



# The potential local and regional impacts of COVID-19 in New Zealand

**With a focus on tourism**

NZIER public discussion paper

Working paper 2020/03



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## Authorship

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## Key points

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### We use our CGE model to assess the potential impacts of COVID-19 on the New Zealand economy and its regions

Our regional CGE model is used to run three scenarios (phases) based on the different alert levels (1-4) imposed by the New Zealand Government.

For each phase, we mostly focus on restrictions applied to the entry and movements of people as well as on labour and capital temporarily rendered idle due to the isolation and social distancing measures.

We do not explicitly model any fiscal response to showcase the base against which fiscal policies can be assessed.

### The impacts of COVID-19 affect the wider-economy, not just tourism

Tourism is hit hardest. The tourism sector (domestic and foreign tourism) is the most affected by COVID-19 restriction measures (Figure 1). It is also the sector that is likely to take longer to recover compared with other sectors.

- Domestic tourism is expected to recover relatively quickly, with public campaigns playing a role in restoring regional demand.
- The impact on international tourism may last much longer given that border restrictions are expected to last until 2022.

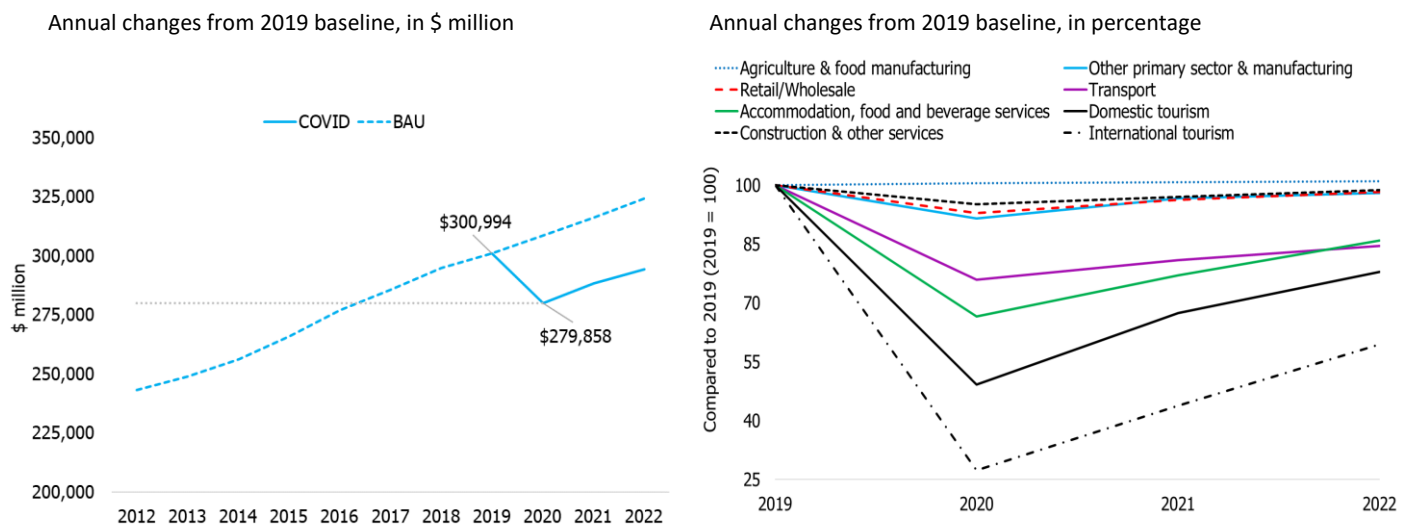
However, the economic effects of COVID-19 go beyond the tourism sector:

- Industries that support the tourism sector, such as accommodation, food and beverage services and transport industries, are also significantly hit by the isolation measures and travel ban.
- Output also decreases, although less sharply, in industries that are not directly reliant on the tourism sector (e.g. other primary sector and manufacturing, construction and other services). This is due to a decrease in available labour and capital immobilised by the implementation of restriction measures.
- While real annual GDP loss (in percentage terms) is the highest in tourism-centric regions (Queenstown-Lakes, Rotorua and Auckland), all regional economies of New Zealand are expected to contract due to the direct and flow-on effects associated with the COVID-19 restriction measures.

### New Zealand's annual GDP could be reduced by up to \$21 billion under lockdown, with the effects lessening as New Zealand moves down the alert levels

Figure 1 shows that New Zealand's GDP has fallen back to a similar level to 2016. In other words, COVID-19 has removed 3 years of GDP growth. We expect that it will take at least an additional 4 years until New Zealand's GDP returns to its pre-COVID level (2019).

**Figure 1 New Zealand's real GDP recovery path and impacts on different sectors<sup>1</sup>**



Source: NZIER

## What are the policy implications?

Over the longer term, as economic impacts remain, there will be a need for greater flexibility to allow for both physical and human capital to be redeployed toward surge industries. Focusing on investment that builds physical and human capital to foster an environment where the New Zealand economy can adapt quickly to changing circumstances will be most conducive to a sustainable recovery.

## Our results are driven by supply and demand side effects

On the supply side, results are driven by the reduction in labour and capital across industries as a result of the lockdown. This includes a marked decline in the amount of manufacturing and services activity, especially under Alert Level 4.

On the demand side, our results flow from the decrease in international tourism and domestic tourism. Both declines largely reflect the effects of border closures and travel restrictions within the country. We expect there will be some substitution from New Zealanders taking domestic holidays instead of international holidays. However, even with this substitution effect, domestic tourism is likely to be 49% lower in 2020, relative to 2019.

<sup>1</sup> For simplification purposes, we have combined industries that have a similar recovery path such as agriculture and food manufacturing, construction and other services, other primary sector and manufacturing industries.



## Assumptions and caveats as of 15 June 2020

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- This discussion paper uses assumptions that were defined before 15 June 2020; the date at which this paper was finalised and submitted to the GTAP conference for presentation. As such, there is considerable uncertainty about the severity of the potential economic impacts of COVID-19. We address some of these uncertainties through the design of modelling scenarios (phases). We are mindful that our modelling scenarios and underlying assumptions are based on data that was available at the time we wrote this paper and that the situation is evolving rapidly.
- We used the static version of our regional CGE model, TERM-NZ, which looks at ‘before’ (i.e. pre-COVID-19) and ‘after’ (with different COVID-19 alert levels). As such, we do not explicitly model the timing of the different restriction measures imposed by the New Zealand Government under the different alert levels. We also do not take into consideration the economic growth that would have happened without COVID-19.
- We decided to not explicitly model any fiscal response in order to showcase the base against which fiscal policies can be assessed.
- The key strength of a CGE model is that it explicitly builds in various constraints around resource availability in the economy, so that any expansion of one part of the economy leads to fewer resources being available elsewhere in the economy (unless the shock is a productivity gain).

As such:

- CGE models are based on a strong theoretical framework that incorporates utility maximising households and cost-minimising firms.
- CGE models also capture the multidirectional flows between the various actors of the national economy and how they interact with the rest of the world. This complexity allows the models to be applied to a wide range of ‘what if’ questions and to be a powerful tool to facilitate evidenced based policy development.
- Additionally, our CGE model incorporates a very high level of industry and commodity detail, so that the distributional impacts of shocks to the economy (i.e. winners and losers) can be estimated. It can also explore the regional and local distribution of economic impacts.
- Despite their strengths, there are some key limitations inherent in most CGE models, for example:
  - As they represent the inner workings of an entire economy, rather than one sector, CGE models depend on many data sources, parameters, equations and assumptions. When official data sources are thin or not available, we need to make assumptions, normally based on unofficial sources or from international literature.
  - The economic theory underpinning CGE models is usually neoclassical in nature. In this setting, consumers maximise utility, firms minimise costs, resources can move between sectors, and firms do not generate super-normal profits. These assumptions can legitimately be questioned.

- These caveats do not mean that our modelling results are not robust. Rather, they reflect the inherent challenges in carrying out economic modelling work in such uncertain times.
- We hope that our approach draws out some of the costs, benefits and trade-offs associated with COVID-19 and associated social and travel restriction measures in New Zealand. We have sought to be as transparent as possible about our methodology, data and assumptions; and their limitations.

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# 1 Introduction

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The outbreak of COVID-19, which started in China in December 2019, has since spread to the rest of the world and was recognised as a pandemic on 11 March 2020. In response to COVID-19, many countries have limited people's movement by closing their borders to foreign visitors and adopting measures of social distancing and confinement.

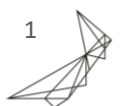
Due to its geographic isolation, New Zealand has been able to watch as the situation evolved in China, Italy, Spain, France and the USA. As a consequence, the country rapidly implemented strict measures to limit and contain the spread. New Zealand's lockdown was imposed on 25 March 2020 when the country had only 262 cases.

As of 15 June 2020, New Zealand's confirmed and probable cases reached 1,504. Like other countries, New Zealand closed its borders to foreign travellers and declared a 4-week confinement period with all business premises closed except for essential services such as medical, pharmaceutical and food supply. The country has also adopted social distancing measures with recommendation such as staying 2 metres away from others, avoiding large groups and ordering groceries online and have them delivered home to avoid supermarket queues.

The duration of New Zealand's business restrictions under COVID alert levels is uncertain and will mostly depend on how fast the country can flatten the curve (i.e. slowing the spread of the virus over time) and reduce the number of new cases. If the lockdown succeeds, social distancing measures will be eased, and non-essential businesses will be able to reopen. However, borders are likely to remain closed for travellers or their entry to the country severely curtailed for the next few months. Given the importance of the tourism sector for the New Zealand economy, COVID-19 is expected to have significant negative impacts for the economy.

To date, no publicly available study has looked at the economic impacts of COVID-19 on New Zealand and its tourism sector using a computational general equilibrium (CGE) modelling framework. Through the work presented here, we provide an attempt to fill the gap by focusing on measuring the impacts of COVID-19 on tourism and the wider economy at both the regional and national levels. Using our regional bottom-up CGE model TERM-NZ, which allows for a disaggregated tourism sector, we model three different scenarios (phases) to better understand the potential economic impacts of COVID-19 on foreign and domestic tourism in New Zealand.

The paper is structured as follows. Section 2 outlines our literature review which explored what has been done in terms of CGE modelling on tourism and pandemics. In section 3 we present a snapshot of the New Zealand tourism sector. We then outline the model, scenarios and input data used for our modelling application in section 4. In the subsequent sections, we present and discuss results as well as the conclusions drawn for industry stakeholders and policy makers.



## 2 Literature review

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Measuring the contribution of tourism to a national economy is a difficult exercise. On the demand side, tourism represents the sum of tourist expenditure on a wide range of products. From the supply side, tourism can be viewed as a collection of productive activities that are mostly used by tourists. As such, tourism is not identified as a single industry in national accounts (United Nations 2010).

A significant amount of research work has been done over the last few decades to fill the gap and better estimate the economy-wide effects of tourism.

Until recently, tourism analysis was heavily reliant on input-output (I-O) analysis. Archer (1977) and Fletcher (1989) provide examples of and discuss some of these studies. However, I-O models suffer several shortcomings. For example, they assume that all wages and prices remain constant, regardless of the levels of production and demand. Hence, they consider that economic resources such as land, labour and capital are infinitely available, are never idle or can be reallocated without adjustment costs. They also do not consider any crowding-out effects (Dwyer et al. 2003). As such, I-O models can lead to misleading results, including in tourism analysis, as they do not take into account the effects of tourism on factor prices, incomes or income distribution.

In contrast, CGE models are not only driven by prices that respond to changes in supply and demand, they also account for resource constraints and flow-on effects. Contrary to I-O analysis, CGE models capture the complex and multi-directional flows between tourism, other sectors in the economy and foreign producers and consumers.

