Medium to long–term employment projections:
Looking ahead to 2028

August 2019

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT

HĪKINA WHAKATUTUKI

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Context

This report presents the Ministry of Business, Innovation and Employment's (MBIE's) latest employment projections to 2028[1]. It gives an indication of the overall outlook for future employment growth, and breaks down this growth by industry sectors and occupations and broad skill groups. The outlook is provided for the next 5 years to 2023 (medium term) and the following 5 years to 2028 (long term).

The Ministry uses these projections to gain insights on where future jobs may be created and which skills are projected to be in demand over the next 5 and 10 years. Projections are updated annually using the latest information on economic, demographic and global trends shaping the New Zealand economy and the labour market.

The baseline projections are related to the forecast overall GDP growth for New Zealand by the Treasury and their other macroeconomic forecasts. The productivity assumptions are informed by measured productivity at the individual industry level. These projections are indicative of the likely growth path for employment over the projection periods using a top-down model. If the actual GDP growth is lower than forecast, employment growth is likely to be lower than we project for the baseline.

The employment projections are used to help inform policy advice and operational decisions across a number of areas including priority settings for skill needs via immigration over the medium to long-term. The projections are also used in Occupation Outlook[2], an online tool and mobile app containing information on occupations for students and job seekers wanting to make career decisions.

In this report, employment projections are included for two additional scenarios in order to capture the uncertainty in the current trade environment associated with the impact of the imposition of bilateral tariffs by our major trading partners as well as the projected impacts of automation on the New Zealand workforce to compare with the baseline employment outlook. There a number of other factors that could contribute to the uncertainty related to the projected net employment growth, but these are considered to be the most salient.

The overall employment outlook and at the industry and occupation or skill level for these two scenarios provide an indication of the level of uncertainty in the baseline forecasts.

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[1] This employment outlook is based on projections of employment outcomes over the medium and long term 2018-23 and 2018-28, respectively. They are based on assessments for 2023 and 2028 March years compared to the base year, 2018 March year. They are not forecasts and do not track the dynamic path of the projections.

[2] https://occupationoutlook.mbie.govt.nz/

Summary

39,400 more workers on average projected each year to 2028

The Ministry projects employment to increase by over 394,000 (or 1.4 per cent per year) over the 10 years to March 2028. The top three contributors to employment growth will be the combined Retail trade, Accommodation and food services (65,800), Business services (61,100) and Construction & utilities (48,500) industries.

Over the medium-term to March 2023, employment is projected to grow at 1.6 per cent each year, increasing employment by 211,000. Employment growth is anticipated to be weaker at 1.3 per cent between 2023 and 2028, adding 184,000 more workers over this 5 year period.

As business and tourism-related services continue to grow over the next 10 years, employment growth in all skills levels is expected. In broad terms, employment growth by occupation is projected to be strongest for highly skilled and skilled occupations, and weakest for elementary and semi-skilled occupations. The office and practice manager occupation group is projected to grow fastest, followed by some IT roles and other occupations prominent in Business services, Construction, and Tourism-related sectors.

Highly skilled workers (most managers and all professionals) will be most in demand over this period, reflecting strong growth in the Business services sector. The Retail trade, accommodation and food services industries also contribute to steady employment growth. Continuing positive net migration will fuel household spending and activity in the construction and business services industries that will drive stronger employment growth, especially over the medium term. Over the longer term, diminishing net migration levels, returning to the long term average, will lower labour force growth and limit employment growth.

The employment growth projected over the medium to long-term in the baseline is based on moderate economic growth driven by continuing population growth, increasing gains from the expanding Business services sector and growth in the exports of goods and services.

The results for the two scenarios illustrate the potential impact on the New Zealand economy and the labour market. The trade disruption scenario focuses on the impacts on exports, the economy and employment in the medium-term (2018-23).

The automation impact scenario looks at the impacts on the economy and employment as well as on both labour and capital productivity over the longer term (2018-28) captured in this top-down modelling approach. This approach, which uses broader industry groups, only captures the net employment effects across these groups and hence is unable to identify the potential for employment growth associated with certain types of automation.

Background

Projections of Industry level employment growth is based on a New Zealand economy wide model

The employment outlook in this report is based on a Computable General Equilibrium (CGE) model of the New Zealand economy operated by the Ministry of Business, Innovation and Employment. This economy wide model captures the labour market impacts across broad industries in New Zealand arising from developments in the domestic economy, with production and consumption, the external trading environment, related to the prospects for

exports and the need for imports and investment for growth. This results in differential growth in employment in export oriented industries and domestic facing (service) industries.

The key drivers of the CGE model include the growth in world demand and prices for New Zealand exports which enabled the impact of potential trade disruption to New Zealand exports from the US-China tariff to be assessed. The other drivers of the CGE model include the baseline changes in industry level labour and capital productivity. These were then varied to capture the impact of automation in a top-down approach, with customised changes to be more prevalent in modelled industries, with relatively lower capital to labour use at present.

The employment outlook is guided by Treasury forecasts of economic growth and other macro-economic factors

The macro-economic setting over the first 5 year projection period is informed by the Treasury forecasts of GDP (Gross Domestic Production) growth and other key macro-economic factors such as household and government consumption, export and import growth and investment.

The projected growth from the 2018 baseline was generated using the BERL CGE Model customised for use by MBIE and is based on assumptions around labour supply and demographic factors, along with an economic and fiscal outlook over the next 10 years. Industries at the 2-3 digit ANZSIC06 level have been combined to create broader industry groups in the economic model. These have been further aggregated to summarise the results for 16 broad industry groups in this report. For example, Primary processing covered Food, beverage & tobacco manufacturing and Wood & paper products manufacturing industries.

A modest outlook for the next 5 and 10 years follows recent solid growth in the economy and employment

The New Zealand economy has experienced solid economic growth of 3.0 per cent per year (on average) along with employment growth of 3.4 per cent on average during the last five years (2013-18) (See Figure 8). This was due to strong growth in imports (5.8 per cent), investment (5.9 per cent), household consumption (3.6 per cent) and steady growth in exports of goods and services (2.9 per cent).

This was aided by steady growth amongst our key trading partners, China and Australia, with China rising in its importance as the destination for our primary product exports, along with other countries. The New Zealand economy was at the higher growth phase of a long business cycle assisted by high and often record net migration levels and strong growth in tourism from China and Australia in particular. During the early part of this 5 year period (2013-16), the stimulus from the post-earthquake Canterbury re-build also assisted.

There is some indication that the New Zealand economy may be returning to its long-term average growth in the medium-term after a few years of near potential growth. This has also been driven by external factors as a result of a gradual slowdown of the world economy, including the economies of our key trading partners.

Detailed employment projections by industries and skills

We project average employment growth of 1.6 per cent per year over the (medium-term) 2018-23 period and 1.3 per cent per year over the 2023-28 period. Over the entire 10-year period (2018-28), annual employment growth is expected to average 1.4 per cent or 39,400 more workers each year. This is lower than the 1.8 per cent projected for the 2016-26 period in the last update that included the (2016-18) period of strong job growth.

Some industries projected to generate more jobs as both employment and GDP grow

Figure 1 plots the relationship between levels of employment and economic growth by industry groups between 2018 and 2028. The size of the bubbles shows each industry group's share of total employment at 2028. The upper-right hand panel of Figure 1 shows where projected employment growth is strongest. The industry level GDP and employment growth projections for the 2018-28 period from the economy-wide modelling using the CGE model are presented to illustrate the industries expected to see similar or differential growth in GDP or economic and employment activity and those that experience greater productivity gains as GDP growth exceeds employment (e.g., Information, media and communications sector).

Figure 1: Four quadrants of projected industry level employment growth in relation to GDP growth
(Annual average changes for industries between 2018 and 2028 benchmarked with overall growth)
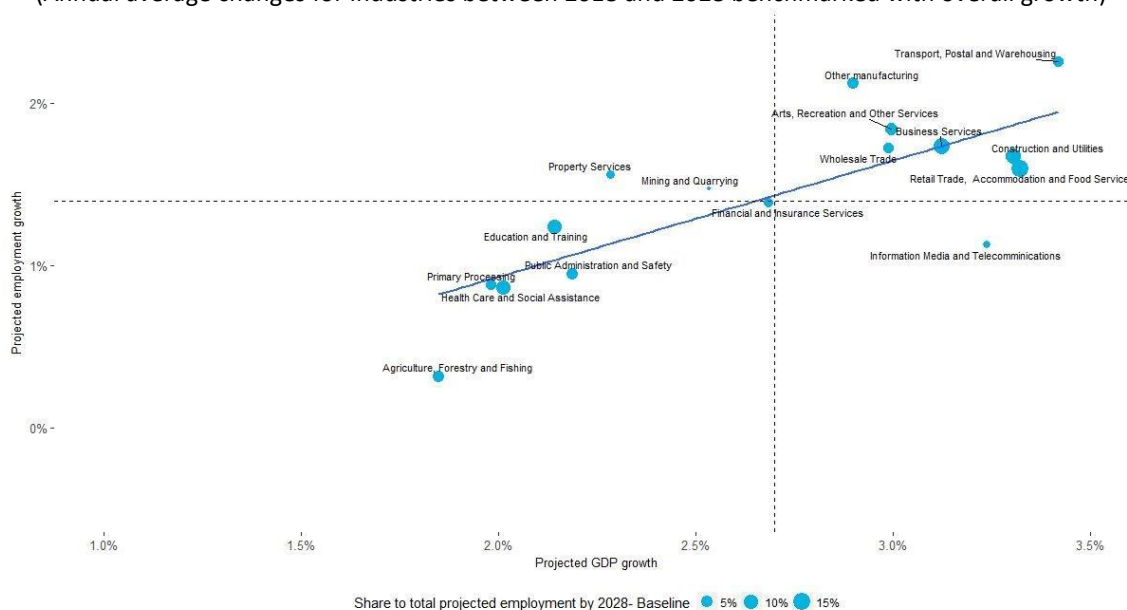
Note: Vertical line marks the national annual average GDP growth rate of 2.6 per cent per year for the 10 years to 2028, and the horizontal line marks the annual average employment growth rate of 1.4 per cent per year to 2028. The business services sector combines professional, scientific and technical services, and administrative and support services. Primary processing includes food and wood manufacturing.

