Economic impacts of changes in Covid-19 border settings and resurgence scenarios

An MDG5-NZ dynamic computable general equilibrium analysis

Final report, 15 October 2020

the MacroDyn Group

SENSE PARTNERS
DATA LOGIC ACTION

Key points

We use an advanced dynamic CGE model to explore the macroeconomic and industry impacts of Covid-related scenarios

Using the MDG5-NZ dynamic computable general equilibrium (CGE) model of the New Zealand economy to project out to March year 2026, we look at two sets of scenarios:

(i) Three simulations that consider **more restrictive border settings** than those assumed in PREFU, broadly proxying:

a. Inbound arrivals being constrained by Managed in Quarantine (MiQ) capacity and focused on returning New Zealanders, with no tourism and only small numbers of overseas students arriving (Low-low scenario)

b. A trans-Tasman and Pacific Island travel bubble (Low scenario)

c. A travel bubble that also includes South East Asia (medium scenario).

(ii) Three simulations examining a **resurgence of Covid community transmission** in the year to March 2021, which vary in terms of length, severity and regional coverage. We also model a variant which explores the impacts of an additional wage subsidy.

We compare the impacts of these scenarios against a baseline calibrated to The Treasury's July 2020 version of PREFU. Those projections were completed before the 12 August 2020 announcement that community transmission had recommenced and a shift up in Alert Levels was required.

For the scenarios modelled for this report, recalibrating the model baseline to the final PREFU projections released on 16 September 2020 would not materially change the results and narrative presented here.

The scenarios are illustrative only

The purpose of this research is to highlight the implications at the economywide and industry level of hypothetical scenarios: to answer a series of 'what if?' questions.

The scenarios are not true forecasts in that they **do not incorporate a comprehensive set of likely economic shocks like changes in fiscal policy or monetary policy settings** beyond those contained in PREFU. A comprehensive forecast that includes these factors can easily be incorporated in future research. They do not reflect any Treasury policy positions.

Keeping the scenarios simple allows a clearer examination of how industries and the economy as a whole respond to tighter border restrictions or resurgence events.

We do not consider every possible economic factor at play. For example, in this report we do not address the health or social costs associated with the spread of Covid, so **the analysis does not purport to be a comprehensive cost-benefit analysis** in terms of impact coverage. However, in terms of the specific issues that are addressed, the economy-wide and sectoral detail of the CGE approach offer deeper insights into cost-benefit trade-offs than does traditional analysis. Again, a comprehensive analysis is an option for a future study.

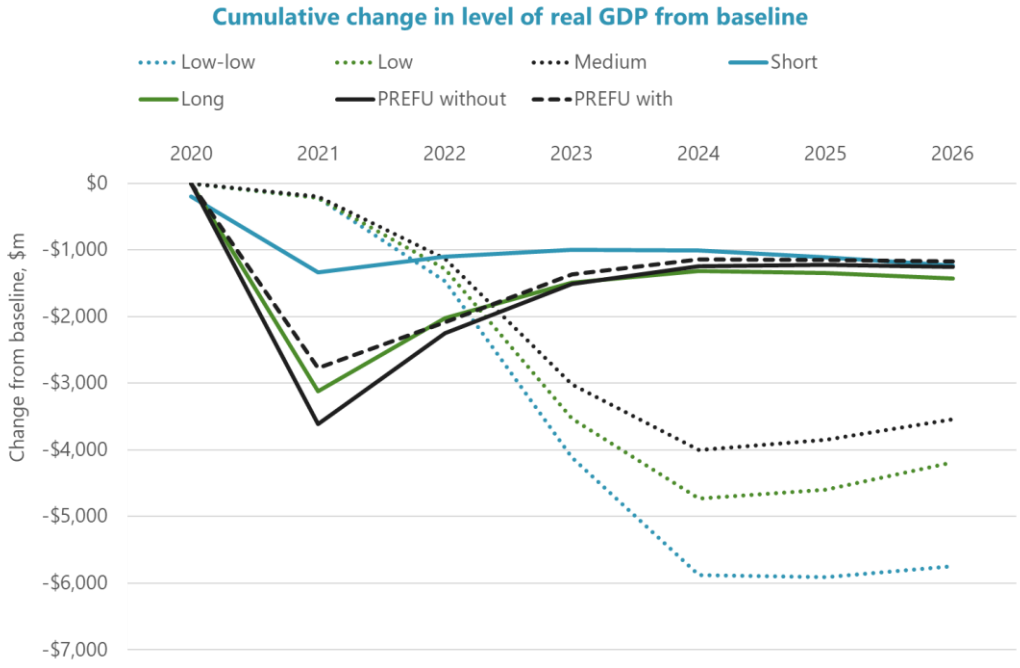
Tighter border settings have minimal short-term impacts outside of tourism and education, but reduce productive capacity over time

Restrictive border settings result in narrow but deep demand-side impacts (on tourism and education in particular) and broad but very shallow supply-side effects (via a reduction in labour supply).

These impacts are small in the short-term, relative to the PREFU baseline (Figure 1), as the vast majority of primary sector and manufacturing industries are not materially impacted by weaker tourism and education exports. Real GDP is only marginally lower ($0.2 billion) than baseline in March year 2021

GDP falls by between $1.1 billion and $1.5 billion below baseline in March year 2022 as weaker tourism and education exports drag real export growth between 1.4% and 2.0% below baseline.

FIGURE 1 GDP IMPACTS ACROSS SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

These relatively small short-term negative impacts accumulate over time as ongoing weak investment causes the rate of accumulation in the productive capital stock to fall relative to control and population growth moderates due to lower-than-baseline immigration and temporary work visa arrivals.

Both effects **reduce the productive capacity of the economy**, but the period of reduced capital stock accumulation causes a persistent and perhaps permanent loss to economic output on a year-on-year basis.

By March year 2024, the accumulated real GDP impact is $4.0 billion to $5.9 billion below baseline.

Covid resurgence delivers a short and sharp supply-side jolt, felt widely across industries

As Alert Levels rise in response to community transmission, almost all industries send workers home. **Production decreases are widespread, albeit small** at the industry level compared to the impacts on tourism and education in the border settings scenarios.

The breadth of production losses in the resurgence scenarios results in a more significant short-term negative impact on GDP than in the border restrictions scenarios: real GDP falls by $1.3 billion (short outbreak) to $3.6 billion (PREFU outbreak, no wage subsidy) below baseline in March year 2021.

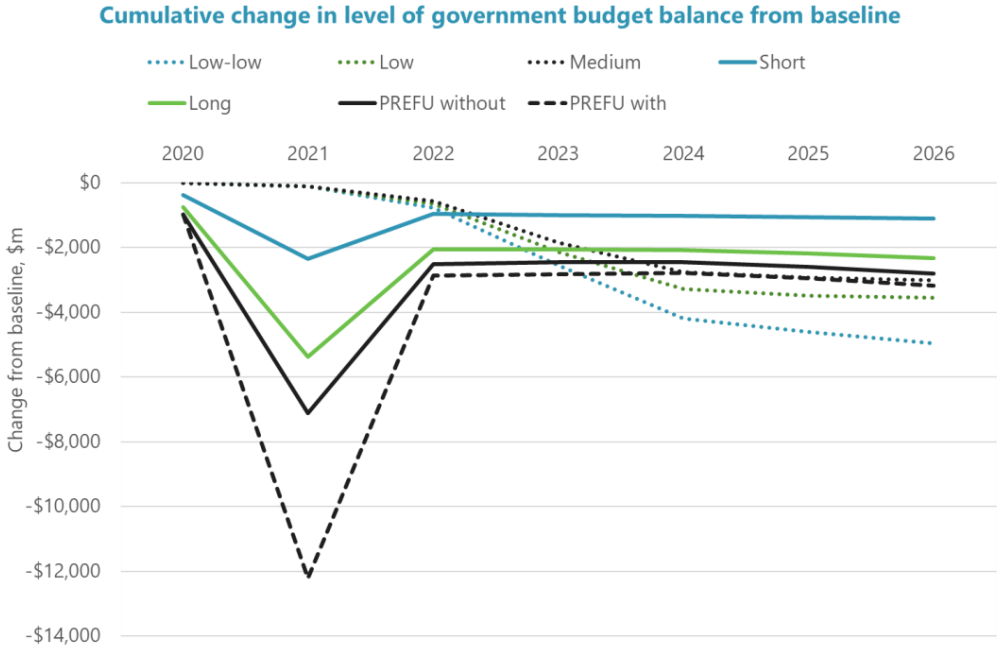
When an additional wage subsidy is included in the PREFU outbreak scenario, the GDP costs are moderated somewhat, with GDP falling $2.8 billion below baseline in March year 2021.

As soon as Auckland and the rest of New Zealand move back down to the Alert Level 1 assumed in the PREFU baseline, **activity rebounds closer to baseline relatively quickly**.

Yet even in these temporary production disruption scenarios, the economy does not fully recover by 2026. This is due to the impacts of lost production and revenue on industries' profits, which suppresses their investment intentions. This leads to a smaller capital stock: because capital is accumulated, years in which investment is suppressed can lead to persistent or even permanent losses in the size of the capital stock thereafter that have long-term consequences.

Tax revenue declines as the economy contracts below baseline, worsening the fiscal balance

FIGURE 2 IMPACTS OF ALL SCENARIOS ON GOVERNMENT BUDGET BALANCE



SOURCE: MDG5-NZ MODELLING ESTIMATES

Government responses to these scenarios would be made more challenging by **a drop in tax revenue that puts further dents in the fiscal balance** (Figure 2).

Total tax revenue drops by between $1.1 billion and $1.9 billion below the PREFU baseline in March year 2024 in the outbreak scenarios; and by between $3.1 billion and $4.8 billion in the border settings scenarios.

The impacts of the $5 billion wage subsidy in the 'PREFU with' outbreak scenario can be seen clearly in Figure 2. Our modelling framework allows for the accumulation of additional government debt over time, so the immediate fiscal envelope may not be overly constrained beyond additional interest payments. That is, the full cost of taking on additional debt is not captured within the relatively short projection period of this modelling.

Scenario design in our model allows for a wide range of fiscal response assumptions to be imposed and contrasted.

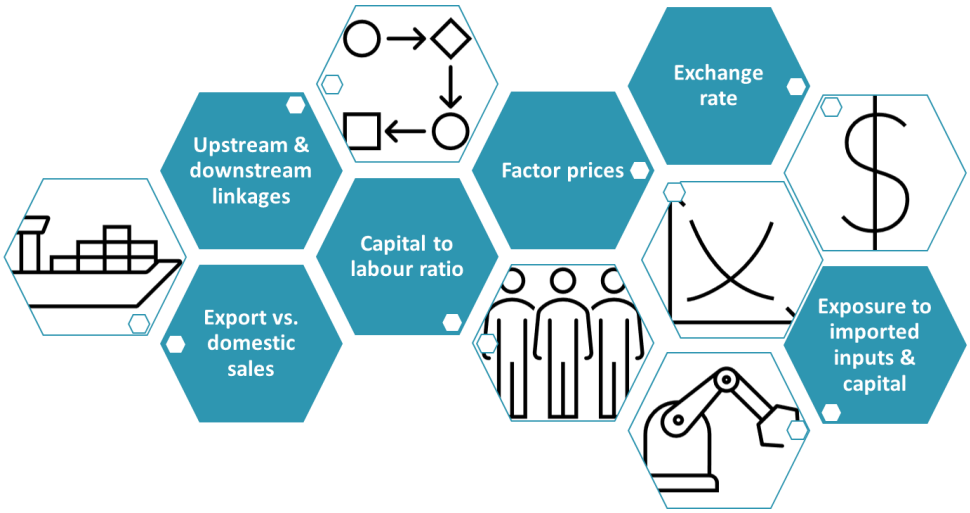
Industry impacts differ significantly between the two sets of scenarios

The MDG5-NZ model captures the interlinkages between 106 industries producing 201 commodities and generates detailed results for each of them in every year. Additional industries and commodities can be included as required for specific projects (the US version of the model has over 500 industries, for example).

Modelling output includes industry value-added, various types of productivity metrics, domestic sales, exports, investment, employment split into eight occupations, various views of labour costs, etc. This provides considerable granularity when assessing the industry impacts of scenarios.

Industry impacts are driven by a wide range of factors in a CGE modelling framework. In essence **industries respond to multiple relative price shifts, often acting in opposite directions** at the same time. By identifying each industry's production, cost and sales structures, including links to other industries, these impacts can be readily explained using conventional economic logic.

FIGURE 3 KEY DRIVERS OF INDUSTRY IMPACTS



SOURCE: SENSE PARTNERS

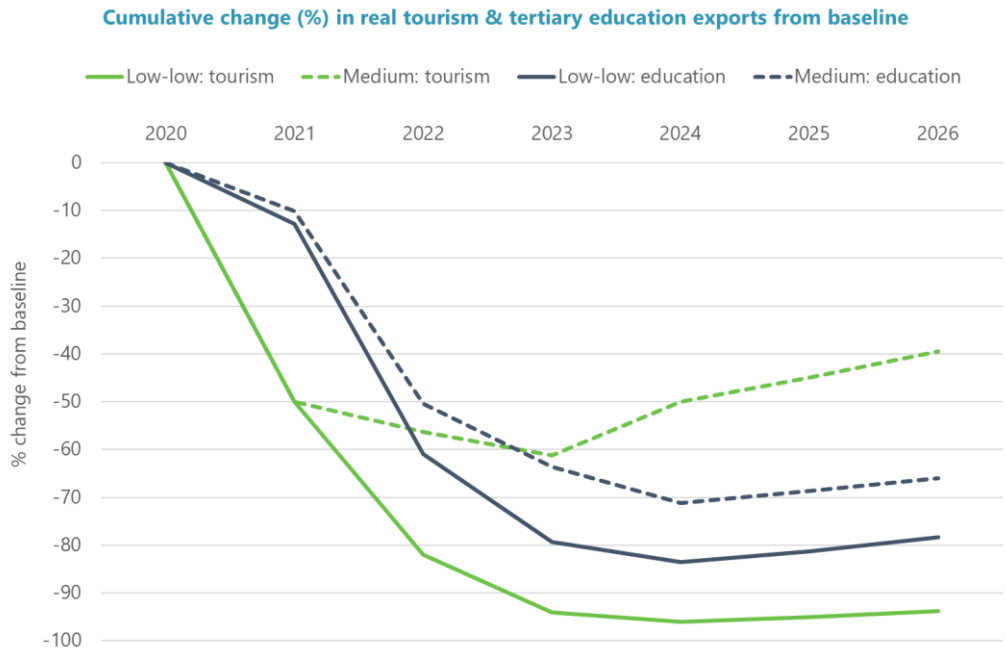
Tighter than expected border settings would decimate the tourism and education export industries…

The PREFU forecasts we used to calibrate the model baseline included an assumption that New Zealand's borders would be open from late 2021 (since pushed back to early 2022).

As Figure 4 shows, if borders do not open this rapidly and inbound travel is limited by MiQ capacity, New Zealand's tourism and tertiary education exports could drop by up to 82% and 31% respectively below baseline in March year 2022.

These export impacts worsen to an accumulated 96% (tourism) and 84% (education) below the PREFU baseline by March year 2024.

FIGURE 4 IMPACTS OF TIGHTER BORDER SETTINGS ON TOURISM & TERTIARY EDUCATION EXPORTS



SOURCE: MDG5-NZ MODELLING ESTIMATES

For many private sector industries, **the longer the period of depressed activity, the more difficult and costly is the recovery**, due to factors like the deterioration of infrastructure, loss of skilled workers to other sectors, or loss of market share to competitors.

…but effects on the wider economy are relatively muted

Outside of tourism and education, **most industries are largely unaffected from tougher border settings**, relative to the PREFU baseline (see the blue bars in Figure 5 overleaf).

Indeed, some industries *benefit* from tighter border settings. Capital-intensive, export-driven industries (outside of tourism and education) gain from a large drop in capital rental prices (relative to the prices of other factors of production) and the real exchange rate depreciation generated by the loss in tourism and education export revenue and the deflationary impact of suppressed economic activity on factor prices and domestic industry costs.

Examples of such industries include forestry and logging, seafood processing, primary metal product manufacturing, paper product and wood product manufacturing, clothing and footwear manufacturing.

Covid resurgence has broad industry impacts initially…

The red bars in Figure 5 overleaf show the change in industry value-added from baseline in March years 2022 and 2024 for the long outbreak scenario.[1]

In this scenario, almost all industries experience an immediate loss in production and revenue as employees are unable to come to work.

These impacts are small in percentage change terms on an annual basis, but **their collective short-term cost is far greater than in the border settings scenarios**.

…but labour-intensive and export industries will recover faster

As the resurgence eases, industries respond to lower labour costs relative to capital rental prices. The latter do not change much in these resurgence scenarios[2] because implicit, temporary labour-saving technological change is used to accommodate the temporary shocks. Industries work their existing capital stocks harder during lockdowns to ameliorate capacity constraints when workers are at home.

Hence in the resurgence scenarios, **relative factor price shifts move in favour of labour- and land-intensive industries, allowing them to recover faster**.

The **real exchange rate depreciates** as New Zealand's factor costs fall relative to those overseas. The value of the currency against foreign currency comes under further pressure as import demand drops in line with lower household spending. Offsetting this somewhat, nominal and real depreciation supports the recovery of export-focused industries not directly impacted by the pandemic shocks.

The most negatively affected industries are those reliant on foot traffic (e.g. retail, wholesale), those that import a lot of intermediate inputs (e.g. petroleum and coal manufacturing), and those that rely heavily on household spending and export tourism (e.g. sport and recreation services, travel and tour services).

The strongest performing industries – in relative terms – tend to be land-intensive (e.g. horticulture and fruit growing), produce for export (e.g. coal mining) or government services (e.g. schools and hospitals, as they do not immediately respond to swings in aggregate demand for obvious reasons).

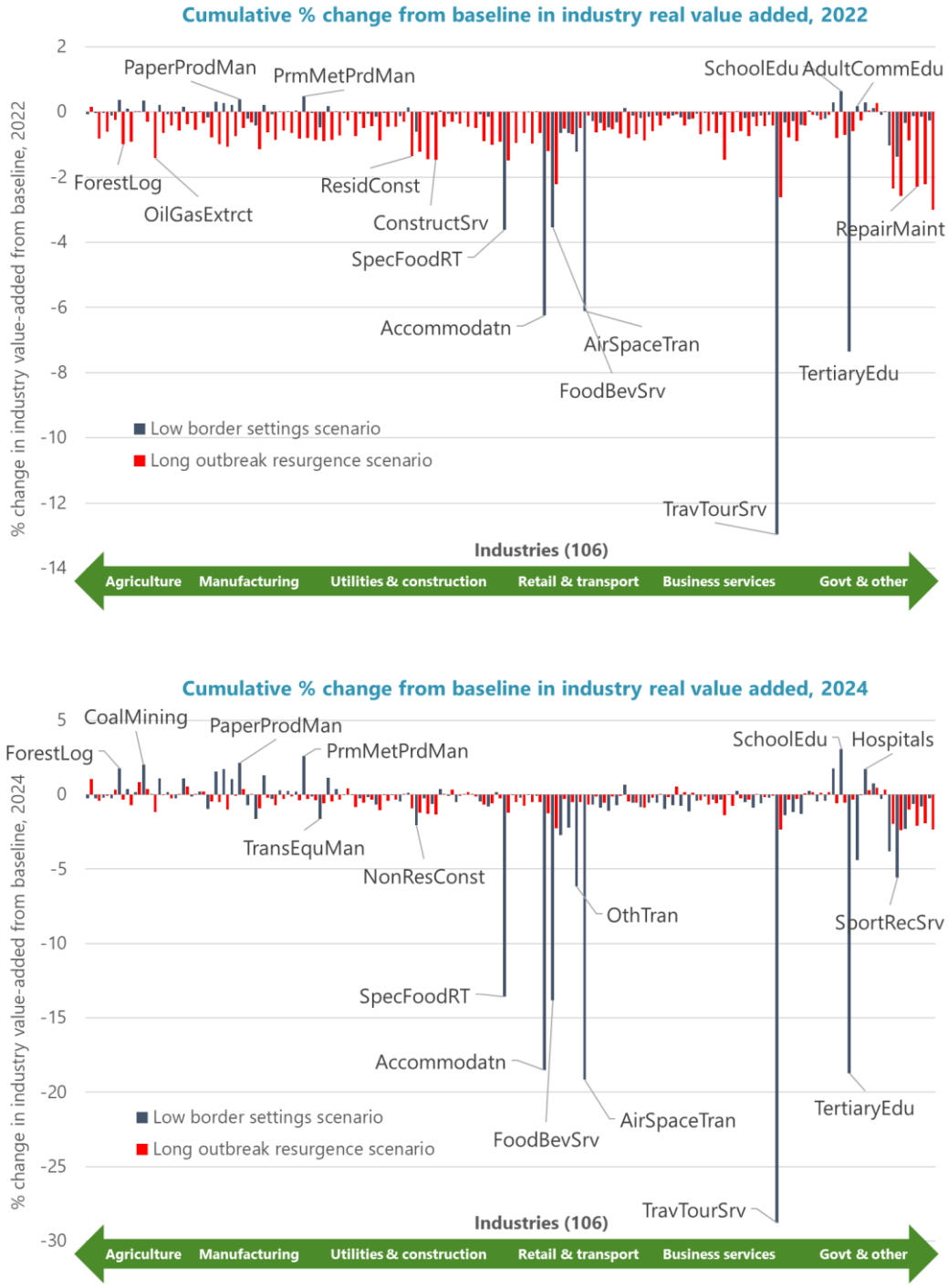
In the PREFU resurgence scenario which includes an additional fiscal response (not in chart), most non-tradable industries recover slightly faster as households spend some of the wage subsidy

[1] In this scenario Auckland's population operates at AL3 for 6 weeks, then AL2 for 2 weeks, before returning to AL1. The rest of New Zealand operates at AL2 for 6 weeks before returning to AL1. No additional fiscal response is considered.

[2] The exception is in the PREFU outbreak with a fiscal stimulus, which sees the price of capital rise sharply in March year 2021 before moving back to the baseline. The real exchange rate also temporarily rises in this scenario.

domestically. However, the appreciation of the real exchange rate associated with the additional fiscal stimulus leans against primary sector exporters' competitiveness.

FIGURE 5 INDUSTRY IMPACTS OVER TIME: MARCH YEARS 2022 AND 2024



SOURCE: MDG5-NZ MODELLING ESTIMATES

Potential implications of our analysis

The difference in industry impacts between the border settings and resurgence scenarios may have implications for the nature of policy responses.

When border settings are more restrictive, capital-intensive exporters far relatively well, suggesting they may need less ongoing support. In contrast, the resurgence scenarios see labour- or land-intensive industries recover faster.

This could inform policy thinking around the balance between broad-brush policies such as a wage subsidy and more targeted industry support when considering the prospect of an extended period of tight border restrictions.

In both scenarios, a key driver of GDP losses is a reduction in investment. To avoid secular stagnation (a sustained confluence of weak investment demand and abundant aggregate savings), incentivising firms to *not* put capital expansion plans on ice in the face of a weaker economic outlook would therefore seem to be a sensible avenue to explore.

For example, the role of accommodative monetary policy (e.g. negative interest rates) and fiscal policy (e.g. accelerated depreciation) in encouraging investment could be an avenue for future research.

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1. Purpose and scope

We use a dynamic CGE model to consider the economic impacts of several hypothetical Covid-related scenarios

The New Zealand Treasury has engaged Sense Partners and MacroDynGroup (MDG) to explore the macroeconomic and industry-level impacts of scenarios that consider:

- Different Covid-related border policy settings
- Illustrative second wave Covid resurgence outbreaks.

We use an advanced dynamic computable general equilibrium (CGE) model of the New Zealand economy – MDG5-NZ – to show these impacts out to 2026. The model provides detailed results for 106 industries and 201 commodities, as well as standard macroeconomic measures.

The model's database is calibrated to reflect The Treasury's initial Pre-Election Fiscal and Economic Update (PREFU) forecasts to 2024 and projected to 2026 in part by using external macroeconomic projections taken from official sources. All scenario results are compared against this baseline.

Our focus is on economic impacts rather than health effects

This modelling exercise does not purport to be a cost-benefit analysis of alternative scenarios. We do not, for example, explore the economic value of lost lives or quality adjusted life years.

Our scope and resourcing were limited to identifying the economywide and industry-level implications of different border policy settings and potential outbreak scenarios.

We explore 'what if?' scenarios to inform The Treasury's thinking

The hypothetical scenarios modelled do not reflect Government policy or The Treasury's view on border policy settings or the appropriate Alert Levels for second wave Covid outbreaks.

The scenarios were designed by the Treasury to inform internal discussions and policy advice around the distributional impacts of Covid-related changes to the New Zealand economy. They are not forecasts of what *will* happen, as for economic and social shocks of the type under examination there is too much uncertainty around the path of key autonomous factors (including policy responses) to enable formal forecasting.

Rather they explore a range of possible scenarios of what *could* happen under different assumptions for the path of specific alternative policy responses, highlighting the implications of certain changes to the economy, under certain assumptions about the way economic agents respond to relative price shocks, implicit structural change, and other response factors.

In most scenarios, fiscal policy does not play a significant role

In all but one scenario, there is no additional fiscal response to either border settings being restricted for longer than expected or a resurgence of Covid-19. This approach was taken to allow a simpler examination of the macroeconomic and industry impacts of such negative shocks.

In reality, additional fiscal injections would act as a stabiliser, which would result in moderated short-term impacts, funded by additional borrowing. In effect, the use of debt for anti-cyclical policy intervention amounts to an intertemporal adjustment to aggregate demand, and (as all financial asset transaction do) breaking the nexus between consumption and income. This essentially brings forward future output and income to be consumed today.

As that future income will have already been consumed when the output is produced, the increase in government debt would have a dampening effect on longer-term economic growth, especially as tax increases take effect or other fiscal spending is trimmed to start reducing debt. These impacts would be outside of the timeframe (2026) of our current exercise but could easily be explored by running the dynamic model out to 2040 or 2050.

All assumptions can easily be adjusted to conduct sensitivity analysis or to examine different views on how agents respond to economic shocks.