Given their versatility, CGE models have recently appeared as a relevant and important tool for tourism policy analysis (Dwyer 2015) and are now increasingly used for tourism economic analysis and policy implications. CGE analysis of tourism has been facilitated with the introduction of tourism satellite accounts (TSAs) in the mid-1990s,<sup>2</sup> which have enabled tourism to be identified as an economic driver for GDP, employment, investment and consumption. See Dwyer et al. (2006) for an illustration and discussion on the differences, similitudes and complementarities between TSAs and CGE application.

In the last 15 years or so, applications of CGE modelling in tourism have included evaluation of the economic contribution of the tourism sector (Dwyer et al. 2003), economic impact evaluations of government policies (Blake, Gillham and Sinclair 2006) changes in inbound tourism (Dwyer et al. 2003; Dixon et al. 2019) and changes in the number of foreign students (Dixon et al. 2019).

Several studies that use CGE modelling have also looked at the impacts of a special event or crisis, including a disease pandemic. For example, Dixon et al. (2001), Giesecke et al. (2012, 2015) and Nassios and Giesecke (2018) all looked at the tourism and economy-wide effects in Australia of the 9/11 terrorism attack. Other studies such as Moss et al. (2016) explore the impacts of a possible Ebola outbreak in the Asia-Pacific.

Dwyer et al. (2006) used a CGE model of the Australian economy to show that the effects of SARS on the Australian tourism industry were less severe than what was perceived by stakeholders of the tourism industry. The authors show that the economic impact of a crisis

<sup>2</sup> Canada was one of the first to adopt a tourism satellite account and published results in 1994, followed by other countries such as France, New Zealand, Mexico, Norway, Singapore, Sweden and the USA (United Nations 2010).

on an economy is contingent on whether cancelled or delayed outbound travel is substituted by savings, domestic tourism or for the purchases of other goods and services. The results indicate that substitution effects must be considered in estimating the impact of some adverse situation on the economic contribution of tourism to a destination.

Keogh-Brown et al. (2010) and Smith et al. (2011) use a CGE model to measure the potential economic impact of a global infectious disease pandemic on the United Kingdom, France, Belgium and the Netherlands. In both papers, the authors conclude that the impact of a pandemic influenza is less significant than disease-mitigation policies such as school closures and increased absenteeism of healthy workers.

Verikios et al. (2015) assess the global effects of two influenza pandemics with a global CGE model and show that the economic impacts are more significant in the case of a pandemic characterised by a high infection rate and low virulence rather than a pandemic with a low infection rate and high virulence.

More recently and topical, Wittwer (2020) used a multi-regional dynamic CGE model of Australia, TERM-WINE, to provide an assessment of the economic impacts induced by bushfires and COVID-19 in the country, with a particular focus on the grape and wine sectors.

As far as we know, no publicly available study has been done that looks at the economic impacts of a disease pandemic on tourism and the wider economy in New Zealand within a CGE modelling framework. We attempt to fill the gap by focusing on measuring the impacts of COVID-19 on regional tourism in New Zealand.

### 3 Snapshot of the tourism sector in New Zealand

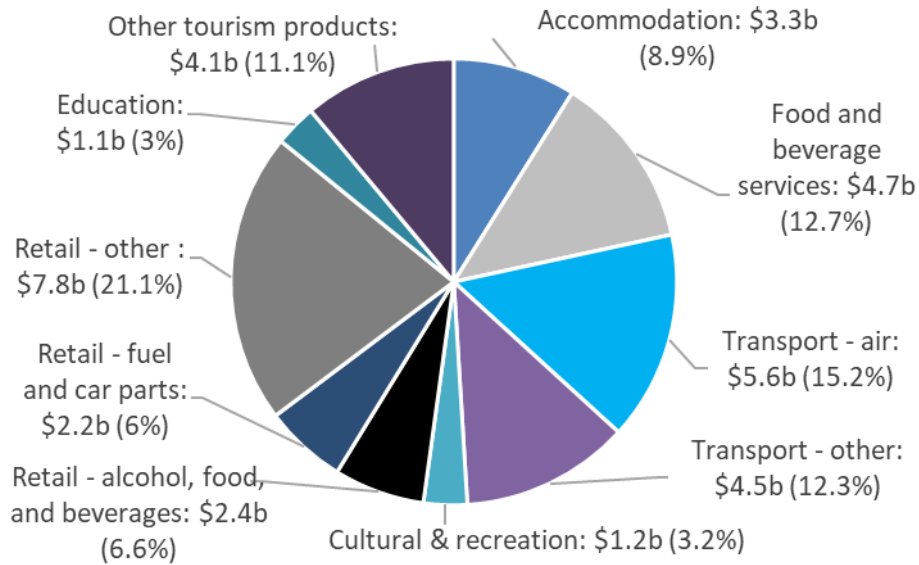
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New Zealand tourism is a \$41 billion industry (from Stats NZ's TSA). Tourism expenditure contributed to \$16.2 billion of direct value added, which represents 5.8% of direct contribution to GDP. It accounted for 20% of New Zealand total exports in the year to March 2019, with international visitors spending \$17 billion. Domestically, New Zealanders spend \$24 billion annually in places outside their residence (40 km radius from home). Tourism also benefits the New Zealand Government, providing \$3.8 billion in value-added tax (GST).

Figure 2 shows that retail trade significantly benefits from tourism, with tourists spending \$12 billion annually on alcohol, food, fuel and other retail products. This is followed by transport (\$10 billion), food and beverage services (\$4.7 billion) and accommodation services (\$3.3 billion). Both air transport and accommodation are highly dependent on tourism with over 90% of all spending in these industries coming from tourists compared to only 43% for the food and beverage services industry.



**Figure 2 Share of tourism expenditure by product in New Zealand**



Source: Stats NZ, Tourism Satellite Account (2019)

Over 220,000 people are directly employed in the New Zealand tourism industry (8.4% of all employment), with an additional 160,000 people indirectly employed through industries supplying the tourism industry (6% of all employment).

Stats NZ's Tourism Satellite Account (TSA) is New Zealand's official source of tourism statistics. However, these numbers are not timely, as provisional numbers are released for the previous year. The Ministry of Business, Innovation and Employment (MBIE) also produces a range of tourism statistics. These numbers represent estimates rather than official statistics. However, they are reasonably robust, timelier and include more detailed breakdowns. This is especially relevant given that MBIE's data can be broken down by region.

Of all tourist expenditure, 29% occurs in Auckland, which is New Zealand's largest city and hosts New Zealand's largest airport. Auckland Airport welcomes 71% of all visitor arrivals in New Zealand. The next largest tourism markets are:

- Queenstown-Lakes (10% of all tourism expenditure)
- Christchurch City (9% of all tourism expenditure)
- Wellington City (7% of all tourism expenditure)
- Hamilton City (3% of all tourism expenditure)
- Tauranga City (3% of all tourism expenditure)
- Rotorua District (3% of all tourism expenditure)
- Dunedin City (3% of all tourism expenditure).

International tourists spend more in Auckland and Queenstown-Lakes than domestic tourists. Auckland and Queenstown-Lakes make up 38% and 16% respectively of the



international tourism market in the country but only 23% and 6% respectively of the domestic tourism market. Conversely, data from MBIE shows that domestic tourists spend more than international tourists in Wellington City, Hamilton City, Tauranga City and Dunedin City.

Based on MBIE's regional tourism estimates described above, we choose to focus on the following districts (territorial authorities):

- Auckland City
- Queenstown-Lakes District
- Christchurch City
- Wellington City
- Hamilton City
- Tauranga City
- Rotorua District
- Dunedin City
- Rest of North Island (which accounts for 20% of tourist expenditure)
- Rest of South Island (which accounts for 13% of tourism expenditure).

## 4 The TERM-NZ model

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For this paper, we use our bottom-up multi-regional CGE model TERM-NZ. TERM-NZ stands for 'The Enormous Regional Model of the New Zealand economy'. It is based on the original Australian multi-regional TERM model (Wittwer 2012, 2017).

### 4.1 Key feature of the model

Given the model's multi-regional bottom-up structure, New Zealand regions/districts are each modelled as an independent CGE model, which means that New Zealand regions/districts are linked via inter-regional trade and inter-regional movements of labour and capital.

The model is based on a neoclassical foundation in which supply and demand are determined for each commodity produced at the regional/district level based on profit maximisation by producers and utility maximisation by households in the region/district.

The model also assumes mobility of labour and competitive markets within each region/district. At the regional/district level, each industry chooses labour, capital and land to maximise its profits while functioning in a competitive market.

A regional representative household purchases an assortment of goods and services based on individual preference, relative prices and available income. Investment is divided amongst regional industries in such a way that it maximises rates of returns to investors (households, firms). Each regional industry uses industry-specific capital in a cost-minimising fashion.



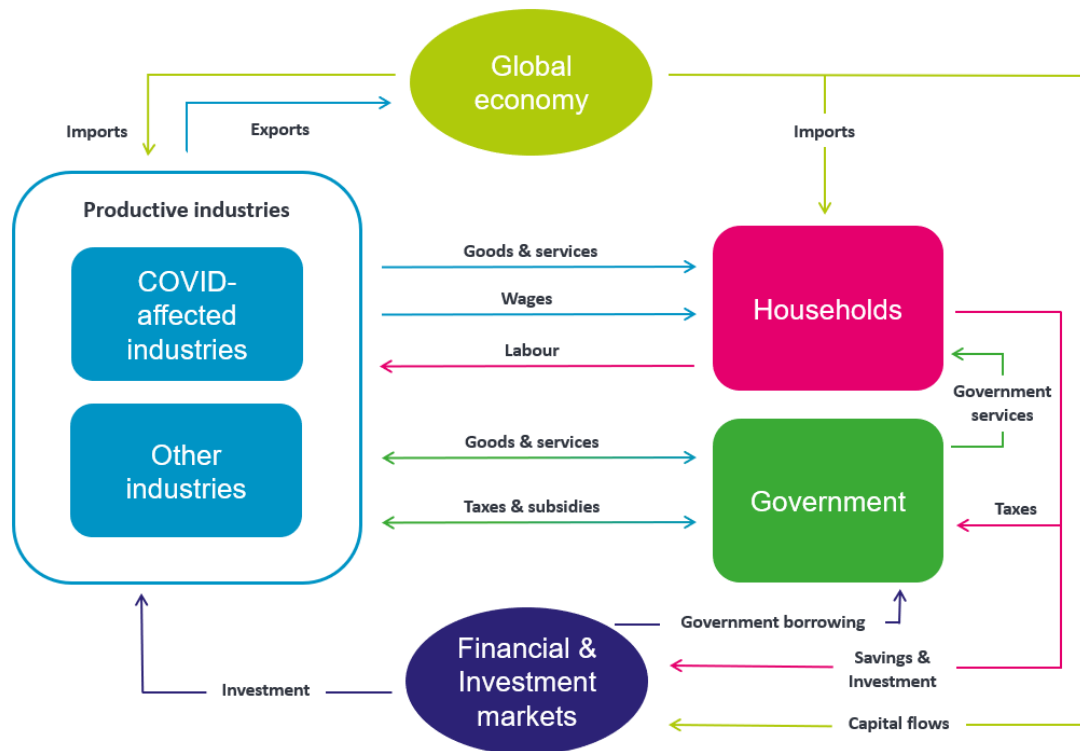
Within each region, there is a local and central government. Local government within each region follows a central fiscal framework. Behaviours of foreign tourists are expressed by export demand curves for goods and services from each region and by supply curves for international imports to each region.

Other key assumptions within the model include the following:

- Production inputs are intermediate inputs (domestic and imported) and primary factors (labour, land and capital).
- The demand for primary factors and the choice between imported and domestic commodities are determined by constant elasticity of substitution (CES) production nests. This means an increase in the price of one input shifts sourcing towards another input.
- Intermediate goods, primary factors and other costs are combined using a Leontief production function. This means the proportion of production inputs is held constant for all levels of output.
- The production mix of each industry is dependent on the relative prices of each commodity. The proportion of output exported or consumed domestically is also dependent on relative prices.