The modest employment growth over the 2018-28 period reflects the impact of those industry groups expected to drive economic growth in the long-term. Higher than average annual GDP and employment growth is projected in Retail trade, Accommodation and food services, Construction and utilities, and Business services. Together, these sectors (with an increase of 175,400) provide nearly half of the total employment gains and more than a third of the total GDP growth over the period. While elements of these sectors are associated with lower labour productivity levels, they are expected to experience productivity gains as forecast GDP growth exceeds employment growth over the 10 years to 2028.

The lower-left panel of Figure 1 shows which industry groups are projected to experience slower than national rates of GDP and employment growth over the projection period. Employment opportunities in the public sector, including in Health care and social assistance, Education & training and Public administration & safety, will be steady, but weaker than the more private sector oriented service industries. The lower-right panel of Figure 1 shows a different growth pattern. Employment growth in industry groups such as Information media & telecommunications, with relatively higher labour productivity, are projected to experience modest employment growth despite higher than average GDP growth.

Employment shift to services will continue over the next 10 years

Figure 2 shows that nine of the sixteen summarised industry groups are projected to have higher than average annual employment growth (i.e., more than 1.4 per cent per year) over the 10 years to 2028. Of these industry groups, Transport, postal and warehousing (logistics) will have the strongest annual growth rate (2.3 per cent but only 2,700 additional employment per year as it is a small sector), followed by 'Other manufacturing' (2.1 per cent or 3,200 more employment per year) which are those not related to the processing of primary products.

Figure 2: Employment growth in aggregated sectors compared to NZ average during 2018-28
(Annual average percentage changes between 2018 and 2028)
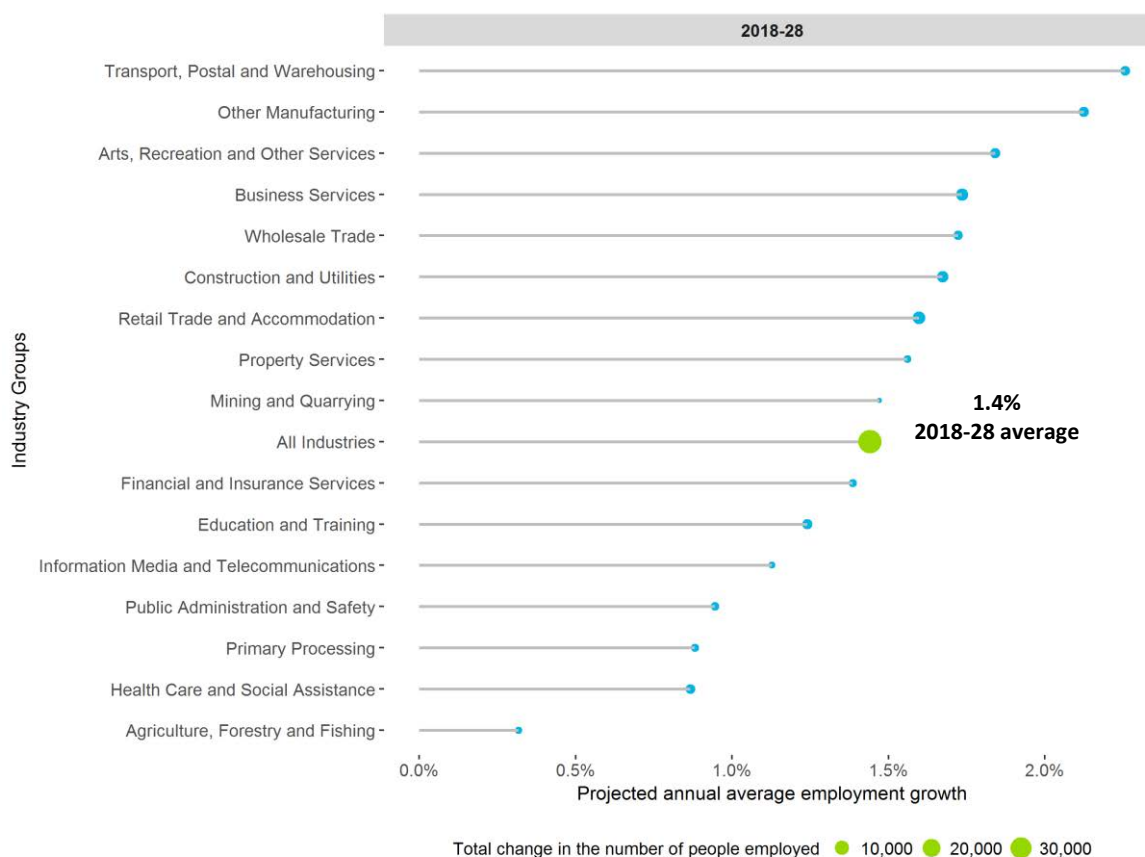
Note: The projected growth from the 2018 baseline was generated using the MBIE (BERL) CGE Model and are based on assumptions around industry level productivity, demographic factors along with economic and fiscal outlook over the next 10 years. We combine ANZSIC06 2-3-digit industries to create broader industry groups. For example, primary processing includes food, beverage & tobacco manufacturing and wood & paper products manufacturing.

Business services, Retail trade and Construction will drive employment growth

In terms of the size of the employment growth, it will be higher in Business services (6,100 more employment per year or 1.7 per cent), Retail trade and accommodation (6,600 more employment per year or 1.7 per cent), and Construction and utilities (4,800 more employment or 1.7 per cent). Strong growth in household spending, residential investment and tourism will underpin this growth.

We project that Agriculture and Primary (products) processing will experience the weakest employment growth in the coming 10 years (less than one per cent, on average). Some private sector industry groups including Information, media & telecommunications, Property services, and Finance & insurance services will see modest annual employment growth (1.0 to 1.5 per cent, on average). Modest employment growth is also projected in most public sector related industry groups, such as Public administration & safety and Health care & social assistance.

Figure 3: Employment growth in aggregated sectors compared to the NZ average in sub-periods
(Fastest to slowest growing industry groups, ranked according to 5-yr average growth rates)
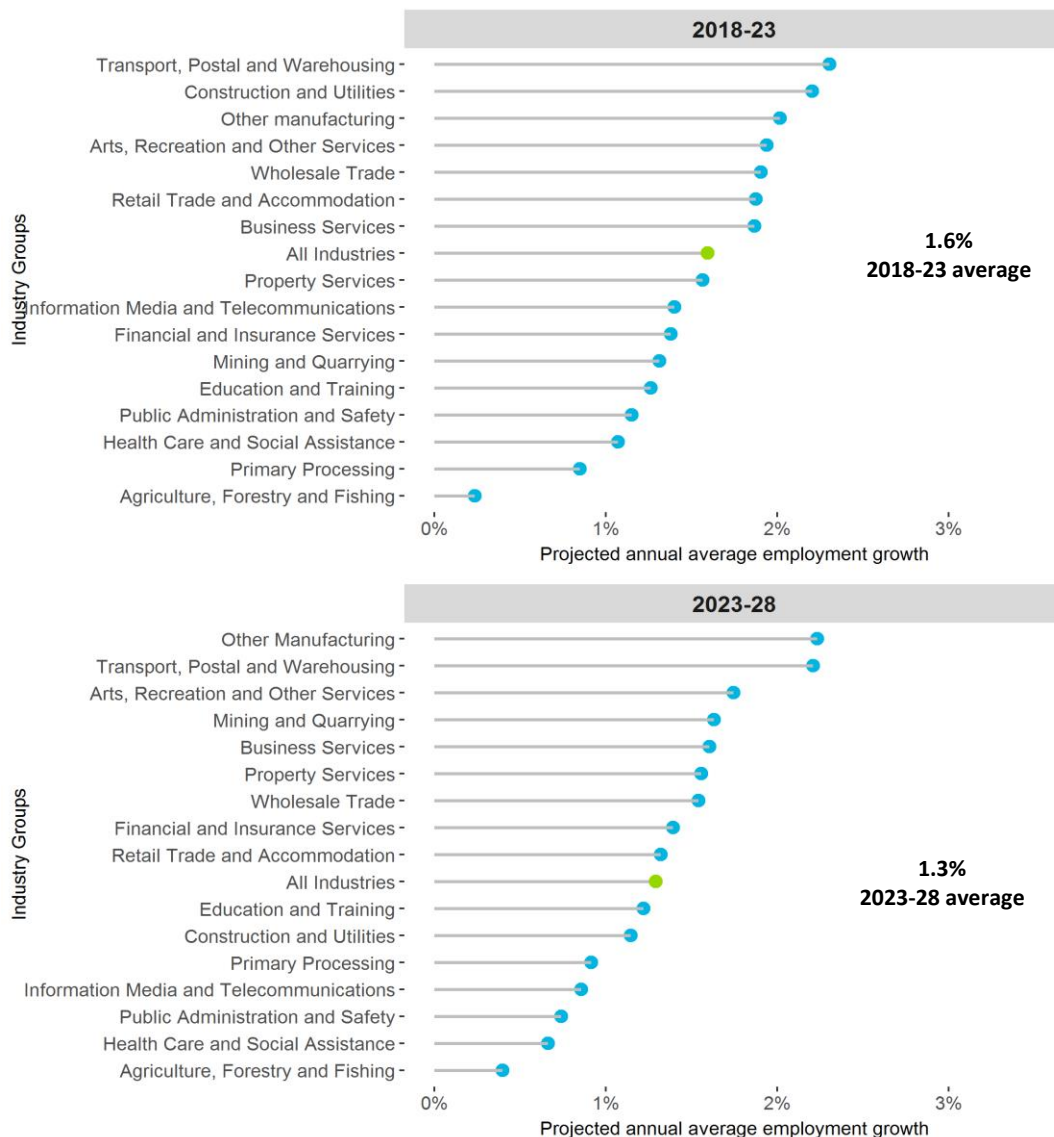
Strongest employment growth in Logistics and Construction in 2018-23 period and in 'Other manufacturing' and Logistics in 2023-28 period

Over the medium term (2018-23), above average employment growth is projected across a number of broad industries. Amongst these, strongest growth is projected in the Logistics sector (covering transport, postal and warehousing) and Construction and utilities industries. This is followed by an aggregate 'Other' manufacturing sector, which is all of the remaining manufacturing activities besides those related to the processing of primary products.

During the later years (2023-28), the 'Other' manufacturing sector is projected as the strongest followed by the logistics sector while construction and utilities is projected to see below average growth. In both periods, the aggregate Agriculture, Forestry and Fishing sector is projected to see the lowest average employment growth.

Employment prospects strongest for highly skilled workers

22,800 more highly skilled workers each year to 2028

Figure 4 shows strong employment growth in highly skilled (managers and professionals) occupations to continue over the next 10 years. Over the projection period, employment for highly skilled occupations is expected to increase by 228,000. Within this group, annual growth with be fastest for business & systems analysts, ICT managers and advertising, public relations & sales managers.