Our CGE modelling delivers detailed industry-level results that are not available elsewhere within government, and highlights trade-offs within a consistent economic framework

A key strength of CGE modelling is that it takes into account limited resources such as land, labour and capital and can identify how these resources move between industries following economic 'shocks' that change their relative prices.

So, for example, a wage subsidy that reduces the effective real wage for producers will tend to result in greater employment in the short to medium term than would otherwise have occurred, and will tend to benefit labour-intensive industries compared to capital-intensive industries. In the longer run, subsidies must be paid for, and the implied need for higher fiscal revenues or adjustment in spending priorities that may result will tend to offset short- to medium-term gains to some degree. A CGE model can trace all these effects.

These resource shifts occur in an internally consistent, interdependent economic system that captures all linkages between industries, government, investors and domestic and international buyers, both in the current year and over time.

There are no free lunches in a CGE framework. Changes in one part of the economy percolate through the wider economy as economic agents respond to relative price changes, in part driven by an underlying tendency for a new equilibrium to be reached where markets clear, sometimes with lags, and by the constraints of macroeconomic and sectoral accounting realities. A "tendency toward equilibrium" is just another way of saying that economies tend to reallocate resources to more valued uses as factors like economic structure, international conditions, and technological progress foment changes in the economic system and the environment in which it operates.

Our CGE modelling framework captures the trade-offs inherent in changing policy in a world of limited resources, which necessarily sees some parts of the economy do relatively better than others, compared to the baseline. It does so in a way that is theoretically and empirically internally consistent, and which allows all results to be explained in a cohesive narrative.

2. Overview of MDG5-NZ methodology

2.1. Introducing MDG5-NZ

We use an advanced dynamic CGE model of the New Zealand economy for this project. Titled MDG5-NZ, it was been built for Sense Partners in late 2019 by Dr. Ashley Winston of MacroDyn Group (MDG) LLC, based in Washington DC.

The New Zealand CGE modelling suite is built on the foundation of MDG's path breaking and proven MDG5 model. MDG5 incorporates a wide range of policy modelling innovations created for high-profile projects conducted by MDG's team in a range of countries over the last 25 years.

Versions of the MDG5 modelling framework continue to be used by governments in several countries, and applications have informed key policy reform and other economic matters in many dozens of countries in addition.

MDG5-NZ has a lineage that traces back to the MONASH dynamic CGE model developed by the Centre of Policy Studies, then at Monash University, now at Victoria University, Melbourne.[3] Dr. Winston implemented several improvements to the MONASH model as a PhD student under the tutelage of Professor Peter Dixon in the late 1990s/early 2000s.

Dr. Winston continued developing dynamic CGE models throughout the next two decades, including the USAGE model of the US economy[4] and the FLAGSHIP[5] suite of models for over 20 countries, before building and continually extending the proprietary MDG suite of models from 2015.

MGD5-NZ is built and run in the GEMPACK software suite.[6] Technical documentation is under development, and a draft is available from the authors on request.

2.2. What is a CGE model?

CGE models are commonly used tools for policy analysis. Such models typically consist of:

1. A **database** that represents an economy in a certain year based on input-output (IO) tables. The database specifies the interactions and relationships between various economic agents including firms, workers, households, the government and overseas markets.

[3] See https://www.copsmodels.com/monmod.htm. Full documentation is in Dixon and Rimmer (2002b).

[4] See https://www.copsmodels.com/usage.htm. Dixon and Rimmer (2002a) has the technical documentation.

[5] See KMPG (2015).

[6] See Horridge J.M., Jerie M., Mustakinov D. & Schiffmann F. 2018. 'GEMPACK manual'. GEMPACK Software, ISBN 978-1-921654-34-3. https://www.copsmodels.com/gpmanual.htm

2. Behavioural **parameters** governing agents' responses to relative price changes (e.g. elasticities).[7]

3. A **system of equations** that define the model specification or theory, which is generally based on fairly standard economic assumptions[8], but not necessarily constrained by them (for example, in the always-and-everywhere attainment of equilibrium after shocks are imposed).

From an initial equilibrium where demand equals supply in all factor, final demand and intermediate input markets,[9] the system is then 'shocked' by changing one or more variables that represent a policy change or other change in economic conditions. By comparing the pre- and post-shock databases, we can then observe the effects of the shock in question in terms of changes to GDP, employment, wages, industry output, etc.

2.3. Bringing dynamics into the picture

Static CGE models consider only 'before' and 'after' the policy shock. There is no ability to consider the nature of the adjustment path between equilibria.

A dynamic CGE model allows the user to examine in each intervening period (usually each year) how variables adjust from the time when a shock is implemented to the time when all of its effects have worked through the economy (which may be a number of years).

MDG5-NZ contains four key **dynamic mechanisms** that link successive years:

1. The deviation in the real wage rate away from its forecast path in year *t* caused by a policy shock equals the deviation in year *t-1* plus a term reflecting the gap in year *t* between the employment deviation and the deviation in labour supply. That is, real wages deviate from the baseline based on the gap between the changes in the labour supply and employment caused by a policy shock.

   Real wages are sticky in the short term, meaning labour market impacts are felt more through changes in employment. Further out in the projection period, employment

[7] We rely on published studies for elasticity estimates to calibrate MDG5-NZ. Elasticities are set at values widely understood to be valid in the modelling community and can be replaced by country- or industry-specific estimates where available for specific projects.

[8] These include, for example, consumers maximise their utility subject to their budget constraints; firms maximise their profits by buying intermediate goods and inputs (labour and capital) and selling outputs to other domestic and international firms, households and government; there is a market for each commodity (goods and intermediates) and in equilibrium market prices are such that demand equals supply in all input and output markets; and under the standard assumption of constant returns to scale firms, earn zero pure profit.

Alternative theoretical specifications can be incorporated where the project dictates it.

[9] This is true in both a theoretical and real-world sense. For example, goods market clear because the macroeconomic accounting used in these models accommodates inventory accumulation (or decumulation), and labour markets allow for structural unemployment and other factors that allow something like a NAIRU to act as the market-clearing condition.

gradually returns to the baseline, meaning impacts are more commonly seen through real wage changes.

2. Capital at the start of year *t* equals capital at the end of year *t-1*.

   Capital stock in an industry at the end of year *t* equals the capital stock at the start of year *t,* depreciated at a given rate, plus investment in year *t* for that industry.

   Investment in year *t* for an industry is a function of the expected rate of return (i.e. gross operating surplus) in that industry. The expected rate of return is a function of the rental and asset prices of that industry's capital in year *t*, depreciation, taxes on capital, and expected changes in those variables.[10]

3. Net foreign liabilities at the start of year *t* equal net foreign liabilities at the end of year *t-1*. Net foreign liabilities at the end of year *t* equal net foreign liabilities at the start of year *t* plus the current account deficit for year *t*.

   The current account deficit for year *t* is imports less exports plus interest payments for foreign liabilities less exports of royalties, and less net transfers from foreigners to New Zealand residents.

4. Public sector debt at the start of year *t* equals public sector debt at the end of year *t-1*.

   Public sector debt at the end of year *t* equals public sector debt at the start of year *t* plus the public sector deficit for year *t*.

The MDG5-NZ model is generally solved in recursive dynamic mode, as this has clear advantages in terms of (for example) realistic behavioural responses that can include errors in expectations. We can also conduct comparative static analyses of both short- and long-run timeframes, along with (much less frequently) forward-looking or 'rational expectations' dynamic simulations that capture anticipation effects (but that impose arguably unrealistic 'clarity of foresight' assumptions on simulation output).

2.4. Baseline development

In a dynamic CGE modelling exercise, the impacts over time of policy changes are deviations relative to a baseline scenario that represents a set of business-as-usual projections.

[10] A novel feature of MDG5-NZ is the inclusion of "slack capital" capabilities for dynamic projections using nested complementarity relationships. This allows for endogenously determined proportions of productive capital stocks and other "fixed" factors (like land and other natural endowments) to become idle at low rates of return during periods of falling demand. Along with the labour market treatment described above, the modelling suite is capable of more realistic dynamic simulations through the business cycle, tempering a standard dynamic CGE tendency to create unrealistically fast recoveries from downturns in response to low primary factor prices.

The baseline scenario here mirrors The Treasury's macroeconomic forecasts prepared for the original PREFU date of 20 August 2020. They assume all of New Zealand remains at Alert Level 1.[11]

Our projections of the New Zealand economy and the 106 industries in the database forward to 2024 are based on:

- The sales and use structure of the New Zealand economy in 2013[12]
- Historical patterns of labour, capital and multifactor productivity[13]
- Macroeconomic aggregates forecast by The Treasury
- Projections of the accumulation of factors of production (land, labour, capital).

For March years 2025 and 2026 we let the economy in the model start to return to its long run growth path. This long run path is driven by structural macroeconomic growth factors, mainly labour supply growth (driven by population and demographic change), year-to-year changes in multifactor productivity, and capital accumulation consistent with a set of investment/saving relationship assumptions that rule out infinitely-expanding net foreign liability accumulation.

We apply a database updating procedure to bring the database forward to the latest data year, in this case March 2020. Actual historical data for a variety of variables including various macroeconomic aggregates, employment growth and other sector-specific data, and productivity trends are imposed exogenously on the projection from 2013 to bring the 2013 IO table up to date in an internally consistent and robust fashion.

The aim is to pass the model through the most recent data year as it projects into the future. This is made possible by the dense array of structural variables (including productivity changes, preference shifts, and so on) and the flexible closure capabilities of the model.

2.5. Model closure

The closure of a CGE model refers to the elements that we tell the model about (**exogenous variables**) and those which we want the model to tell us about (**endogenous variables**). In MDG5-NZ the closure is extremely flexible, allowing us to incorporate a wide variety of inputs into simulations depending on the availability of data in a particular country, often including expert speciality forecasts from official or other expert sources.

In MDG5-NZ, we can adjust the closure assumptions from year to year, depending on the policy simulations we are considering.

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[11] These forecasts were subsequently revised following the Covid resurgence in Auckland that resulted in the election being delayed, and PREFU being pushed out to 16 September. In future work, we will draw on these revised forecasts to calibrate our baseline. However, given the macroeconomic outlook is not significantly different in the revised projections, and the results are shown as deviations from the PREFU baseline, the narrative in this report would not change considerably.

[12] StatsNZ has not released a full set of input-output (IO) tables since its 2016 publication of the IO tables for 2013.

[13] StatsNZ. 2017. 'Productivity Statistics: 1978–2016'.

The **baseline or 'forecast' closure** is designed to accept as much information from official macroeconomic and reputable speciality forecasters as possible. Baseline simulations can include many hundreds or even thousands of shocks.

When the database is built on data that is several years old (which is often the case), the initial period of the forecast uses actual historical information on macroeconomic variables for most of the expenditure and income sides of GDP, various price indexes, a variety of productivity and preference shift variables, nominal and/or real exchange rates, paths for private/public/national asset and liability stocks, capital stocks, and so on,

For the period 2013 to March 2020, the model is trying to trace actual New Zealand economic history as closely as possible with the aim of passing-through the actual 2020 economy with the right trajectories for key variables macroeconomic aggregates, sectoral and employment, expenditure on goods and services, trade, etc.

The idea of 'trajectory' or 'momentum' is important in dynamic modelling, because, for example, a particular sector's future prospects are in part informed by its historical performance: so, knowing that Sector X has been in historical decline allows the model to make sense of, for example, low capital growth rates, low or negative rates of return, and comparatively poor multifactor productivity growth in assessing a possible path for output and factor demand for that industry.

As the baseline transitions into a forward-looking phase (post-March 2020 for the simulations reported here), the closure is adjusted. For example, for some industries that are subject to atypical economic market structures (agricultural and mining commodity producers, for instance, impacted by such things as seasonal productivity variation driven by weather, longer-term bulk contracts, and keen international competition for relatively homogenous products) we might make use of official commodity supply and price forecasts, accommodating these by allowing, for example, input-saving or output-augmenting technological change to become endogenous.

The baseline is then rerun using the deviation or 'policy' closure. The '**baseline rerun**' simulation re-produces the baseline forecast but with the closure to applied in the derivation experiment. This creates a baseline that has the same closure as the deviation experiment to rule out any computational errors arising from different closures. With the multi-step, extrapolated solution methods available in the GEMPACK software, these errors are normally negligibly small, but the rerun is always generated as a normal part of the simulation process.

The **deviation or 'policy' simulation** is the run that includes the shocks for the economic or policy experiment itself. The number of shocks can vary from a single shock to dozens or hundreds of shocks.

The results are reported as deviations – that is, as the difference between the baseline rerun results and the policy simulation results for each variable. This enables us to report results that capture only the impact of the experimental shocks themselves.

The purpose of comparing them against a formal dynamic baseline forecast is mainly to do with the path dependencies of dynamic system. This means that the nature of the baseline can influence the response of the deviation simulation to the experimental shocks.

The deviation simulation closure looks much more like a 'standard' economic closure. By this we mean that if we were to write down an economic model's equation in a standard theoretical manner, most of the left-hand side variables would be endogenous in the deviation simulation.[14]

Closure choice, across all three simulation types, reflects choices about the economic environment and normally goes beyond a simple assessment of matching exogenous variables with shocks.

For example, in simulations that involve changes to tax revenue (via shocks to rates, changes in tax mix, or major tax reform) an economist is faced with questions about the budget implications of these changes. In MDG5-NZ, a large range of assumptions can be made about how revenue changes are accommodated over time, or not accommodated over time. For example, in simulations in which consumer welfare impacts are important, revenue can be transferred back to households via lump-sum transfers to isolate the efficiency impacts of tax changes, although these closure choices tend to be more constructive and informative if used in comparative static simulations.

In a dynamic simulation, decisions can be made about how the budget accommodates revenue shifts, and the timing of these accommodations. The budget could be allowed to move further into deficit in the short run in response to tax decreases, but then a budget target (which can be an absolute amount or a ratio measured against a macro variable like GNI) can be imposed via expenditure adjustments, tax mix shifts or an increase in another tax (normally a broad based indirect tax like a GST). Various measures of tax efficiency can also be calculated and tracked, including marginal and average excess burdens.

In short, the closure choices reflect the nature of the simulations fundamentally (forecast, rerun, and deviation simulation), but also (and more importantly) allow enormous flexibility for setting the economic environment to address a large range of questions.

Beyond the constraints of the mathematics (which serve only to ensure the maintenance of logic and consistency), the closure choice is limited only by the imagination of the analyst and the nature and scale of the question under examination.

[14] There are some exceptions: for example, if a path has been endogenously generated for a certain productivity metric in the forecast, these results might be used as shocks in the deviation simulation if we believe that the nature of the experiment does not lead to additional productivity change. However, sometimes the deviation experiment does require further accommodation of shocks by productivity shifts, in which case we would leave it endogenous and report the difference between the baseline and deviation experiments.

3. Scenario development

Our modelling consists of two sets of scenarios, compared against the common baseline out to March year 2026 described above.

3.1. Border settings scenarios

Under the baseline, we adopt the initial PREFU's assumption that the border becomes fully open by October 2021, with some small amount of tourism and education exports occurring in the interim.[15]

We consider three alternative representative scenarios related to border settings, as summarised below in Table 1. We focus solely on inbound arrivals.[16]

The **Low-low scenario** represents a worst-case situation where the capacity of New Zealand's Managed in Quarantine (MiQ) facilities provides a binding constraint on the number of people able to enter New Zealand.[17] The Treasury assumes:

- Capacity expands from around 47,000 presently to 87,500 in March 2021, 98,000 by March 2022 and 200,000 for the outyears.
- 70% of this capacity is designated for returning New Zealanders. The remaining 30% is split equally between overseas students, non-New Zealanders migrating here on a Permanent and Long Term (PLT) basis, and temporary work visa holders.
- No international tourists enter New Zealand.

The **Low scenario** introduces an Oceania travel bubble in late 2021, with visitors from Australia and the Pacific Islands not needing to enter MiQ facilities.

- Tourist, student, PLT and temporary work visa numbers from these markets gradually increase towards pre-Covid levels between March years 2022 and March 2024.
- All other assumptions are as per the Low-low scenario.

[15] One can also think of the baseline as the 'High' scenario. We note The Treasury has since pushed back the border opening assumption to 1 January 2022 in its final PREFU projections.

[16] We do not look at the impact of more New Zealanders travelling overseas if border settings relax, either for tourism or permanently. We essentially assume these flows remain constant across the baseline and border settings scenarios. This is clearly unrealistic. But it allows us to focus on isolating the economic impacts associated with the number of people *arriving* in New Zealand. Similarly, we make no assumptions around domestic tourism spending. As such we caution against reading the results as a complete picture of the costs and benefits of travel bubbles. These issues can be explored in future research.

[17] This could be thought of as representative of a hypothetical scenario where a Covid vaccine was not readily available in the next few years, and the pandemic continues to flare up around the world, meaning New Zealand takes a zero risk approach to the border.

The **Medium scenario** expands the travel bubble above to include visitors from South East Asia.[18]

TABLE 1 SUMMARY OF BORDER SETTINGS SCENARIOS FOR INBOUND VISITORS

a = actual; f = forecast; rounded to nearest 1000

March year	2019a	2020a	*2021f*	*2022f*	*2023f*	*2024f*
Baseline scenario (initial PREFU)						
Tourists	3,842,000	3,638,000		*576,000*	*1,729,000*	*2,497,000*
Students	108,000	105,000	*13,000*	*32,000*	*81,000*	*102,000*
Non-NZ-PLT	90,000	88,000	*13,000*	*36,000*	*79,000*	*88,000*
Temporary work visas	221,000	232,000	*13,000*	*98,000*	*194,000*	*216,000*
Medium scenario						
Tourists	3,842,000	3,638,000		*311,000*	*902,000*	*1,274,000*
Students	108,000	105,000	*13,000*	*32,000*	*54,000*	*56,000*
Non-NZ-PLT	90,000	88,000	*13,000*	*36,000*	*58,000*	*61,000*
Temporary work visas	221,000	232,000	*13,000*	*43,000*	*69,000*	*72,000*
Low scenario						
Tourists	3,842,000	3,638,000		*247,000*	*741,000*	*1,071,000*
Students	108,000	105,000	*13,000*	*31,000*	*42,000*	*43,000*
Non-NZ-PLT	90,000	88,000	*13,000*	*35,000*	*51,000*	*52,000*
Temporary work visas	221,000	232,000	*13,000*	*33,000*	*47,000*	*48,000*
Low-low scenario						
Tourists	3,842,000	3,638,000	-	-	-	-
Students	108,000	105,000	*13,000*	*13,000*	*30,000*	*40,000*
Non-NZ-PLT	90,000	88,000	*13,000*	*13,000*	*30,000*	*40,000*
Temporary work visas	221,000	232,000	*13,000*	*13,000*	*30,000*	*40,000*

SOURCE: THE TREASURY

[18] Namely Brunei, Myanmar, Cambodia, Timor-Leste, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand and Vietnam. This group of countries was selected by The Treasury.

3.2. Border settings scenarios shock development

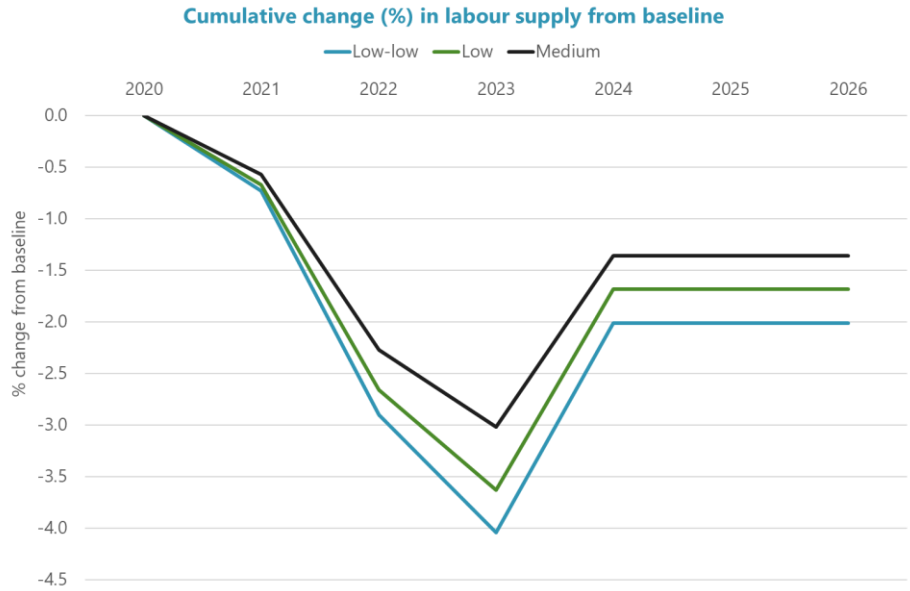
The next stage of the modelling process involved 'translating' the assumptions above into variables that can be exogenously fed into the CGE model.

We did this by:

- Adjusting net immigration and hence population growth to reflect PLT and working visa arrivals. As the size of the labour force is a function of population, amongst other things, more restrictive border settings lead to a smaller New Zealand population and slower labour force growth, relative to the baseline.
- Reducing the demand for tourism[19] and education exports, relative to the baseline. The scale of the export demand shock was estimated by converting tourist and overseas student numbers by source country into export values using per tourist/student spend data.[20]

The supply-side shock can be seen in Figure 6, with the labour supply dropping by between 2.3% and 2.9% below the PREFU baseline in March year 2022 and 3.0% to 4.0% in March year 2023. The labour supply then stabilises at around 1.4% to 2.0% below baseline for the outer years.

FIGURE 6 CHANGE IN LABOUR SUPPLY DUE TO MORE RESTRICTIVE BORDER SETTINGS



SOURCE: TREASURY, MDG5-NZ MODELLING ESTIMATES

[19] Since there is no single 'tourism' industry in the New Zealand IO tables, we construct a tourism commodity bundle based on the Tourism Satellite Accounts.

[20] Tourism spending data is taken from the International Visitor Survey. Education spending is taken from the Tourism Satellite Accounts 2019.

The initial demand-side impacts can be seen in Figure 7, which shows the cumulative change from PREFU in real tourism and tertiary education exports. The exports of both commodities drop sharply below baseline when border policy settings are more restrictive.

FIGURE 7 CHANGE IN TOURISM AND EDUCATION EXPORTS DUE TO MORE RESTRICTIVE BORDER SETTINGS

SOURCE: MDG5-NZ MODELLING ESTIMATES

3.3. Covid resurgence scenarios

We consider three second wave Covid resurgence[21] scenarios. All are assumed to take place in March year 2021.

The short and long outbreak scenarios were designed shortly *before* the 12 August 2020 increase in Alert Levels (ALs) and are nominally focused on outbreaks in Auckland. The national outbreak scenario replicates one contained in the final PREFU report as an alternative to its core forecasts (Treasury, 2020, p.33).

The **short outbreak** scenario assumes:

- Auckland's population operates at AL3 for 2 weeks, then AL2 for 2 weeks, before returning to baseline conditions (AL1)
- The rest of New Zealand operates at AL2 for 2 weeks before returning to baseline.

The **long outbreak** scenario assumes:

- Auckland's population operates at AL3 for 6 weeks, then AL2 for 2 weeks, before returning to AL1.
- The rest of New Zealand operates at AL2 for 6 weeks before returning to AL1.

The **PREFU outbreak** scenario assumes the whole country experiences 3 weeks at AL3 then 6 weeks at AL2.

TABLE 2 SUMMARY OF WEEKS BY ALERT LEVEL FOR RESURGENCE SCENARIOS

	Auckland				Rest of New Zealand			
Weeks	**Baseline**	**Short**	**Long**	**PREFU**	**Baseline**	**Short**	**Long**	**PREFU**
AL0	0	0	0	0	0	0	0	0
AL1	42	38	34	33	42	40	36	33
AL2	4	6	6	10	4	6	10	10
AL3	2	4	8	5	2	2	2	5
AL4	4	4	4	4	4	4	4	4
Total	52	52	52	52	52	52	52	52

SOURCE: TREASURY

We do not exogenously impose additional fiscal transfers in these scenarios, in order to focus the results solely on the effects of a return to AL3 and AL2, rather than entangling them with additional government support.

However, we do carry out a sensitivity analysis for the PREFU outbreak scenario that includes an additional $5 billion of fiscal support, designed to proxy a wage subsidy.

[21] We use 'outbreak' and 'resurgence' interchangeably in this report.

3.4. Resurgence scenarios shock development

All modelling was carried out at the national level, as the timing and resourcing for this project did not allow for dynamic projections at the regional level. However, the differential impacts on Auckland and the rest of New Zealand were incorporated in the shock development outlined below.

To translate the increase in ALs into CGE modelling shocks, we followed several steps:

(i) Estimate weekly value-added for New Zealand, Auckland and the rest of New Zealand for each of the 106 industries in the CGE database in the year ended March 2021.

   a. The data for New Zealand economy was taken from our baseline projections.

   b. We determined Auckland's value-added at the 106-industry level using regional employment shares by industry, drawing on previous Sense Partners work for ATEED.

   c. Value-added by industry for the rest of New Zealand was the residual (a – b).

(ii) Estimate weekly loss of production for each industry under each AL, for Auckland and the rest of New Zealand. We drew on Treasury estimates of production losses by broad sector and extrapolated these onto the 106 industries in our database.

(iii) Multiply these weekly losses by the number of weeks at each AL in the scenarios, again done separately for Auckland and the rest of New Zealand.

(iv) Sum these production losses by industry across Auckland and rest of New Zealand to derive a national loss in production for each outbreak scenario.

(v) Determine the percentage change in annual value-added by industry at the national level in the year to March 2021.

We did not impose any post-lockdown spending bounce backs in these scenarios, although this could be easily incorporated in future research.

The direct macroeconomic impacts of the outbreak scenarios are summarised in Table 3 overleaf. The outbreaks reduce March year 2021 industry value-added by $1.4 billion (short), $3.7 billion (long) and $4.7 billion (PREFU).

The outbreak scenario direct impacts in March year 2021, by industry, are in Table 9 of Appendix A.

We translated these production losses by industry impacts into CGE modelling shocks primarily by adjusting labour demand by industry for the year ended March 2021. We then let the model drive the results in the outer years.

In the PREFU scenario with an additional fiscal response, we assume the $5 billion wage subsidy is paid to households by firms. Essentially workers are paid to stay at home, rather than missing out on wages during this period. We recognise this is a considerable simplification, but a more complex treatment was not feasible with the time and resources available for this project.