A visual representation of our CGE model is shown in Figure 3. It highlights how the model captures the complex and multidirectional flows between the various actors of the national economy and how they interact with the rest of the world.

**Figure 3 Our CGE model represents the circular flows between all the agents and activities in the economy**



Source: NZIER



## 4.2 The TERM-NZ database

TERM-NZ is originally based on Stats NZ's 2013 Input-Output tables, which contain information on 106 industries and 201 commodities. The model's database is benchmarked to the latest annual national accounts data (GDP expenditure and income side components) once year.

We have recently worked on extending our original database. The new TERM-NZ database contains information on 88 districts, which represent New Zealand's 67 territorial authorities and 21 local boards in Auckland. The model also contains information on 149 industries producing a similar number of commodities. This development work included the addition of five new tourism industries, which are directly relevant to this paper.

The TERM-NZ model is usually run with an aggregated version of the database to speed up the computational process and because it is not technically possible to run such a large database with its full dimensions.

A description of the aggregated industries can be found below in Table 6 in Appendix E. Figure 12, Figure 13 and Figure 14 in Appendix F show maps of the New Zealand districts and Auckland local boards.

We provide below an overview of the methodology we applied to add tourism industries and (sub)regional details. Figure 11 in Appendix A provides an overview of the different steps undertaken to extend our TERM-NZ and add sector and district-level detail.

## 4.3 Introduction of new tourism industries

In the original TERM-NZ database, tourism<sup>3</sup> is not identified as a separate industry or product but rather is nested in the expenditure of households and industries on products such as accommodation, food and beverages or transport.

We follow the approach of Wittwer (2017) to extend the TERM-NZ database with the addition of five new tourism industries. This is done by combining all the economic activities linked to tourism (characteristic and related tourism activities).

These are the new tourism industries:

- **Domestic holiday**, which represents tourist expenditure made by New Zealanders, undertaken domestically, either locally or inter-regionally. We used visitor expenditure by New Zealanders, including all corresponding taxes and margins.
- **Foreign holiday** (imported New Zealand tourism) represents tourism-related expenditure made by New Zealanders travelling abroad. We used international expenditure of New Zealanders travelling abroad.
- **Export tourism** (foreign tourism) covers tourism expenditure by foreign visitors in New Zealand, not travelling for education purposes. We used expenditure by foreign travellers in New Zealand other than foreign students studying in the country.
- **Export student** (foreign student) represents the expenditure by foreign students in New Zealand. We used expenditure by foreign students in New Zealand. This expenditure includes all corresponding taxes and margins.

<sup>3</sup> In its definition, tourism includes usual domestic or international travellers who are holidaying, visiting friends and relatives, on business or travelling for educational purposes.





- **International flights** cover the use of imported and domestically produced air transport by New Zealanders travelling abroad.

Unlike all the other industries in the database, the new tourism industries do not use labour and capital directly. Instead, tourism industries purchase goods and services (e.g. accommodation, food and beverage, transport) and sell them to foreign and domestic visitors. As such, these tourism industries combine goods and services produced by a variety of industries so that all tourism expenditure is grouped within these five tourism industries.

We construct data for the costs and sales of the new tourism industries by disaggregating the existing TERM-NZ database using information from Stats NZ's TSA and MBIE's regional tourism estimates.

We provide further detail on steps undertaken to develop these new industries in Appendix B.1 of this paper.

#### 4.4 Bottom-up regional modelling

Our methodology to extend the database at the regional/district level is based on Wittwer and Horridge (2010) and follows a bottom-up approach. In such an approach, each region/district is modelled as a separate economy linked by trade of goods and services, common but imperfectly mobile factor markets, a common central government and exchange rate. The use of a bottom-up framework allows us to estimate variations in both quantities and prices at the regional/district levels.

The TERM-NZ database is based on national input-output tables and has been split so that it now contains information for 88 districts (68 territorial authorities and 20 local boards in the Auckland region). These districts can easily be aggregated into regions.<sup>4</sup>

Similarly to the original TERM model (Wittwer 2012, 2017), we usually run TERM-NZ with an aggregated version of the database to speed up the model computation and because it would not be technically possible to run the model with such a large database. TERM-NZ allows us to estimate the impacts of territorial authorities or local boards (sub-regions) such as Queenstown-Lakes and Central Otago in the Otago region or Rotorua and Tauranga in the Bay of Plenty.

Two maps highlighting the different regions, territorial authorities and Auckland local boards can be found in Figure 12 and Figure 14, both in Appendix F.

Appendix B.2 provides further detail on the methodology used to add (sub)regional detail in our database.

<sup>4</sup> The 16 regions of New Zealand are defined according to Stats NZ, [http://archive.stats.govt.nz/browse\\_for\\_stats/Maps\\_and\\_geography/Geographic-areas.aspx](http://archive.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas.aspx)



## 5 Illustrative simulations on the tourism sector in New Zealand

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We examine the effects of COVID-19 on two major categories of tourism expenditure:

- Foreign visitors to New-Zealand (excluding foreign students).
- Domestic travellers.

### 5.1 Scenario design based on NZIER tourism forecasts

Each quarter, NZIER publishes its *Quarterly Predictions*<sup>5</sup> for members, which provides 5-yearly macroeconomic forecasts for the New Zealand economy. For the June quarter 2020 forecasting round, NZIER has forecasted the New Zealand tourism expenditure to capture the effects of COVID-19.

NZIER used the following assumptions for its forecasts:

- International and domestic tourism falls close to zero during the month of Alert Level 4 (lockdown) due to travel restrictions.<sup>6</sup>
- Domestic travel restrictions and isolation measures continue for an additional 3 weeks where New Zealand has moved to Alert Level 3.
- New Zealand moves to Alert Level 2 on 15 May in a phased approach that will unfold over 4–6 weeks and to Alert Level 1 by July 2020. We expect domestic tourism to resume and grow quickly due to pent-up demand for recreation activities and New Zealanders substituting local holidays over foreign holidays. We forecast domestic tourism will peak in December 2020 for the holiday period.
- At the start of July 2020, New Zealand moves to Alert Level 1 and international tourism can resume with restriction upon entry (i.e all travellers arriving in the country will have to self-isolate for a 2-week period and the number of international flights is limited).
- Australia and New Zealand both have COVID-19 under control and have a joint border control at the start of August 2020. This allows for an open border policy between both countries. As a result, some domestic tourism is substituted to the newly opened Australian market, and Australian tourist expenditure grows.

Figure 4 presents a visual illustration of the timing we are considering regarding New Zealand international and domestic travel restrictions. Our scenarios (phases) are based on the assumptions illustrated in this figure. Results of NZIER tourism forecasts can be seen in Figure 5.

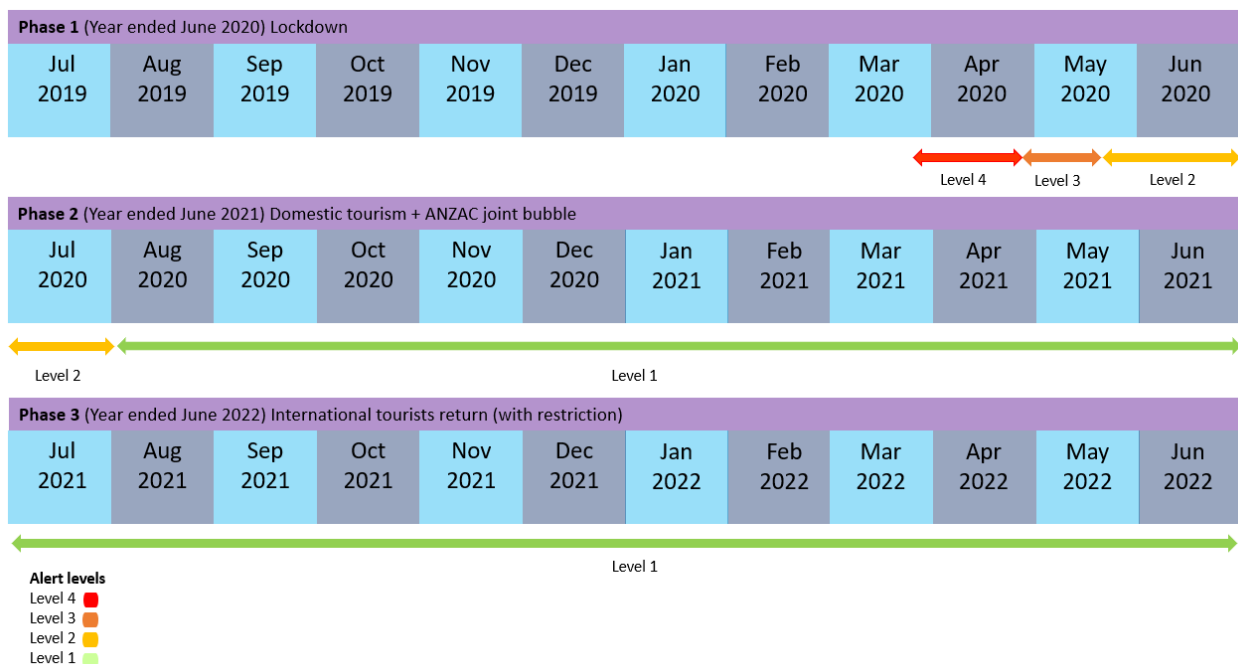
<sup>5</sup> NZIER's *Quarterly Predictions* are calculated using a multi-sector macroeconomic model of the New Zealand economy. Complementary data analysis is also employed to make professional judgements when macroeconomic conditions have changed from trend.

<sup>6</sup> Our assumption takes into account the fact that, since the country has closed its borders, a number of foreigners are still in New Zealand, on extended holidays or on temporary work visas, and continue to contribute in tourist expenditure.



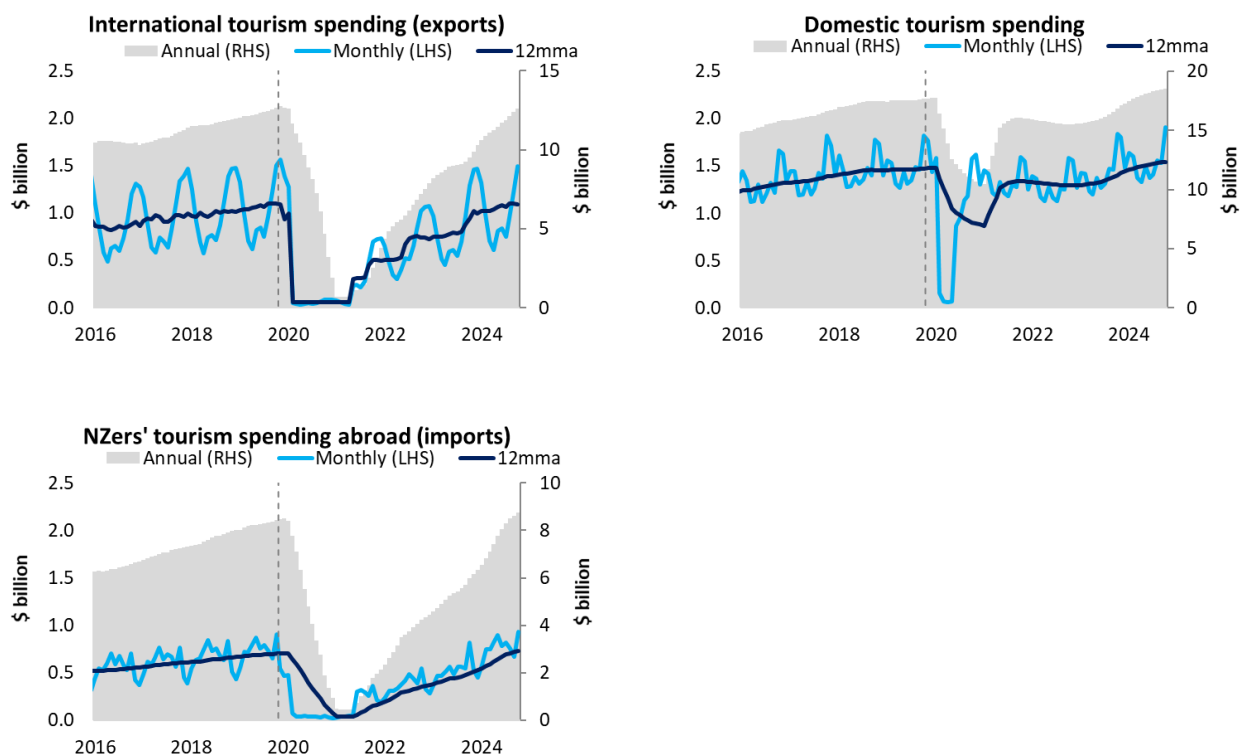
**Figure 4 Potential timing of lifting New Zealand international and domestic travel restrictions**

Our shocks are annualised

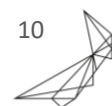


Source: NZIER

**Figure 5 NZIER's monthly tourism forecasts and 12-monthly moving average (12mma)**



Source: NZIER, derived from Stats NZ's balance of payments and MBIE tourism estimates



To date (15 June 2020), New Zealand Government strategy is to eliminate COVID-19 from the country rather than take a herd immunity approach. As such, the country is likely to adopt very restrictive measures on inbound and outbound international travel to avoid the risk of imported cases that would put the country at risk of an increased spread.