Figure 4: Employment growth for skill categories from aggregated ANZSCO 3-digit occupation groups (Employment change between 2018 and 2028)
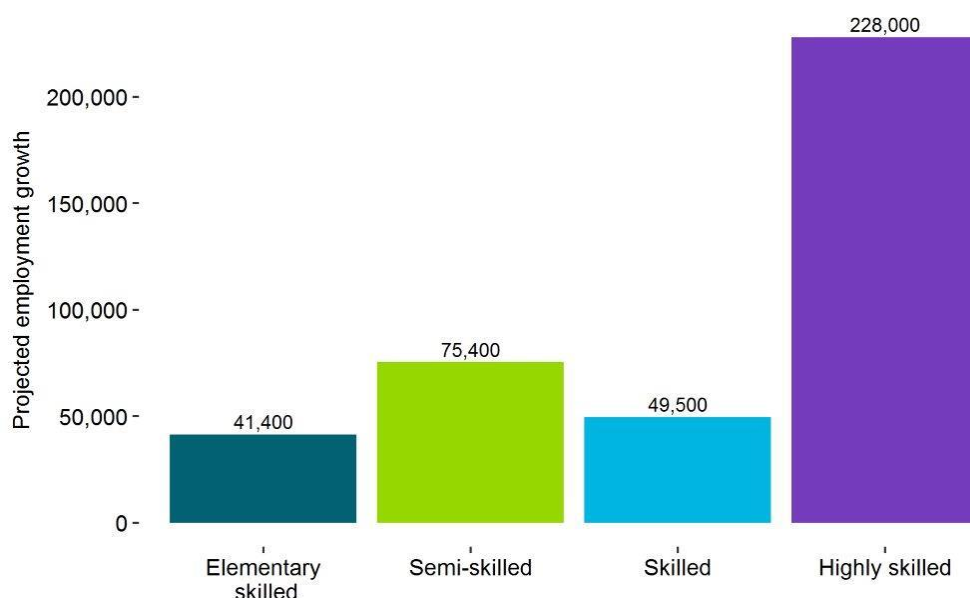
Business and building services drive strong demand for other workers

Building activities, both residential and non-residential, are projected to support demand for 49,500 more skilled workers (technicians and trades workers) by 2028 (see Figure 4). Within the skilled occupation group, annual growth rates will be fastest for construction-related occupations like glaziers, plasterers & tilers and electricians, along with fabrication engineering trades workers.

Projected growth in Tourism, Business and administrative services sectors is expected to increase demand for more semi-skilled workers (sales, support and office workers), with 75,400 more workers in this group by 2028. Within the semi-skilled occupation group, annual growth will be most rapid for office and practice managers, programme and project administrators and sports & fitness workers.

Compared with other skill levels, the demand for elementary skilled workers (machinery & plant operators and other labourers) is projected to increase by 41,400. This is more than one in 10 employment opportunities expected to be generated between 2018 and 2028. The fastest growing occupations within this group are drivers (delivery and transport) and construction & mining labourers.

Employment growth by occupation is projected to be strongest for highly skilled and skilled occupations, and weaker for elementary and semi-skilled occupations. This is sustained over both the medium term (2018-23) and the long term (2023-28) (see Figure 5). Total employment growth is also projected to slow from 1.6 per cent per year in the medium term to 1.3 per cent per year in the long term.

Figure 5: Business and building services drive strong demand for professionals and managers
(Annual average percentage change, 5-yr projection periods)
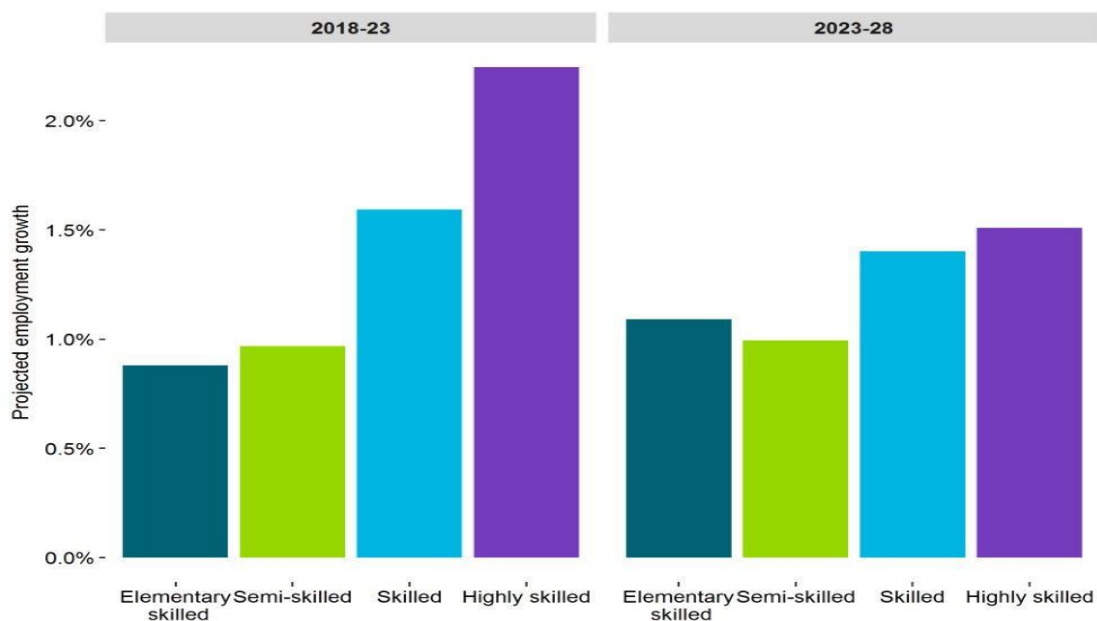
Fastest growing occupation groups over next 10 years are mostly highly-skilled

Figure 6 (part 1) ranks the top 25 occupation groups by growth rate over the 2018 to 2028 period. Of the top 25 occupations, 13 are highly-skilled, six are skilled, five are semi-skilled, and one is elementary skilled. Office and practice managers is the occupation group projected to grow the fastest, followed by some IT roles and other occupations prominent in business services (e.g., legal professionals, contract administrators) and construction (e.g. glaziers, plasterers & tilers, architects and engineers). The demand for automobile, bus and rail drivers occupation group is in the top 25 occupations in terms of growth for the 2018-28 period.

Figure 6 (part 2) shows the occupation groups projected to show a decline in employment in the 10 years to 2028. This is as a result of lower GDP growth in industries where they are

employed along with their importance declining over time. The decline projected for skilled and semi-skilled occupations relates to printing services and a range of clerical work. Farmers and farm managers are the only highly skilled occupation group projected to decline.

Figure 6: Highest growth occupation groups and those projected to decline over the next 10 years

(1) Top 25 Occupation Groups with strongest projected average growth (2018-28)
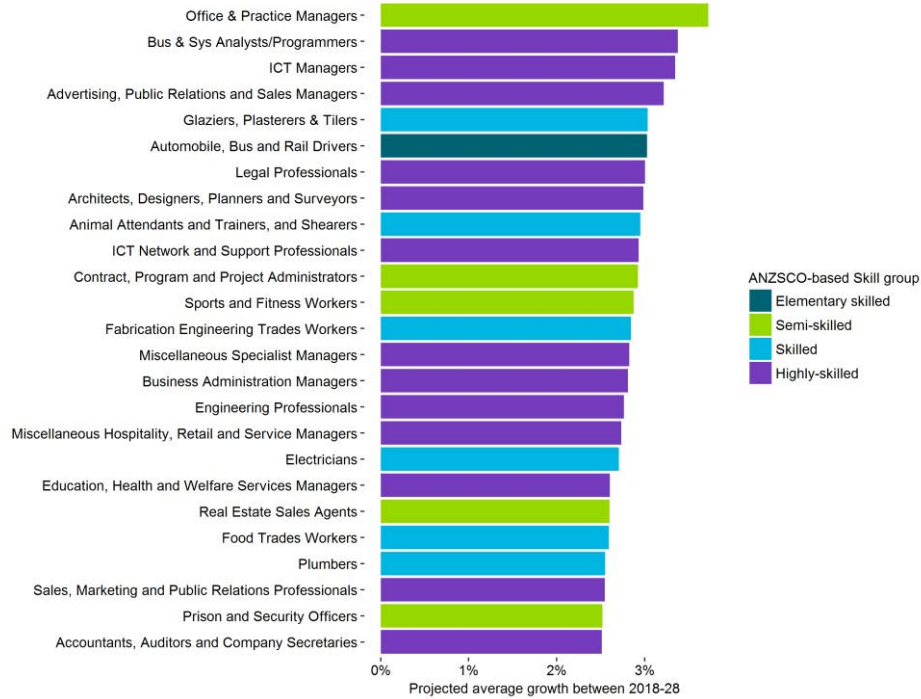
(2) Occupation Groups projected to decline across all Skill groups (2018-28)
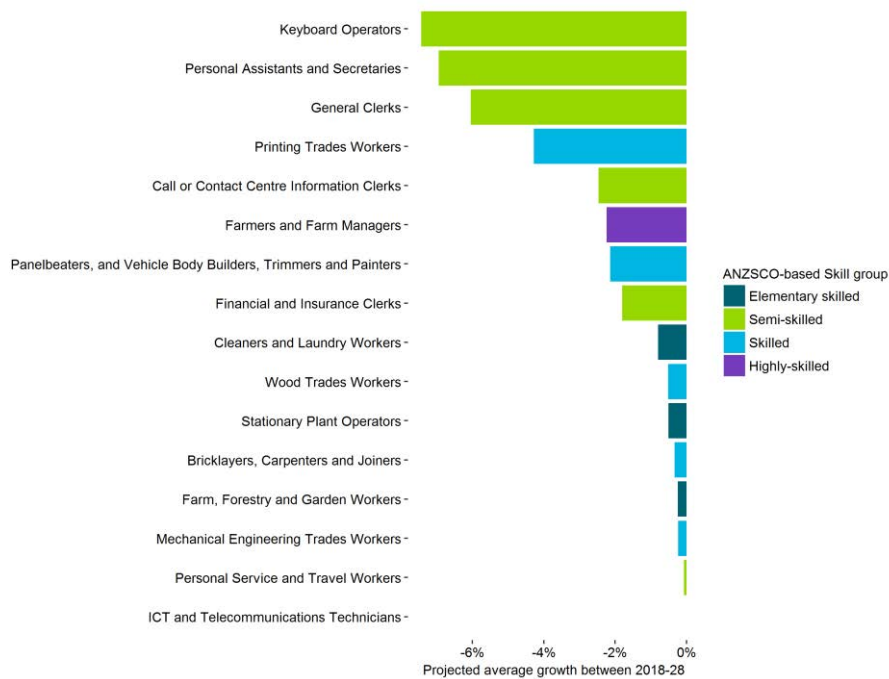
Growth in occupation groups across all four skill categories over next 10 years

Figure 7 summarises employment growth for high level (ANZSCO-1 digit) occupation groups which are also classified into the four broad skill categories. It provides insights about the distribution of positive and negative employment growth over the projection period. Positive employment growth rate, some exceeding 2.5 per cent on average, well above the overall average growth (1.6 per cent on average), is projected for occupation groups across all four skill categories. Levels of employment growth of over 10,000 and 20,000 are also seen in a number of occupation groups over the 10 year projection period. Conversely, decline in employment is projected for only a few occupation groups across all skill categories.