TABLE 3 SUMMARY OF OUTBREAK SCENARIOS

Sum of industry value-added, $ billions, year to March 2021; totals may not sum due to rounding

Scenario	Baseline	Short outbreak	Long outbreak	PREFU outbreak
Auckland	87	86	84	85
Rest of New Zealand	148	147	147	145
Total	**234**	**233**	**230**	**230**

Percentage change from baseline

Scenario	Baseline	Short outbreak	Long outbreak	PREFU outbreak
Auckland	-	-1.20%	-3.01%	-2.23%
Rest of New Zealand	-	-0.24%	-0.73%	-1.89%
Total	**-**	**-0.60%**	**-1.57%**	**-2.02%**

SOURCE: SENSE PARTNERS CALCULATIONS

3.5. Model closure in scenarios

As explained in section 2.5, the choice of exogenous (what we tell the model) and endogenous (what the model tells us) variables in the model closure reflects in part the nature of the shocks to be modelled and the economic environment in which they are applied. The closure varies with the questions being researched and even over time within the same simulation.

With over 500 variable sets exogenised in our scenarios, we do not list them all here. Rather, we flag some common exogenous variables across the scenarios and highlight those used to impose the shocks in each case.

General approach to model closure choices

Our closure choice mainly reflects the availability of external information and the theoretical requirements of maintaining comparability between baselines and deviation scenarios, as well our belief that some variables should not change *endogenously* as a result of the short-term resurgence of Covid in New Zealand or with changes to border settings.

Where high quality, rigorously sourced/developed information is available to inform the model, it is incorporated into a simulation via exogenising a range of appropriate variables and imposing shocks that capture that information.

An example we often confront is the availability of policy shocks from government sources (for example, intended tax reform options, or legislation that has passed but not yet been implemented) that can be imposed on a baseline or deviation. Another example is that, sometimes, baseline simulations are designed to generate a detailed economy-wide picture consistent with (say) official Treasury macroeconomic forecasts, as was the case in the current project.

The choice of naturally exogenous variables can include, for example, an experimental design decision that, for a small open economy like New Zealand, a change in domestic economic or policy variables will not materially impact on world economic growth international prices.

Another example is the imposition of special treatments, for example, making world oil prices exogenous and driven by external forecasts while freeing-up (i.e. endogenising) a set of variables related to pure profits in the domestic oil sector to accommodate the implicit breakdown of the standard zero pure profits assumption underpinning the derivation of some of the model's behavioural equations.

Recall that setting a variable to be exogenous does not necessarily mean that its *level* is held constant – often its *growth* or *share relative to another variable* (such as GDP) is set exogenously. That is, an exogenous variable can still change in the simulations, but at a rate determined by the modeller.

Closure choices for this project

Population growth, people per household, change in net immigration and change in labour supply are all exogenised. This allows us to adjust net immigration in the border settings scenarios under alternative MiQ and travel bubble assumptions.

Across the policy scenarios, some forms of technical change are exogenous, as we would not expect resurgence or border settings to alter the rate of technical change within the timeframe of the simulations. These technical change variables are technical parameters in the production function and other key elements of producer behaviour in the model. A wide range of other technical change or productivity variables are endogenous and can react (for example) to changes in capital/labour ratios through adjustments to rental/wage rates.

In these simulations, the exception to the technical change parameter closure is in healthcare and education, where we allow technical change to occur in the simulations. This allows these industries to expand when all other industries are constrained by a lower demand for labour, weaker GDP growth and reduced government revenue.

We exogenise world GDP growth, global consumer preferences and world export prices, recognising that these simulations are for a small open economy without market power in most of its traded sectors, and that the shocks are domestic in nature and unlikely to have a material effect on the global economy. This is a standard small country assumption. The industries in which New Zealand has a significant-enough share of global exports (e.g. dairy or kiwifruit) to potentially influence world goods prices – i.e. where it could be said that what happens domestically might influence world prices – are not heavily affected by the policy shocks in these simulations.

We exogenise the *shares* in GDP of real central and local government consumption and investment since these simulations do not incorporate any significant government investment (e.g. in infrastructure) over and above those contained in the PREFU baseline.

More generally, government outlays in consumption and investment categories tend to not be impacted as much by market forces as do their private sector counterparts: governments make longer term strategic decisions about the path of outlays that is often better set exogenously, via ratios linking them to macro aggregates like GDP or GNI, or in absolute real or nominal terms.

We also exogenise government transfers related to social protection activities in the resurgence scenarios to allow us to model a wage subsidy.

For ten industries, we exogenise growth in real investment. This prevents unrealistic volatility in capital growth in parts of the economy where investment tends to be 'sticky', long-lived and not hugely responsive to temporary changes in expected rates of return (e.g. coal mining, non-residential construction. Furthermore, long-lived assets with comparatively low depreciation rates can experience large swings in investment in response to small changes in capital stock growth rates.

In the border settings scenarios, we exogenise growth in the volume of tourism and education exports. These were determined out of model in consultation with the Treasury, based on assumptions on the number of visitors allowed through the border.

In part to accommodate these large export shocks, and in relation to a modelling environment decision to set the most appropriate numeraire for these simulations, we also exogenised the nominal exchange rate.

The real exchange rate on which we report is endogenous: it is the real exchange rate that adjusts and accommodates trade balance of payments responses most directly, including reflecting relative changes in the path of domestic productivity growth.

The nominal exchange rate essentially plays the role of a 'benchmark' price against which changes in other domestic price variables can be compared. Such a numeraire is necessary (and preferable) in the absence of a working theory of endogenous absolute-price-level setting that might come (for example) from an endogenously operating central bank managing the supply of credit and liquidity via a monetary aggregate supply or interest rate policy.

In future work, we would be happy to explore the implications of different closure assumptions.

4. Border settings scenarios: results

4.1. Macroeconomic impacts

As noted above in section 3.1, these scenarios all feature two key drivers:

(i) **Supply-side shock**: a decrease in population and labour force growth relative to the baseline as fewer migrants and temporary work visa holders enter New Zealand. This reduces the productive and consumptive capacity of the economy.

(ii) **Demand-side shock**: a decrease in tourism and education exports relative to the baseline. This materially reduces export revenue and employment in these industries, placing downwards pressure on factor prices (especially labour costs) and the exchange rate.

The hit to tourism and education exports (Figure 7 above) when border settings are more restrictive have material impacts on total exports, as seen in the bottom left panel of Figure 10 below. Total exports drop by 4.4% to 7.3% below the PREFU baseline by 2024.

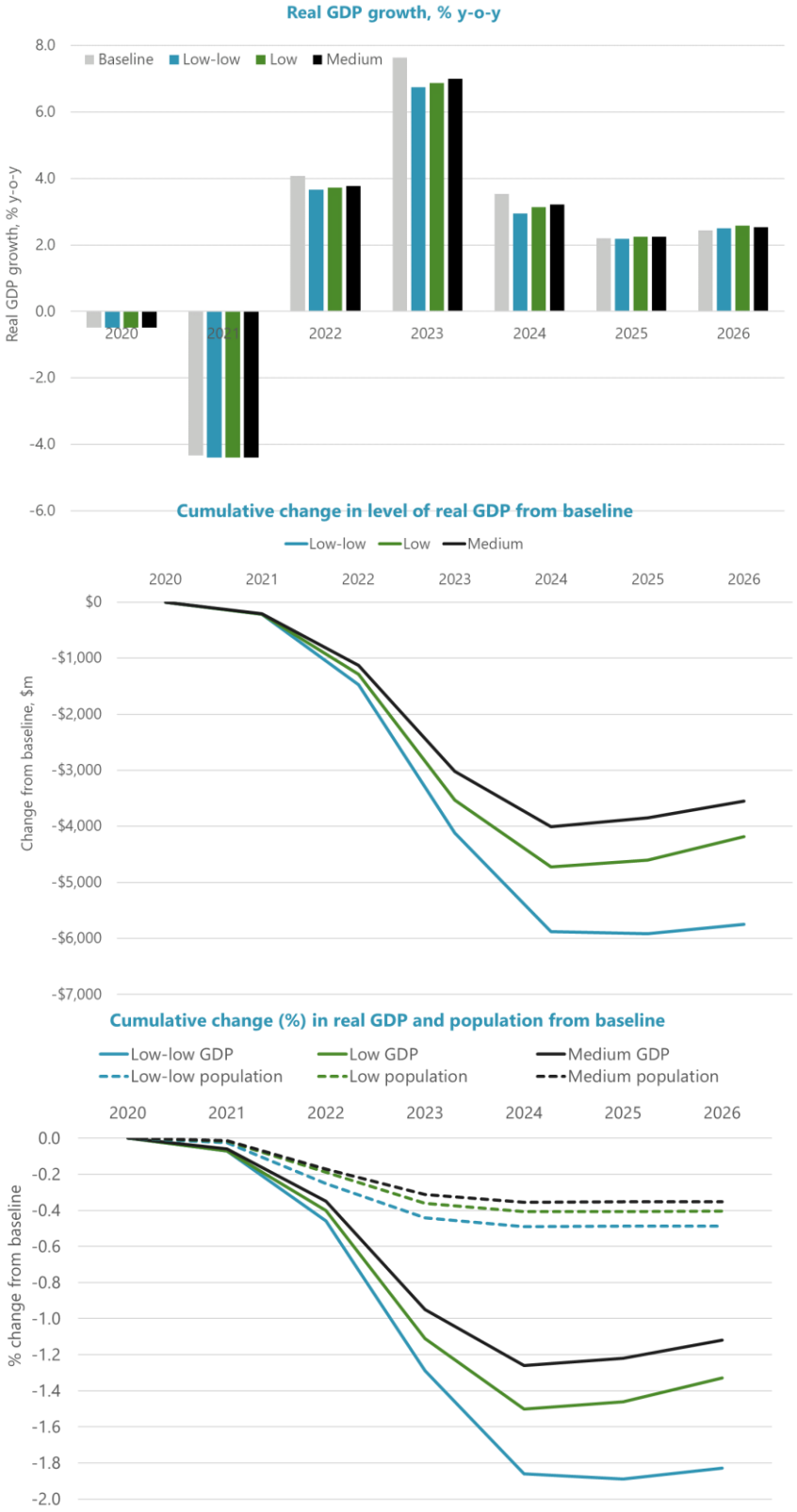
Household spending is dragged down as employment and real wages fall. The number of FTE jobs decreases by 1.7% to 2.7% below baseline by 2024 (or around 36,000 to 59,000 jobs.

As economic activity shrinks relative to the baseline and expected rates of return on capital fall, investment (GFCF in the figure) also gradually declines by 0.8% to 1.2% below baseline by 2024. Lower investment causes the capital stock to decline, relative to the baseline. This permanently reduces the productive potential of the economy. There is no obvious reason why catch-up investment would occur in these scenarios.

The combined effects of a smaller capital stock and constrained labour supply is a cumulative drop in GDP relative to the baseline of $4.0 billion (1.3%) to $5.9 billion (1.9%) by 2024.

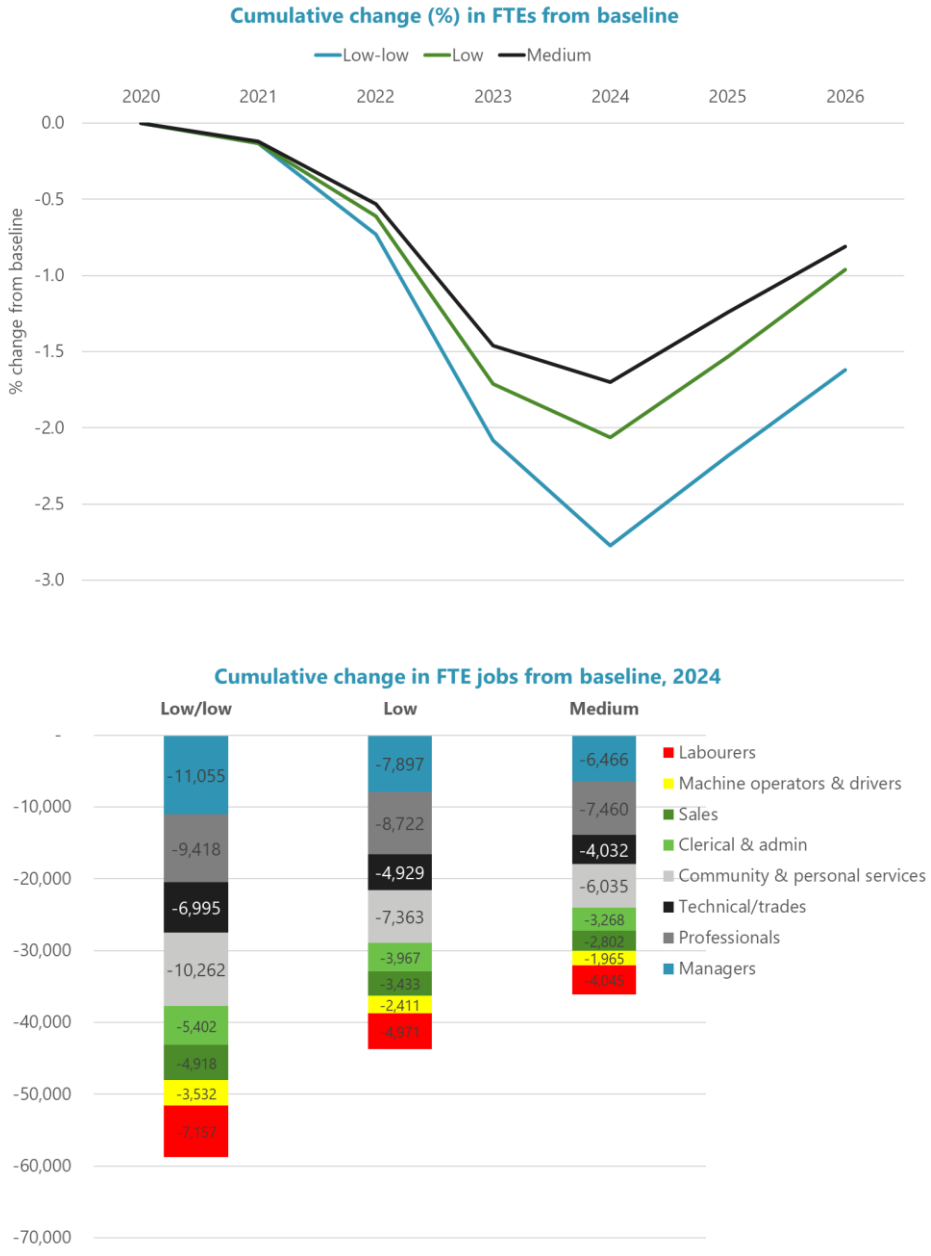
The decreases in GDP are far larger than the declines in population growth, indicating that GDP per capita is also dropping relative to baseline in these scenarios.

FIGURE 8 GDP IMPACTS OF BORDER SETTINGS SCENARIOS



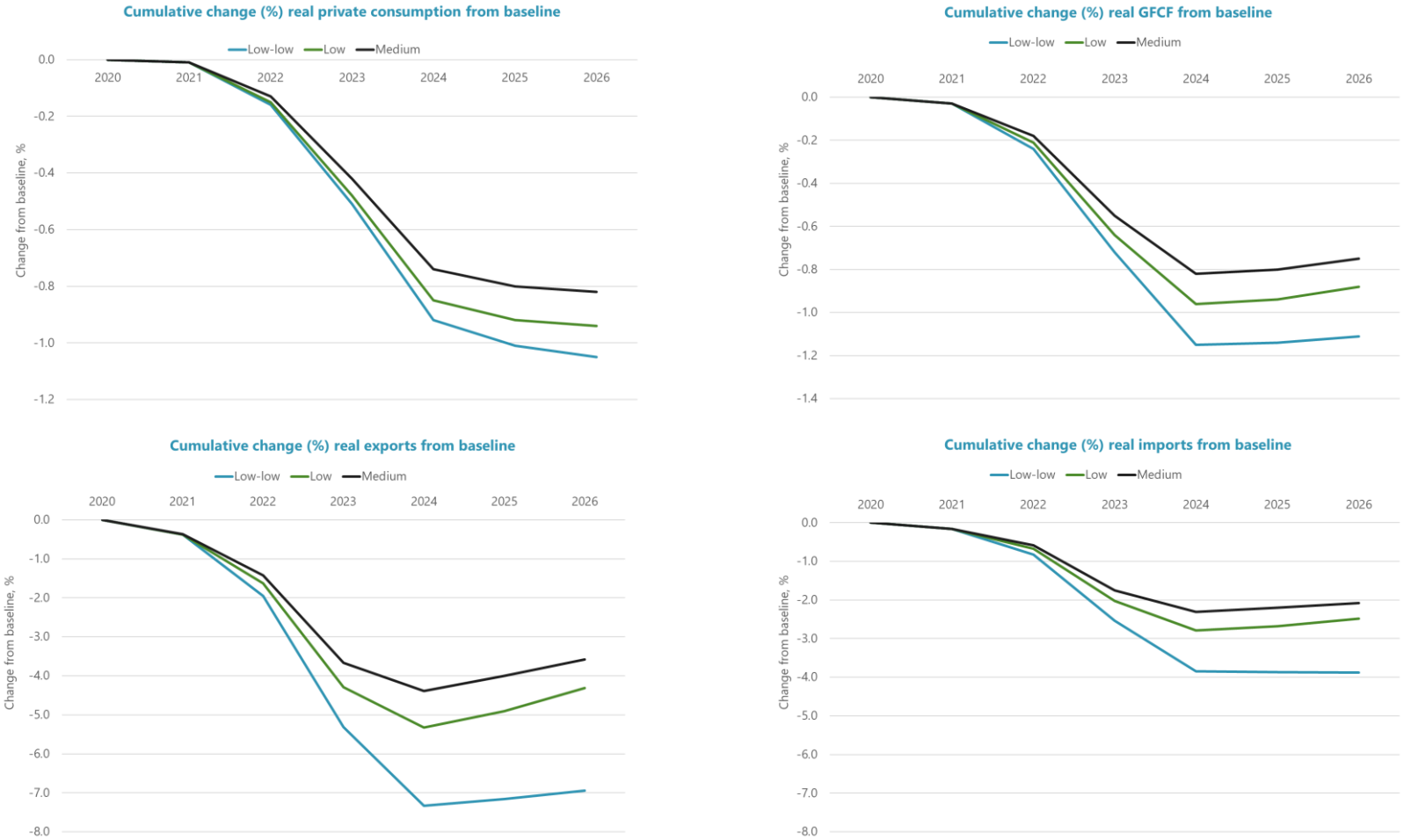
SOURCE: MDG5-NZ MODELLING ESTIMATES

FIGURE 9 EMPLOYMENT IMPACTS OF BORDER SETTING SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

FIGURE 10 COMPONENTS OF EXPENDITURE GDP FOR BORDER SETTINGS SCENARIOS



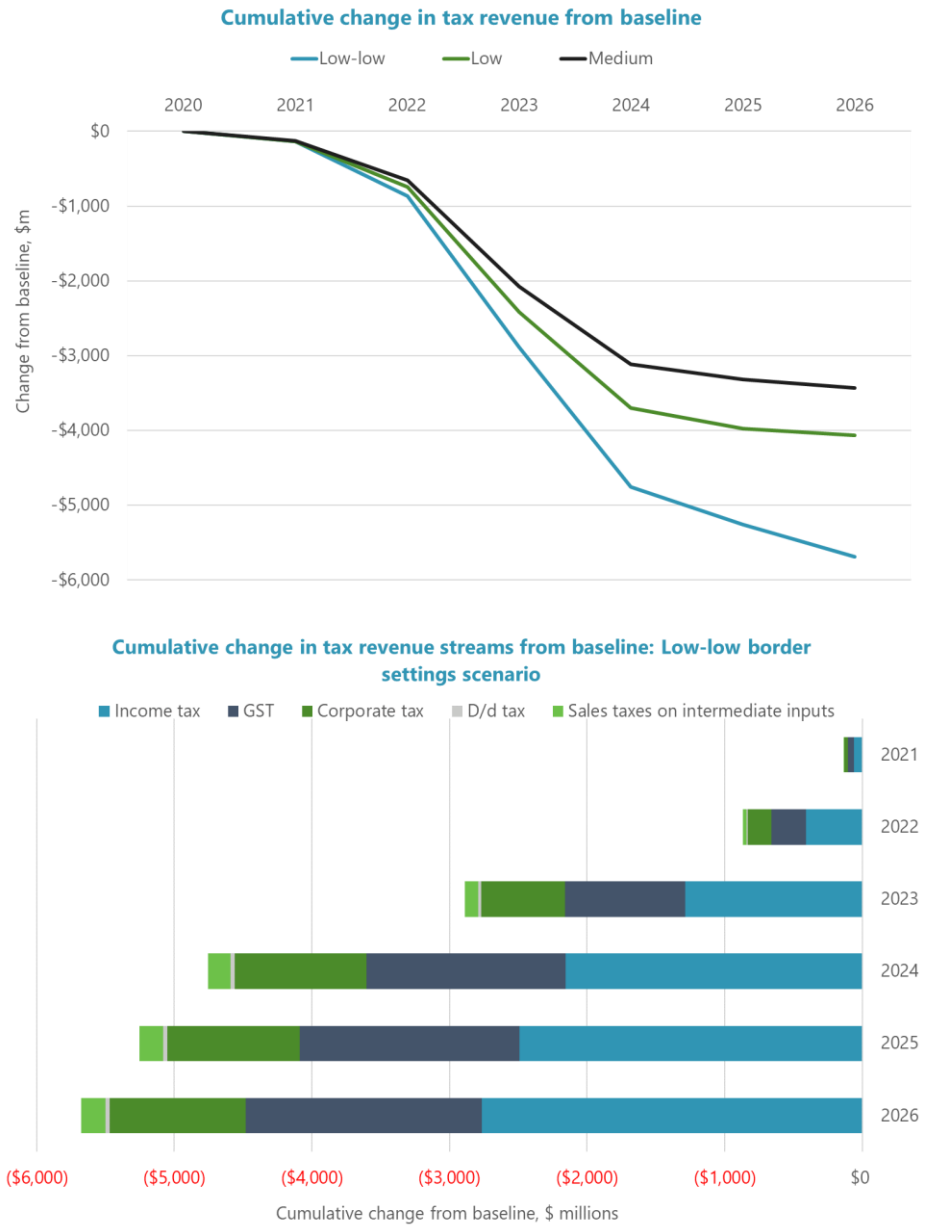
SOURCE: MDG5-NZ MODELLING ESTIMATES

4.2. Fiscal impacts

As employment contracts and household spending declines relative to the baseline, tax revenue also track lower. In total, central government tax revenue drops by $3.1 billion to $4.8 billion below baseline by 2024 (Figure 11).

By 2024, personal income tax revenue is $1.4 billion to $2.2 billion lower than baseline, and GST revenue $0.9 billion to $1.5 billion lower (see bottom panel of Figure 11 for Low-Low scenario). Corporate tax income and capital taxes display similar patterns.

FIGURE 11 CHANGE IN TAX REVENUE IN BORDER SETTINGS SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

4.3. Industry impacts

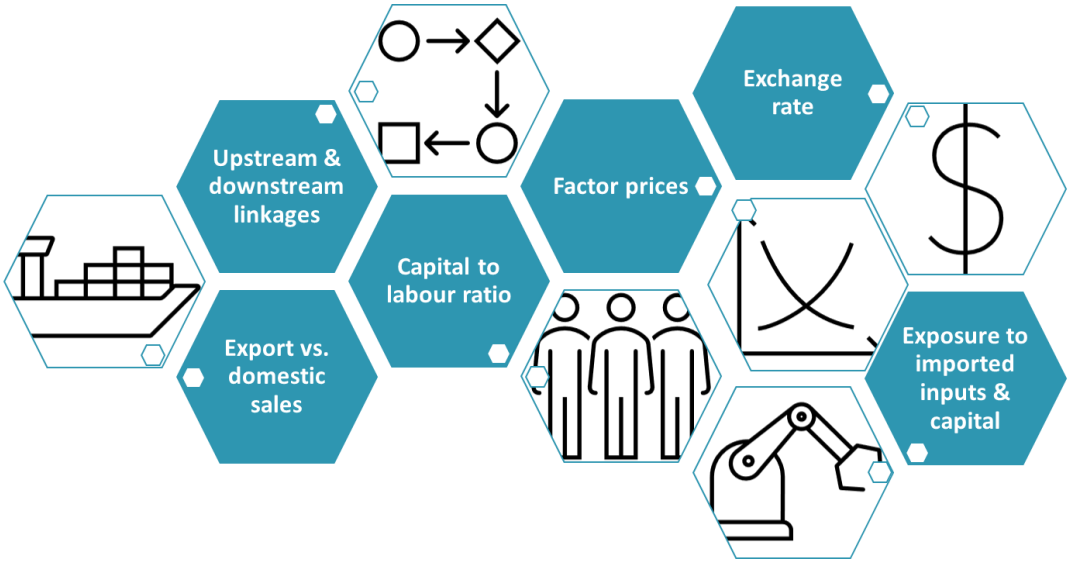
We provide here an overview of the industry impacts and dig deeper into selected industries in section 6. We are happy to provide additional information on industries of interest on request.

4.3.1. What drives industry impacts?

Understanding the industry impacts of more restrictive border settings requires unpicking the effects of a wide range of factors, all of which occur contemporaneously and often have offsetting effects (as occurs in the real economy).

One of the benefits of CGE modelling is that these impacts can be traced through by looking at the model's equations, so the drivers of changes can be readily identified.

FIGURE 12 KEY DRIVERS OF INDUSTRY IMPACTS



SOURCE: SENSE PARTNERS

In the border restrictions scenarios, a useful starting point is examining how the prices of factors of production change. Since all industries use these factors (land, labour, capital, natural resources) to varying extents, movements in their prices provide a helpful way of thinking about how an industry might be affected.