We designed three scenarios (phases) to explore the potential impacts of COVID-19 on the New Zealand economy. These phases are based on the set of measures imposed by the New Zealand Government for the different alert levels (1 to 4).<sup>7</sup> We mostly focus on restrictions applied to the entry and movements of people as well as on labour and capital temporarily rendered idle due to the isolation and social distancing measures.

In all our simulations, we use the static version of TERM-NZ so that we compare the economy before and after COVID-19, looking at the impacts of different social and travel restriction measures ('shock').

We therefore do not explicitly model the timing of the different restriction measures imposed by the New Zealand Government under the different alert levels. There is no time dimension in the static model, so we do not look at how the economy adjusts to a new equilibrium over time.<sup>8</sup>

We also do not take into consideration the economic growth that would have happened without COVID-19. Prior to the COVID-19 outbreak, the New Zealand economy had been expected to grow by around 2% between 2020 and 2022. This highlights how significant the estimated reduction in key macroeconomic metrics are when we compare with the counterfactual in which the economy would have *grown* in the absence of the COVID-19 pandemic.

The shock applied disturbs the equilibrium in the economy, and the model calculates changes in demand, supply and prices of inputs (like labour and capital). It then reallocates them across sectors according to where they get greatest returns, establishing a new equilibrium after a policy has been implemented.

Given the immediate enforcement of a lockdown, travel ban and closure of New Zealand's borders and given the short timeframe the different alert levels will play out, we assume an immediate effect on the tourism industries and the New Zealand economy. Therefore, we apply a short-term closure for the three phases. See Appendix C for further detail on the underlying assumptions of a short-run model closure.

For each phase, we report results as percentage deviation from the 2019 base case. In other words, we measure it as the percentage difference between the state of the New Zealand economy pre-COVID (counterfactual) and the situation with the COVID-19 outbreak pandemic and its associated travel restrictions and isolation measures.

### **Phase 1: Lockdown and travel ban – year ended June 2020**

We consider the situation of New Zealand during the 5-week period that extended from 25 March to 26 April 2020 and some relaxation of restrictions under Alert Level 3 in the subsequent 2 weeks. Under the lockdown, borders are closed to foreign visitors (inbound travel) and New Zealanders are not allowed to travel abroad (outbound travel) and within

<sup>7</sup> <https://covid19.govt.nz/alert-system/covid-19-alert-system/>

<sup>8</sup> These fluctuations may have significant impacts in their own right and could be captured in future research by using our more sophisticated dynamic CGE model.

the country (domestic travel). We also assume overall export education decreases by 20% under the lockdown period based on figures from Immigration New Zealand.

The lockdown measures are also likely to impact the labour market as firms in non-essential manufacturing and services industries have been forced to shut temporarily. Based on NZIER's *Quarterly Predictions* June 2020 forecasts, we assume a 7% decrease in the average labour demand for 2020.

To reflect the measures imposed by the lockdown, we take into consideration the fact that part of the capital stock in manufacturing, services and construction sectors cannot be used under the lockdown. We also impose a change in households' tastes away from consumer goods and services (retail, hotels and restaurants, transport, childcare, sports and recreation activities, etc.).

Finally, recent export figures released by NZ Statistics show that, during the lockdown period, there was an increase in export demand (mostly from China) for dairy, fruit, meat and seafood products and a decrease in forestry and non-food manufactured goods. We include these changes in export demand in our simulations.

### **Phase 2: Alert Level 2 – only domestic tourism is allowed (under conditions) – year ended June 2021**

In this scenario, New Zealand returns to Alert Level 2 (15 May) then to Alert Level 1 in August 2020. We assume that most of the measures for Alert Level 2 will be implemented in a staged approach over a few weeks, with most measures becoming less restrictive over time.<sup>9</sup>

Under Alert Level 2, borders stay closed to foreign visitors, but international students with a student visa can travel back to the country. New Zealanders are allowed to travel domestically, and more economic activities can resume (restaurants, bars, etc.). Additionally, we assume households' tastes partly move back to consumer goods and services as more retail, sports and recreation activities can resume under Alert Level 2.

We also assume a slight increase of labour demand as some workers on zero-hour contracts can go back to work and capital is put back to use with the reopening of most non-essential manufacturing and services industries. Capital stays mostly immobilised in air transport as Air New Zealand maintains a reduced number of domestic flights.<sup>10</sup>

### **Phase 3: Alert Level 1 – both foreign and domestic tourism are allowed again (under conditions) – year ended June 2022**

In this scenario, we consider that New Zealand has fully transitioned to Alert Level 1 (early August 2020) and will stay at that level until June 2022.<sup>11</sup> Borders are open to foreign travellers and students under certain conditions (mandatory self-isolation for a 2-week period and access restricted to certain countries). These conditions also apply to New

<sup>9</sup> As Alert Level 2 measures are becoming less restrictive over time, there is a possibility of New Zealand moving into Alert Level 1 during this period. Our forecasts and assumptions take this possibility into account given that our shocks have been annualised and as such, include the estimated number of weeks spent under each alert level. See Figure 4 for a visual illustration.

<sup>10</sup> <https://www.airnewzealand.co.nz/covid19-airnz-updates#flight-changes>

<sup>11</sup> As Alert Level 1 measures are becoming less restrictive over time, there is a possibility of New Zealand moving into a "Level 0" (close to pre-COVID-19 life and with return of international tourism) during this period. Our forecasts and assumptions take this possibility into account given that our shocks have been annualised and as such, include the estimated number of weeks spent under each alert level. See Figure 4 for a visual illustration.



Zealanders who travel abroad and come back into the country. Domestic tourism is allowed, and most economic activities have returned to normal except for air transport.<sup>12</sup>

To estimate our shocks, we first calculate forecast tourism spending using seasonally adjusted monthly data on tourism. We then calculate the annual percentage change in forecast tourism spending compared to June month of the previous year, which allow us to take into account the number of weeks we assumed New Zealand stays under each alert level (Table 1).

Table 1 presents our assumptions for domestic and international tourism (outbound and inbound) under the three different phases.

**Table 1 Tourism and foreign students forecasts under different scenario assumptions<sup>13</sup>**

Annual percentage change from June month of previous year

Phase	Assumed duration under each alert level	Period <sup>14</sup>	International	Domestic	NZers' spending abroad	Foreign students
Phase 1: Lockdown (YE June 2020)	8 weeks	July 2019 – June 2020	-94%	-27%	-94%	-20%
Phase 2: Alert Level 2 (YE June 2021)	4 weeks	July 2020 – June 2021	-58%	-10%	-65%	-10%
Phase 3: Alert Level 1 (YE June 2022)	40 weeks	July 2021 – June 2022	-30%	-11%	-40%	+2%

Note: each scenario is compared with 2019 baseline)

Source: Derived from NZIER tourism forecasts for *Quarterly Predictions*

## 5.2 Simulation results

In this section, we present and discuss the results from our simulations to show the potential impacts of COVID-19 on the local, regional and national New Zealand economies. Results of the simulation help us to understand the importance of the tourism industry in New Zealand and to identify the potential risks to a strong downturn of activities mostly dedicated to tourism. Results are subject to change as we revise our simulations with latest forecasts on the expected impacts of COVID-19 on tourism data.

### 5.2.1 Macroeconomic impacts of restriction measures from COVID-19 in New Zealand

Table 2 shows the national impacts of COVID-19 on main economic variables. Real GDP decreases by between 7.1% (\$21.2 billion) and 2.2% (\$6.8 billion) as New Zealand transitions through the different alert levels. For all three phases, real GDP loss is

<sup>12</sup> Air New Zealand has permanently reduced its fleet on domestic and international flights. <https://www.airnewzealand.co.nz/covid19-airnz-updates#flight-changes>

<sup>13</sup> We use a monthly comparison with the same month last year instead of annual data. This is because, if we used annual data, the sharp decline in domestic tourism will be hidden in the pre-COVID-19 peak and the recovery once New Zealand moves to Alert Level 2 or 1.

<sup>14</sup> Dates were chosen to see the impact as travel bans and alert level restrictions were implemented.

dominated by labour and capital temporarily not used because of the lockdown measures and restrictions imposed on international and domestic travel.

We estimate the decrease in real household consumption to be between 13.1% (Phase 1) and 3.2% (Phase 3). Real household consumption falls by more than the decline in GDP due to a deterioration in the terms of trade from weaker global demand. Export prices are falling more than import prices. Hence, exports are becoming cheaper while imports become relatively more expensive. This leads to a decline in household purchasing power and hence consumption.

Due to the significant drop in employment and utilised capital, there is no offsetting switch in sales to exports. At the national level, export volumes fall by between 10.8% (Phase 1) and 5.6% (Phase 3).

**Table 2 Headline economic impacts**

Annual changes compared to June 2019 baseline, in percent and in \$ million (in real terms)

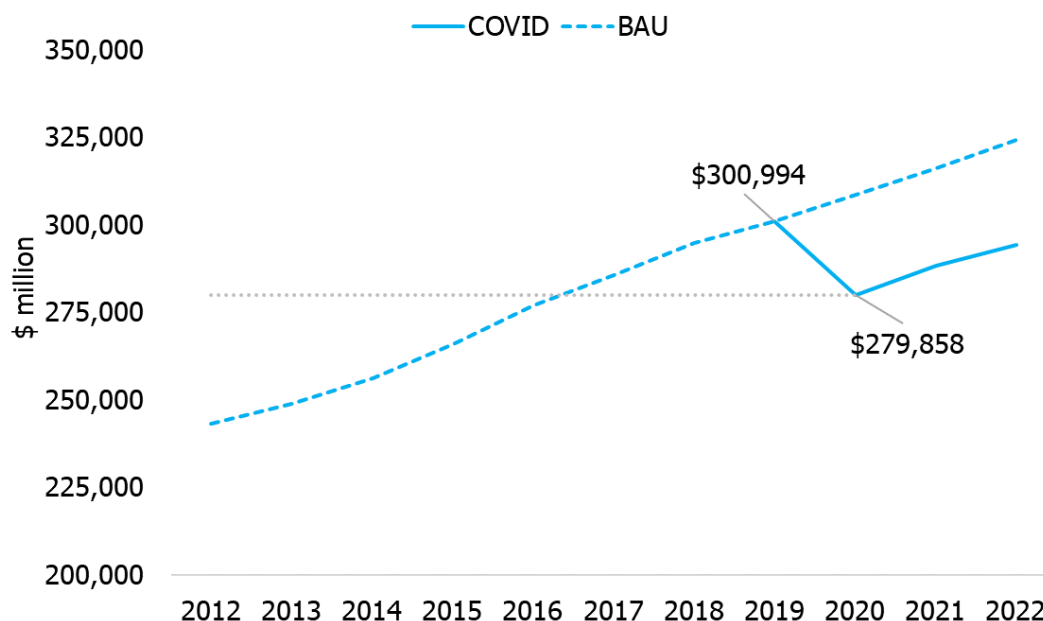
Phase		GDP	Household consumption	Exports	Imports	National output
Phase 1	% change	-7.1%	-13.1%	-10.8%	-11.6%	-8.9%
	Level (\$m)	-21,136	-22,032	-9,096	9,616	-50,348
Phase 2	% change	-4.3%	-7.5%	-7.3%	-7.3%	-5.5%
	Level (\$m)	-12,704	-12,824	-6,145	6,003	-31,388
Phase 3	% change	-2.2%	-3.2%	-5.6%	-4.1%	-3.3%
	Level (\$m)	-6,759	-5,588	-4,710	3,388	-18,772

Source: NZIER

Figure 6 gives an overview of the recovery trajectory of the national real GDP. It shows that New Zealand's GDP has fallen back to a similar level to 2016. In other words, COVID-19 has removed 3 years of GDP growth. We expect that it will take at least an additional 4 years until New Zealand's GDP returns to its pre-COVID level (2019).