Figure 7: Employment growth rates and numbers for 1-digit ANZSCO Occupations over next 10 years
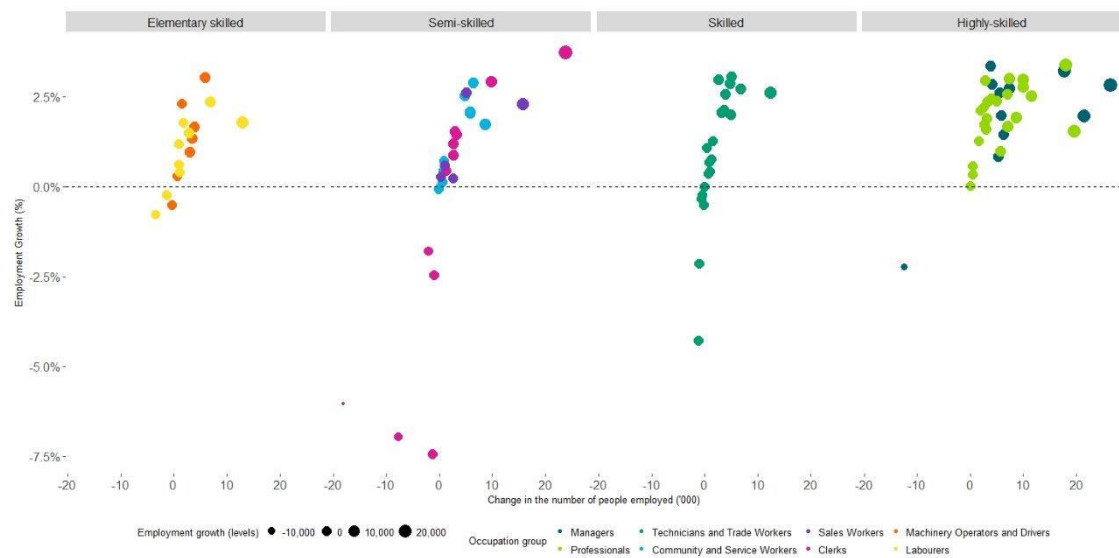
Exports, household consumption and investment drive growth

Expectations about the economy have implications for potential productivity gains and labour market outcomes across various sectors. Over the next ten years, economic growth and demographic trends, underpin the employment projections.

The New Zealand economy is expected to grow at an average rate of 2.7 per cent in the medium-term (2018-23), and 2.5 per cent in the out-years (2023-28) (see figure 8). These rates indicate an average rate of 2.6 per cent per year over the entire 2018-28 period. Investment (residential and infrastructure) spending will drive economic growth over the projection period along with household consumption in the medium term and exports in the longer term.

Figure 8: New Zealand economy expected to grow 2.6 per cent each year to 2028
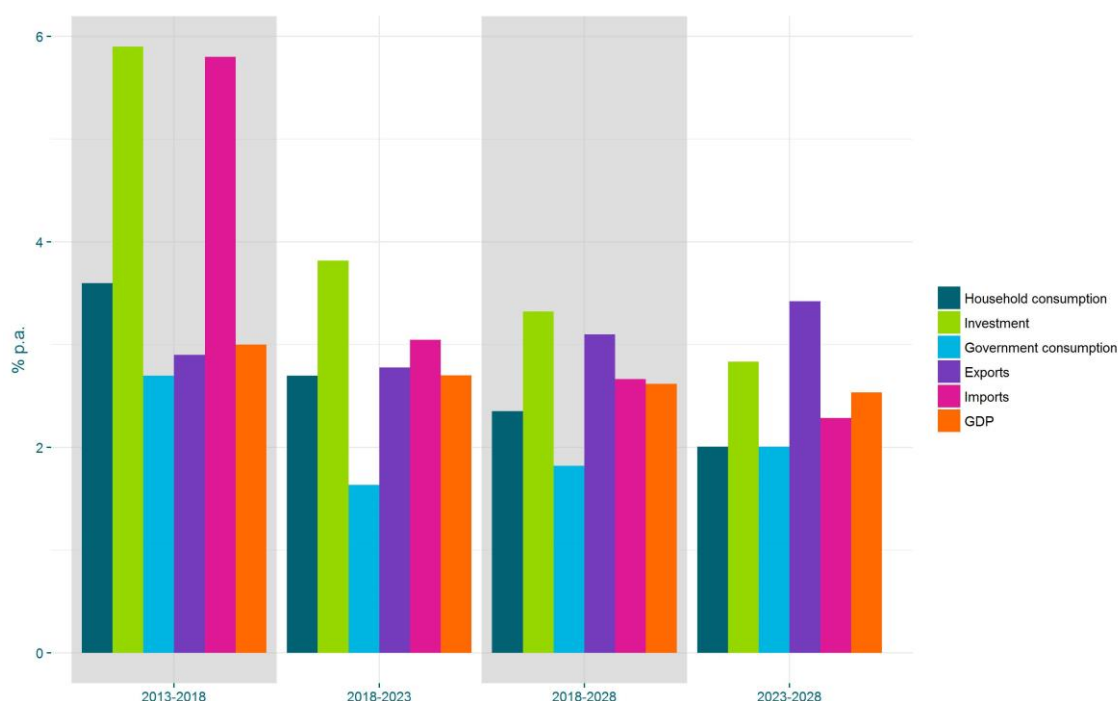
Source: Statistics New Zealand; MBIE

Note: Growth rates over the projections periods were estimated using the MBIE (BERL) CGE Model. Projected economic growth to 2028 may cover the next business cycle in its entirety as well as the end of the present cycle.

Strong growth in domestic demand underpins the medium-term (2018-23) employment projections. Activities in the construction, tourism and services industries and population-led growth in household spending will drive employment growth during this period. The medium-term also incorporates a balance between an export-led growth (2.8 per cent on average) and growth driven by domestic household consumption (2.7 per cent). More importantly, this period will experience investment growth (3.8 per cent) with residential construction and infrastructure work across the regions and moderate Government consumption (1.6 per cent on average).

Over the long-term (2018-28) economic outlook is slightly weaker than the medium-term (2.6 percent GDP growth on average compared 2.7 per cent). Stronger export growth over the

longer term (about 3.1 per cent) represents some improvement to the more moderate growth in the medium-term and will support growth over this period. Import (2.7 per cent) and investment (3.3 per cent) spending growth will be weaker due to some construction activity being past the peak. The long-term outlook is also likely to see slightly weaker household consumption (2.4 per cent) than anticipated in the medium-term accompanied by stronger government consumption (1.8 per cent).

The stronger export growth over the long-term arises from steady growth in exports of dairy (20 per cent higher in the longer term) and horticulture (remaining strong across both periods) products. Exports of wood and logs are projected to be about 15 per cent stronger in the longer term and exports of tourism-related services will be steady across both periods. There is also the likelihood of some of the benefits of bilateral trade agreements coming to fruition.

Labour productivity to only rise slightly over the long-term in the baseline scenario

New Zealand's ability to raise employment and participation levels on an on-going basis is constrained and thus in the long-term greater reliance will be placed on raising productivity for sustained economic growth. Over the past five years, the New Zealand labour market saw strong growth in the labour force and record participation rates. Since 2012, the growth in the labour force was largely driven by strong migration gains, with more arrivals and fewer departures of New Zealanders.

The labour force grew by more than 1.6 per cent each year during the 2011-16 period and is projected to grow about 1.0 per cent each year between 2018 and 2028 to reach nearly three million by 2028.[3] In the long-term, labour force growth will slow as net migration falls from its recent high levels and the participation rate declines due to New Zealand's ageing population. The record high participation levels experienced presently are not expected to be sustainable as the baby boomers age further, with some working fewer hours, while others leave the labour force completely.

Rising labour supply constraints arising from lower participation levels and difficulty in finding and retaining skilled workers will push up labour costs, which could lead to firms increasing their capital investment. Such interactions could result in improvements in labour productivity. Over the projection period, annual labour productivity growth is to increase from 0.97 per cent between 2018 and 2023 and rise to 1.1 per cent between 2023 and 2028.

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[3] These are projections made in 2017 using the 2013 Census base combining the median (50th percentile) projections with the high net migration scenario to reflect the strengthening net migration. Statistics New Zealand will update these projections early in 2020, taking into account the 2018 Census.

Alternate Scenarios – Implications for labour market and economy

Development of two alternate Scenarios for comparison with Baseline

(I) Trade disruption scenario

Over the past year, escalating trade disputes between the world's two largest economies (US and China) has led to the imposition of progressively higher tariffs on bilateral trade between these two countries. Uncertainty to business investment and consumer confidence caused by this development, which does not appear to be easing, has impacted on projected economic growth across many world economies.

The latest Situation and Outlook for the Primary Industries (SOPI)[4] released by the Ministry for Primary Industries (June 2019) acknowledges that the global trade environment is characterised by uncertainty and given this backdrop emphasises that the downside risks to their forecast will be heightened over the next few years. This is in light of the very high export share of China (30 per cent) across all primary sector exports from New Zealand in the 2019 March year followed by Australia (10 per cent) and the USA (9 per cent). The Chinese share of forestry exports from New Zealand is 50 per cent. For horticultural products, China's share was just 12 per cent with the EU and the UK having the largest share, at 18 per cent.