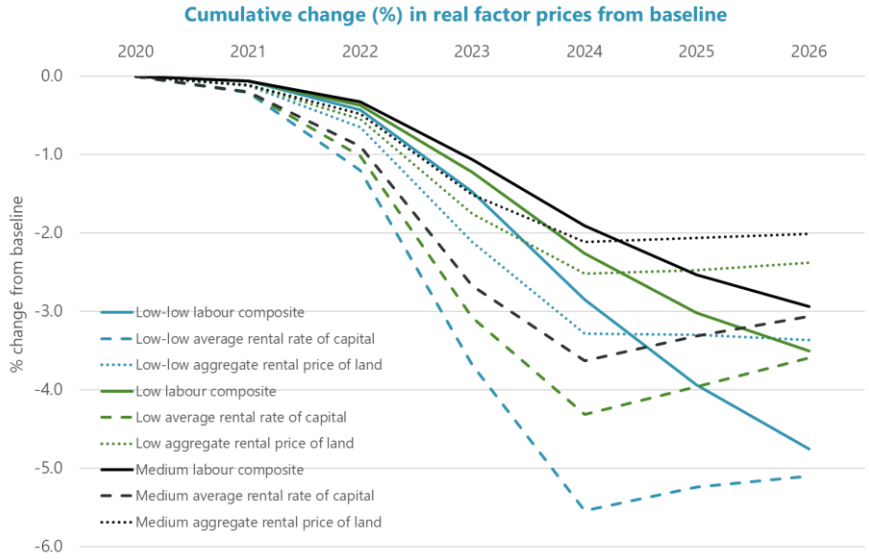
As Figure 13 below shows, more restrictive border settings cause the rental prices of capital and land to fall by more than labour costs.

This benefits capital-intensive and land-intensive industries relatively more than labour-intensive industries – their inputs become relatively cheaper.

As factor costs fall relative to those overseas (which we effectively hold constant, implicit in PREFU's estimates of global economic growth that feed into its export and import forecasts), the real exchange rate depreciates (see Figure 14 below).

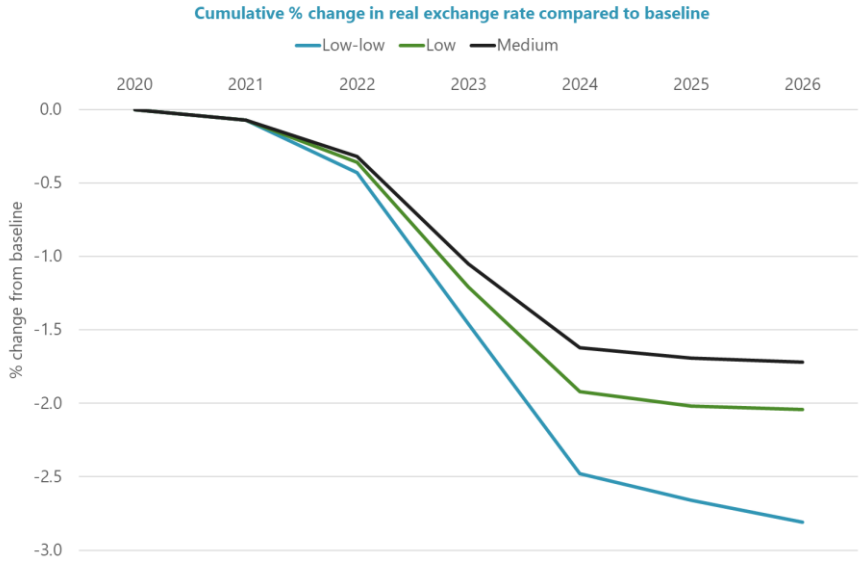
A lower exchange rate benefits export-intensive industries as they become more competitive in world markets.[22] The flipside is imports – including household consumption products and capital items – become more expensive, which reduces household purchasing power and makes investment less attractive (partially offsetting the lower prices of capital discussed above).

FIGURE 13 MOVEMENT IN FACTOR PRICES IN BORDER SETTINGS SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

FIGURE 14 CHANGE IN REAL EXCHANGE RATE IN BORDER SETTINGS SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

[22] Clearly in these scenarios this competitiveness boost is not going to be sufficient to provide tourism and education exports with much relief (see Figure 7 on page 11). But it does make their results marginally 'less bad'.

We can also think about the sales and purchases between industries in the economy: the downstream and upstream linkages in Figure 12.

If one industry is particularly negatively affected by the shocks involved in the scenario – say accommodation in these border restrictions scenarios – then this will flow through to other parts of the economy that rely on its output or provide inputs to it (e.g. food and beverage services, cleaning, etc).

4.3.2. Summary of industry impacts

For the sake of brevity, we focus the discussion of industry impacts here solely on real value-added (the industry equivalent of GDP).[23]

Figure 15 shows the cumulative percentage change from the original PREFU baseline in industry value-added (VA) for the 106 industries in New Zealand's IO tables, for both 2022 and 2024.[24] The results for each border setting scenario are presented.

As would be expected, industries providing tourism goods and services[25] and tertiary education suffer the most. Table 4 shows the ranges of industry VA impacts between the Low-low and Medium scenarios, relative to the baseline.

TABLE 4 MOST NEGATIVELY AFFECTED INDUSTRIES FROM RESTRICTIVE BORDER SETTINGS

	Cumulative % change from baseline in VA by 2022	Cumulative % change from baseline in VA by 2024
Accommodation	-5.4 to -8.0	-14.5 to -29.3
Air and space transport	-5.3 to -7.8	-15.4 to -29.0
Travel agency and tour arrangement services	-11.3 to -16.7	-28.8 to -45.8
Tertiary education	-6.4 to -7.8	-16.1 to -19.2
Specialised food retailing	-3.2 to -4.6	-11.0 to -20.0
Food and beverage services	-3.1 to -4.5	-11.3 to -20.2

SOURCE: MDG5-NZ MODELLING ESTIMATES

Downstream industries associated with overseas tourism such as gambling services and non-residential construction also contract relative to baseline, but by much smaller amounts. And as the retail sector contracts, so too does the wholesale sector.

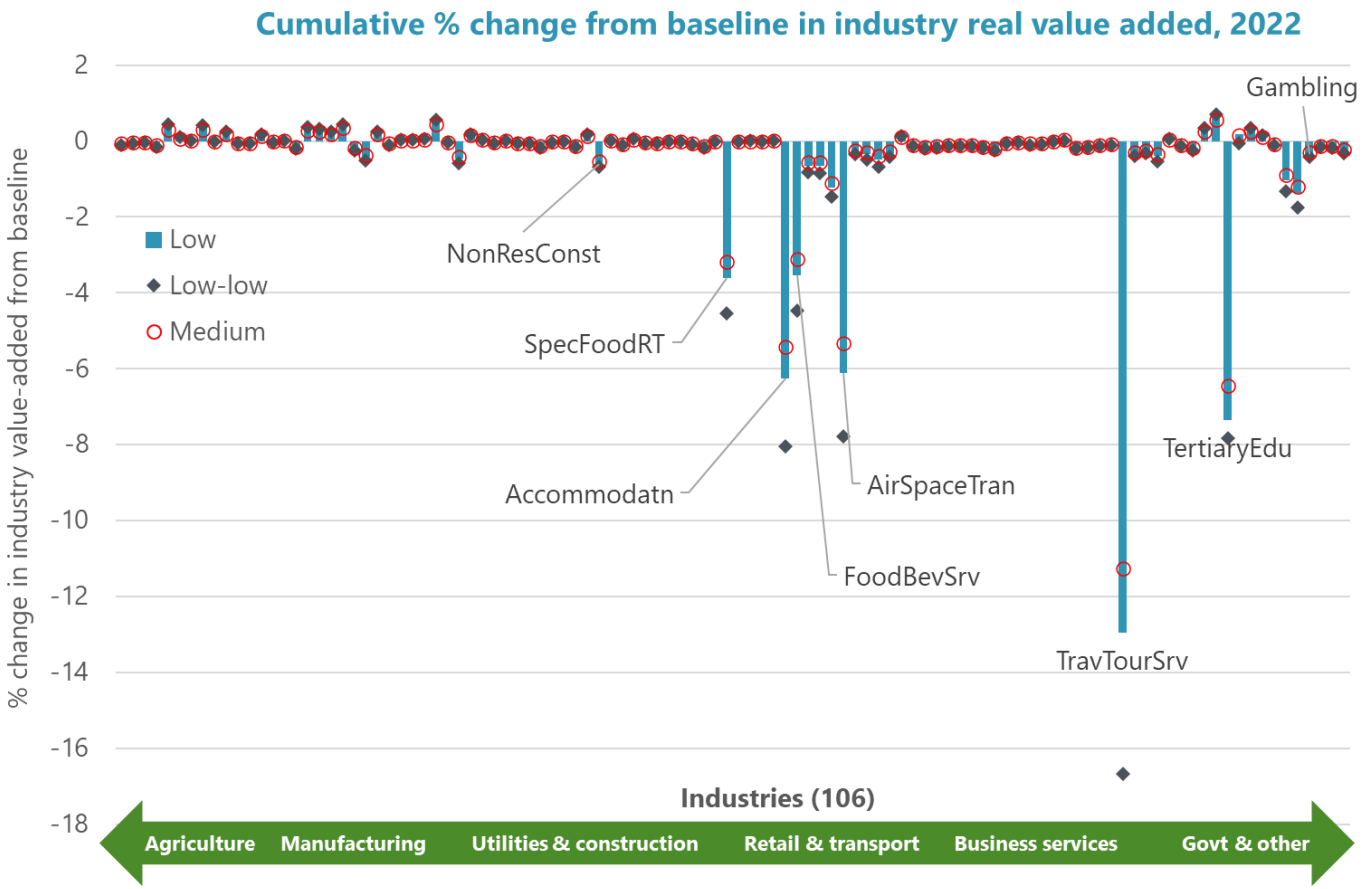
[23] More detailed industry results (jobs, wages, exports, investment, etc.) are available on request.

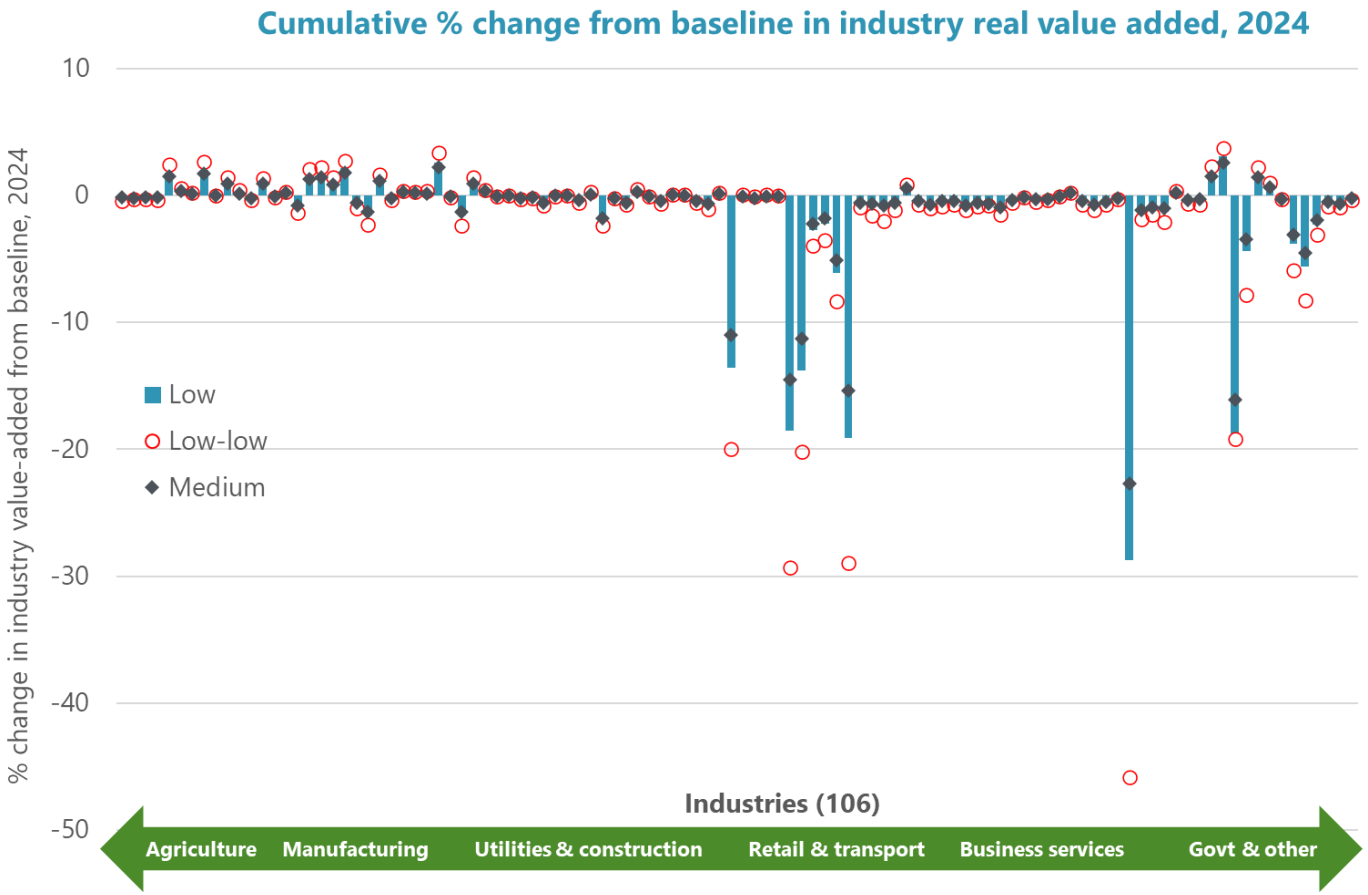
[24] See Appendix A for the results for each industry for each year to 2026. It is not practical to label each industry in the chart, but the bars are in the same order as presented in the IO table industries.

[25] Recall that tourism is not a separate industry in the IO tables.

FIGURE 15 IMPACTS ON INDUSTRY VALUE-ADDED IN BORDER SETTINGS SCENARIOS

Cumulative % change from baseline, 2022 (below) and 2024 (overleaf)



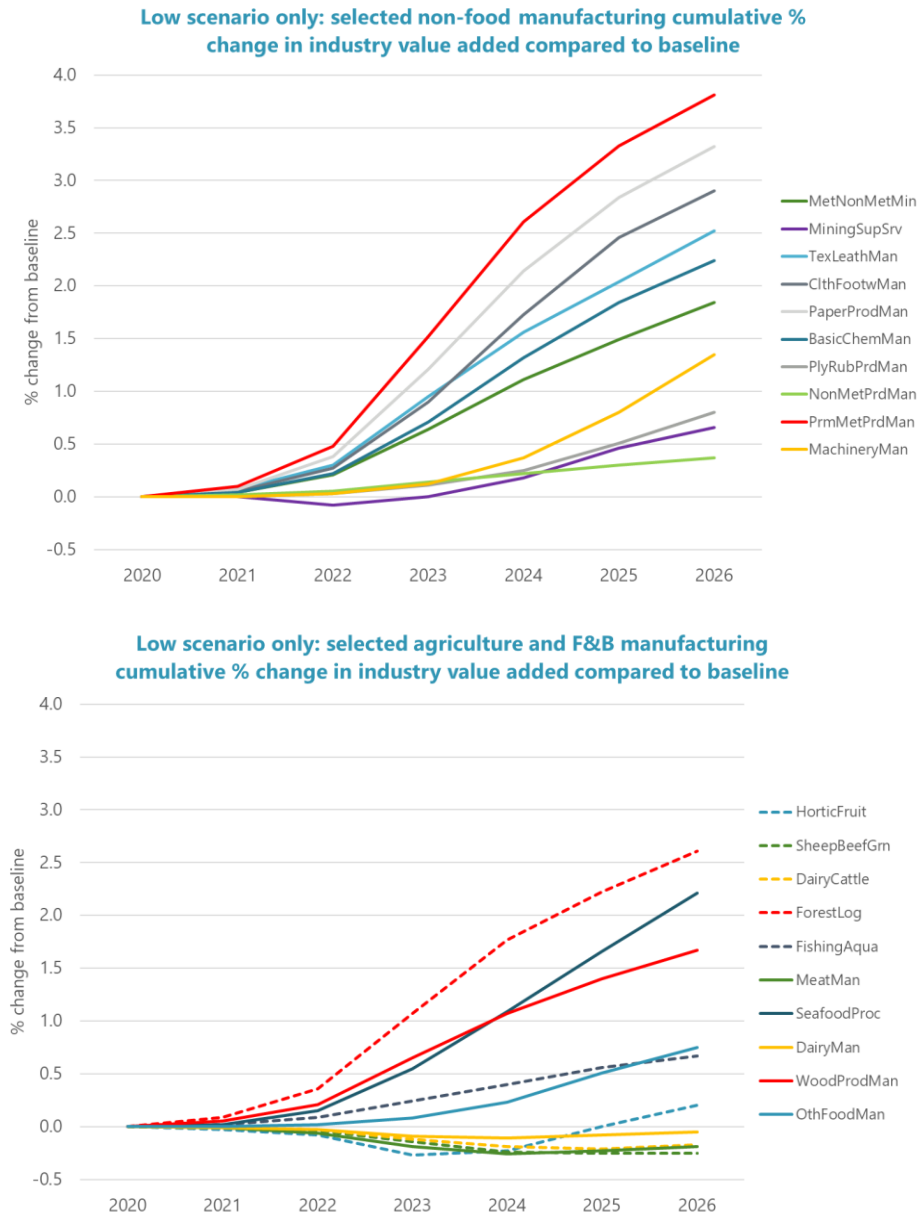


SOURCE: MDG5-NZ MODELLING ESTIMATES

Some industries gain – relative to the baseline – as factor costs fall (see Figure 13) and the real exchange depreciates (Figure 14).

As capital and land rental prices fall by more than labour costs, this benefits capital- and land-intensive industries over labour-intensive industries. And capital- and land-intensive industries that export get an additional boost in competitiveness from the weak New Zealand dollar. These drivers support growth from the baseline in many manufacturing and primary sector industries (Figure 16).

FIGURE 16 RELATIVE WINNERS FROM TIGHTER BORDER SETTINGS (LOW SCENARIO ONLY)

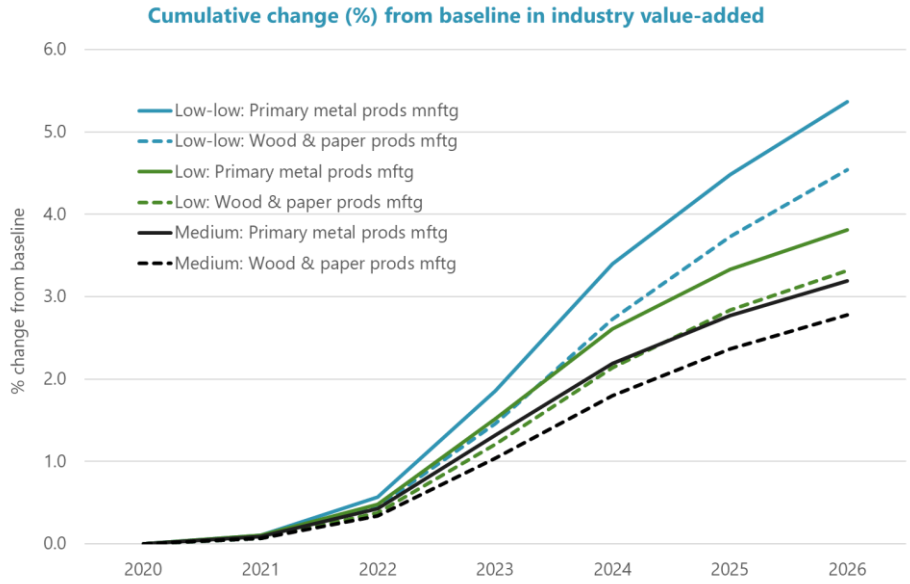


SOURCE: MDG5-NZ MODELLING ESTIMATES

In a perhaps counter-intuitive result, the *more* restrictive the border settings, the more some of these industries benefit (Figure 17).

This is because the tighter the border settings, the more relative factor prices (especially capital rental prices) and the real exchange rate move in their favour.

FIGURE 17 THE TIGHTER THE BORDER, THE BETTER FOR SOME INDUSTRIES



SOURCE: MDG5-NZ MODELLING ESTIMATES

Another point to note is that changes in border settings have minimal effects on most industries, though recall these results are relative to a PREFU baseline which already incorporates a significant economic slowdown.

In the most restrictive Low-low scenario, 91 of the 106 industries experience cumulative declines in VA of less than 1% relative to baseline by 2024.

That is, the negative industry impacts of tighter border settings are highly concentrated on just a handful of industries, either directly or indirectly.

5. Resurgence scenarios: results

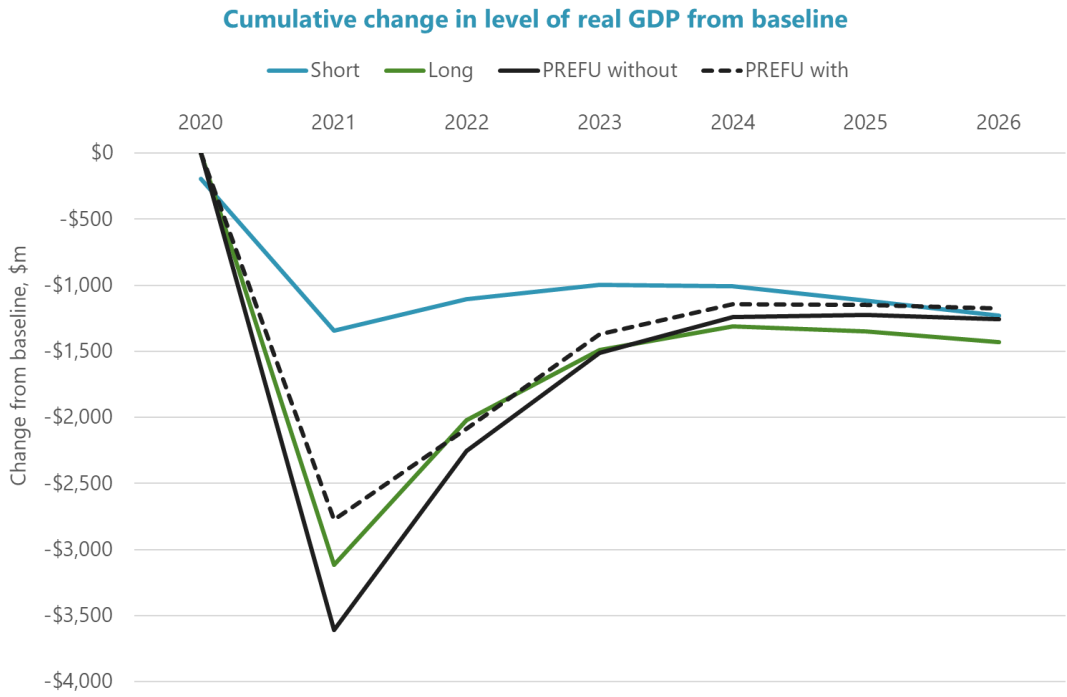
5.1. Macroeconomic impacts

The resurgence scenarios all involve a temporary loss in production in March year 2021 across most industries[26] as workers are unable to attend their workplaces during elevated ALs. The immediate macroeconomic impact of this supply-side shock is a short, sharp decline in GDP, which then moderates as workers return when ALs ease.

As employment falls below baseline, the productive capacity of the economy also drops. Real GDP falls by between $1.3 billion (0.4%) and $3.6 billion (1.1%) below the initial PREFU baseline in March year 2021. By 2024, the cumulative decrease from the baseline is $1.0 billion to $1.2 billion.

The additional wage subsidy in the 'PREFU with' scenario 'saves' $0.8 billion of GDP in March year March 2021 and $0.2 billion in March year 2023. Since much of the additional consumption supported by the wage subsidy is imported, the increase in GDP (relative to the no subsidy PREFU outbreak scenario) is lower than the value of the fiscal support. The key impacts on expenditure GDP are summarised in Table 5 overleaf.

