Meat and Wool sector. These are industries that work with several sectors, such as both dairy and meat, so they were not assigned to a single sector.
- The results suggest that the jobs in the wider food and fibre sectors tend to have lower productivity than jobs in the Red Meat and Wool sector. The Red Meat and Wool sector produces a larger gain in production and exports with an additional workforce, compared to that produced by the food and fibre sectors collectively. Given the modelling results, the Cross-sector industries contribute to the lower average productivity of the combined sectors. These are industries such as agricultural support services and veterinary services. A review of New Zealand input-output multipliers confirms that these industries do have lower output per worker than sheep/beef farming and meat processing.

5 New Zealand economy

5.1 Table of results by scenario

The food and fibre sectors are part of the New Zealand economy. For this project, we have attempted to capture as much of the industrial and commercial linkages as possible, such as the connection between the Dairy sector and cafés and restaurants. Nevertheless, the sectors are part of the wider economy, and impacts can be created through both product markets and resources markets. This section presents results for the whole New Zealand economy; Table 7 provides the gross domestic product (GDP) figures for the scenarios.

Table 7 National GDP by scenario

Results from CGE modelling for all scenarios

Scenario		GDP ($m)
0.	2020 baseline	$320,754
1.	BAU	$440,673
2.	Increased use of technology	$445,607
3.	Transformed sector	$446,824
4.	Lower-productivity BAU	$439,502
5.	Lower-productivity Increased use of technology	$444,000
6.	Lower-productivity Transformed sector	$444,797
7.	Higher-productivity Increased use of technology	$446,790
8.	Higher-productivity Transformed sector	$448,140

Source: NZIER
Note: Figure are in real (inflation-adjusted) dollars.

The GDP results indicate that the impacts are further dampened at the level of the whole economy. For example, when comparing the results for Scenario 6 and Scenario 8, the difference in Table 7 is about $3 billion. The difference in production for the food and fibre sectors in Table 5 is about $8 billion, while the difference in the Red Meat and Wool sector (Table 3) is about $10 billion. Changes in productivity and export demand cause the Red Meat and Wool to absorb or release productive resources, and then the other food and fibre sectors and the rest of the economy adjust to the changes. The economy-wide impact – positive or negative – is smaller than the sector-level impact.

However, it is also important to note that the impact is still felt at the level of the whole economy. It is not the case that the whole economy adjusts to absorb the impacts entirely. This is not a zero-sum picture of the New Zealand economy; the loss in one part is not fully offset by a gain somewhere else. Instead, the results suggest that the Red Meat and Wool sector is large enough to affect the whole economy.

5.2 Key messages

- The performance of the Red Meat and Wool sector influences the performance of the whole New Zealand economy. When the sector does well, it benefits the economy.
- However, the impacts are not one-for-one. The economy-wide impacts are dampened compared to the sector impacts. Other parts of the economy do adjust to offset somewhat any gains or losses in the Red Meat and Wool sector.

6 Conclusion

6.1 Eight scenarios, eight results

We modelled eight scenarios regarding the Red Meat and Wool sector using a model of the New Zealand economy. The scenarios were developed during two projects with MPI, and

they considered different productivity and export demand changes in the sector. In particular, they included low-productivity and high-productivity variations on three core scenarios, to investigate the impacts on the sector's production and workforce.

The eight scenarios can be considered as a set of 'what-if?' possibilities to explore the relative impacts of productivity shifts and export demand shifts. They are not focused on modelling a specific policy or predicting the exact future. Instead, they provide information about the possible future size of the sector and workforce. The variation in outputs – the fact that the numbers change with each scenario – indicates that the modelling is responsive to the input parameters we used and suggests that there is a range of future possibilities for the sector. The size of the changes provides information about potential requirements for the sector's workforce depending on how the sector develops.

6.2 Key messages

The eight scenarios and results regarding production, exports and the workforce lead to a few main observations:

- The Red Meat and Wool sector is likely to need more workers. Across all the scenarios, the sector and its workforce grew. As with all modelling, the outputs are a function of the inputs, and in no scenario did we set out to model a smaller sector. Nevertheless, our results suggest that underlying trends in demand, economic growth and population are likely to lead to a larger sector in 2032.
- Workforce requirements will depend on export demand, productivity, and policy. The size of the future workforce varied by up to 20,000 people across the set of scenarios. The differences were the result of the combination of these three factors.
- Higher export demand leads to a larger workforce. There is a clear and direct link between how much the sector can sell in international markets and its workforce needs, regardless of everything else in the analysis.
- Lower productivity growth has the effect of raising supply costs, which reduces export growth. With lower productivity growth, the output per worker increases slowly so production costs grow relative to other products and industries, or relative to higher-productivity pathways. The scenarios with lower productivity growth therefore had smaller export values.
- The Red Meat and Wool sector includes both on-farm production and meat processing, so it is the combined productivity across the two activities that matters. In our model of the New Zealand economy, the workforce shifts between the two parts of the supply chain to the one with the lower productivity because it has the higher labour need.
- Productivity growth in either part of the supply chain frees up labour for other activities and industries in the food and fibre sectors. Greater efficiency allows the Red Meat and Wool sector to grow more, and allows the food and fibre sectors to grow more.
- The economy is not zero-sum, where gains in Red Meat and Wool come at the expense of the rest of the economy. Instead, higher productivity growth in the Red Meat and Wool sector helps to grow the whole New Zealand economy.