**Figure 6 New Zealand's real GDP recovery path**

Annual changes compared to June 2019 baseline, in \$ million (in real terms)



Source: NZIER

### 5.2.2 Regional effects

Table 3 and Figure 7 present the impacts of COVID-19 on regional real GDP for different alert levels. Regions for which tourism activities account for a larger share of the regional economy are the most affected by COVID-19. This is the case for Queenstown-Lakes, Rotorua and Auckland. For all three phases, real GDP loss (in percentage terms) is the highest for Queenstown-Lakes, which is highly tourism dependent and therefore substantially affected from a downturn in international and domestic tourism. Real GDP losses for Hamilton City and Greater Wellington are not as significant as these economies are not as reliant on tourism.

**Table 3 Impacts on regional GDP**

Annual changes compared to 2019 baseline, in percentage

Region	Phase 1 (Lockdown)	Phase 2 (Alert Level 2)	Phase 3 (Alert Level 1)
Auckland	-7.7%	-4.6%	-2.5%
Greater Wellington	-6.9%	-4.1%	-2.1%
Christchurch City	-7.8%	-4.7%	-2.6%
Queenstown-Lakes	-16.7%	-10.8%	-6.6%
Hamilton City	-6.6%	-3.8%	-1.8%
Tauranga	-7.1%	-4.3%	-2.3%
Rotorua	-8.8%	-5.5%	-3.2%
Dunedin	-7.5%	-4.5%	-2.4%





Rest of North Island	-6.2%	-3.6%	-1.7%
Rest of South Island	-6.2%	-3.7%	-1.9%
<b>New Zealand</b>	<b>-7.1%</b>	<b>-4.3%</b>	<b>-2.2%</b>

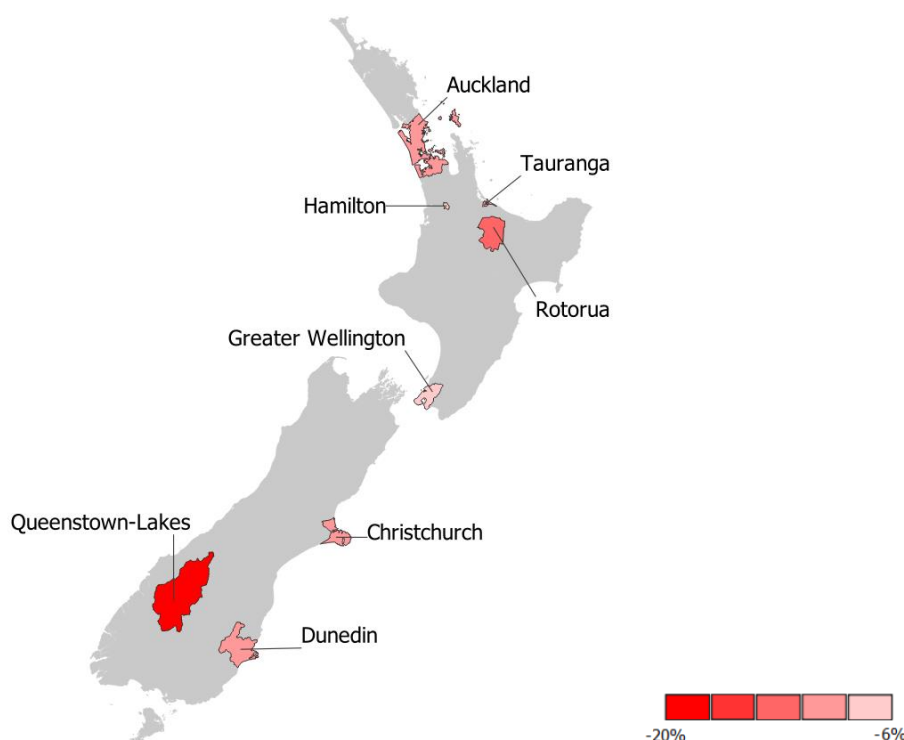
Notes:

- 1 Greater Wellington includes Wellington, Lower Hutt, Upper Hutt and Porirua.
- 2 Prior to the COVID-19 outbreak, the New Zealand economy had been expected to grow by around 2% between 2020 and 2022. This highlights how significant the estimated reduction in key macroeconomic metrics are when we compare with the counterfactual in which the economy would have *grown* in the absence of the COVID-19 pandemic.

Source: NZIER

### Figure 7 Real GDP decreases the most in tourism-centric regions

Annual changes compared to 2019 baseline, in percentage – Phase 1 (lockdown)



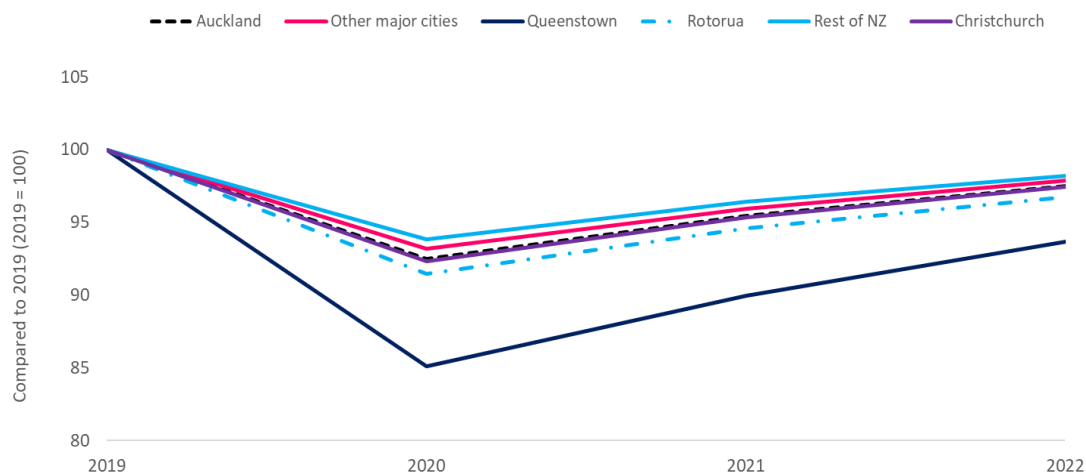
Source: NZIER

Figure 8 shows the recovery path of different regions in terms of real GDP. Under Phase 1 (lockdown in 2020), Queenstown-Lakes' real GDP falls to 85% of its 2019 level. Under Phase 2 (2021) and Phase 3 (2022), Queenstown-Lakes' real GDP is slowly recovering but is still at 90% and 94%, respectively of its 2019 level. Rotorua is the second most affected region from COVID-19 in terms of real GDP, with a drop to 92%, 95% and 97% under Phases 1, 2 and 3, respectively.



**Figure 8 Regional real GDP recovery path under the different phases**

Annual changes from 2019 baseline, in percentage



Source: NZIER

Regional household spending – our proxy for economic welfare – in dollar value (Table 4 and Figure 9) is expected to decrease the most in Auckland, Greater Wellington and Christchurch under each phase. This is because household spending is higher in regions that are more populated and wealthier. Therefore, even a small percentage decrease will have a larger monetary impact than less-populated and less-wealthy regions.

The decrease in regional household spending share is the most significant in regions whose economy is more reliant on tourism activities such as Queenstown-Lakes, Auckland, Christchurch and Rotorua.

**Table 4 Impacts on regional real household spending**

Annual changes compared to 2019 baseline, in percentage

Region (TLA)	Phase 1 (Lockdown)	Phase 2 (Alert Level 2)	Phase 3 (Alert Level 1)
Auckland	-14.0%	-8.2%	-3.7%
Greater Wellington	-12.5%	-7.2%	-3.1%
Christchurch City	-13.7%	-8.0%	-3.5%
Queenstown-Lakes	-28.2%	-18.4%	-10.7%
Hamilton City	-12.5%	-7.1%	-3.1%
Tauranga	-12.8%	-7.4%	-3.3%
Rotorua	-13.5%	-7.8%	-3.4%
Dunedin	-13.1%	-7.7%	-3.5%
Rest of North Island	-11.9%	-6.6%	-2.6%
Rest of South Island	-11.9%	-6.6%	-2.6%
<b>New Zealand</b>	<b>-13.1%</b>	<b>-7.5%</b>	<b>-3.2%</b>

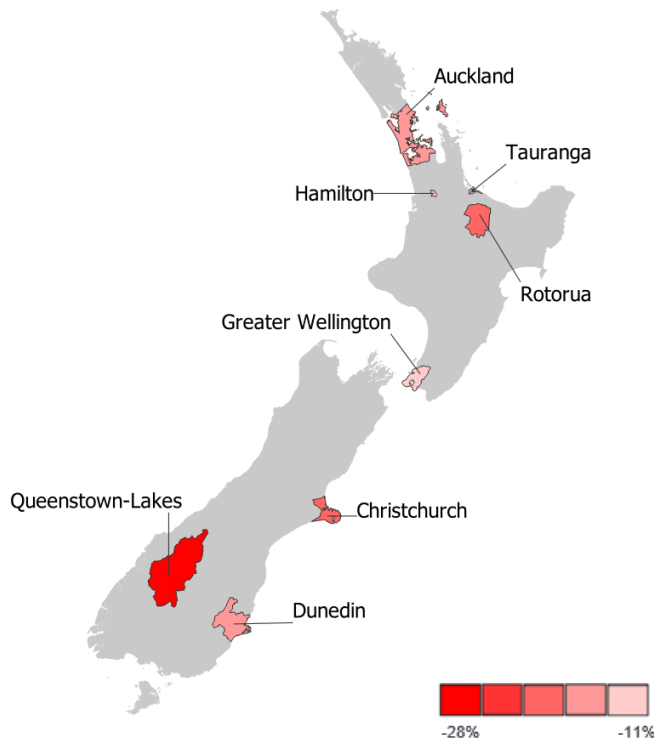
Note: Greater Wellington includes Wellington, Lower Hutt, Upper Hutt and Porirua.

Source: NZIER



### Figure 9 Real household spending decreases the most in tourism-centric regions

Annual changes compared to 2019 baseline, in percentage – Phase 1 (lockdown)



Source: NZIER

#### 5.2.3 Impacts on sector activities

Figure 10 presents the changes in aggregated industries compared with the 2019 baseline under each phase.

The tourism sector (domestic and foreign tourism) is the most affected by COVID-19 and restriction measures. It is also the sector that is likely to take longer to recover compared with other sectors.