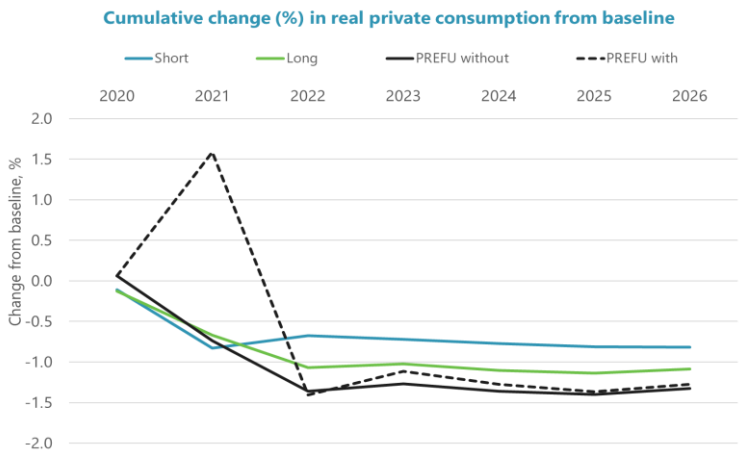
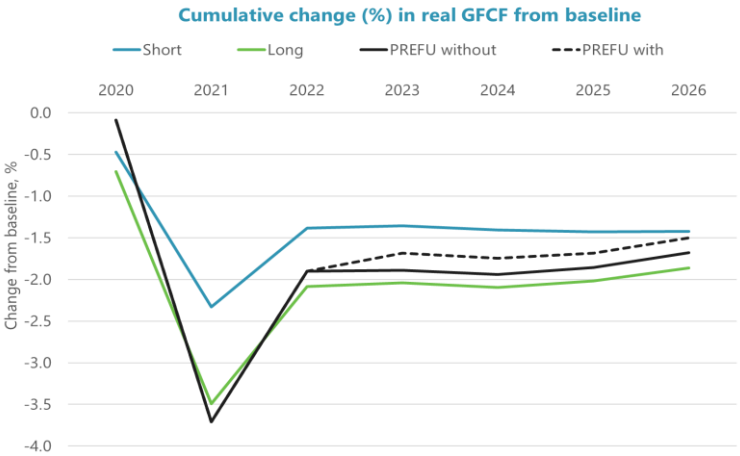
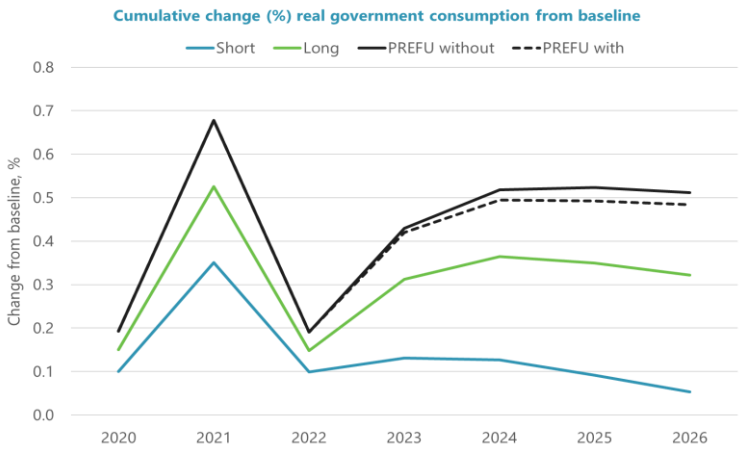
FIGURE 18 GDP IMPACTS OF RESURGENCE SCENARIOS

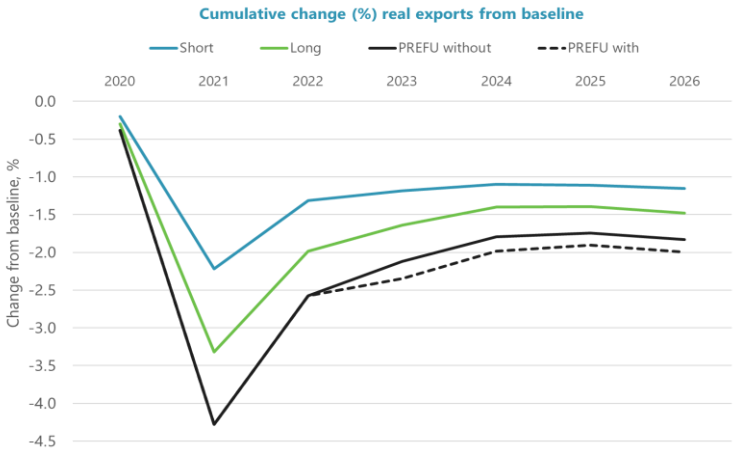
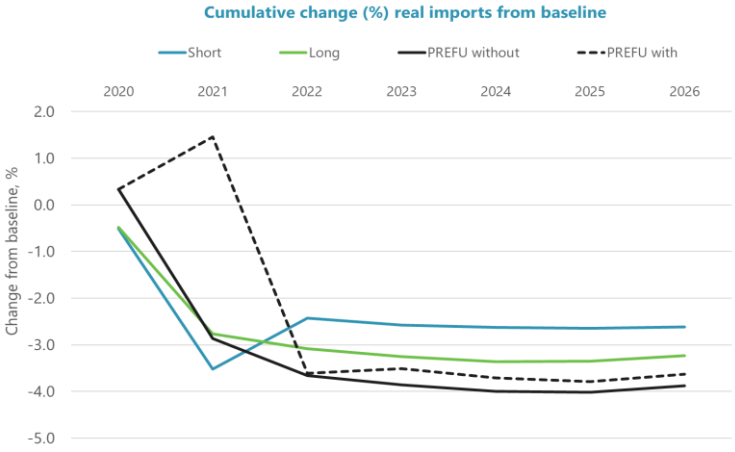


SOURCE: MDG5-NZ MODELLING ESTIMATES

[26] The main exceptions are healthcare-related industries: hospitals, medical and other health care services, and residential care services and other social assistance; and some essential utilities: electricity distribution, water supply and sewerage, for example. They industries are subsequently affected by increased government funding (healthcare) and slower economic activity (utilities).

TABLE 5 IMPACTS OF RESURGENCE SCENARIOS ON EXPENDITURE GDP COMPONENTS

Metric		Explanation
Private consumption		Without a wage subsidy, household incomes fall, leading to lower aggregate spending. A weaker currency pushes up the prices of imported consumption goods. With a wage subsidy, household spending spikes briefly before falling below baseline.
Gross Fixed Capital Formation		As firms' gross operating surplus declines with lower production and prices, so too does their current and expected rate of return. This leads to a decline in capital growth, which pushes down investment. Unless there are strong reasons for investment catch-up, this has semi-permanent impacts on the economywide capital stock.
Government		Central government spending increases slightly to account for higher costs of administering social protection schemes (benefits and transfers), plus additional funding for the healthcare and education sectors.

Exports		Temporarily lower output during lockdowns leads to exports falling. The New Zealand dollar depreciates as factor costs fall, which supports a rebound in exports. With a wage subsidy in the PREFU outbreak scenario, the currency depreciates slightly less, leading to exports being slightly softer. Some exports are also diverted to domestic sales to meet stronger household demand.
Imports		Without a wage subsidy, household consumption falls and the real exchange rate depreciates, dampening import growth. When household incomes *are* supported by a wage subsidy, additional consumption is part-satisfied through additional imports in March year 2021.

SOURCE: MDG5-NZ MODELLING ESTIMATES

Relative factor prices play a vital role in explaining results

As Figure 19 shows, in these resurgence scenarios, the rental price of capital either increases or falls very slightly, compared to labour prices and land prices, which both fall more sharply.

This can be explained by the nature of the shocks associated with moving up ALs. These come through reduced labour demand – many workers are not able to go to their workplace or are operating under distancing restrictions. Employment drops by 2-6% across industries, and labour costs fall accordingly.

In order for output to be maintained, the existing capital stock works harder. As capital productivity increases, the rental price of capital is supported. Capital rentals decrease by more in the short outbreak as industries with relatively large shares of the New Zealand capital stock are hit in the long scenario by a smaller multiple of the shock in the short scenario.

FIGURE 19 FACTOR PRICES AND THE REAL EXCHANGE RATE IN RESURGENCE SCENARIOS

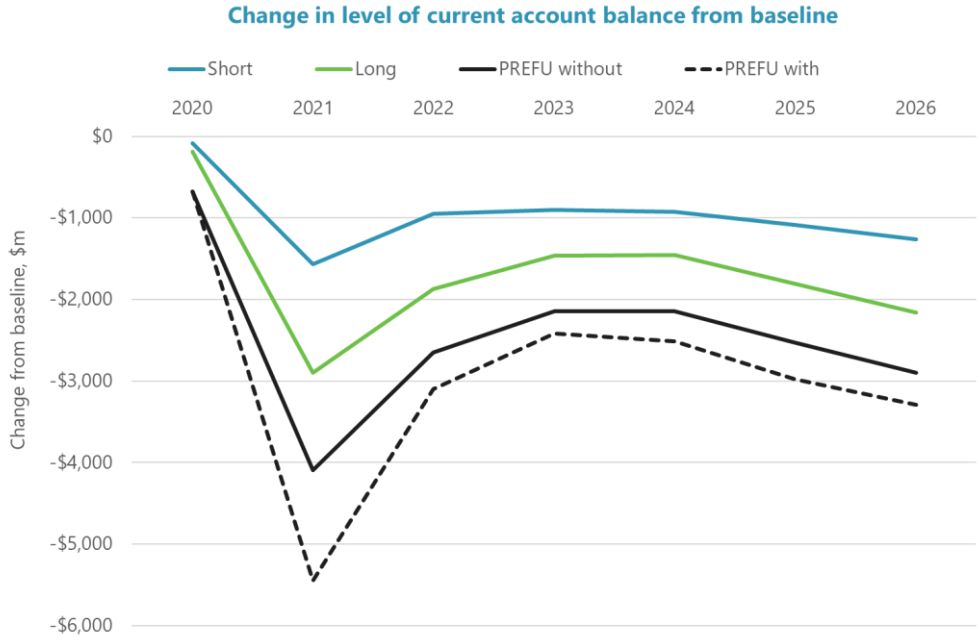
SOURCE: MDG5-NZ MODELLING ESTIMATES

Without a wage subsidy, the real exchange rate depreciates initially as New Zealand's factor costs fall relative to those overseas.[27] The currency comes under further pressure as import demand drops in line with lower household spending.

When we introduce an additional $5 billion wage subsidy in the PREFU resurgence scenario, the real exchange rate lifts briefly, as aggregate factor prices (a composite of land, labour and capital) rise by 0.7% above baseline in March year 2022, before gradually easing as the stimulus fades.

The more severe the resurgence, the larger the deterioration in the current account balance. The wage subsidy sucks in higher amounts of imports to satisfy household demand, as well as diverting some output from exports to domestic consumption (since there is no reason to expect export demand to be any stronger in the wage subsidy scenario – the global economy does not change).

FIGURE 20 IMPACT OF RESURGENCE ON CURRENT ACCOUNT BALANCE



SOURCE: MDG5-NZ MODELLING ESTIMATES

5.2. Fiscal impacts

As the economy contracts below baseline, tax revenue decreases and the government budget balance follows, falling by $2.3 billion to $7.1 billion below baseline in March year 2021 (top chart of Figure 21).

The wage subsidy dents the fiscal balance by a further $5 billion.

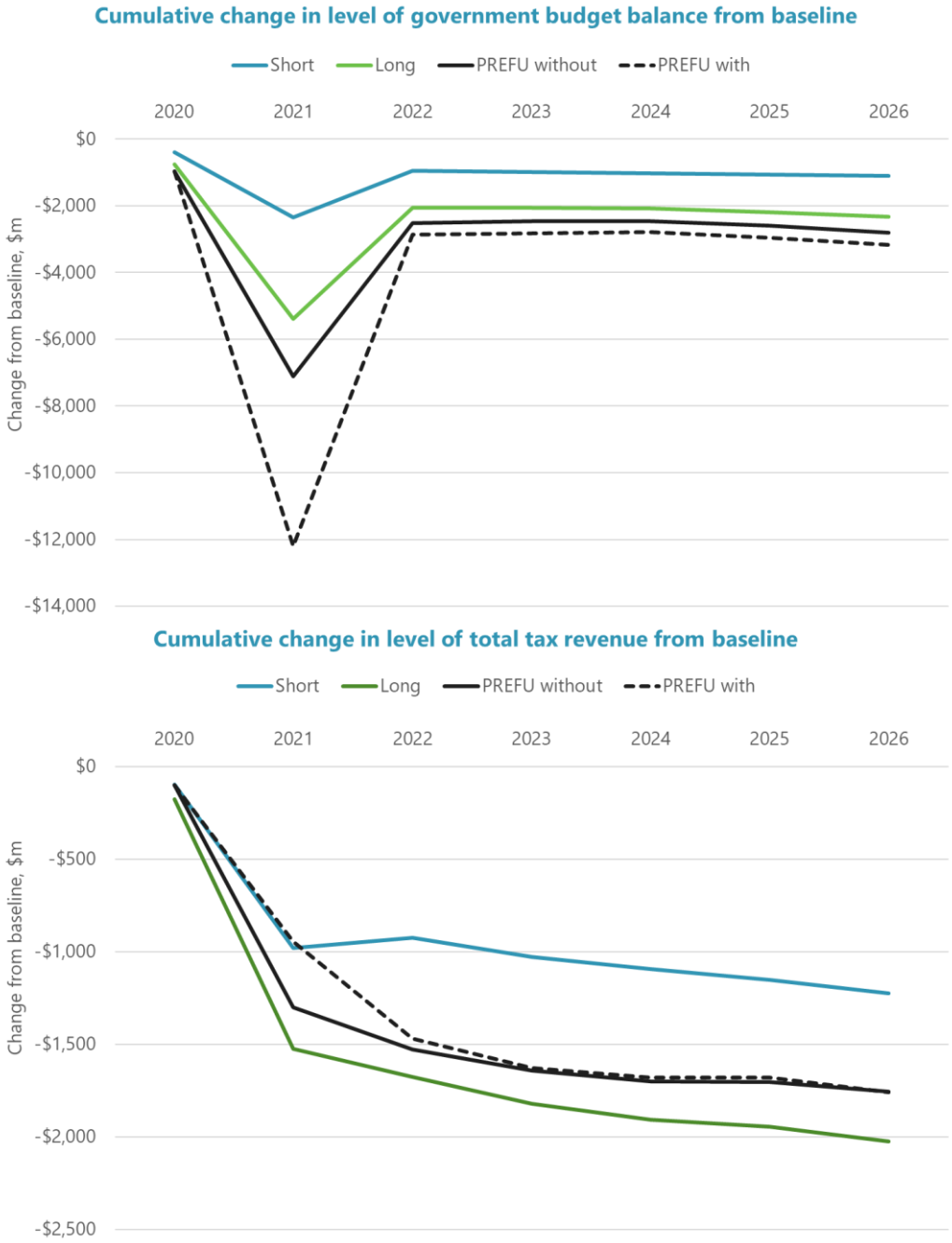
As would be expected for temporary resurgence situations, the fiscal balance deterioration relative to the PREFU baseline is short-lived. However, the fiscal balance does not return fully to baseline

[27] Overseas factor costs do not change across these scenarios, which seems reasonable given the resurgence events modelled are domestic events not global ones.

because the economy is permanently slightly smaller due to a lower capital stock. This limits potential tax revenue in the outyears (see bottom chart of Figure 21).

The wage subsidy scenario supports a slightly higher tax take than the same scenario without a subsidy, as would be expected.

FIGURE 21 IMPACT OF RESURGENCE ON GOVERNMENT BUDGET BALANCE AND TAX REVENUE



SOURCE: MDG5-NZ MODELLING ESTIMATES

5.3. Industry impacts

In the border settings scenarios, the immediate pain is felt by the tourism and education industries, while the wider economy gradually suffers as the aggregate labour supply fall below baseline. That is, we see a concentrated and sharp demand-side shock followed by a broad, long-lived but shallow supply-side shock.

In the resurgence scenarios, almost all industries experience an immediate drop in output due to workers staying at home – a broad and temporary supply-side shock.

The differences in initial impacts between industries in each resurgence scenario are largely driven by the net effects of, *inter alia*:

i. The assumed percentage production losses for each industry due to workers not being able to go to work (based on unpublished Treasury estimates related to the proximity of workers and degree of interaction with the public).

ii. The relative importance of the industry to the Auckland economy compared to the rest of the New Zealand economy[28] (industries more prominent in Auckland than the rest of New Zealand have a relatively larger impact on the national results, since the AL-related production losses are higher in Auckland than elsewhere).

iii. The capital/labour ratios of industries, which influences their response to changing factor prices (see Figure 19 above: labour- and land-intensive industries benefit from relatively more favourable factor prices than capital-intensive industries).

iv. The domestic/export sales mix of industries, given the exchange rate depreciation (industries with a high export share benefit relatively more than domestic sales-focused industries, unless a wage subsidy is in place).

v. The degree to which industries rely on imported intermediates (which become more expensive as the New Zealand dollar depreciates).

vi. Whether any additional fiscal impulse (e.g. temporary wage subsidy extension) was included in the simulation (this will proportionately benefit labour-intensive industries and those that rely on household spending).

The initial hit

As Figure 22 shows, in the year to March 2021, all industries apart from those in the healthcare and utilities sectors contract relative to baseline. The hardest hit include:

- Retailers (and supporting wholesalers) that rely on foot traffic as more people work from home.

[28] Recall the short and long outbreak scenarios involve Auckland being at higher levels of AL than the rest of New Zealand. This was incorporated into the scenario design and subsequent shocks.

- Heavily capital-intensive industries such as petroleum and coal manufacturing[29], residential and non-residential construction, real estate services.
- The travel agency and tour arrangement services industry suffers because it sells over 40% of its output to domestic households, whose incomes fall as employment and real wages drop. A similar picture emerges for sports and recreation services industry, which sells largely to the domestic market.
- The textiles, clothing and footwear manufacturing industry contracts relative to baseline due to its:
    - high reliance on imported intermediates, which make up over 40% of its cost base and become more expensive as the New Zealand dollar depreciates.
    - relatively capital-intensive structure, which works against it given the factor price results discussed above (with capital becoming more expensive compared to labour).
    - sales patterns, whereby domestic households (which are seeing income drops) buy around 80% of the output of its key commodities.

The recovery

After the initial production losses, we let the model adjust without any further guidance. The bottom panel of Figure 22 shows the cumulative change in industry VA in March year 2023, some two years after the resurgence occurs.

Most industries remain below baseline, although by less than 1%. The strongest performing industries – in relative terms – tend to be land-intensive (e.g. horticulture and fruit growing), produce for export (e.g. coal mining) or are labour-intensive government services (e.g. schools and hospitals).

Real wages deviate from the baseline with a lag, so even though employment has largely recovered by 2023, households continue to experience lower-than-baseline incomes. This pulls down the demand for commodities such as life insurance (which sells 100% of its output to households), gambling (96%), footwear (85%), bakery products (85%) and broadcast services (80%).

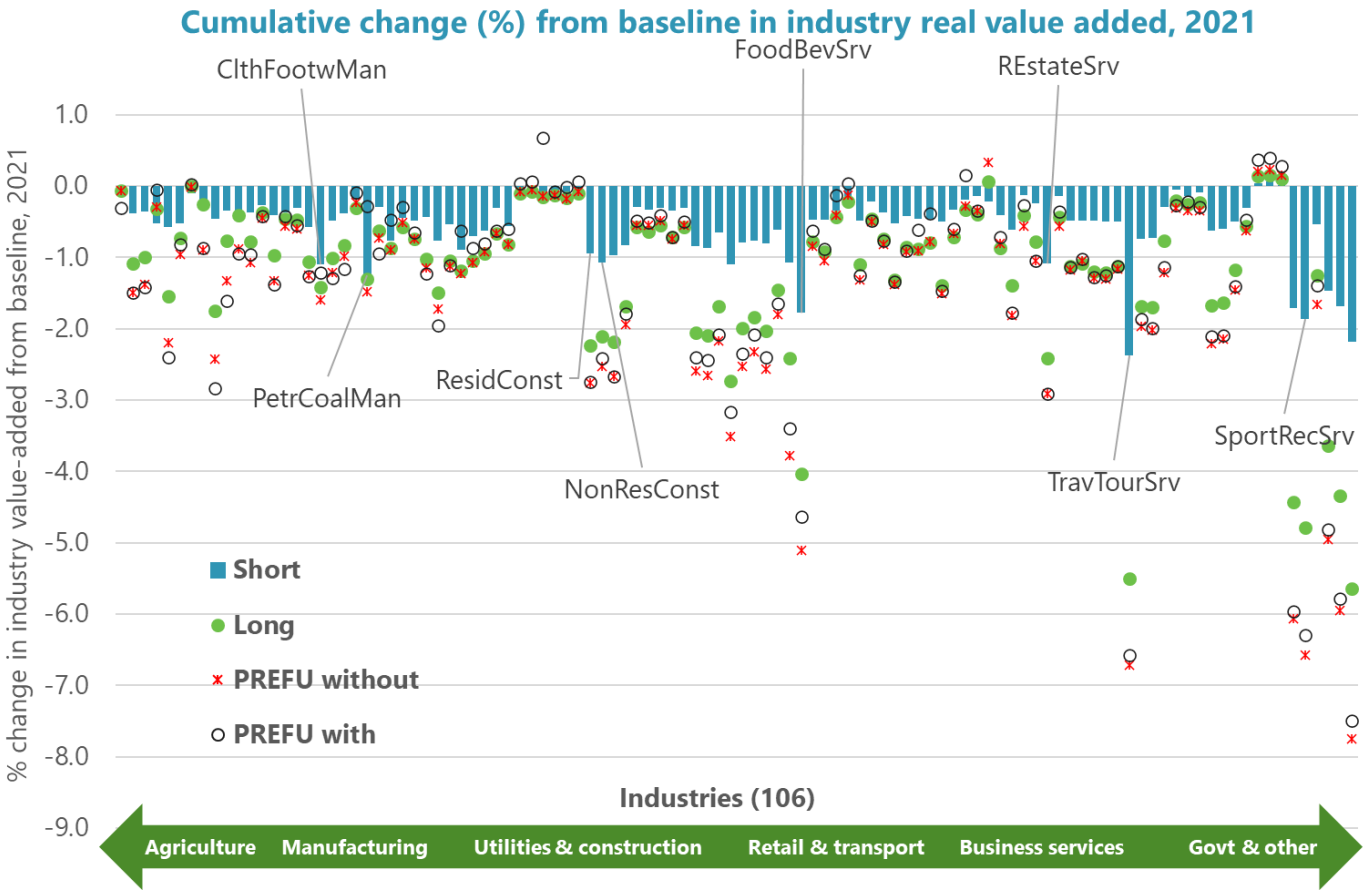
The industries that produce the bulk of these commodities (recalling that an industry can produce many commodities) struggle commensurably, such as clothing and footwear manufacturing, specialised food retailing and telecommunications.

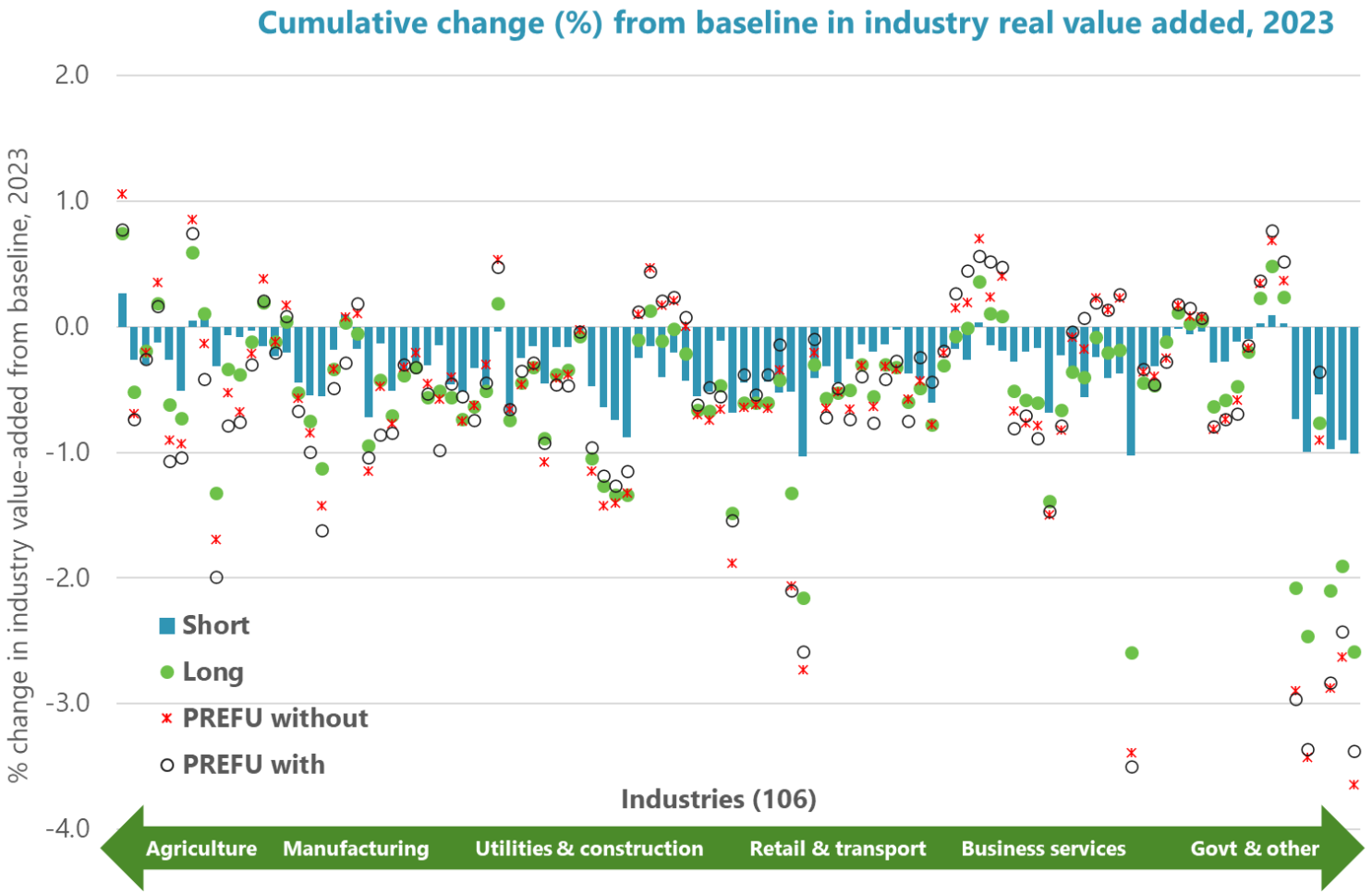
The wage subsidy ameliorates some of these household-spending related industry impacts.

[29] This industry is also heavily reliant on now more expensive imported intermediate inputs (78% of its cost base) due to the weaker currency.

FIGURE 22 IMPACTS ON INDUSTRY VALUE-ADDED IN RESURGENCE SCENARIOS

Cumulative % change from baseline, 2021 (below) and 2023 (overleaf)





SOURCE: MDG5-NZ MODELLING ESTIMATES

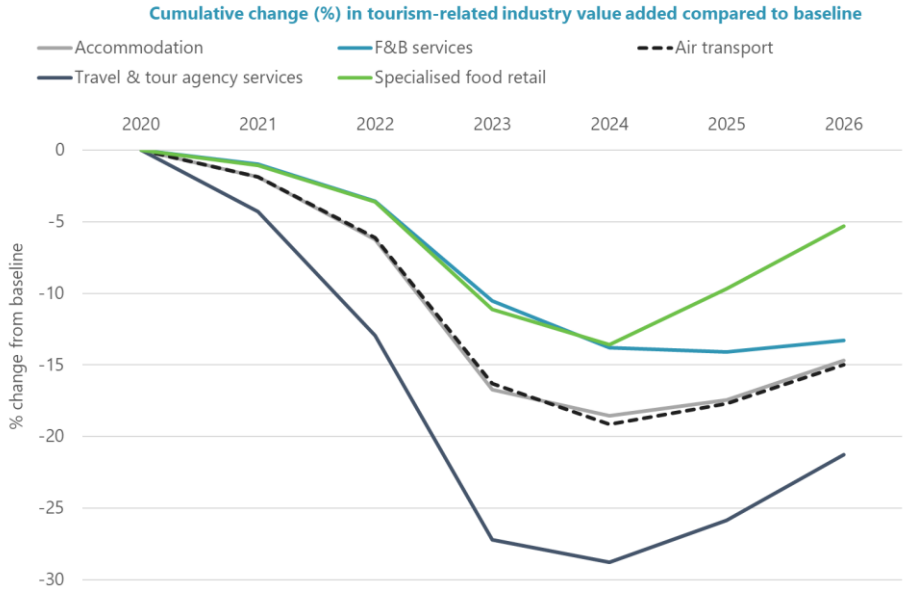
6. Industry deep dives

We explore selected industry results in more detail in this section.[30] To keep things simple, we focus solely on the **Low variant** of the border settings scenarios, apart from the analysis of the construction sector, for which we use the long outbreak scenario.[31]

6.1. Tourism

Tourism exports fall by around 50% below baseline in March year 2021, cumulating to 70.6% below baseline by 2023. This has a significant impact on VA in tourism-related industries, which all contract well below baseline.[32]

FIGURE 23 IMPACTS ON TOURISM INDUSTRIES' VALUE-ADDED



SOURCE: MDG5-NZ MODELLING ESTIMATES

Weaker activity in the tourism-related industries has flow-on effects for the demand for commodities such as cleaning services: 7% of the output of this commodity is purchased by accommodation and food and beverage services (i.e. restaurants) industries.[33]

[30] The industries were selected by The Treasury.