Given the potential adverse impact on the domestic economies of our major trading partners (i.e. China, Australia and the US) and implications for demand and prices for *all goods and services* exported from New Zealand, we assume that this trade disruption could lower export demand by 20 per cent and export prices by 10 per cent compared to the baseline scenario. This has the potential to reduce export growth by up to 1 percent in the medium term (2018-23), economic growth by 0.3 per cent and employment growth by 0.2 percent. This equates to about 30,000 fewer employment opportunities than in the baseline (i.e., reduce projected net employment growth over this period to 180,000 compared to 210,000). The impact is seen across all occupation groups, but with sales/service/support workers impacted the most. In terms of broad industry groups, over 70 per cent of this reduction will be in the service sector.

Table 1: GDP, employment, productivity and exports –Trade disruption scenario vs 2019 Baseline

Annual average percentage change	2013-18 (%)	2018-23 (%)	2023-28 (%)	2018-28 (%)
GDP growth	3.3	2.7	2.5	2.6
Trade impact		**2.4**		**2.4**
Labour productivity growth	0.3	1.1		1.2
Trade impact		**1.0**		**1.0**
Employment growth	3.0	1.64		1.44
Trade impact		**1.41**		**1.27**
Export growth	3.1	2.4		2.9
Trade impact		**1.5**		**2.1**

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[4] https://www.mpi.govt.nz/dmsdocument/34938-situation-and-outlook-for-primary-industries-sopi-june-2019

(II) Automation scenario

The possible impact of automation on employment growth arising from digitisation, artificial intelligence and other technological developments was assessed across the New Zealand industries based on their current capital and labour use. This was carried out by assuming progressively lower to higher capital to labour substitution over the ten year projection period, with greater rates of K/L ratio changes in industries with lower K/L ratio in the 2018 base year.

The results indicate the potential to reduce employment growth by 0.2 per cent, or by over 60,000 jobs, by the end of the projection period compared to the baseline, while maintaining economic growth due to compensating rise in labour productivity growth. The top-down modelling approach adopted using the CGE model, which also uses broader industry groups only captures the net employment effects across these groups and hence is unable to identify the potential for employment growth associated with certain types of automation, such as in new industries.

This reduction in employment growth over the ten years is not spread evenly across all occupation groups, with sales/service/support workers impacted the most and trade workers and technicians the least, with some impact also on some managers and professionals. Among broad sector groups, the service sector will account for over 80 per cent of this decline and private sector services projected to experience most of this. The primary sector and processing and manufacturing activities will account for less than 8 per cent of this reduction.

Table 2: GDP, employment, productivity and export– Automation scenario vs 2019 Baseline

Annual average percentage change	2013-18 (%)	2018-23 (%)	2023-28 (%)	2018-28 (%)
GDP growth	3.3	2.7	2.5	2.6
Customised AI impact		2.6		2.6
Labour productivity growth	0.3	1.1	1.2	1.2
Customised AI impact		*1.2*		*1.3*
Employment growth	3.0	1.64	1.32	1.44
Customised AI impact		*1.42*		*1.29*
Capital productivity growth		0.3		0.5
Customised AI impact		0.3		0.4
Capital stock growth	2.4?	2.3		2.1
Customised AI impact		2.3		2.2
	2018	**2023**		**2028**
K/L Ratios (annual average per cent changes)	0.376	0.386(0.53%)		0.397(0.55%)
Customised AI impact		0.388(0.62%)		0.397(0.54%)

Appendix A: Latest baseline results compared to a year ago

Economic drivers of employment growth – Now and a year ago

We project employment growth over the 2018-23 medium-term period to average 1.6 per cent per year, and then 1.3 per cent per year over the subsequent 2023-28 long-term period (see Table 1). Over the entire 10-year period (2018-28), annual employment growth is expected to average 1.4 per cent or 39,400 more workers each year. This is considerably lower than the 1.8 percent (Table 2) projected for 2016-26 (10-year period) in the previous update as it included the strong (2016-18) period of job growth.

Appendix A - Table 1: GDP, employment and productivity changes (March years[5])

(Historical (**2013-18**) and projected growth, average annual percentage change)

Annual average percentage change	2013-18 (%)	2018-23 (%)	2023-28 (%)	2018-28 (%)
GDP growth	3.3	2.7	2.5	2.6
Labour productivity growth*	-0.1	1.1	1.2	1.2
Employment growth	3.4	1.6	1.3	1.4

Source: MBIE version of BERL-CGE model runs for 2018-23 and 2018-28 periods; Results for the 2023-28 period are derived.

Appendix A - Table 2: GDP, employment and productivity changes (March years)
Previous (2018) M-L Term Update

(Historical (**2011-16**) and projected growth, average annual percentage change)

Annual average percentage change	2011-16 (%)	2016-21 (%)	2021-26 (%)	2016-26 (%)
GDP growth	2.9	3.2	2.6	2.9
Labour productivity growth*	1.1	0.9	1.2	1.1
Employment growth	1.8	2.3	1.4	1.8

Source: MBIE version of BERL-CGE model runs for 2016-21 and 2016-26 periods; Results for the 2021-26 period derived.

*Implied labour productivity growth

The stronger employment growth over the 2016-26 period projected was consistent with the somewhat higher GDP growth (2.9 per cent) compared to that projected for the 2018-28 period (2.6 per cent). This consists of slightly higher GDP growth (2.7 per cent) over the medium term (2018-23) and lower growth over the out years (2023-28) at 2.5 per cent. The increase in productivity growth over these two periods is also projected to be modest (from 1 to 1.1 per cent) compared to that projected before (from 0.9 to 1.2 per cent).
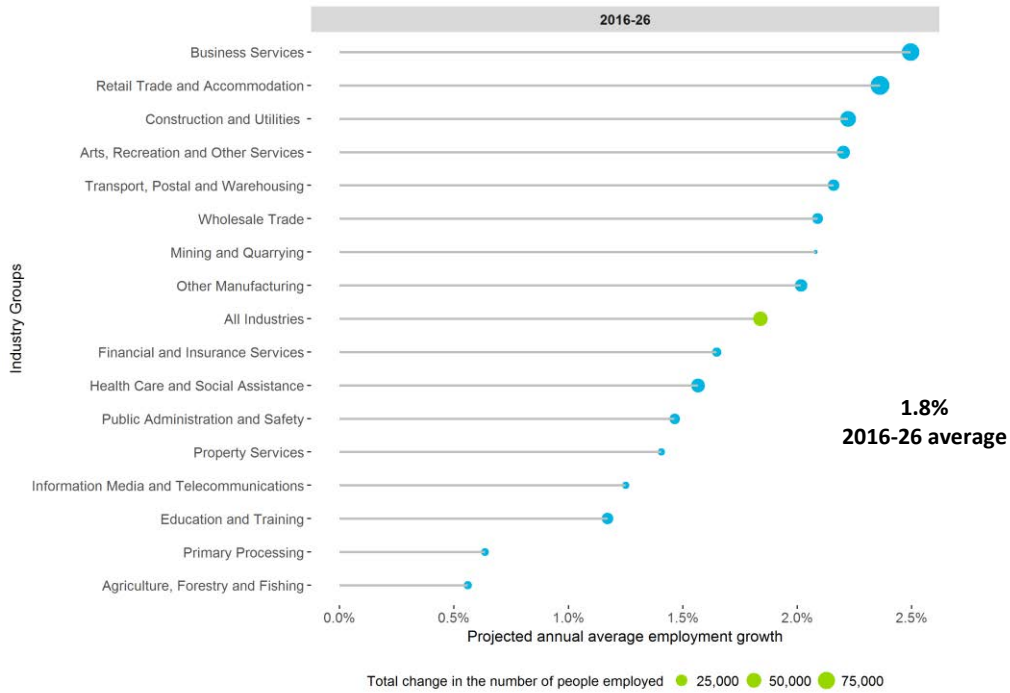
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[5] All projections on a year to 31 March basis (i.e. Annual Average Percentage Change).

Industry level employment growth projections – Now and a year ago

(Annual average percentage changes between 2018 and 2028)

1.4%
2018-28 average
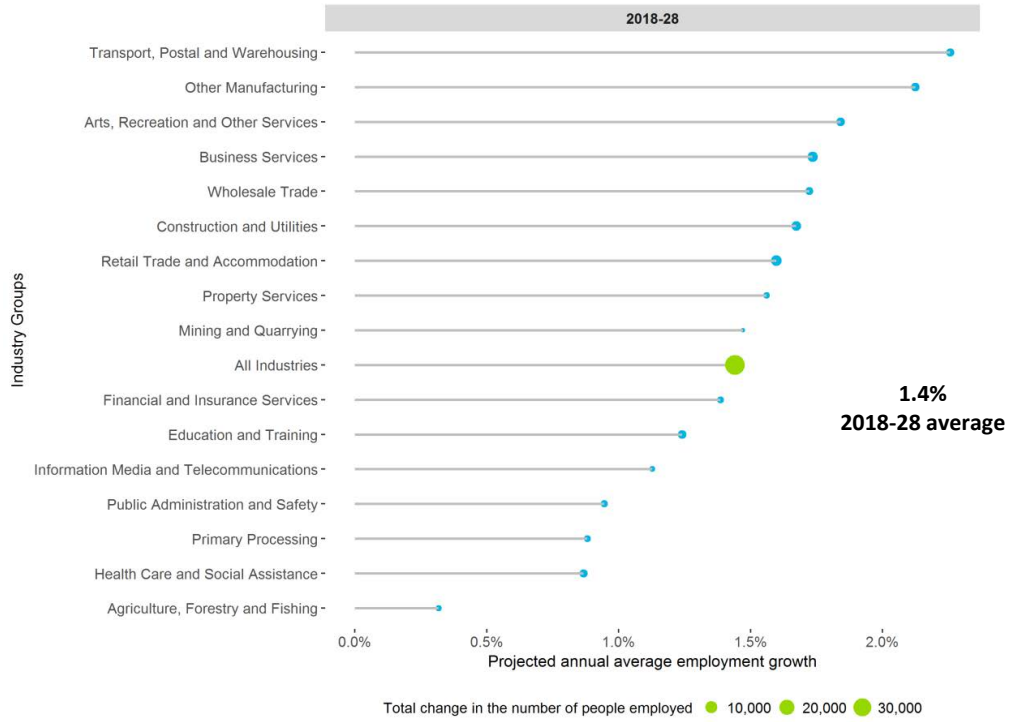
(Annual average percentage changes between 2016 and 2026)