With COVID-19, international tourism output falls to 27% of its 2019 level and slowly recovers over time to reach 59% of its 2019 level in 2022 (Phase 3). Domestic tourism output falls to 49% of its 2019 level in 2020 (Phase 1) and reaches 78% of its 2019 base in 2022 (Phase 3). Domestic tourism is expected to recover relatively quickly, with public campaigns playing a role in restoring regional demand. The impact on international tourism may last much longer given that border restrictions are expected to last until 2022.

Industries that support the tourism sector, such as accommodation, food and beverage services and transport (mostly air transport) industries, are also significantly hit by the isolation measures and travel ban, with output for each of these industries dropping to 66% and 76% respectively of their 2019 base.

Output decreases less sharply in industries that are not directly reliant on the tourism sector (e.g. other primary sector and manufacturing, construction and other services). The output decrease in these industries is due to the decrease in available labour and capital immobilised by the implementation of restriction measures. There are also some

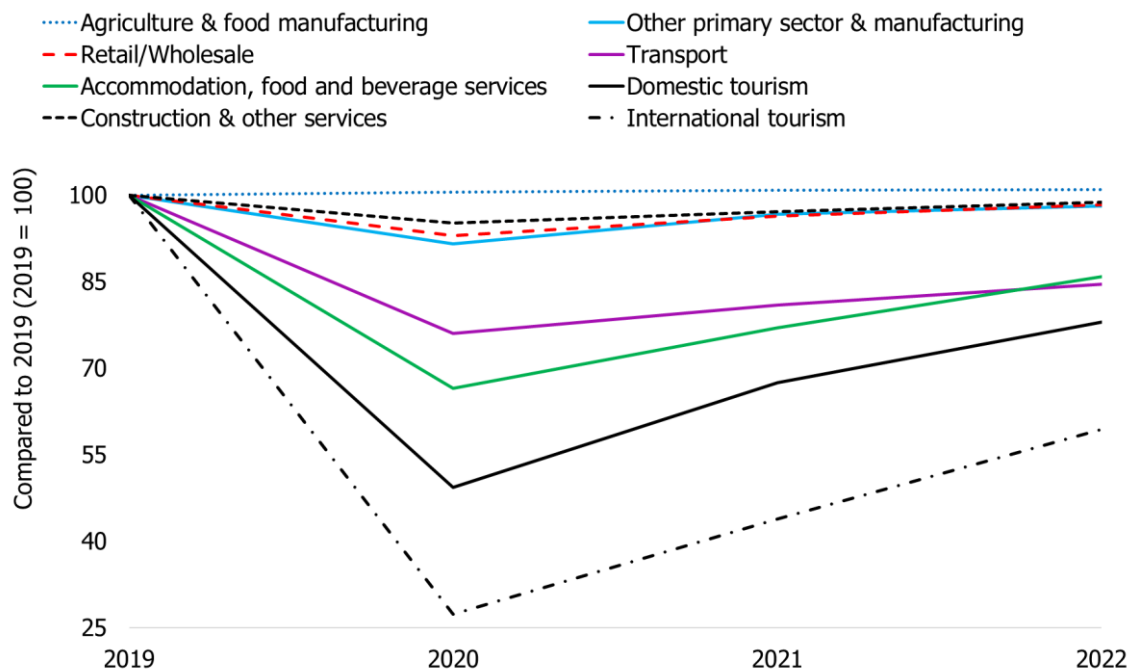


substitution effects at play. With the decrease in expenditure towards visitor economic activity, households might allocate a larger portion of their budgets to other industries such as health and education (included in construction and other services).

With a weakening demand for tourism, the exchange rate goes down. This leads to a demand increase for other export commodities such as dairy, meat and fruit products, which in turns leads to a slight increase in output for agriculture and food manufacturing products relative to the 2019 baseline.

**Figure 10 Sector impacts under the different phases at the national level<sup>15</sup>**

Annual changes from 2019 baseline, in percentage



Source: NZIER

<sup>15</sup> For simplification purposes, we have combined industries that have a similar recovery path such as agriculture and food manufacturing, construction and other services, other primary sector and manufacturing industries.

## 6 Discussion on assumptions and policy implications

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At the national level, restriction measures and the travel ban due to COVID-19 led to substantial real GDP loss (between \$21 billion and \$6.8 billion between Phase 1 and Phase 3, respectively). For all three phases, the fall in real GDP is dominated by labour and capital temporarily not used because of the social and travel restriction measures imposed in the country. The decrease in domestic and foreign tourism is also expected to have a significant impact on regional economies, especially those for which tourism activities represent a larger share of the regional economy, such as Queenstown-Lakes, Christchurch, Auckland and Rotorua.

Domestic tourism has the potential to partially mitigate the negative impacts of COVID-19 on foreign tourism in New Zealand. Further research is needed to estimate the extent to which expenditure in both inter-region/district and intra-region/district tourism represent a substitution from foreign travellers' expenses foregone.

There is considerable uncertainty about the severity of the potential economic impacts of COVID-19. We attempted to explore some of these uncertainties through the design of modelling scenarios (phases). The magnitude of these impacts is highly dependent on the assumptions made regarding the duration of travel ban and restriction measures and their likely effects on labour, capital or household demand for consumer goods and services. Most of our assumptions are derived from NZIER's *Quarterly Predictions*. We are mindful that our assumptions are based on data that was available at the moment we wrote this paper and that the situation is evolving rapidly. This means that assumptions made at the time this paper was written might need to be updated as more timely information comes to hand.

We use the static version of our regional CGE model, TERM-NZ, which looks at 'before' (i.e. pre-COVID-19) and 'after' (with different COVID-19 alert levels). We therefore do not explicitly model the timing of the different restriction measures imposed by the New Zealand Government under the different alert levels.

Additionally, and given the information available at the time this paper was written (June 15 202), we have not explicitly modelled labour productivity loss resulting from social distancing measures in essential industries as its importance is still uncertain. However, labour productivity loss has been taken into account in NZIER's labour forecasts and hence in our assumptions as well.

We also assume no fiscal response by government outside wage subsidies, which are implicitly included in NZIER's labour forecasts. Therefore, public consumption follows the decrease in household consumption (in nominal terms). While the New Zealand Government has recently announced a substantial COVID-19 economic response package, we decided to not explicitly model any fiscal response in order to showcase the base against which fiscal policies can be assessed.

Budget 2020 included a \$50 billion COVID-19 Response and Recovery Fund (CRRF), including the Wage Subsidy Scheme and Business Tax Relief Package aimed at supporting businesses to keep workers in their jobs.

The Reserve Bank has also stepped in to support the recovery. In addition to the emergency 75 basis points official cash rate (OCR) cut undertaken on 16 March 2020, the RBNZ has



launched a large-scale Government bond purchase programme which increased to a potential of \$60 billion<sup>16</sup>. It also opened the door to the potential for a negative OCR.

These concerted measures are designed to reduce borrowing costs and inject money into the economy to encourage spending and investment. Over the longer term, as economic impacts remain, there will be a need for greater flexibility to allow for both physical and human capital to be redeployed toward surge industries. Focusing on investment that builds physical and human capital to foster an environment where the New Zealand economy can adapt quickly to changing circumstances will be most conducive to a sustainable recovery.

<sup>16</sup> The RBNZ announced on 12 August 2020 a further expansion of its large-scale Government bond purchase programme to \$100 billion to provide additional support to the New Zealand economy <https://www.rbnz.govt.nz/news/2020/08/further-easing-in-monetary-policy-delivered>



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## Appendix A Our CGE model: TERM-NZ

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We use the static version of our regional CGE model, TERM-NZ, so that we can compare the economy before and after a policy option is applied. There is no time dimension in the static model, so we do not look at how the economy adjusts to a new equilibrium.<sup>17</sup>

Restriction measures imposed as a response to COVID-19 disturb the equilibrium in the economy, and the model calculates changes in demand, supply and prices of inputs (like labour and capital) then reallocates them across sectors according to where they get greatest returns, establishing a new equilibrium after a policy has been implemented.

NZIER's TERM-NZ<sup>18</sup> model is a bottom-up CGE model of the New Zealand economy. TERM-NZ is based on Stats NZ's Input-Output tables that identify the structure of the industries involved. The model database is benchmarked to 2019 using Stats NZ's latest National Accounts available (November 2019).

The model contains information for 88 districts (68 territorial authorities and 20 local boards in the Auckland region, 149 industries and 149 commodities. We usually run TERM-NZ with an aggregated version of the database to speed-up the model computation and because it is not technically possible to run the model with such a large database in its full dimensions. For this study, we have aggregated the model's database to 14 regions and 58 industries.

TERM-NZ treats New Zealand's regions as separate economies. This means that we are able to account for region-specific inter-linkages between industries, as well as their links to households (via the labour market), local and central government, capital markets, the rest of New Zealand (via inter-regional trade) and the global economy (via imports and exports).

The model shows how restriction measures under the different COVID-19 Alert Levels might affect the regional and national economies.

<sup>17</sup> These fluctuations may have significant impacts in their own right and could be captured in future research by using our more sophisticated, dynamic CGE model.

<sup>18</sup> TERM-NZ stands for "The Enormous Regional Model" of the New Zealand economy. It was developed at NZIER based on the original Australian TERM model created by Professor Glyn Wittwer of the Centre of Policy Studies, Victoria University Melbourne, Australia. <http://www.copsmodels.com/term.htm>. NZIER maintains close connections with the Centre, ensuring that our modelling techniques reflect international best practice.

## Appendix B Extending the TERM-NZ database – methodology

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### B.1 Adding tourism industries

In the classic TERM-NZ database, tourism<sup>19</sup> is not identified as a separate industry or products but rather is nested in the expenditure of households and industries on products such as accommodation, food and beverages or transport.

Following the approach of Wittwer (2017) which is detailed in Dixon et al. (2019), we extended the TERM database with the addition of five new tourism industries. This has been done by combining all the economic activities linked to tourism.

These are the new tourism industries :

- **Domestic holiday**, which represents tourist expenditure made by New Zealanders, undertaken domestically, either locally or inter-regionally. We used visitor expenditure by New Zealanders, including all corresponding taxes and margins.
- **Foreign holiday** (imported New Zealand tourism) represents tourism-related expenditure made by New Zealanders travelling abroad. We used international expenditure of New Zealanders travelling abroad.
- **Export tourism** (foreign tourism) covers tourism expenditure by foreign visitors in New Zealand, not travelling for education purposes. We used expenditure by foreign travellers in New Zealand other than foreign students studying in the country.
- **Export student** (foreign student) represents the expenditure by foreign students in New Zealand. We used expenditure by foreign students in New Zealand. This expenditure includes all corresponding taxes and margins.
- **International flights** cover the use of imported and domestically produced air transport by New Zealanders travelling abroad

Unlike all the other industries in the database, the new tourism industries do not use labour and capital directly. Instead, tourism industries purchase goods and services (e.g. accommodation, food and beverage, transport) and sell them to foreign and domestic visitors. As such, these tourism industries combine goods and services produced by a variety of industries so that all tourism expenditure is grouped within these five tourism industries.

We build cost and sale structures for each of the new tourism industries by disaggregating the existing TERM-NZ database using the TSA from Stats NZ and the monthly regional tourism estimates from MBIE.

Table 5 in Appendix C presents a summary of the data requirements for extending the TERM-NZ database at the sector and district levels.

<sup>19</sup> In its definition, tourism includes usual travellers who are holidaying, visiting friends and relatives, on business or travelling for educational purposes.



## Domestic tourism

This section describes the steps done to build the domestic tourism industry in the TERM-NZ database.

Stats NZ's TSA provides data on the value of total domestic consumption on the seven tourism-characteristic products<sup>20</sup> and the two tourism-related products<sup>21</sup> purchased by New Zealand households, businesses and governments at purchasers' (market) prices.