[31] This is because the construction industries are not materially affected by the border settings scenarios, aside from non-residential construction, which suffers because the education industries combined account for around 12% of its sales.

[32] By contrast, these industries' value added fall by 1% to 4% in March year 2021 in the Long outbreak resurgence scenario, before gradually returning close to the baseline from March year 2022 onwards.

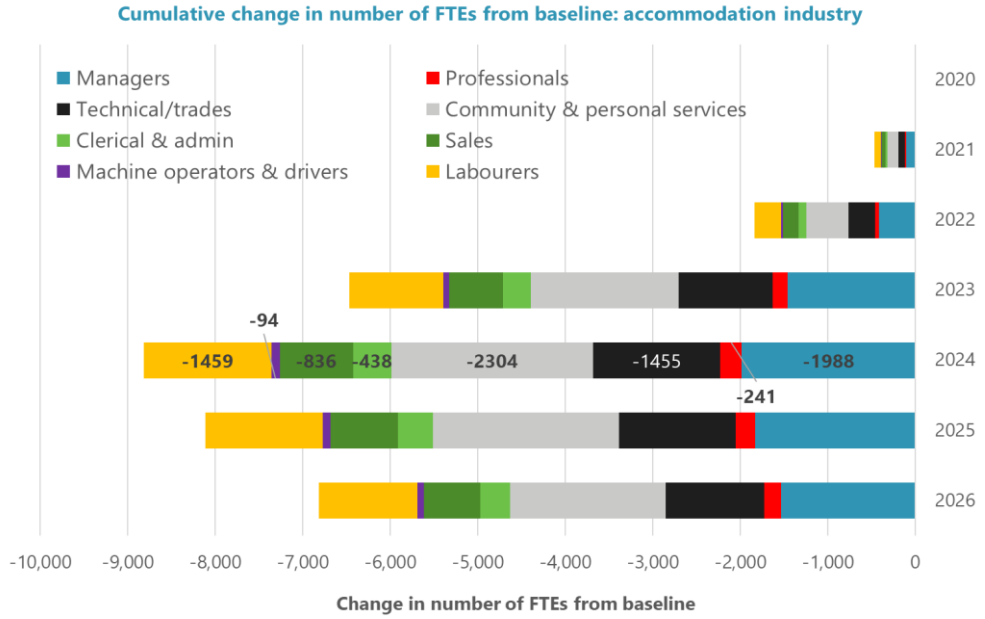
[33] The weakness in demand in the tourism industries is partially offset by slightly stronger demand from the healthcare industries, which account for 12% of its sales; and non-tertiary education industries, which account for 9%.

Firms selling beverages also feel the effect of the slower restaurant and accommodation industries: these two industries account for 14% of beverage sales (mainly beer and soft drinks), 10% of spirits and tobacco sales, and 4% of wine sales.

Similarly, a weaker air transport industry due to tighter border restrictions drives down the demand for commodities such as the maintenance of domestic and office equipment (air transport accounts for 8% of its sales), cargo services (3%), takeaways (3%) and other petrol products (i.e. aviation fuel, 24%), equipment hire (7%).

We can also explore employment impacts by type of occupation. Figure 24 shows the illustrative effects on FTE jobs in the accommodation industry when border settings are more restrictive than assumed in the baseline. A key takeaway is that it is not just the lower-paid roles that will be laid off over time – managers and professionals in the industry will also feel the pain of a decimated tourism industry.

FIGURE 24 EMPLOYMENT BY OCCUPATION IMPACTS: ACCOMMODATION INDUSTRY



SOURCE: MDG5-NZ MODELLING ESTIMATES

6.2. Education

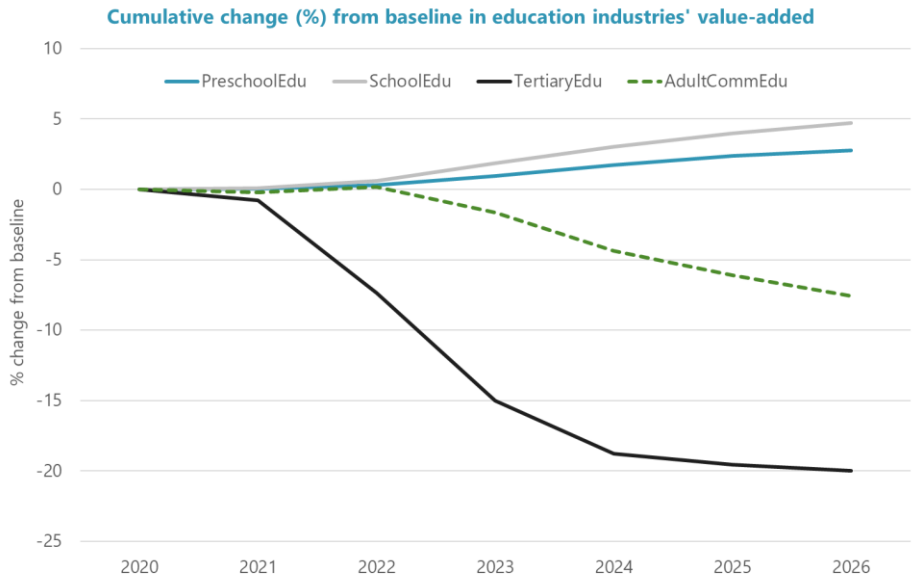
The impacts of tighter border restrictions on the education sector are shown in Figure 25 below. The different paths of these industries are due in part to:

- **Different sales structures**: tertiary education generates 30% of its sales from overseas students, which are severely restricted due to the tighter border settings. Preschool education has no export exposure, and school education has minimal exposure (6% of the secondary school education commodity revenue comes from overseas).
- **Different roles in the economy**: adult and community education services are relatively widely used by other industries as intermediate inputs in the shape of vocational training (55% of the sales of the industry comes from other industries). This is not the case for the other education industries. Their funding structure is also more heavily weighted towards

households. Income for the other education industries is between 77% and 93% funded by government, which does not contract as much as the private sector in these simulations.

- **Links to the labour market**: The path of industry VA for adult and community education services shows a slight uptick in March year 2022 as more people move from the labour force into vocational education. It then moves below baseline as demand from other industries and households eases as the economy contracts relative to the baseline.

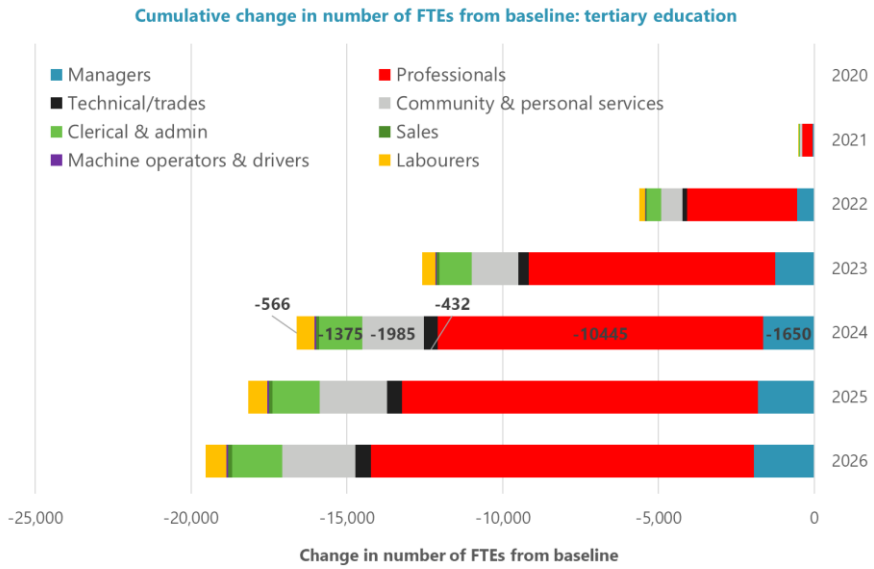
FIGURE 25 IMPACTS ON EDUCATION INDUSTRIES' VALUE-ADDED



SOURCE: MDG5-NZ MODELLING ESTIMATES

In the Low border setting scenario, the number of FTE jobs in the tertiary education industry drops significantly below baseline (66,310 FTES) as export education is severely constrained (Figure 26).

FIGURE 26 EMPLOYMENT IMPACTS BY OCCUPATION ON THE TERTIARY EDUCATION INDUSTRY



SOURCE: MDG5-NZ MODELLING ESTIMATES

A key difference in the employment impacts compared to the accommodation industry shown above (Figure 24) is the loss of proportionately more highly-paid roles for professionals and managers, compared to labourers and tradespeople.

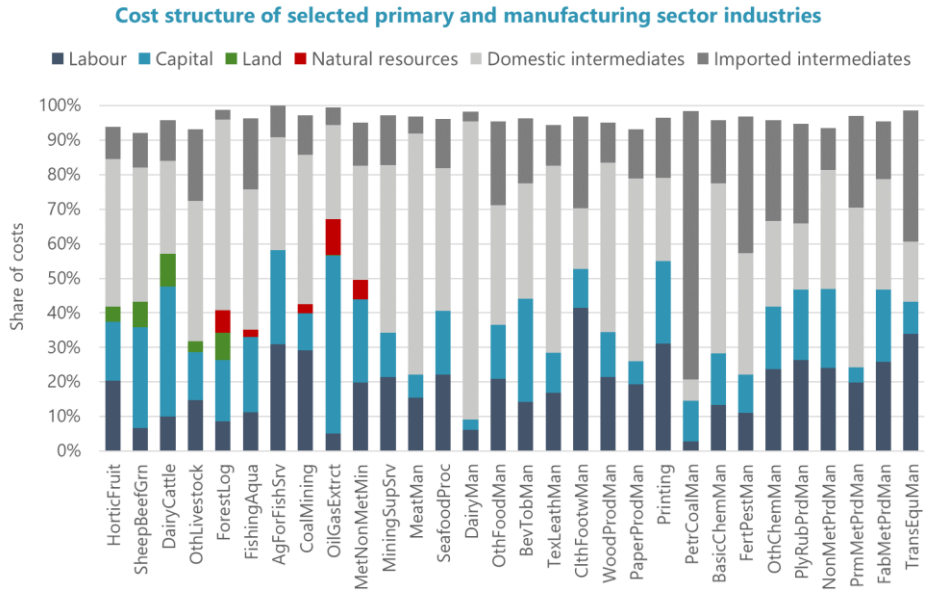
In the Long outbreak resurgence scenario, the impacts on the education sector are much more muted, as there is no loss in export revenue beyond that included in the PREFU baseline. Value-added in the Tertiary education industry falls by 1.2% below baseline in March year 2021, school education falls by 1.6% and adult and community education drops by 0.6%. These contractions are small and temporary, and activity in all education industries then return close to baseline over the forecast period.

6.3. Primary sector and manufacturing export industries

As noted in section 4.3, capital and land rental prices fall by slightly more than labour costs in the border settings simulation. These factor price movements tend to favour industries that are relatively more capital- and land-intensive industries than labour-intensive industries (see Figure 16 and Figure 17 above).

As Figure 27 shows, industries such as forestry and logging and wood product manufacturing are relatively capital-intensive, which contributes to their comparatively strong performance.

FIGURE 27 COST STRUCTURE OF PRIMARY SECTOR INDUSTRIES



SOURCE: MDG5-NZ DATABASE

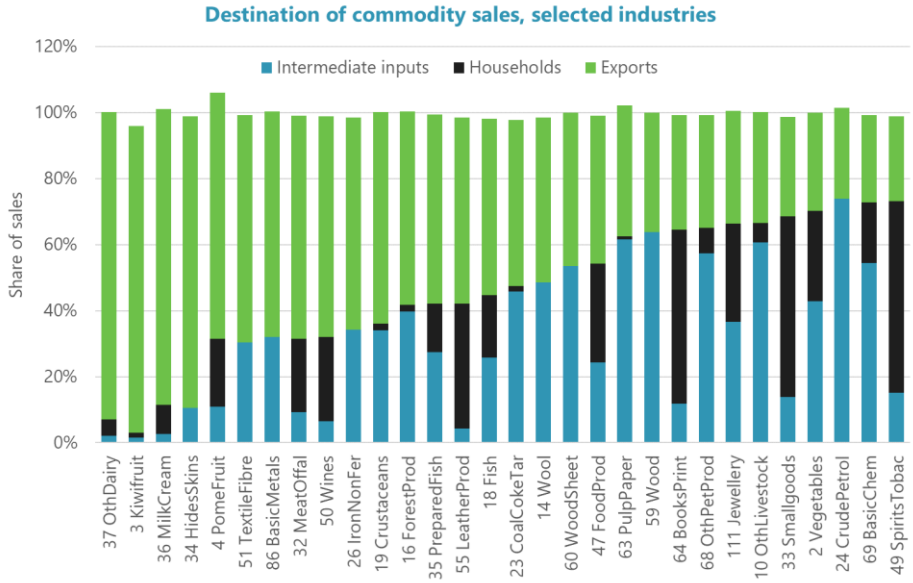
We also have to consider the sales structure of the commodities these industries produce (recalling that in our model database, industries produce multiple commodities).

Figure 28 overleaf shows that for products such as kiwifruit, exports account for over 90% of sales revenue. Industries that produce these commodities benefit from the fall in the exchange rate that results from tighter border settings (see Figure 14).

Given the fall in the exchange rate, one might expect dairy and meat manufacturing to perform better (they both decline very slightly relative to the baseline). The bulk of these industries' costs come from the purchase of intermediate inputs: raw milk and sheep/cattle/deer/pigs respectively. Changes in factor prices therefore have only a very small impact.

Note that we make no assumptions in the border settings scenarios about the availability or otherwise of critical overseas workers for primary industries such as horticulture. If tight border settings were to preclude certain workers (such as foreign winemakers or orchard managers, etc.) from entering New Zealand, this could have material impacts on these industries supply chains, as domestically-sourced labour is unlikely to be an appropriate substitute. This would be a useful area for future research.

FIGURE 28 REVENUE SOURCES FOR SELECTED PRIMARY SECTOR COMMODITIES



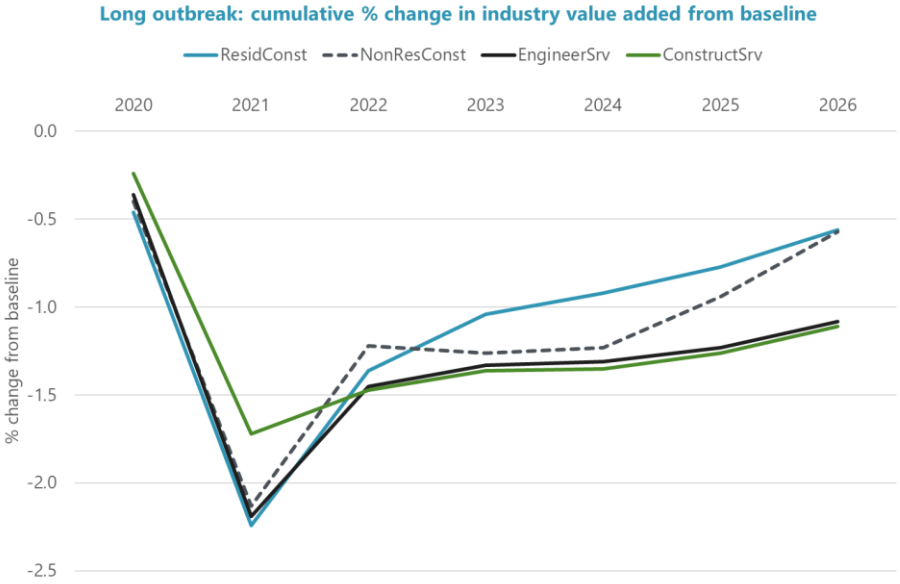
SOURCE: MDG5-NZ DATABASE

In contrast, the picture is generally slightly different for these industries in the Long outbreak resurgence scenario. In this scenario, labour costs fall by more than capital costs and the real exchange rate depreciates. This tends to favour more labour-intensive, export-focused industries such as horticulture and fruit growing. More capital-intensive industries such as oil and gas extraction struggle, especially since it imports a lot of capital equipment which becomes more expensive due to the weaker currency.

6.4. Construction

In a long resurgence scenario, construction industries see their VA fall by 1.7% to 2.2% below baseline in March year 2021, before slowly trending back towards the baseline.

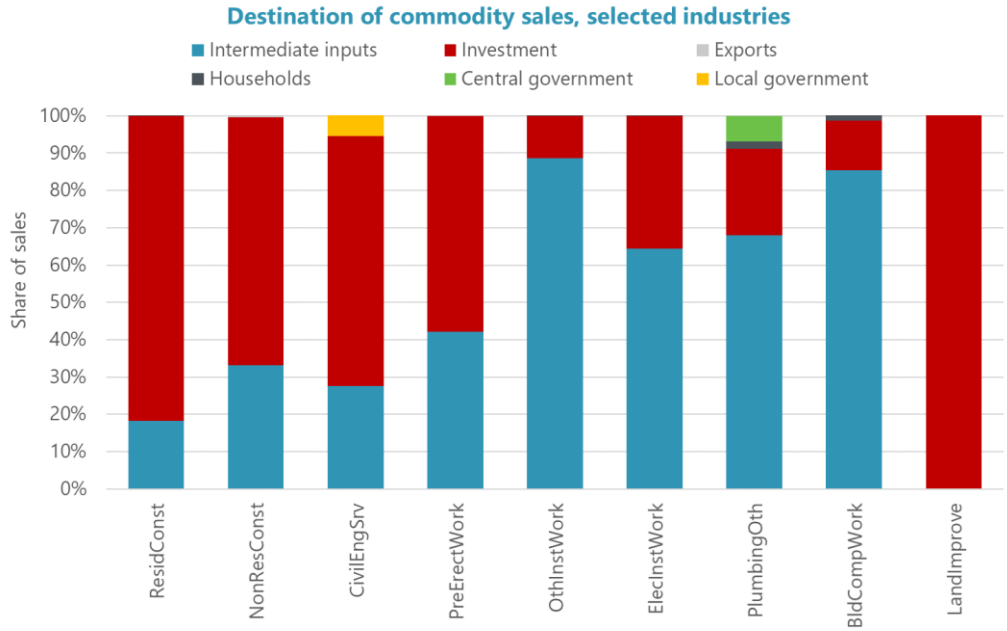
FIGURE 29 IMPACT OF THE LONG RESURGENCE SCENARIO ON VALUE-ADDED IN THE CONSTRUCTION INDUSTRY



SOURCE: MDG5-NZ MODELLING ESTIMATES

These industries suffer primarily because the commodities they produce are largely investment (capital) goods and services (Figure 30). As described in section 5.1, investment drops sharply in this scenario as firms' gross operating surpluses decline due to production losses. This feeds straight into lower demand for construction industry outputs.

FIGURE 30 SALES OF SELECTED CONSTRUCTION-RELATED COMMODITIES



SOURCE: MDG5-NZ DATABASE

In addition, the cost of their imported intermediates – which account for 7% to 16% of their costs – increase as the currency depreciates.

To the extent that construction industries purchase intermediate goods (which account for between 34% and 64% of their costs) from domestic industries who themselves may have imported the products in the first place (e.g. nails from China sold by a building trade merchant), they will experience increased costs here too.

The construction sector is not so severely affected in our border settings scenarios. In the Low border scenario, residential construction expands very slightly relative to baseline (0.3% above baseline by March year 2023). The vast majority of residential construction's costs (59%) are domestically-produced intermediates (e.g. wood products), the prices of which fall marginally relative to baseline due to weaker aggregate economic activity.

Non-residential construction contracts slightly relative to baseline in the border settings scenarios, falling by an accumulated 2% by March year 2024. This is in part due to weaker demand from the tourism and education industries, whose capital expansion plans will be put on hold as tourism and export education suffer. The industry's costs rise due to a relatively high reliance on imported intermediates such as petrol and diesel (8% of its intermediates cost base) which become more expensive due to the softer currency. The industry also uses large amounts of domestic intermediates (e.g. concrete and stone products, 7% of intermediate costs; structured metal products, 10%) which are based themselves on imported inputs.

Construction services and engineering services fall very slightly relative to baseline in the border settings scenarios. Both are used heavily by residential and non-residential construction, and the latter's drop in activity just outweighs the former's growth in determining overall demand for construction and engineering services.

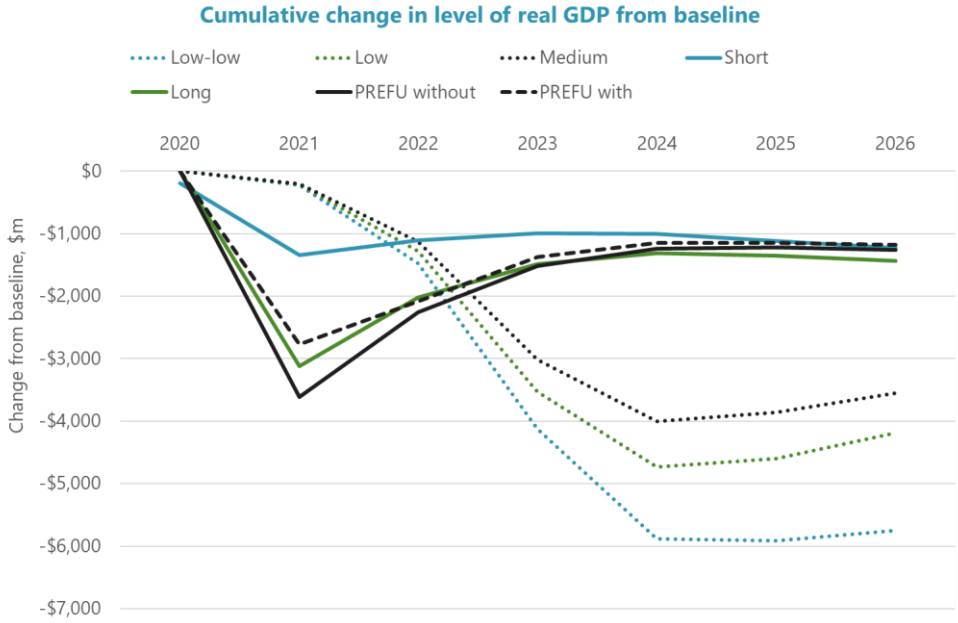
7. Discussion and implications

In the charts in this section:

- all border settings results are shown in dotted lines
- all resurgence scenarios *without* a wage subsidy are solid lines
- the resurgence scenario *with* a wage subsidy is the dashed black line.

The sets of scenarios have very different macroeconomic impacts…

FIGURE 31 GDP IMPACTS ACROSS SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

Restrictive border settings result in both demand-side impacts (on tourism and education in particular) and supply-side effects (via a smaller labour supply). These have small negative effects in the short-term, relative to the PREFU baseline.

But these impacts accumulate over time as ongoing weak investment causes the capital stock to fall and population growth reduces due to lower-than-baseline immigration and temporary work visa arrivals. Both effects reduce the productive capacity of the economy.

The Covid resurgence scenarios, in contrast, are short, sharp supply-side jolts that have a more significant negative impact on GDP in the short-term as production is temporarily curtailed across the economy. As soon as Auckland and the rest of New Zealand move back down the Alert Levels to the Alert Level 1 assumed in the PREFU baseline, activity rebounds closer to baseline relatively quickly.

The wage subsidy moderates the immediate negative economic impacts of a resurgence but cannot prevent a significant GDP decline.

As real wages are sticky in the short-term, the initial downturn is caused largely by softer employment. Over time, the model's dynamic labour market adjustment sees employment head back towards the baseline and real wages bear the brunt of weaker labour demand. There is no decrease in population in these scenarios.

… but in both cases, the resources available for production decline permanently

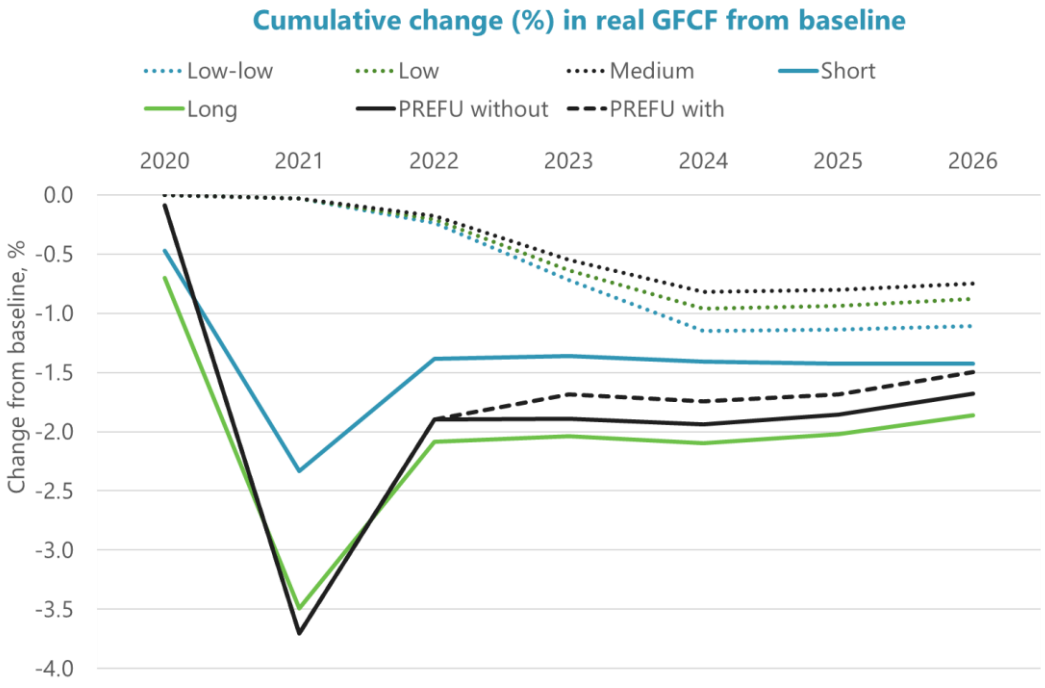
The economy never returns to baseline in any scenario – it is permanently smaller. Even if we extended the modelling period out another decade or two, GDP would still never return to baseline in these scenarios (unless we incorporated additional positive productivity shocks).