1.8%
2016-26 average

Employment growth projections by skill groups – Now and a year ago

Employment prospects strongest for highly skilled workers (Employment change between 2018 and 2028)
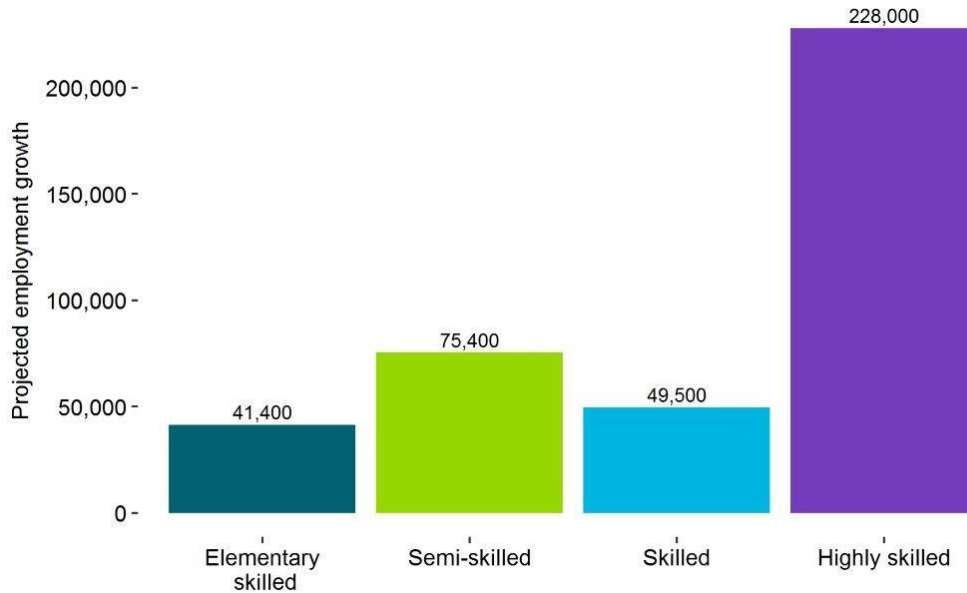
Previous Update (Employment change between 2016 and 2026)
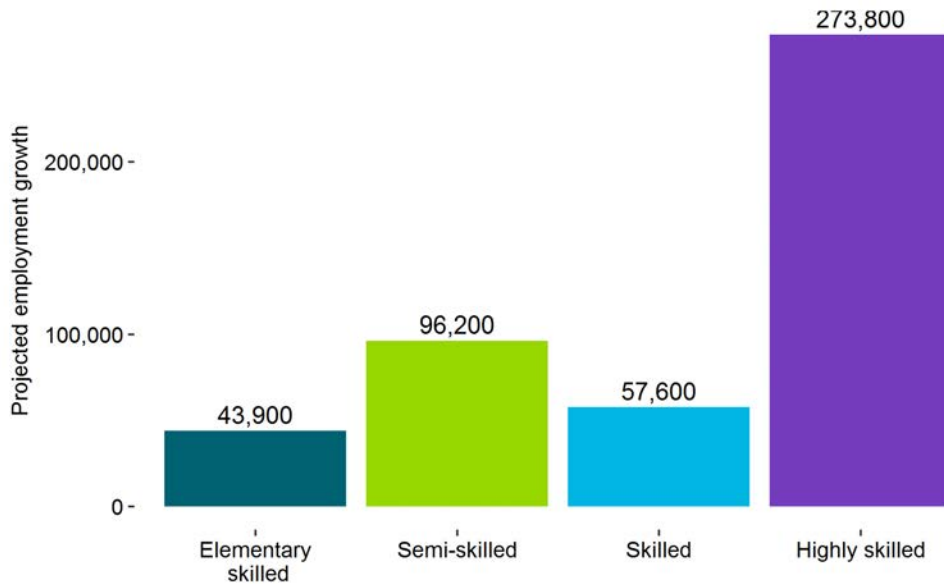
Employment growth strongest for highly skilled workers in the medium term (2018-23) and less differentiated in the out-years (2023-28)

(Employment change for sub-periods between 2018 and 2028)

Previous Update (Employment change for sub-periods between 2016 and 2026)

Appendix B:

Development of the two alternate Scenarios- (I) Trade disruption and (II) Automation Impact scenarios for comparison with the Baseline results

I: Capturing the impact of Trade disruptions on exports, the labour market and the economy

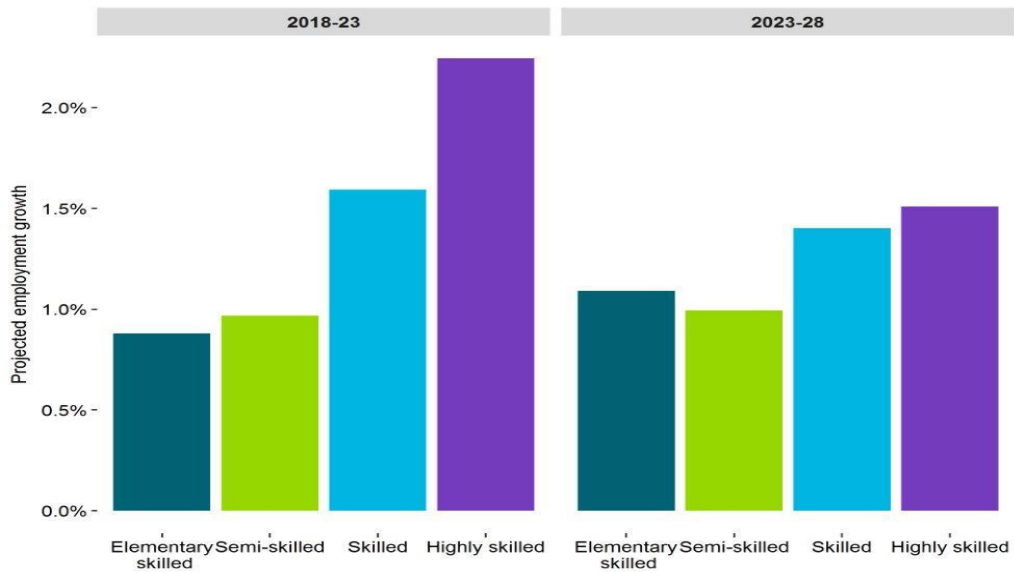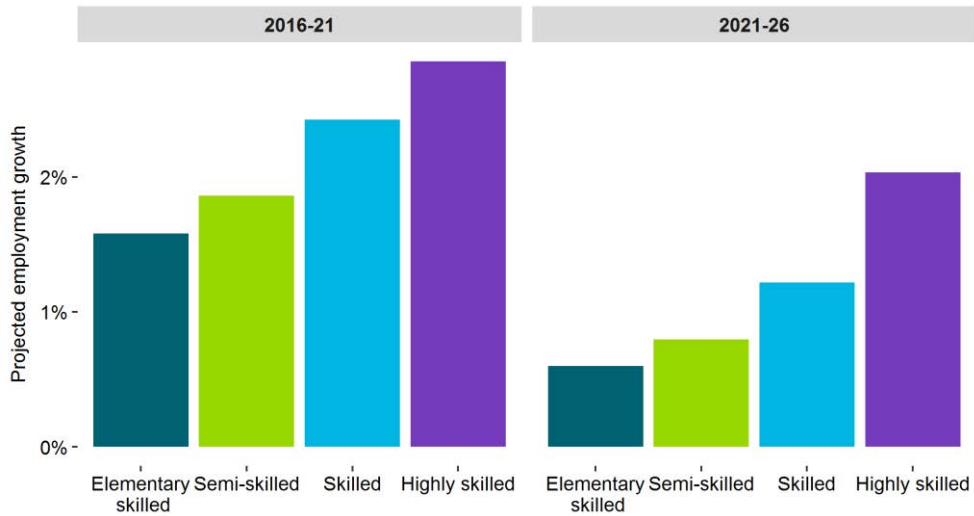**Assessment of the International Monetary Fund (IMF) and World Trade Organization (WTO)**

Over the past year, escalating trade dispute between the world's two largest economies (US and China) has led to the imposition of progressively higher tariffs on bilateral trade between these two countries. Uncertainty to business investment and consumer confidence caused by this development, which do not appear to be easing, has impacted on lower projected economic growth across the world economies (IMF, April 2019)[6].

"World trade will continue to face strong headwinds in 2019 and 2020 after growing more slowly than expected in 2018 due to rising trade tensions and increased economic uncertainty. WTO economists expect merchandise trade volume growth to fall to 2.6% in 2019 — down from 3.0% in 2018. Trade growth could then rebound to 3.0% in 2020; however, this is dependent on an easing of trade tensions" (WTO, April 2019)[7].

Trade growth in 2018 was weighed down by several factors, including new tariffs and retaliatory measures affecting widely-traded goods, weaker global economic growth, and volatility in financial markets and tighter monetary conditions in developed countries, among others. Consensus estimates have world GDP growth slowing from 2.9% in 2018 to 2.6% in both 2019 and 2020.

The above-average trade growth of 4.6% in 2017 suggested that trade could recover some of its earlier dynamism, but this has not materialized. Trade only grew slightly faster than output in 2018, and this relative weakness is expected to extend into at least 2019. This is partly explained by slower growth in the European Union, which has a larger share in world trade than in world GDP.

The preliminary estimate of 3.0% for world trade growth in 2018 is below the WTO's most recent forecast of 3.9% issued in September 2018. The shortfall is mostly explained by a worse-than-expected result in the fourth quarter, when world trade as measured by the average of exports and imports declined by 0.3%. Until then, third quarter trade had been up 3.8%, in line with WTO's projections.

In recognition of the high degree of uncertainty associated with trade forecasts under current conditions, charts with shaded bands were used by WTO to illustrate a range of possible trade outcomes in 2019. Trade expansion in the current year is most likely to fall within a range from 1.3% to 4.0%. It should be noted that trade growth could be below this range if trade tensions continue to build, or above it if they start to ease.

Previous analysis of the New Zealand Treasury

The Treasury in its 2018 Half Year Economic and Fiscal Update (HYEFU) of December 2018 included alternate scenarios to capture the risks to their baseline forecasts and one of them

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[6] https://www.imf.org/en/Publications/WEO/Issues/2019/03/28/world-economic-outlook-april-2019

[7] https://www.wto.org/english/news_e/pres19_e/pr837_e.htm

related to the Downside risk related to trade tensions that could lead to trade disruption and lower economic and export growth in New Zealand compared to the baseline. The first scenario modelled here is related to this potential development, which has been alluded to in latest IMF-World Economic Outlook (April 2019) and also by the World Trade Organisation.