Using this information and concordance between TSA's tourism products and commodities in the TERM database, we derive domestic tourism ratios, defined at the national level as follows:

$$D(c) = \frac{\text{NZer tourist domestic spending } (c)}{\text{Total expenditure}(c)} \quad \text{with } c \text{ defined as commodity} \quad (1)$$

with information for the numerator is taken from Stats NZ's TSA and data for the denominator is taken from the TERM database and defined as the total expenditure from household and industry on tourism commodity at purchasers' prices. Because of data inconsistencies, the ratio can be higher than 1. When this happens, we manually set its value to 1.

We assign this domestic tourism ratio across all regions of destination, households, industries and associated sales taxes and margins to the TERM database. This allows us to pull out expenditure on tourism-related products made by New Zealanders travelling domestically. This expenditure is then placed into the cost structure of the domestic tourism industry. For each affected industry other than the domestic tourism industry, total cost is lower than total sales because of costs associated with domestic travel being removed. Conversely, total costs for the domestic tourism industry exceed total sales and consumption expenditure is lower than its initial level due to the costs of domestic travel being removed.

## Foreign holiday (New Zealanders travelling abroad)

This section describes the steps done to build the foreign holiday industry in the TERM database.

The TSA from Stats NZ provides data on the market price value of total external consumption on tourism-characteristic and tourism-related products by New Zealand households, businesses and governments.

We use concordance between tourism products described in Stats NZ's TSA and commodities that are in the TERM-NZ database to estimate the foreign holiday ratios, defined at the national level as follows:

$$FH(c) = \frac{\text{NZer tourist spending overseas } (c)}{\text{Import expenditure } (c)} \quad \text{with } c \text{ defined as commodity} \quad (2)$$

where data for the numerator is from Stats NZ's TSA and data for the denominator is the sum of household and industry use of a commodity at purchasers' prices from the TERM

<sup>20</sup> Stats NZ classifies tourism-characteristic product as a product where at least 25% of its production is purchased by tourists and for which the level of consumption would decrease significantly in the absence of tourists.

<sup>21</sup> Stats NZ defines a tourism-related product as a product where up to 25% of its production is purchased by tourists. However, 'Retail sales – clothing and footwear', which exceeds the 25% of production threshold, is categorised as a tourism-related retail commodity because the activity undertaken specifically relates to retail.



database. Because of data inconsistencies, the ratio can be higher than 1. When this happens, we manually set its value to 1.

We assign this ratio across all regions of destination, households, industries and associated sales taxes and margins to the TERM database. This allows us to pull out expenditure on tourism-related products made by New Zealanders travelling abroad. Once these tourism-related values are taken out from the industry costs matrices, the sum of costs is less than the sum of sales for each affected industry. Similarly, the value of consumption expenditure is below its initial level after we removed overseas travel costs.

### International air transport

The international air transport industry represents the use of imported and domestically produced air transport by New Zealanders travelling abroad.

In the TERM-NZ database, air transport is used indirectly as a margin for freight and directly for passenger transport. Here, we are only interested in passenger transport demand. As such, we isolate the expenditure of New Zealanders travelling overseas, including air transport, from the existing flows of imported goods and corresponding taxes and margins. Given that New Zealanders who travel overseas might also purchase domestic air flights, we account for this domestic spending as follows:

- We first make an informed guess of the Air New Zealand revenue share generated by fares bought by New Zealanders travelling abroad and apply this share to the existing value of domestic air transport in the database.<sup>22</sup> This gives us a dollar value that we allocate towards fares paid by New Zealanders travelling abroad.
- We maintain the same allocation to industry and household users and regions as the initial allocation of imported air transport expenditure.
- Expenditure on domestic flights is added into the margin matrices (for passenger transport, not for freight) in the database. This expenditure represents the use of domestically produced air transport in the purchase of imported New Zealand tourism (outbound New Zealand tourism).
- As a final step, we ensure that the total purchasers' value of air transport associated with outbound New Zealand tourism corresponds to what is reported in Stats NZ's TSA. To do so, we decrease the basic value of imported air transport, which was initially taken out from the basic value of industry spending on domestic or imported commodities and from the basic value of regional household expenditure, and associated taxes and margins.

We ensure the database is balanced by adding sales of the domestic holiday industry into the cost matrices of industries and households. At this stage, regional users (households and industries) purchase small amounts on imported tourism products (e.g. accommodation and air transport), and their expenditure is now indirectly taken into account through spending on imported domestic tourism services.

### Foreign tourism

This section describes the steps done to build the foreign tourism industry in the TERM-NZ database.

<sup>22</sup> We looked at Air New Zealand's annual reports to inform our assumptions.

Stats NZ's TSA provides information on the value of total domestic consumption on the seven tourism-characteristic products and the two tourism-related products purchased by foreign tourists at purchasers' (market) prices.

Using this information and concordance between TSA's tourism products and commodities in the TERM-NZ database, we derive the following export tourism ratios, defined at the national level as follows:

$$ET(c) = \frac{\text{Foreign tourist domestic spending } (c)}{\text{Export expenditure } (c)} \quad \text{with } c \text{ defined as commodity} \quad (3)$$

with information for the numerator taken from Stats NZ's TSA and data for the denominator taken from TERM database and defined as the value of exports at purchasers' prices for each tourism commodity. Similarly, to the other industry splits, the ratio is manually set to 1 if its value is greater than 1.

We assign this foreign tourism ratio across all regions of destination to extract the contribution of foreign tourists to New Zealand exports by commodity (along with sales taxes and margins associated with exports by commodity).

### Foreign students

Spending by foreign visitors in New Zealand by commodity and region of expenditure generated in the previous step is split into spending by students and non-students based on the number of foreign students arriving in New Zealand.

It is unlikely that the Stats NZ's Input-Output tables account for spending of foreign students as sales to exports after their first year of study. As such, we focus on the expenditure of new foreign student arrivals.

To do so, we consider that the tourism-related product 'education' in Stats NZ's TSA represents the expenditure made by foreign students on higher-education services that are domestically produced. We then estimate the value of foreign student expenditure for all the other commodities in TERM-NZ as the product of the number of first-year foreign students and the per capita spending by commodity reported for a single person aged under 35 in the Household Expenditure Survey from Stats NZ.

We then removed expenditure made by foreign tourists and students in New Zealand by commodity and by regions from the existing export values and associated sales taxes and margins. We insert these expenditure values into the cost structure of foreign tourism and foreign student industries. In the TERM-NZ database, we take into account imports of goods and services purchased by foreign tourists and students in New Zealand as re-exports. In other words, we consider that re-exports correspond to the own use of imported tourism products, and therefore, we estimate the value of tourism re-exports as the ratio of imports to total sales by commodity at the national level.

At this stage, the total costs of foreign tourism and foreign student industries are lower or equal than the sum of sales. Export expenditure in each of these two industries is lower than its original level due to visitor exports being taken out.

We ensure the TERM-NZ database is balanced by taking out export sales (equal to the previous value of re-exports to foreign visitors) and adding them to the domestic tourism industry to equal the cost of inputs that are domestically produced and imported. This allows for export expenditure to return to its original level. In the extended TERM-NZ database, tourism-related industries such as accommodation have few direct exports and



little inputs of imported own product. Exports of the foreign tourism industry are now produced by the newly created domestic tourism sectors.

## B.2 Bottom-up regional modelling

Our methodology to extend the database at the regional/district level is based on Wittwer and Horridge (2010) and follows a bottom-up approach. In this approach, each region/district is modelled as a separate economy linked by trade of goods and services, common but imperfectly mobile factor markets, a common central government and exchange rate. The use of a bottom-up framework allows us to estimate variations in both quantities and prices at the regional/district levels.

The TERM-NZ database is based on a master database that contains information for 88 districts (68 territorial authorities and 20 local boards in the Auckland region).<sup>23</sup> Similarly to the original TERM model (Wittwer 2012, 2017), we usually run TERM-NZ with an aggregated version of the database to speed up the model computation and because it is not technically possible to run the model with such a large database in its full dimensions.

Wittwer and Horridge (2010) use Census data to represent the regional database at a smaller regional level for Australia. We follow their methodology to introduce detail at the district level in our TERM-NZ database.

We use regional employment data from Stats NZ, by industry and for each district (i.e. territorial authority or local board in Auckland) to estimate the following industry and district-level shares:

- R001: Production/output shares
- R002: Investment shares (same as R001)
- R003: Household consumption shares
- R004: Export shares
- R005: Government shares

To estimate these shares at the regional and district level, we use available information on employment by disaggregated industry and available at the district level (territorial authority or local board) and we assume an identical technology or input cost structure for a given industry in all districts, following the Wittwer and Horridge (2018) methodology.

### B.2.1 District-level share of industry value added

The district shares of industry value added  $VA_i$  for industry  $i$  is aggregated from districts  $ta$  to the regional level  $r$  and from industry  $i$  to broad sectors  $s$  so that the sum of district shares of industry value added equals to the regional level of sector value added  $VA_{s,r}$ .

$$\sum_{ta \in r} \sum_{i \in s} (R001_{i,ta} \cdot VA_i) = VA_{s,r} \quad (4)$$

<sup>23</sup> The 16 regions of New Zealand are defined according to Stats New Zealand, [http://archive.stats.govt.nz/browse\\_for\\_stats/Maps\\_and\\_geography/Geographic-areas.aspx](http://archive.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas.aspx)



From the above equation, we may need to adjust district production shares in a given region if the sum of these shares over industries and districts is different from the national account data.

### B.2.2 Household consumption shares at the district level

We define as  $R003$  the share of household consumption by commodity and district.  $R003$  is equal to the product of the district's share of regional population and the region's share of national broad commodity consumption, aggregated from the granular commodity level  $c$  to the broad sector level  $s$ :

$$R003_{c,r} = \left( POP_{ta} / POP_{r(ta)} \right) \cdot \left( V3_{-R_{s(c),r(ta)}} / V3_{NAT_{s(c)}} \right) \quad (5)$$

### B.2.3 Government consumption shares at the district level

As there is no sector breakdown in government spending in the national accounts (for the regional level), we simply define  $R005$ , the share of government expenditure by commodity and district, as follows:

$$R005_{cta} = \left( POP_{ta} / POP_{r(ta)} \right) \cdot \left( V5_{-R_{r(ta)}} / V5_{NAT} \right) \quad (6)$$