This is largely driven by the effects of the two sets of shocks on investment, and hence the capital stock. Recall that the capital stock at the end of period *t+1* equals the capital stock at the end of period *t* plus investment in period *t+1*, less depreciation.

Investment at the industry level, in turn, is driven by the expected rate of return in that industry (i.e. expected profits or gross operating surplus, GOS).

In the resurgence scenarios, almost all industries are affected by production losses and hence lower GOS. This results in the investment impacts being more severe than in the border settings scenarios, in which only certain industries (e.g. tourism, education, retail) are materially negatively impacted.

FIGURE 32 IMPACTS OF SCENARIOS ON INVESTMENT



SOURCE: MDG5-NZ MODELLING ESTIMATES

In order to recoup the 'lost' investment in both scenarios, industries would have to expect an improvement in GOS over and above that contained in the baseline. This seems unlikely.

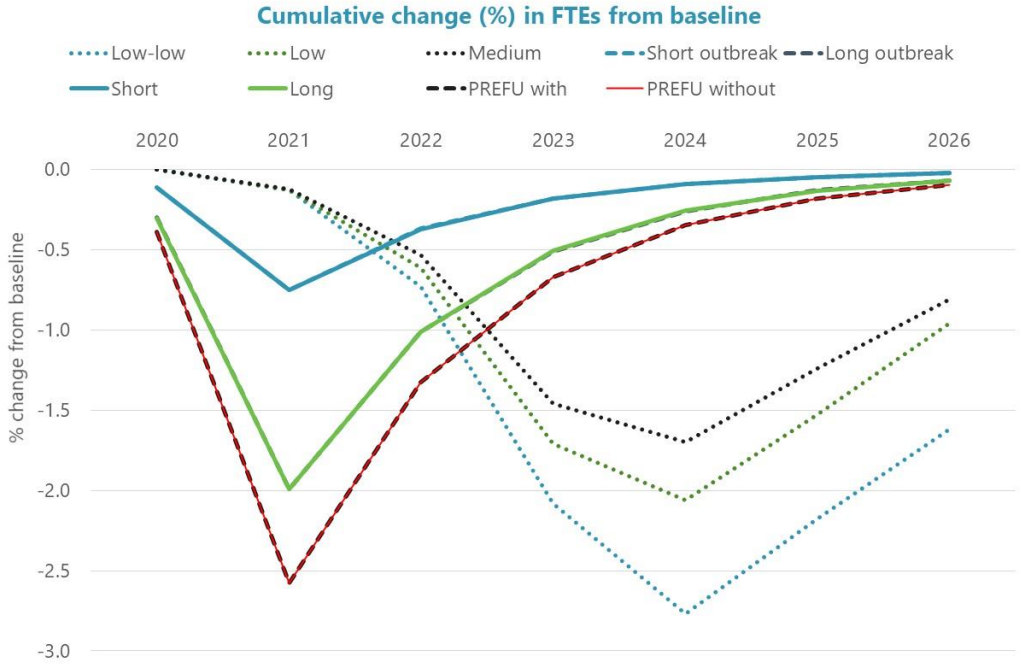
One useful policy response to these scenarios might be promoting business investment

The most significant fiscal response to date has focused on encouraging firms *not* to lay off staff. The wage subsidy policy[34] has important economic and social benefits, as dislocation from the labour force can be highly damaging for workers and society.

Focusing on retaining labour makes sense, given the nature of the employment impacts of the two sets of scenarios (see Figure 33).

- The border settings scenarios have minimal short-term impact on aggregate employment *over and above those built into the baseline*. Over time employment slowly recovers but struggles due to the accumulated effects of a slower economy and a shrinking labour supply due to lower migration.
- The resurgence scenarios, in contrast, are highly damaging for employment in the short term, but the impacts are largely transitory.

FIGURE 33 EMPLOYMENT IMPACTS IN ALL SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

[34] Note there is no difference between the employment tracks in the 'PREFU with' and 'PREFU without' scenarios. This is a function of the way we modelled lockdowns through exogenous shocks to labour demand. Essentially the wage subsidy pays workers to stay at home, whereas those workers are unpaid in the 'without' scenario. We can explore alternative approaches to modelling these scenarios in future work.

Taking a medium-term perspective, boosting the productive capacity of the economy through encouraging capital growth will be important. As Figure 32 above shows, the impacts of the scenarios on the capital stock presents a material risk to long-term potential output.

Using fiscal and monetary policy to help firms accelerate investment – or at least to incentivise them *not* to put capital expansion plans on ice – in the face of a weaker economic outlook would therefore seem to be a sensible avenue to explore.

The sets of scenarios have very different industry impacts too

In the border settings scenarios, the initial industry impacts are **narrow and deep**.

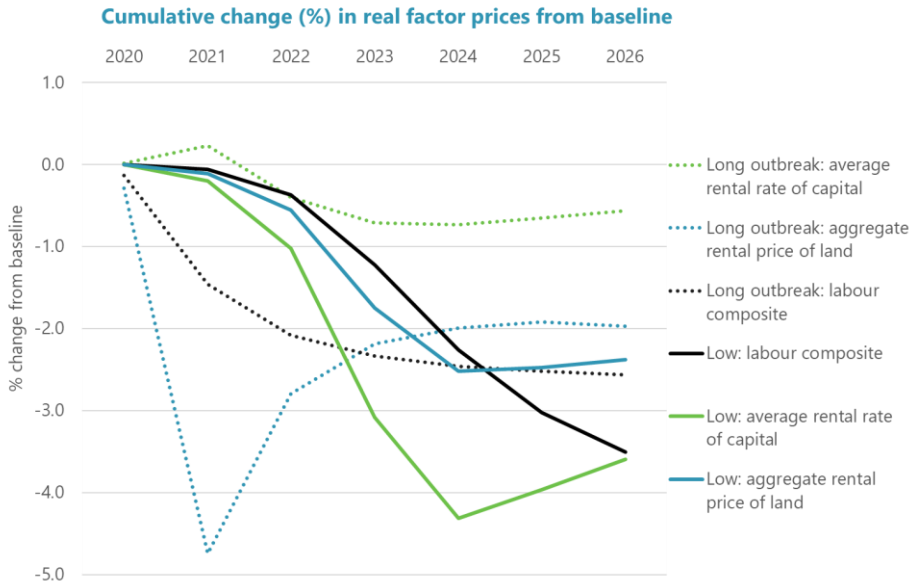
Tourism and tertiary education exports drop sharply. Industries involved in these sectors suffer: transport, travel services, restaurants, accommodation, retail, wholesale, etc. Those supplying the tourism and education sectors experience output declines too, such as producers of wine and other beverages.

Potential travel bubbles as modelled, while certainly providing a degree of mitigation, cannot offset these industries' losses.

Yet the wider economy is largely unaffected from these tougher border settings, relative to the PREFU baseline. Indeed, some industries *benefit* from tighter border settings, relative to the baseline.

Capital-intensive, export-driven industries gain from a large drop in capital prices (relative to the prices of other factors of production, see solid lines in Figure 34) and the real exchange rate depreciation.

FIGURE 34 IMPACT ON FACTOR PRICES: BORDER SETTINGS VS. RESURGENCE SCENARIOS



SOURCE: MDG5-NZ MODELLING ESTIMATES

This indicates the resource reallocation effects across industries that are built into CGE modelling frameworks are more prominent in the border settings scenarios than in the resurgence scenarios where all industries are negatively affected, at least initially.

In the resurgence scenarios, the impacts are **broad and shallow** initially. Almost all industries experience a supply-side driven loss of production as workers are sent home when Alert Levels rise (see Figure 35). This lowers their GOS and curtails investment across the board.

FIGURE 35 INDUSTRY IMPACTS OVER TIME: MARCH YEARS 2022 AND 2024

SOURCE: MDG5-NZ MODELLING ESTIMATES

Labour and land prices fall by more than capital prices (see dotted lines in Figure 34). This partly reflects industries using their capital more intensively during resurgence lockdowns to moderate output declines. This leads to an improvement in capital productivity, which support the rental price of capital.

Relatively lower labour and land prices allows some primary sector and labour-intensive industries – especially export-exposed industries which also benefit from a lower real exchange rate – to recover fairly quickly.

Given the negative effects of moving up Alert Levels on investment across large swathes of the economy, our modelling suggests investment support is equally as important as active labour market policy, if not more so, in avoiding 'secular stagnation', a phrase made popular by Larry Summers in the wake of the GFC.

If tight border settings materially constrain tourism and education exports, what should replace them?

More broadly, in the border settings scenarios, policymakers will need to consider how to support the economy for a protracted period of below-baseline economic activity; and to also manage the effective loss of two of New Zealand's largest services export revenue generators: tourism and education.

Quite what might replace the output of these industries is unclear, but these results suggest policymakers will need to think creatively about designing policy to cope with enforced structural change.

And how will it be funded?

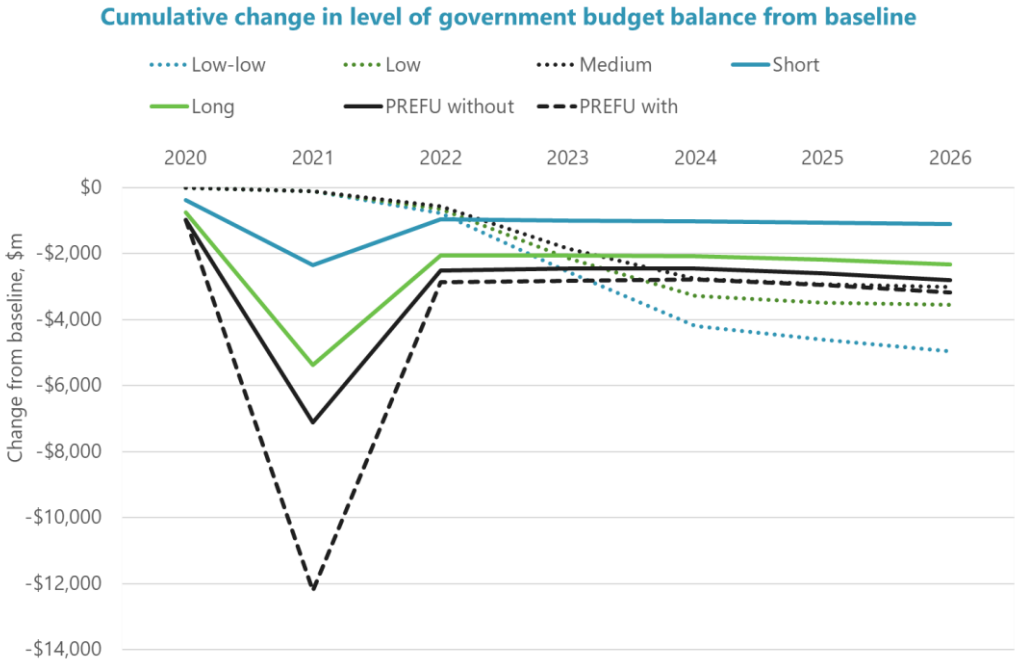
This task will be made all the harder by government having to operate in a constrained fiscal environment where tax revenue is below baseline and the government fiscal balance is further dented (Figure 36 below).

While taking on additional debt is a sensible immediate response to the worst economic crisis in a century, there are limits to how much borrowing is desirable from an inter-generational equity perspective.

As we only project economic impacts out to 2026 here, these longer-term debt repayment impacts have not been explored in this exercise[35] but will require careful consideration.

[35] The debt build-up is captured in the modelling and interest payments on that debt increase, but its repayment will lie beyond 2026.

FIGURE 36 IMPACTS OF ALL SCENARIOS ON GOVERNMENT BUDGET BALANCE



SOURCE: MDG5-NZ MODELLING ESTIMATES

8. Next steps

This research has provided The Treasury with a detailed macroeconomic and industry-level analysis of the potential economic impacts of Covid-related scenarios.

It is important to reiterate that the scenarios modelled here are somewhat artificial, due to additional fiscal responses to worse-than-expected economic conditions not being explicitly considered in all cases.

But the results do at least provide some indication of the potential size of the prize (in terms of GDP losses avoided) associated with policy interventions that ameliorate some of the negative impacts demonstrated.

The MDG5-NZ dynamic CGE modelling framework allows for a granular examination of how industries might respond over time to a prolonged period of tighter-than-hoped border restrictions and further outbreaks of Covid that result in elevated Alert Levels.

It does so in a framework that is consistent with the macroeconomic projections produced for PREFU. The adding-up conditions and resource constraints inherent in the CGE model ensure that trade-offs across industries are uncovered, and there can be no free lunches associated with fiscal policy (or any other policy) interventions.

Since the MDG5-NZ modelling theory is based on a set of behavioural equations that align with standard economic thinking, all results can be explained using relatively intuitive cause-and-effect logic (albeit logic that can be challenging at times when multiple drivers influence outcomes).

This allows The Treasury to develop a more nuanced and richer narrative for Ministers and/or other stakeholders around how the recovery from Covid might take shape, and to consider whether more targeted industry-centric policy responses – as opposed to blanket economywide initiatives – would deliver greater value for money.

The MDG5-NZ framework is highly flexible and adaptable, meaning we can:

- consider alternative theoretical world views, for example around labour market clearing lags.
- incorporate new industries or rates of technological change.
- disaggregate households into income deciles or ethnic groups to allow a better analysis of distributional issues
- develop a highly sophisticated greenhouse gas emissions module for the framework, as has been done with this model to advise the US Federal government.

In terms of potential avenues for future research, the MDG5-NZ modelling framework could be used to, for example:

- Stress-test the internal consistency of The Treasury's macroeconomic forecasts and longer-term projections, along with its fiscal outlook.
- Support The Treasury's thinking around microeconomic analysis of New Zealand's industry-level prospects in a post-Covid environment.

- Explore the regional economic impacts of Covid-related initiatives or any other form of policy interventions.
- Run scenarios around different outlooks for the global economy and hence the demand for New Zealand's goods and services exports.
- Compare the relative merits of highly industry-specific fiscal responses and economywide initiatives.
- Investigate alternative approaches to reducing New Zealand's public debt over time, through changes to a variety of taxes or shifts in government spending patterns.

We would be happy to discuss any of these options with you further.

9. References

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Appendix A Border settings scenarios

TABLE 6 IMPACTS BY INDUSTRY: VALUE ADDED - LOW-LOW SCENARIO

Cumulative percentage change from baseline

Industry	2021	2022	2023	2024	2025	2026
HorticFruit	-0.03	-0.11	-0.37	-0.42	-0.15	0.07
SheepBeefGrn	-0.01	-0.05	-0.18	-0.31	-0.36	-0.36
DairyCattle	-0.01	-0.04	-0.15	-0.26	-0.31	-0.28
OthLivestock	-0.04	-0.15	-0.41	-0.37	0.08	0.25
ForestLog	0.09	0.44	1.37	2.41	3.07	3.73
FishingAqua	0.02	0.11	0.33	0.56	0.79	0.97
AgForFishSrv	0	0.01	0.03	0.18	0.56	0.86
CoalMining	0.07	0.41	1.43	2.65	3.5	4.23
OilGasExtrct	0	0	0.02	0.03	0.11	0.27
MetNonMetMin	0.04	0.25	0.79	1.46	2.01	2.57
MiningSupSrv	0	-0.06	0.1	0.43	0.9	1.26
MeatMan	-0.01	-0.07	-0.24	-0.35	-0.33	-0.29
SeafoodProc	0.02	0.17	0.64	1.34	2.09	2.86
DairyMan	-0.01	-0.03	-0.11	-0.16	-0.14	-0.1
OthFoodMan	0	0.02	0.09	0.27	0.64	0.97
BevTobMan	-0.04	-0.21	-0.76	-1.35	-1.57	-1.59
TexLeathMan	0.07	0.36	1.17	2.05	2.75	3.53
ClthFootwMan	0.05	0.32	1.1	2.24	3.28	4.02
WoodProdMan	0.05	0.26	0.83	1.46	1.95	2.42
PaperProdMan	0.07	0.45	1.46	2.73	3.73	4.54
Printing	-0.05	-0.25	-0.74	-1	-0.8	-0.6
PetrCoalMan	-0.11	-0.51	-1.53	-2.31	-2.36	-2.35
BasicChemMan	0.04	0.25	0.84	1.65	2.38	3.01
FertPestMan	-0.02	-0.1	-0.26	-0.38	-0.29	-0.27
OthChemMan	0	0.03	0.15	0.38	0.79	1.14
PlyRubPrdMan	0	0.03	0.13	0.31	0.64	1.03
NonMetPrdMan	0.02	0.06	0.2	0.35	0.49	0.62
PrmMetPrdMan	0.1	0.57	1.86	3.4	4.48	5.37
FabMetPrdMan	0	-0.04	-0.13	-0.12	-0.01	0.13
TransEquMan	-0.14	-0.59	-1.67	-2.35	-1.72	-1.27
ElectPrdMan	0.02	0.19	0.66	1.41	2.26	2.93
MachineryMan	0	0.03	0.14	0.46	1.02	1.78
FurnitureMan	-0.01	-0.05	-0.12	-0.06	0.25	0.61
OthMan	0	0.01	0	0.01	0.09	0.37
ElectricGen	-0.01	-0.06	-0.18	-0.28	-0.28	-0.28

Industry	2021	2022	2023	2024	2025	2026
ElectricDist	-0.01	-0.06	-0.17	-0.2	-0.1	-0.02
GasSupply	-0.02	-0.17	-0.54	-0.81	-0.84	-0.84
WaterSupply	-0.01	-0.03	-0.09	-0.07	0.04	0.09
Sewerage	0	-0.01	-0.02	0.01	0.14	0.24
Waste	-0.03	-0.16	-0.46	-0.56	-0.3	-0.08
ResidConst	0.04	0.17	0.35	0.25	-0.04	-0.17
NonResConst	-0.07	-0.67	-1.62	-2.35	-2.43	-2.51
EngineerSrv	0.01	0.02	-0.06	-0.22	-0.31	-0.33
ConstructSrv	-0.01	-0.11	-0.37	-0.73	-0.94	-1.03
BasicMatWS	0.01	0.06	0.23	0.49	0.88	1.3
MachEquipWS	-0.01	-0.05	-0.14	-0.08	0.22	0.79
MotorVehWS	-0.01	-0.07	-0.31	-0.63	-0.88	-0.84
GrocLiqTobWS	0	-0.01	0	0.09	0.39	0.7
OthWS	0	0	0.02	0.04	0.13	0.33
MotorVehRT	-0.01	-0.09	-0.33	-0.56	-0.45	-0.19
FuelRT	-0.04	-0.19	-0.64	-1.05	-0.92	-0.76
FoodRT	0	0	0.05	0.24	0.67	0.97
SpecFoodRT	-1.05	-4.55	-14.23	-19.95	-16.62	-13.47
FurnElecHwRT	0	0	0.02	0.09	0.48	0.85
RecCloFwPaRT	0.01	0.02	0	-0.08	-0.04	0.12
DeptStoreRT	0	0	0	0.06	0.41	0.74
OthRT	0.01	0.02	0.03	-0.01	0.03	0.19
Accommodatn	-1.87	-8.03	-22.41	-29.31	-30.41	-30.79
FoodBevSrv	-1	-4.47	-13.74	-20.21	-21.81	-22.84
RoadTran	-0.18	-0.82	-2.61	-3.99	-4.14	-4.14
RailTran	-0.21	-0.85	-2.51	-3.51	-3.15	-2.85
OthTran	-0.3	-1.47	-5.17	-8.35	-8.98	-9.57
AirSpaceTran	-1.86	-7.77	-21.46	-28.96	-29.08	-28.67
PostCourSrv	-0.06	-0.34	-0.89	-0.94	-0.31	0.26
TranSupSrv	-0.13	-0.48	-1.36	-1.59	-1.21	-0.93
WHStorageSrv	-0.18	-0.67	-1.78	-1.98	-1.07	-0.36
Publishing	-0.09	-0.41	-1.1	-1.15	-0.15	0.46
FilmSoundRec	0.02	0.13	0.45	0.86	1.3	1.8
BrcstIntPub	-0.02	-0.14	-0.45	-0.73	-0.75	-0.72
Telecom	-0.03	-0.2	-0.63	-1.02	-1.1	-1.15
LibInfoSrv	-0.05	-0.19	-0.65	-0.88	-0.65	-0.48
BankingFinan	-0.03	-0.14	-0.44	-0.73	-0.67	-0.47
LifeInsurnce	-0.01	-0.12	-0.49	-1.12	-1.54	-1.58
HealthGenIns	-0.01	-0.12	-0.49	-0.88	-1.07	-0.5
SuperPension	-0.02	-0.19	-0.56	-0.81	-0.58	-0.51

Industry	2021	2022	2023	2024	2025	2026
AuxFinInsSrv	-0.04	-0.26	-0.88	-1.48	-1.57	-1.32
RentHireSrv	-0.01	-0.07	-0.29	-0.57	-0.7	-0.69
ResPropOp	-0.01	-0.04	-0.12	-0.17	-0.14	-0.13
NonResPropOp	-0.02	-0.1	-0.33	-0.5	-0.53	-0.57
REstateSrv	0	-0.09	-0.21	-0.35	-0.35	-0.35
OwnOccPropOp	0	-0.02	-0.06	-0.06	-0.02	-0.01
SciArcEngSrv	0	0.02	0.08	0.24	0.54	0.89
LegalAccSrv	-0.02	-0.2	-0.55	-0.7	-0.87	-0.86
AdvManSrv	-0.03	-0.19	-0.69	-1.15	-1.28	-1.08
VetOthPrfSrv	-0.02	-0.12	-0.45	-0.72	-0.84	-0.75
CompDesSrv	-0.02	-0.11	-0.28	-0.27	0.03	0.5
TravTourSrv	-4.28	-16.66	-36.91	-45.83	-45.24	-44.19
EmpAdmSrv	-0.08	-0.4	-1.23	-1.88	-1.69	-1.38
BldingSupSrv	-0.06	-0.33	-1.01	-1.51	-1.4	-1.21
LocGovAdm	-0.13	-0.53	-1.62	-2.1	-1.55	-1.12
CentGovSrv	0.01	0.06	0.22	0.36	0.46	0.54
Defence	-0.03	-0.14	-0.45	-0.67	-0.71	-0.83
PubOrdRegSrv	-0.06	-0.26	-0.76	-0.72	0.17	0.89
PreschoolEdu	0.05	0.34	1.18	2.27	3.16	3.89
SchoolEdu	0.1	0.71	2.16	3.74	5.04	6.19
TertiaryEdu	-0.82	-7.83	-15.53	-19.2	-19.77	-20.06
AdultCommEdu	-0.22	-0.06	-2.85	-7.86	-10.96	-14.6
Hospitals	0.05	0.34	1.15	2.22	3.02	3.64
MedHealthSrv	0.02	0.15	0.51	1	1.45	1.91
ResCareSocAs	-0.02	-0.11	-0.35	-0.31	0.4	0.97
HeritageArts	-0.32	-1.33	-4.06	-5.93	-5.6	-5.34
SportRecSrv	-0.38	-1.74	-5.72	-8.26	-7.62	-7.03
Gambling	-0.07	-0.41	-1.53	-3.09	-4.3	-5.06
RepairMaint	-0.03	-0.16	-0.51	-0.87	-0.88	-0.78
PerSrvHHStf	-0.03	-0.17	-0.58	-0.97	-1.03	-1.04
RelCivilProf	-0.06	-0.31	-0.82	-0.34	1.37	2.66

SOURCE: MDG5-NZ MODELLING ESTIMATES

TABLE 7 IMPACTS BY INDUSTRY: VALUE ADDED - LOW SCENARIO

Cumulative percentage change from baseline

Industry	2021	2022	2023	2024	2025	2026
HorticFruit	-0.03	-0.08	-0.27	-0.23	0	0.2
SheepBeefGrn	-0.01	-0.04	-0.14	-0.24	-0.25	-0.25
DairyCattle	-0.01	-0.03	-0.12	-0.19	-0.21	-0.17
OthLivestock	-0.04	-0.12	-0.33	-0.24	0.1	0.23
ForestLog	0.09	0.36	1.07	1.77	2.22	2.61
FishingAqua	0.02	0.09	0.24	0.4	0.56	0.67
AgForFishSrv	0	0.01	0.03	0.17	0.45	0.66
CoalMining	0.07	0.34	1.16	2.01	2.58	2.99
OilGasExtrct	0	0	0.01	0.03	0.1	0.23
MetNonMetMin	0.04	0.21	0.64	1.11	1.49	1.84
MiningSupSrv	0	-0.08	0	0.18	0.46	0.66
MeatMan	-0.01	-0.06	-0.19	-0.26	-0.23	-0.19
SeafoodProc	0.02	0.15	0.55	1.09	1.66	2.21
DairyMan	-0.01	-0.03	-0.09	-0.11	-0.08	-0.05
OthFoodMan	0	0.02	0.08	0.23	0.51	0.75
BevTobMan	-0.04	-0.17	-0.59	-0.95	-1.03	-0.93
TexLeathMan	0.07	0.3	0.95	1.56	2.04	2.52
ClthFootwMan	0.05	0.27	0.9	1.73	2.46	2.9
WoodProdMan	0.05	0.21	0.65	1.07	1.4	1.67
PaperProdMan	0.07	0.38	1.21	2.14	2.84	3.32
Printing	-0.05	-0.21	-0.59	-0.71	-0.52	-0.3
PetrCoalMan	-0.11	-0.41	-1.2	-1.62	-1.55	-1.37
BasicChemMan	0.04	0.22	0.71	1.32	1.84	2.24
FertPestMan	-0.02	-0.08	-0.21	-0.29	-0.21	-0.18
OthChemMan	0	0.02	0.13	0.31	0.62	0.87
PlyRubPrdMan	0	0.03	0.11	0.25	0.51	0.8
NonMetPrdMan	0.02	0.05	0.14	0.22	0.3	0.37
PrmMetPrdMan	0.1	0.48	1.52	2.61	3.33	3.81
FabMetPrdMan	0	-0.04	-0.13	-0.13	-0.04	0.06
TransEquMan	-0.14	-0.47	-1.3	-1.62	-1.05	-0.58
ElectPrdMan	0.02	0.17	0.56	1.13	1.73	2.15
MachineryMan	0	0.03	0.12	0.37	0.8	1.35
FurnitureMan	-0.01	-0.04	-0.11	-0.06	0.18	0.46
OthMan	0	0.01	-0.01	-0.02	0.04	0.26
ElectricGen	-0.01	-0.05	-0.16	-0.23	-0.23	-0.23
ElectricDist	-0.01	-0.05	-0.15	-0.16	-0.09	-0.02
GasSupply	-0.02	-0.15	-0.47	-0.66	-0.66	-0.63