"The risks to the international outlook are skewed to the downside and include: rising trade tensions; political uncertainty in different parts of the world; uncertainty about the impacts of tightening US monetary policy; and the uncertainty about global commodity prices. Should these risks materialise, global growth will deviate from that presented in the main forecasts and, with it, export growth, the terms of trade and the exchange rate" (New Zealand Treasury, December 2018)[8].

The Treasury scenario explored the impacts of further escalation in global trade tensions. Declining trade volumes weigh directly on global growth, lowering the demand for New Zealand exports, while weaker sentiment lowers business investment, consumption, and global commodity prices. The overall impact of the scenario sees GDP growth falling in nominal and real terms, affecting tax revenue and the fiscal position.

Imposition of tariffs on trade

Trade tensions, particularly between the US and China, had escalated since early 2018. Initially, US tariff rates on Chinese products were 25% on US$50 billion worth of imports from China and 10% on an additional US$200 billion. The latter set of tariffs has recently risen to 25%. China retaliated with tariffs on imports from the US. The rise in protectionism was not limited to restricting imports and has extended to supporting domestic industries affected by the protectionist measures, as in the case of US agricultural sector.

The risk lies in what may follow if trade tensions continue to escalate. IMF estimates suggest that US tariffs of 25% on US$250 billion of Chinese imports could reduce Chinese growth by around 0.7 percentage points over the next 12 months. Spill-overs are especially possible for Southeast Asian economies given their role in global value chains that often include China, which are increasingly important export destinations for New Zealand. The impacts of continued trade tensions on sentiment may have a stronger negative impact on global growth as compared to the direct impacts of restricting the flow of trade.

Further analysis of the IMF

Very recent assessment of the US economy by the IMF in its Country report states that "The U.S. economy is in the longest expansion in recorded history. Unemployment is at levels not seen since the late 1960s, real wages are rising, and inflationary pressures remain subdued. Economic activity, while still growing above potential, is expected to slow to around 2.6 percent this year and 1.9 percent in 2020" (IMF, June 2019)[9]. This report also includes an assessment of the 'Outward Spillovers of Trade Tensions', which includes three scenarios around the US-China trade war intensifying and/or a deal being reached and assesses the negative real GDP impact on the Chinese economy to be in the range of -0.15 to as high as -0.55 per cent and on the US economy in the range of +0.1 per cent to as high as -0.35 per cent.

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[8] https://treasury.govt.nz/publications/efu/half-year-economic-and-fiscal-update-2018-html#section-6

[9] https://www.imf.org/en/Publications/CR/Issues/2019/06/24/United-States-2019-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-47019?cid=em-COM-123-39030

Appendix B - Figure 1:

Four quadrants of industry level employment growth in relation to GDP growth – Trade disruption
(Industry GDP and employment growth between 2018 and 2028 benchmarked with overall growth)

Potential impact of trade disruption in the medium term (2018-23):

The trade disruption arising from trade tensions and the imposition of trade tariffs by the US and China has the prospects for demand and prices for goods and services exported from New Zealand to be lower by 20 per cent and 10 per cent, respectively, in the medium term (2018-23) compared to the baseline scenario.

With the adverse impacts of the trade war on the domestic economies of all of our major trading partners, this has the potential to reduce export growth by up to 1 percent in the medium term (2018-23), economic growth by 0.3 per cent and employment growth by 0.2 percent. This result from different levels of industry level economic (GDP) growth and consequent employment growth in these industries as seen in Appendix B: Figure 1 compared to Figure 1 in the main report.

Employment growth difference for Trade Disruption - By Occupation groups		
(2018-23 period)		
	Reduction	**Percent of total**
Managers	6,300	21%
Professional	6,200	20%
Trades workers/Technicians	3,700	12%
Sales/Service/Support Workers	7,700	25%
Operators/Drivers/labourers	6,600	22%
Total	**30,500**	**100%**

This is about 30,000 fewer employment growth over the 5 years than in the baseline with the impact across all occupation groups but with the sales/service/support workers impacted more. In terms of broad industry and sector groups, over 70 per cent of this decline will be among the service sector, mainly across private services and also some public.

Employment growth difference for Trade Disruption Scenario - By Sectors		
(2018-23 period)		
	Reduction	**Percent of total**
Primary sector	3,300	11%
Processing & manufacturing	5,500	18%
Private services	16,200	53%
Public services	5,500	18%
Total	**30,500**	**100%**

II: Capturing the impact of AI & Automation on the labour market and the economy

Background:

There has been considerable debate about the impacts of automation arising from digitisation, artificial intelligence and other related technological developments on the future of work and the employment levels, including the skills needed by the workforce in the future and the resulting skill mix. There has also been a range of bottom-up assessments of specific jobs based on the technical feasibility of automation of tasks involved and the rates of its take-up.

This is based on the readiness across different industries and sectors in a country and over what periods, including some assessments for New Zealand. But most of them have not been carried out in an economy-wide context as is the case with this modelling effort, with the ability to assess the impact of automation and routinisation on resulting economic growth and overall labour productivity. This is despite the recognition that the timeframe for any appreciable impacts of automation on the employment outlook is beyond the ten year projection period of this report.

Will it be an automation revolution or evolution?

Infometrics had estimated that 31% of New Zealand's jobs are at a high risk of automation over the next 20 years. If anything, the tight labour market and proposed sizable increases to the minimum wage will hasten the adoption of automation in the near term[10]. They also concluded that there is some variation in the proportion of at-risk jobs across different parts of the country and the biggest regional disparities were in terms of where new jobs are created.

"Disruptive technologies: risks and opportunities" was published in 2015 by Chartered Accountants Australia and New Zealand (CAANZ) and the New Zealand Institute of Economic Research (NZIER)[11]. The paper estimated that over 885,000 jobs in New Zealand are at a high risk of automation, possibly within the next 20 years. This figure represented about 37% of all jobs in New Zealand at the time.

Will robots really steal our jobs?

In 2018, PricewaterhouseCoopers (PwC) published "Will robots really steal our jobs?" estimating the proportion of at-risk jobs in New Zealand at a much lower 24%. PwC's analysis suggests that jobs in New Zealand are less at risk of automation than might have been initially feared "due to relatively high employment rates and education and skill levels across all major demographic groups." Even so, it is still worth taking notice of the potential disruption of about 578,000 jobs in this country due to automation[12].

Artificial intelligence (AI), robotics and other forms of 'smart automation' are advancing at a rapid pace and have the potential to bring great benefits to the economy, by boosting productivity and creating new and better products and services. In an earlier study, PWC estimated that these technologies could contribute up to 14% to global GDP by 2030, equivalent to around $15 trillion at today's values" (PWC, 2018). For advanced economies like

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[10] http://www.infometrics.co.nz/infometrics_megatrends/

[11] https://nzier.org.nz/static/media/filer_public/6d/6e/6d6ecf8b-032c-4551-b0a7-8cd0f39e2004/disruptive_technologies_for_caanz.pdf

[12] https://www.pwc.co.nz/pdfs/2018pdfs/impact-of-automation-on-jobs-Feb-2018.pdf

the US, the EU and Japan, these technologies could hold the key to reversing the slump in productivity growth seen since the global financial crisis. But they could also produce a lot of disruption, not least to the jobs market. Indeed a recent global PwC survey found that 37% of workers were worried about the possibility of losing their jobs due to automation.

The analysis by PwC also identified how this process might unfold over the period to the 2030s in three overlapping waves:

1. **Algorithm wave**: focused on automation of simple computational tasks and analysis of structured data in areas like finance, information and communications – this is already well underway.

2. **Augmentation wave**: focused on automation of repeatable tasks such as filling in forms, communicating and exchanging information through dynamic technological support, and statistical analysis of unstructured data in semi-controlled environments such as aerial drones and robots in warehouses – this is also underway, but come to full maturity in the 2020s.

3. **Autonomy wave**: focused on automation of physical labour and manual dexterity, and problem solving in dynamic real-world situations that require responsive actions, such as in manufacturing and transport (e.g. driverless vehicles) – these technologies are under development already, but may only come to full maturity on an economy-wide scale in the 2030s.

The PwC estimates were based primarily on the technical feasibility of automation, so in practice the actual extent of automation may be less, due to a variety of economic, legal, regulatory and organisational constraints. Just because something can be automated in theory does not mean it will be economically or politically viable in practice.

The New Zealand Productivity Commission has embarked on an enquiry on 'Technological change and the future of work' and recently summarised the assessments by various agencies over the past 5-6 years in its blog entitled "What to do when forecasts diverge?"(NZPC)[13].They clearly show the gradual reduction in the extent of the impact of automation assessed on jobs.

Headline job-automation forecasts

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[13] https://www.productivity.govt.nz/blog/what-to-do-when-forecasts-diverge
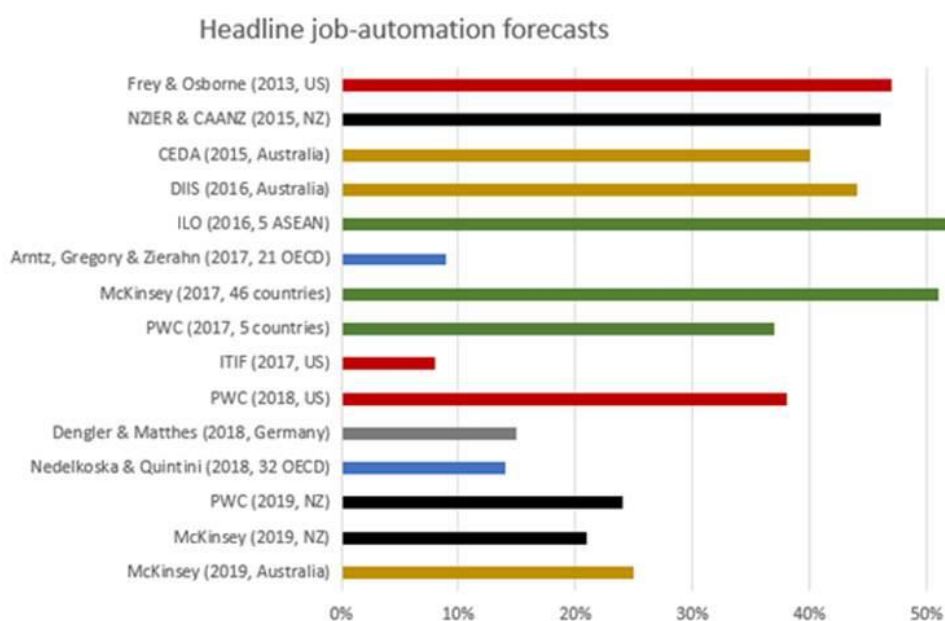
How can AI and automation be captured via labour and capital productivity changes?