For local commodities, we assume that household and government consumption shares are equal to the production shares (one commodity corresponds to one industry in the TERM-NZ database), such as:

$$R005_{cta} = R001_{ita} \quad (7)$$

and

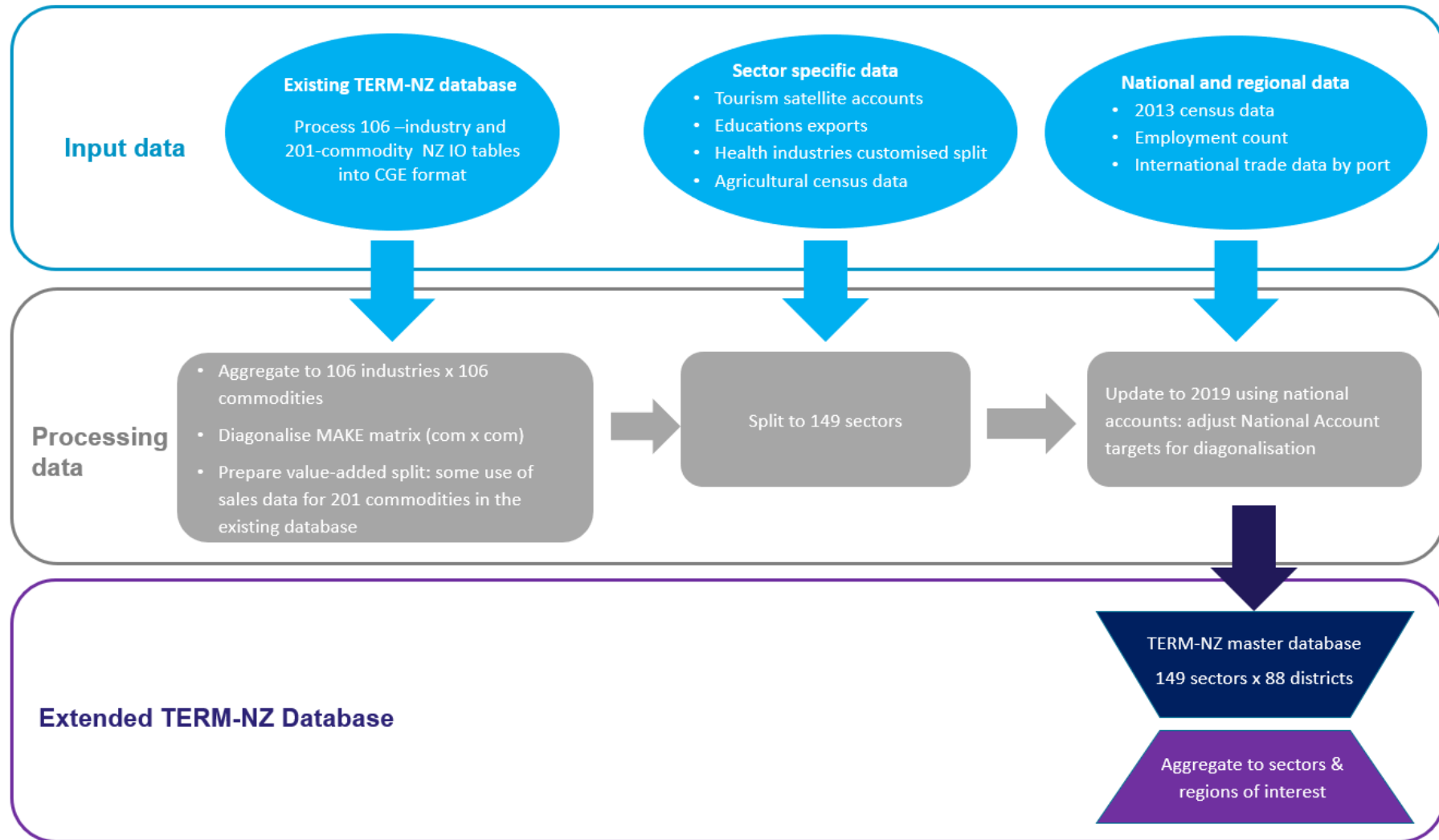
$$R003_{cta} = R001_{ita} \quad (8)$$

Figure 11 provides an overview of the different steps undertaken to extend our TERM-NZ and add sector and district-level detail.





Figure 11 Process overview to extend the TERM-NZ database



Source: NZIER, based on Wittwer (2012,2017)



## Appendix C Model closure

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Given that the COVID-19 Alert Levels restriction measures have an immediate and unprecedented effect, we assume a short-run model closure in which we made the following assumptions:

- Real wage is typically inflexible at the national level in the short term. We also assume that labour is mobile across industries and regions. As such, adjustments on the regional labour market in the short-run is done through changes in employment and regional wages adjust slowly, with gradual adjustment in regional labour market supply (i.e., through migration between regions).
- Capital stock is (naturally) fixed within each region and the short-run rates of return to capital adjust. National real investment is fixed.
- Regional nominal household consumption follows regional nominal wage income.
- Ratio between balance of trade and GDP is fixed (in nominal terms).
- Real government consumption is exogenous.
- Foreign currency prices of imports are naturally exogenous.



## Appendix D Information needed to extend the database

**Table 5 Regional and sectoral information and sources**

Data	Source	Latest data available
Product detail to extend sales detail of 206 commodities in the IO tables	National Accounts 2006 Commodity Classification (NA06CC) to Central Product Classification (CPC) classification	
Employment data	Stats NZ	2019
Agricultural data	Stats NZ	2018
Education data (exports)	Ministry of Education	2018
Employment data	Business Demographics, Stats NZ	2018
International exports by ports (HS10)	Stats NZ	2018
International imports by ports (HS10)	Stats NZ	2018
National accounts	Stats NZ	YE March 2019
Tourism satellite account (national level)	Stats NZ	2018
Tourism satellite account (regional and TA levels)	MBIE	August 2019 (monthly data)
Concordances (product, industry and geographic details)	Stats NZ	



## Appendix E Aggregated industries in the TERM-NZ database

Table 6 CGE industries in the extended TERM-NZ database

Description
Horticulture and fruit growing
Sheep, beef cattle, and grain farming
Dairy cattle farming
Poultry, deer, and other livestock farming
Forestry and logging
Fishing and aquaculture
Agriculture, forestry, and fishing support services
Coal mining, oil and gas extraction
Mining and exploration
Meat and meat product manufacturing
Seafood processing
Dairy product manufacturing
Fruit, oil, cereal, and other food product manufacturing
Beverage and tobacco product manufacturing
Textile and leather manufacturing
Clothing, knitted products, and footwear manufacturing
Wood product manufacturing
Pulp, paper, and converted paper product manufacturing
Printing & publishing
Petroleum and coal product manufacturing
Basic chemical and basic polymer manufacturing
Fertiliser and pesticide manufacturing
Pharmaceutical, cleaning, and other chemical manufacturing
Polymer product and rubber product manufacturing
Non-metallic mineral and metal manufacturing
Transport equipment manufacturing
Electronic and electrical equipment manufacturing
Machinery manufacturing

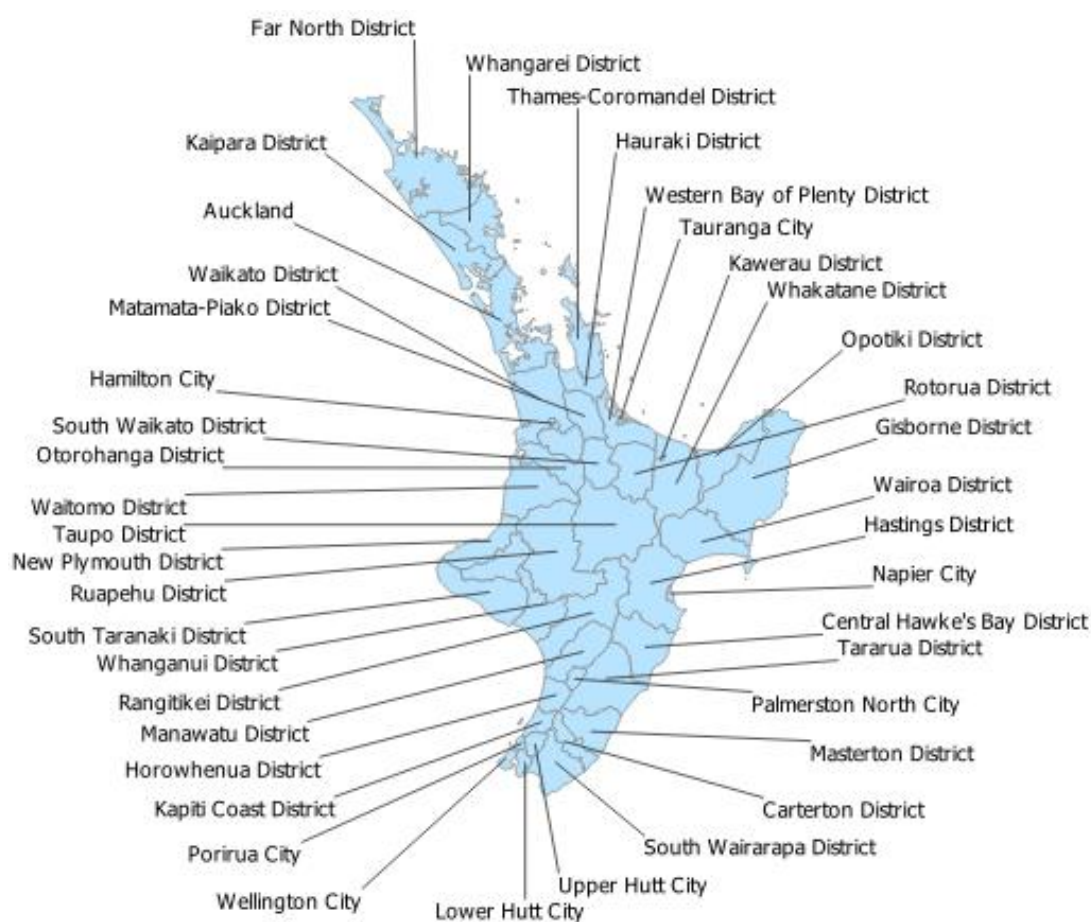


Furniture and other manufacturing
Electricity generation and transmission
Gas and water supply
Waste and sewage services
Residential, non-residential, heavy construction and construction services
Wholesale
Retail
Accommodation, food and beverages services
Road and rail passenger transport
Road and rail freight
Other transport equipment and parts
Air and other passenger transport
Air freight
Transport support and storage services
Publishing, movies, broadcasting, telecommunication services
Finance and insurance services
Property services and owner-occupied dwelling
Business services
Local government administration services
Central government administration services
Education and health services
Sport and recreation services, gambling activities
Personal, community and other services
Domestic holiday
Foreign holiday
Export tourism
Domestic and international air transport by New Zealanders travelling abroad
Export of education (foreign students studying in New Zealand)



## Appendix F Geographical detail in the TERM-NZ database

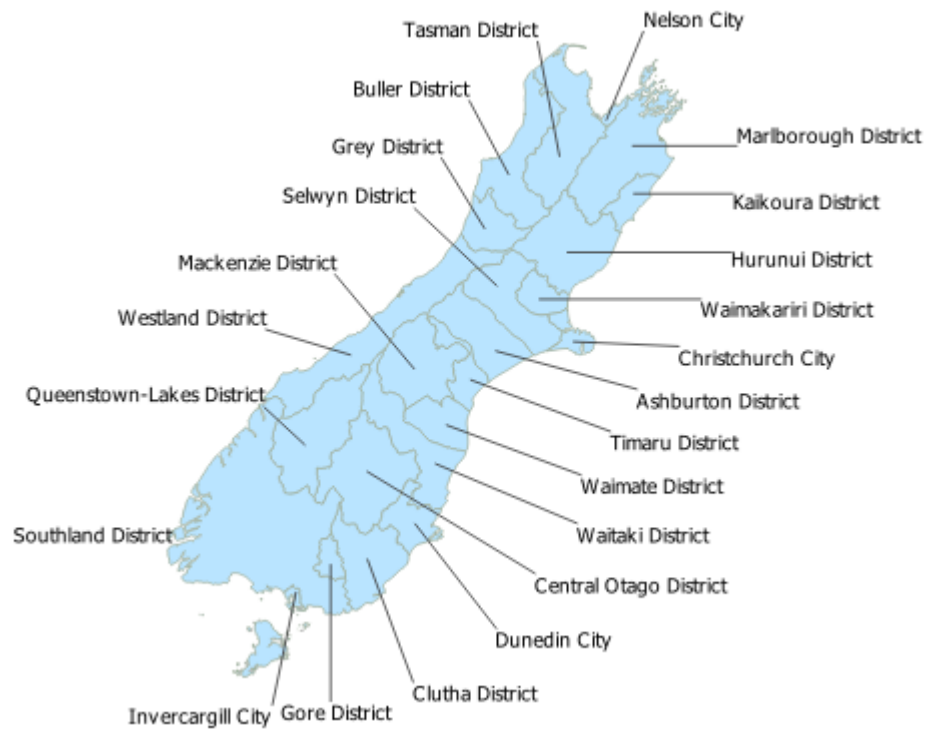
Figure 12 New Zealand districts represented in our database – North Island



Source: Stats NZ



Figure 13 New Zealand districts represented in our database – South Island



Source: Stats NZ

Figure 14 Auckland local boards represented in our database



Source: Stats NZ