Industry	2021	2022	2023	2024	2025	2026
WaterSupply	-0.01	-0.03	-0.07	-0.04	0.04	0.08
Sewerage	0	-0.01	-0.03	-0.01	0.08	0.15
Waste	-0.03	-0.14	-0.4	-0.44	-0.22	-0.04
ResidConst	0.04	0.14	0.27	0.13	-0.09	-0.2
NonResConst	-0.07	-0.61	-1.48	-2.06	-2.11	-2.13
EngineerSrv	0.02	0.01	-0.07	-0.23	-0.31	-0.31
ConstructSrv	-0.01	-0.1	-0.34	-0.64	-0.8	-0.85
BasicMatWS	0.01	0.05	0.18	0.36	0.65	0.93
MachEquipWS	-0.01	-0.05	-0.13	-0.09	0.16	0.58
MotorVehWS	-0.01	-0.07	-0.27	-0.51	-0.66	-0.59
GrocLiqTobWS	0	-0.01	-0.02	0.05	0.27	0.48
OthWS	0	0	0	0.01	0.07	0.21
MotorVehRT	-0.01	-0.08	-0.3	-0.47	-0.37	-0.15
FuelRT	-0.04	-0.16	-0.54	-0.81	-0.67	-0.47
FoodRT	0	0	0.02	0.16	0.48	0.68
SpecFoodRT	-1.05	-3.62	-11.13	-13.59	-9.68	-5.3
FurnElecHwRT	0.01	-0.01	-0.03	-0.02	0.24	0.48
RecCloFwPaRT	0.01	0	-0.06	-0.19	-0.21	-0.12
DeptStoreRT	0	-0.01	-0.04	-0.04	0.21	0.43
OthRT	0.01	0.01	0	-0.07	-0.05	0.06
Accommodatn	-1.87	-6.25	-16.71	-18.54	-17.43	-14.69
FoodBevSrv	-0.99	-3.55	-10.53	-13.81	-14.1	-13.29
RoadTran	-0.18	-0.65	-1.98	-2.71	-2.61	-2.29
RailTran	-0.21	-0.65	-1.82	-2.21	-1.8	-1.33
OthTran	-0.3	-1.23	-4.24	-6.14	-6.23	-6.03
AirSpaceTran	-1.86	-6.11	-16.29	-19.14	-17.71	-14.99
PostCourSrv	-0.06	-0.29	-0.73	-0.68	-0.16	0.31
TranSupSrv	-0.13	-0.34	-0.9	-0.87	-0.51	-0.18
WHStorageSrv	-0.18	-0.48	-1.2	-1.07	-0.32	0.32
Publishing	-0.09	-0.33	-0.86	-0.71	0.09	0.64
FilmSoundRec	0.02	0.11	0.37	0.67	0.99	1.32
BrcstIntPub	-0.02	-0.12	-0.37	-0.56	-0.55	-0.5
Telecom	-0.03	-0.18	-0.54	-0.82	-0.87	-0.87
LibInfoSrv	-0.05	-0.15	-0.49	-0.56	-0.34	-0.13
BankingFinan	-0.03	-0.11	-0.36	-0.55	-0.48	-0.29
LifeInsurnce	-0.01	-0.11	-0.43	-0.95	-1.24	-1.24
HealthGenIns	-0.01	-0.11	-0.41	-0.7	-0.77	-0.27
SuperPension	-0.01	-0.17	-0.53	-0.75	-0.57	-0.48
AuxFinInsSrv	-0.04	-0.22	-0.73	-1.14	-1.14	-0.87
RentHireSrv	-0.01	-0.06	-0.23	-0.43	-0.49	-0.44

Industry	2021	2022	2023	2024	2025	2026
ResPropOp	-0.01	-0.04	-0.11	-0.14	-0.12	-0.11
NonResPropOp	-0.02	-0.07	-0.24	-0.32	-0.31	-0.28
REstateSrv	0	-0.09	-0.21	-0.35	-0.37	-0.39
OwnOccPropOp	0	-0.02	-0.05	-0.05	-0.03	-0.02
SciArcEngSrv	0	0.03	0.1	0.25	0.48	0.73
LegalAccSrv	-0.02	-0.18	-0.45	-0.52	-0.57	-0.5
AdvManSrv	-0.03	-0.16	-0.56	-0.86	-0.9	-0.66
VetOthPrfSrv	-0.02	-0.11	-0.38	-0.57	-0.62	-0.53
CompDesSrv	-0.02	-0.09	-0.24	-0.22	0	0.33
TravTourSrv	-4.27	-12.96	-27.23	-28.77	-25.86	-21.26
EmpAdmSrv	-0.08	-0.33	-0.99	-1.37	-1.14	-0.79
BldingSupSrv	-0.05	-0.28	-0.84	-1.15	-1.02	-0.8
LocGovAdm	-0.13	-0.39	-1.15	-1.28	-0.78	-0.33
CentGovSrv	0.01	0.05	0.17	0.25	0.3	0.32
Defence	-0.03	-0.11	-0.35	-0.47	-0.49	-0.53
PubOrdRegSrv	-0.06	-0.2	-0.56	-0.4	0.3	0.89
PreschoolEdu	0.05	0.29	0.97	1.75	2.37	2.79
SchoolEdu	0.09	0.63	1.86	3.05	3.98	4.7
TertiaryEdu	-0.76	-7.36	-15.02	-18.75	-19.54	-19.97
AdultCommEdu	-0.23	0.18	-1.64	-4.38	-6.1	-7.55
Hospitals	0.05	0.29	0.96	1.73	2.28	2.64
MedHealthSrv	0.02	0.12	0.42	0.77	1.1	1.39
ResCareSocAs	-0.02	-0.09	-0.32	-0.29	0.24	0.66
HeritageArts	-0.32	-1.04	-3.04	-3.82	-3.24	-2.5
SportRecSrv	-0.38	-1.38	-4.4	-5.58	-4.7	-3.63
Gambling	-0.07	-0.34	-1.21	-2.29	-3.05	-3.37
RepairMaint	-0.03	-0.13	-0.4	-0.62	-0.57	-0.43
PerSrvHHStf	-0.03	-0.15	-0.5	-0.78	-0.81	-0.78
RelCivilProf	-0.06	-0.27	-0.71	-0.26	1.02	1.98

SOURCE: MDG5-NZ MODELLING ESTIMATES

TABLE 8 IMPACTS BY INDUSTRY: VALUE ADDED - MEDIUM SCENARIO

Cumulative percentage change from baseline

Industry	2021	2022	2023	2024	2025	2026
HorticFruit	-0.03	-0.07	-0.24	-0.17	0.02	0.17
SheepBeefGrn	-0.01	-0.04	-0.12	-0.20	-0.21	-0.20
DairyCattle	-0.01	-0.03	-0.10	-0.16	-0.17	-0.14
OthLivestock	-0.04	-0.10	-0.28	-0.18	0.09	0.18
ForestLog	0.08	0.31	0.92	1.48	1.85	2.18
FishingAqua	0.02	0.07	0.21	0.34	0.46	0.56
AgForFishSrv	0.00	0.01	0.02	0.14	0.37	0.54
CoalMining	0.07	0.30	1.01	1.69	2.15	2.50
OilGasExtrct	0.00	0.00	0.01	0.03	0.08	0.20
MetNonMetMin	0.04	0.18	0.55	0.93	1.24	1.54
MiningSupSrv	0.01	-0.06	0.01	0.12	0.36	0.52
MeatMan	-0.01	-0.06	-0.17	-0.22	-0.19	-0.16
SeafoodProc	0.02	0.13	0.47	0.93	1.41	1.87
DairyMan	-0.01	-0.02	-0.07	-0.09	-0.07	-0.04
OthFoodMan	0.00	0.02	0.06	0.20	0.43	0.62
BevTobMan	-0.04	-0.15	-0.51	-0.79	-0.84	-0.76
TexLeathMan	0.06	0.27	0.83	1.30	1.70	2.12
ClthFootwMan	0.05	0.24	0.78	1.46	2.06	2.42
WoodProdMan	0.05	0.19	0.56	0.89	1.16	1.40
PaperProdMan	0.07	0.34	1.04	1.80	2.37	2.78
Printing	-0.05	-0.18	-0.51	-0.58	-0.41	-0.25
PetrCoalMan	-0.11	-0.36	-1.04	-1.33	-1.26	-1.14
BasicChemMan	0.04	0.19	0.61	1.12	1.55	1.89
FertPestMan	-0.02	-0.07	-0.18	-0.24	-0.17	-0.15
OthChemMan	0.00	0.02	0.11	0.27	0.52	0.73
PlyRubPrdMan	0.00	0.02	0.10	0.22	0.43	0.68
NonMetPrdMan	0.02	0.04	0.12	0.17	0.24	0.31
PrmMetPrdMan	0.09	0.43	1.32	2.19	2.77	3.19
FabMetPrdMan	0.00	-0.04	-0.11	-0.11	-0.04	0.05
TransEquMan	-0.14	-0.41	-1.13	-1.31	-0.84	-0.49
ElectPrdMan	0.02	0.15	0.48	0.96	1.45	1.80
MachineryMan	0.00	0.03	0.10	0.32	0.68	1.14
FurnitureMan	-0.01	-0.04	-0.10	-0.05	0.15	0.38
OthMan	0.00	0.01	-0.01	-0.02	0.04	0.22
ElectricGen	-0.01	-0.05	-0.14	-0.20	-0.20	-0.20
ElectricDist	-0.01	-0.05	-0.12	-0.14	-0.07	-0.02
GasSupply	-0.02	-0.13	-0.40	-0.55	-0.56	-0.54

Industry	2021	2022	2023	2024	2025	2026
WaterSupply	-0.01	-0.02	-0.06	-0.03	0.03	0.06
Sewerage	0.00	-0.01	-0.02	-0.02	0.06	0.12
Waste	-0.02	-0.12	-0.34	-0.36	-0.18	-0.04
ResidConst	0.04	0.12	0.23	0.09	-0.09	-0.17
NonResConst	-0.06	-0.53	-1.25	-1.77	-1.79	-1.81
EngineerSrv	0.02	0.01	-0.06	-0.21	-0.27	-0.27
ConstructSrv	0.00	-0.09	-0.29	-0.56	-0.68	-0.72
BasicMatWS	0.01	0.04	0.15	0.30	0.54	0.77
MachEquipWS	-0.01	-0.04	-0.11	-0.07	0.13	0.48
MotorVehWS	-0.01	-0.06	-0.23	-0.44	-0.55	-0.49
GrocLiqTobWS	0.00	-0.01	-0.02	0.04	0.22	0.40
OthWS	0.00	0.00	0.00	0.00	0.05	0.18
MotorVehRT	-0.01	-0.07	-0.26	-0.41	-0.32	-0.13
FuelRT	-0.03	-0.14	-0.47	-0.68	-0.56	-0.40
FoodRT	0.00	0.00	0.02	0.14	0.40	0.56
SpecFoodRT	-1.05	-3.17	-9.76	-11.01	-7.54	-4.27
FurnElecHwRT	0.01	-0.01	-0.03	-0.04	0.18	0.38
RecCloFwPaRT	0.01	0.00	-0.05	-0.19	-0.20	-0.12
DeptStoreRT	0.00	-0.01	-0.04	-0.05	0.16	0.34
OthRT	0.01	0.01	0.00	-0.07	-0.05	0.04
Accommodatn	-1.87	-5.43	-14.39	-14.54	-13.47	-11.80
FoodBevSrv	-0.99	-3.11	-9.16	-11.28	-11.43	-11.06
RoadTran	-0.18	-0.57	-1.72	-2.22	-2.11	-1.89
RailTran	-0.20	-0.56	-1.56	-1.77	-1.42	-1.10
OthTran	-0.30	-1.10	-3.74	-5.08	-5.12	-5.05
AirSpaceTran	-1.85	-5.33	-14.13	-15.37	-14.06	-12.31
PostCourSrv	-0.06	-0.25	-0.62	-0.55	-0.12	0.26
TranSupSrv	-0.13	-0.29	-0.77	-0.68	-0.38	-0.14
WHStorageSrv	-0.18	-0.40	-1.02	-0.83	-0.21	0.26
Publishing	-0.09	-0.28	-0.74	-0.55	0.12	0.53
FilmSoundRec	0.02	0.10	0.32	0.57	0.83	1.12
BrcstIntPub	-0.02	-0.10	-0.32	-0.47	-0.46	-0.42
Telecom	-0.03	-0.16	-0.47	-0.70	-0.73	-0.74
LibInfoSrv	-0.05	-0.13	-0.42	-0.44	-0.26	-0.10
BankingFinan	-0.02	-0.10	-0.31	-0.46	-0.40	-0.24
LifeInsurnce	-0.01	-0.10	-0.38	-0.82	-1.05	-1.05
HealthGenIns	-0.01	-0.10	-0.35	-0.59	-0.63	-0.21
SuperPension	-0.01	-0.15	-0.46	-0.67	-0.50	-0.43
AuxFinInsSrv	-0.04	-0.20	-0.63	-0.96	-0.94	-0.72
RentHireSrv	-0.01	-0.06	-0.20	-0.36	-0.41	-0.37

Industry	2021	2022	2023	2024	2025	2026
ResPropOp	-0.01	-0.03	-0.09	-0.12	-0.10	-0.10
NonResPropOp	-0.02	-0.06	-0.21	-0.26	-0.24	-0.22
REstateSrv	0.00	-0.07	-0.18	-0.31	-0.32	-0.34
OwnOccPropOp	0.00	-0.02	-0.04	-0.05	-0.02	-0.02
SciArcEngSrv	0.00	0.03	0.08	0.22	0.41	0.61
LegalAccSrv	-0.02	-0.17	-0.39	-0.44	-0.46	-0.40
AdvManSrv	-0.03	-0.15	-0.49	-0.73	-0.74	-0.54
VetOthPrfSrv	-0.02	-0.10	-0.33	-0.48	-0.52	-0.44
CompDesSrv	-0.02	-0.08	-0.21	-0.19	0.00	0.27
TravTourSrv	-4.27	-11.25	-23.39	-22.70	-20.16	-17.24
EmpAdmSrv	-0.08	-0.29	-0.86	-1.14	-0.93	-0.66
BldingSupSrv	-0.05	-0.25	-0.72	-0.95	-0.84	-0.67
LocGovAdm	-0.13	-0.34	-0.99	-1.01	-0.60	-0.27
CentGovSrv	0.01	0.04	0.15	0.20	0.24	0.27
Defence	-0.03	-0.10	-0.30	-0.38	-0.40	-0.44
PubOrdRegSrv	-0.06	-0.17	-0.49	-0.30	0.28	0.74
PreschoolEdu	0.05	0.26	0.84	1.47	1.97	2.33
SchoolEdu	0.09	0.55	1.59	2.58	3.34	3.94
TertiaryEdu	-0.65	-6.44	-12.26	-16.13	-16.61	-16.89
AdultCommEdu	-0.25	0.16	-1.64	-3.45	-4.81	-6.14
Hospitals	0.05	0.26	0.83	1.46	1.91	2.20
MedHealthSrv	0.02	0.11	0.36	0.65	0.92	1.17
ResCareSocAs	-0.01	-0.08	-0.28	-0.26	0.19	0.53
HeritageArts	-0.32	-0.90	-2.64	-3.06	-2.55	-2.06
SportRecSrv	-0.38	-1.20	-3.83	-4.52	-3.75	-3.00
Gambling	-0.07	-0.30	-1.06	-1.94	-2.53	-2.80
RepairMaint	-0.03	-0.12	-0.35	-0.52	-0.47	-0.35
PerSrvHHStf	-0.02	-0.13	-0.43	-0.67	-0.68	-0.67
RelCivilProf	-0.05	-0.23	-0.62	-0.22	0.85	1.61

SOURCE: MDG5-NZ MODELLING ESTIMATES

Appendix B Resurgence scenarios

TABLE 9 DIRECT IMPACTS BY INDUSTRY FROM SHORT AND LONG OUTBREAKS

Percentage change from baseline, March year 2021

Industry	Short	Long	PREFU	Industry	Short	Long	PREFU
HorticFruit	0.0%	0.0%	0.0%	FurnElecH	-1.1%	-3.1%	-4.0%
SheepBeefGrn	0.0%	0.0%	0.0%	RecCloFwP	-1.1%	-3.1%	-4.0%
DairyCattle	0.0%	0.0%	0.0%	DeptStore	-1.1%	-3.1%	-4.0%
OthLivestock	0.0%	0.0%	0.0%	OthRT	-1.1%	-3.1%	-4.0%
ForestLog	0.0%	0.0%	-0.1%	Accommo	-2.0%	-5.4%	-8.2%
FishingAqua	0.0%	0.0%	-0.1%	FoodBevSr	-2.5%	-6.3%	-8.2%
AgForFishSrv	0.0%	0.0%	-0.1%	RoadTran	-0.5%	-1.3%	-1.6%
CoalMining	0.0%	-0.1%	-1.0%	RailTran	-0.5%	-1.3%	-1.6%
OilGasExtrct	0.0%	-0.1%	-1.0%	OthTran	-0.5%	-1.3%	-1.6%
MetNonMetMin	0.0%	-0.1%	-1.0%	AirSpaceTr	-0.5%	-1.3%	-1.6%
MiningSupSrv	0.0%	-0.1%	-1.0%	PostCourS	-0.5%	-1.3%	-1.6%
MeatMan	-0.2%	-0.4%	-0.6%	TranSupSr	-0.5%	-1.3%	-1.6%
SeafoodProc	-0.2%	-0.4%	-0.6%	WHStorag	-0.5%	-1.3%	-1.6%
DairyMan	-0.2%	-0.4%	-0.6%	Publishing	-0.7%	-1.9%	-2.2%
OthFoodMan	-0.2%	-0.4%	-0.6%	FilmSound	-0.7%	-1.9%	-2.2%
BevTobMan	-0.2%	-0.4%	-0.6%	BrcstIntPu	-0.7%	-1.9%	-2.2%
TexLeathMan	-0.4%	-1.1%	-1.3%	Telecom	-0.7%	-1.9%	-2.2%
ClthFootwMan	-0.4%	-1.1%	-1.3%	LibInfoSrv	-0.7%	-1.9%	-2.2%
WoodProdMan	-0.4%	-1.0%	-1.3%	BankingFin	-0.6%	-1.5%	-1.6%
PaperProdMan	-0.4%	-1.0%	-1.3%	LifeInsurnc	-0.6%	-1.5%	-1.6%
Printing	-0.2%	-0.6%	-0.6%	HealthGen	-0.6%	-1.5%	-1.6%
PetrCoalMan	-0.4%	-1.0%	-1.2%	SuperPens	-0.6%	-1.5%	-1.6%
BasicChemMan	-0.4%	-1.0%	-1.2%	AuxFinInsS	-0.6%	-1.5%	-1.6%
FertPestMan	-0.4%	-1.0%	-1.2%	RentHireSr	-2.1%	-5.2%	-6.7%
OthChemMan	-0.4%	-1.0%	-1.2%	ResPropO	-2.1%	-5.2%	-6.7%
PlyRubPrdMan	-0.4%	-1.0%	-1.2%	NonResPr	-2.1%	-5.2%	-6.7%
NonMetPrdMan	-0.5%	-1.4%	-1.6%	REstateSrv	-2.1%	-5.2%	-6.7%
PrmMetPrdMan	-0.5%	-1.4%	-1.6%	OwnOccPr	0.0%	0.0%	0.0%
FabMetPrdMan	-0.5%	-1.4%	-1.6%	SciArcEng	-0.8%	-2.2%	-2.5%
TransEquMan	-0.5%	-1.4%	-1.6%	LegalAccSr	-0.8%	-2.2%	-2.5%
ElectPrdMan	-0.5%	-1.4%	-1.6%	AdvManSr	-0.8%	-2.2%	-2.5%
MachineryMan	-0.5%	-1.4%	-1.6%	VetOthPrf	-0.8%	-2.2%	-2.5%
FurnitureMan	-0.5%	-1.4%	-1.6%	CompDesS	-0.8%	-2.2%	-2.5%
OthMan	-0.5%	-1.4%	-1.6%	TravTourSr	-2.6%	-6.5%	-8.2%
ElectricGen	0.0%	0.0%	-0.1%	EmpAdmS	-0.9%	-2.3%	-2.9%

ElectricDist	0.0%	0.0%	-0.1%	BldingSup	-0.9%	-2.3%	-2.9%
GasSupply	0.0%	0.0%	-0.1%	LocGovAd	-0.4%	-1.0%	-1.6%
WaterSupply	0.0%	0.0%	-0.1%	CentGovSr	-0.1%	-0.3%	-0.5%
Sewerage	0.0%	0.0%	-0.1%	Defence	-0.1%	-0.3%	-0.5%
Waste	0.0%	0.0%	-0.1%	PubOrdRe	-0.1%	-0.3%	-0.5%
ResidConst	-0.6%	-1.7%	-2.2%	PreschoolE	-0.8%	-2.1%	-2.8%
NonResConst	-0.6%	-1.7%	-2.2%	SchoolEdu	-0.8%	-2.1%	-2.8%
EngineerSrv	-0.7%	-1.8%	-2.5%	TertiaryEd	-0.8%	-2.1%	-2.8%
ConstructSrv	-0.7%	-1.8%	-2.5%	AdultCom	-0.8%	-2.1%	-2.8%
BasicMatWS	-0.4%	-1.0%	-1.1%	Hospitals	0.0%	0.0%	0.0%
MachEquipWS	-0.4%	-1.0%	-1.1%	MedHealt	0.0%	0.0%	0.0%
MotorVehWS	-0.4%	-1.0%	-1.1%	ResCareSo	0.0%	0.0%	0.0%
GrocLiqTobWS	-0.4%	-1.0%	-1.1%	HeritageAr	-2.3%	-6.3%	-8.7%
OthWS	-0.4%	-1.0%	-1.1%	SportRecS	-2.3%	-6.3%	-8.7%
MotorVehRT	-1.1%	-3.1%	-4.0%	Gambling	-2.3%	-6.3%	-8.7%
FuelRT	-1.1%	-3.1%	-4.0%	RepairMai	-2.3%	-6.3%	-8.7%
FoodRT	-1.1%	-3.1%	-4.0%	PerSrvHHS	-2.3%	-6.3%	-8.7%
SpecFoodRT	-1.1%	-3.1%	-4.0%	RelCivilPro	-2.3%	-6.3%	-8.7%

SOURCE: SENSE PARTNERS CALCULATIONS

Appendix C PREFU assumptions

These assumptions shaped our baseline. They were finalised in early July 2020. Note they were never published due to the second outbreak of Covid in Auckland, which delayed the election (and hence PREFU) by a month.

All figures are quarterly, seasonally adjusted and in 09/10 prices.

Quarter	Real GDP(E)	Real private consumption	Real govt consumption	Real resid investment	Real business investment	Real exports	Real imports	Unempl rate	LFPR	Net migration
2019Q3	63912	39684	12220	4001	12117	18075	22040	4.1	70.4	15850
2019Q4	64218	39810	12445	4073	12017	18205	22133	4.0	70.1	15530
2020Q1	63194	39708	12445	3850	11753	17821	20885	4.2	70.4	12000
2020Q2	52451	32561	12871	1925	7052	14062	15617	7.3	68.0	1000
2020Q3	59794	37770	13003	3273	10373	14256	18440	8.5	69.0	1000
2020Q4	60508	38193	13089	3202	11001	14304	18824	8.4	69.3	1000
2021Q1	61047	38700	13160	3342	11033	14431	19083	8.2	69.5	1000
2021Q2	61483	38959	13228	3354	11051	14754	19278	8.2	69.6	2000
2021Q3	61916	39243	13282	3389	11030	15057	19466	8.2	69.8	3000
2021Q4	62624	39567	13338	3489	11035	15697	19855	8.0	69.9	4000
2022Q1	63349	39901	13390	3600	11210	16168	20251	7.8	70.1	5000
2022Q2	64061	40243	13446	3697	11413	16588	20640	7.5	70.2	5500

Quarter	Real GDP(E)	Real private consumption	Real govt consumption	Real resid investment	Real business investment	Real exports	Real imports	Unempl rate	LFPR	Net migration
2022Q3	64766	40592	13498	3815	11622	16964	21022	7.2	70.4	6000
2022Q4	65452	40945	13546	3916	11848	17302	21387	6.9	70.5	6500
2023Q1	66130	41304	13591	4019	12075	17619	21745	6.5	70.6	7000
2023Q2	66807	41671	13630	4124	12308	17916	22097	6.2	70.7	7500
2023Q3	67484	42046	13666	4232	12545	18198	22445	5.9	70.8	8000
2023Q4	68162	42430	13697	4342	12788	18467	22790	5.6	70.8	8500
2024Q1	68841	42821	13724	4453	13034	18725	23133	5.3	70.9	9000
2024Q2	69519	43217	13746	4566	13282	18972	23471	5.0	71.0	9500

SOURCE: THE TREASURY

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