A recent NBER study examined four direct effects through which advances in prediction technology may affect labor in a task-based framework[14]:

1) Substituting capital for labour in prediction tasks - artificial intelligence may directly substitute capital for labour in prediction tasks. Some tasks, like demand forecasting, are already prediction tasks. Where humans currently perform these prediction tasks, they are increasingly replaced by artificial intelligence.
2) Automating decision can increase relative returns to capital versus labour in complementary decision tasks and it can lead to the complete automation of a complementary task.
3) enhancing labour when automating the prediction task increases labor productivity in related decision tasks and thereby increases the relative returns to labor versus capital in those tasks, and

4) Creating new decision tasks when automating prediction sufficiently reduces uncertainty as to enable new decisions that were not feasible before.

Development of the automation scenario for use in the CGE model:

The potential impact of automation on employment growth arising from digitisation, artificial intelligence (AI) and other technological developments was assessed across the New Zealand industries based on their current capital and labour use.

Industries Grouped by 2018 K/L Ratio (Indexed to overall K/L Ratio)

Very High K/L Ratio Industries (3-22 times overall K/L ratio)	High K/L Ratio Industries (over 1-3 times overall K/L ratio)
1 Oil and gas extraction	1 Basic metals
2 Electricity and gas	2 Dairy processing
3 Real estate services	3 Equipment and other non-property rental
4 Water, sewerage, drainage and disposal	4 Scientific research services
5 Petroleum	5 Forestry and logging
6 Mineral exploration	6 Beverages and tobacco
7 Other transport and storage	7 Chemicals
8 Mining and quarrying	8 Pulp and paper
9 Communications and information services	

Medium to Low K/L Ratio Industries (0.3-1 times overall K/L ratio)	Low K/L Ratio Industries (less than 0.3 times overall K/L ratio)
1 Arts, culture, sport and recreation	1 Other health and community services
2 Dairy farming	2 Transport equipment
3 Sheep, beef and livestock farming	3 Primary sector support services
4 Other education	4 Construction services
5 Air transport	5 Meat processing
6 Other farming	6 Wholesaling other
7 Government services	7 Other personal services
8 Fishing and aquaculture	8 Textiles clothing, footwear and leather
9 Finance and insurance	9 Wholesaling industrial
10 School education	10 Publishing
11 Non-metallic minerals	11 Accommodation and food services
12 Printing	12 Fabricated metals
13 Polymers and rubber	13 Other manufacturing
14 Electronic, machinery and equipment	14 Business services
15 Wood product manufacturing	15 Retail other
16 Hospitals	16 Retail motor vehicles and related
17 Rail transport	17 Other construction
18 Horticulture and fruit growing	18 Admininstrative and support services
19 Other food	19 Residential construction
20 Road transport	

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[14] Artificial Intelligence: The Ambiguous Labor Market Impact of Automating Prediction -- by Ajay Agrawal, Joshua S. Gans, Avi Goldfarb

NBER Working Paper No. 25619, February 2019

The latest available capital and labour use data for the base year (2018 March year) of the model used for this application was used to apply a customised automation scenario based on the Capital to Labour (K/L) ratio which was indexed to the overall ratio across all industries in the base year. This resulted in four groups of industries from very high K/L ratio industries (9 of them) to low K/L ratio industries (19 of them) with 8 high and 20 medium to low K/L ratio industries as presented in the table below.

This differentiation of industries by K/L ratios was used to apply different rates of labour productivity growth over and above used in the baseline scenario:

(a) *No change in labour productivity* over that in the baseline scenario for the medium (2018-23) and longer (2023-28) term for the *very high K/L ratio industries* (already with a K/L ratio more than 3 times the overall K/L ratio across all industries in New Zealand – Top left corner)

(b) A 10 per cent increase in labour productivity growth over and above the baseline in the medium term rising to 20 per cent in the longer term applied for *industries with high K/L ratios* (8 Industries grouped in the top right corner),

(d) A 20 per cent increase in labour productivity in the medium term rising to 30 per cent increase in the longer term for industries with *medium to low K/L ratios* (20 industries grouped in the bottom left corner), and

(c) A 30 per cent increase in labour productivity in the medium term (2018-23) and 40 per cent increase in the longer term (2023-28) in labour productivity above the baseline for the *low K/L ratio industries* (less than 0.3 times the overall ratio) (i.e., 19 industries in bottom right).

### *Key results for the automation scenario:*

The application of the automation scenario results in slightly lower average economic growth (2.6 per cent compared to 2.7 per cent in the baseline) over the medium term (2018-23) but similar economic growth over the ten year projection period (2018-28) at 2.6 per cent. This is related to lower employment growth, both in the medium term (1.4 per cent compared to 1.6 per cent) and the longer term (1.1 per cent compared to 1.4 per cent), but with some compensating additional increase in labour productivity in the medium term (0.1 per cent) and the longer term (0.2 per cent).
The results presented in Appendix B: Figure 2 (compared to Figure 1) illustrate the differences in the placement of the different industries in relation to their relative contribution to GDP and employment growth reflecting the rates of changes in labour productivity applied in the automation scenario compared to the baseline.

The impacts of progressively low to higher automation over the ten year projection period, has the potential to reduce employment growth by over 60,000 jobs compared to the baseline, while maintaining economic growth due to compensating rise in labour productivity growth.

Appendix B: Figure 2: Four quadrants of industry level employment growth in relation to GDP growth – Automation Impact

(Industry GDP and employment growth between 2018 and 2028 benchmarked with overall growth)
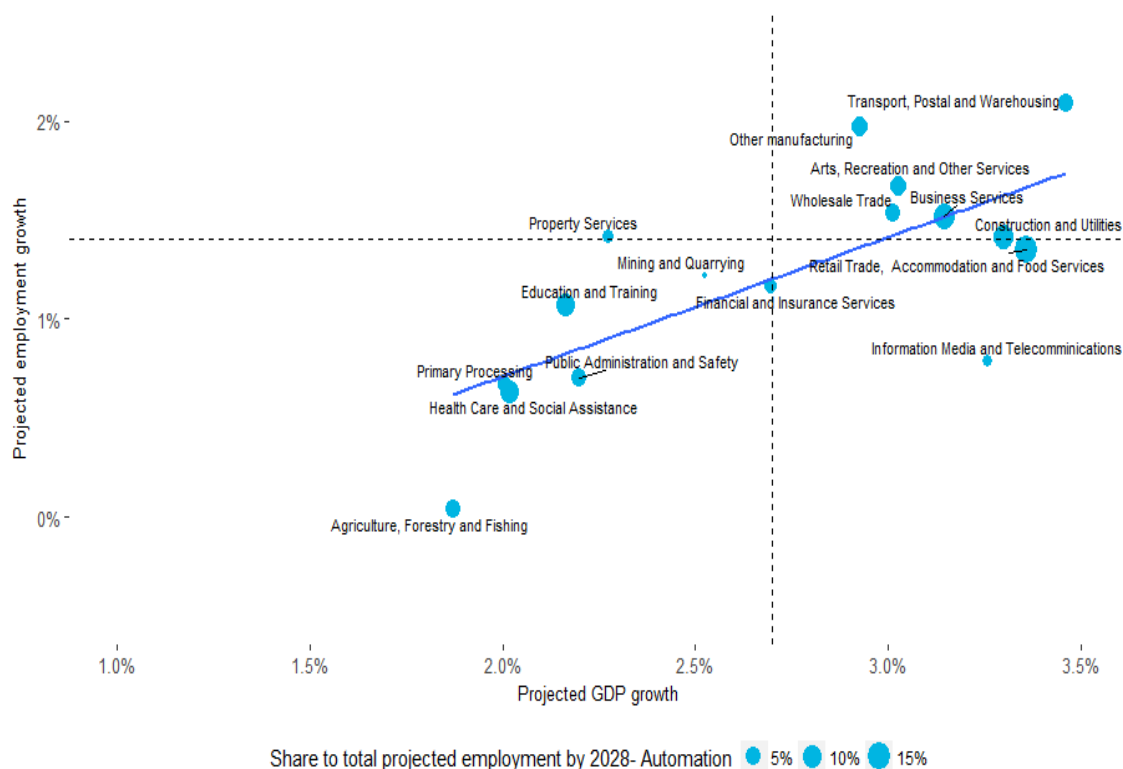
Employment growth difference for Automation Impacts - By Sectors		
	(2018-28 period)	
	Reduction	**Percent of total**
Primary sector	4,500	7%
Processing & manufacturing	5,000	8%
Private services	36,000	57%
Public services	17,500	28%
Total	**63,000**	**100%**

The reduction in this employment growth over the ten years is not spread evenly across all occupation groups with sales/service/support workers impacted the most and trade workers and technicians the least while both managers and professionals are also impacted. Among broad sector groups, service sector will account for over 80 per cent of this decline and private services seeing most of this. The primary sector and processing and manufacturing activities will account for less than 8 per cent of this decline.

Employment growth difference for Automation Impacts - By Occupation groups		
(2018-28 period)		
	Reduction	**Percent of total**
Managers	12,700	20%
Professional	15,700	25%
Trades workers/Technicians	7,800	12%
Sales/Service/Support Workers	17,500	28%
Operators/Drivers/labourers	9,300	15%
Total	**63,000**	**100%**

The employment reduction assessed in this top-down economy-wide modelling as described here using the automation scenario applied to four groups of industries from a total of 56 industries modelled results in less than 5 per cent reduction in employment over the ten year (2018-28) projection period. This is even lower than the OECD estimate using the PIAAC data of 12 percent of jobs being at high risk of automation in New Zealand but over a longer period and an average of 14 per cent of workers at high automation risk across the OECD.

An assessment based on the K/L use in more disaggregated and specific industries may have produced greater employment effects but over a longer period of time than ten years studied here. The research undertaken for the AI forum looked at 18 even broader industries in terms of their absorptive capacity of AI based on the estimated returns to labour and capital and provided an assessment of the low and high estimates of the maximum proportion of the labour force that can be substituted by AI in each of those industries[15]. This would have required further aggregation of the industries in the CGE model used here.

Appendix C: Methodology

The Ministry of Business, Innovation and Employment (MBIE) projections reported here use a Computable General Equilibrium (CGE) model developed by the Business and Economic Research Limited (BERL) for use by the Ministry of Business Innovation and Employment.

The forecast update commenced in January 2019 after the 2018 Half Yearly Economic and Fiscal Update (HYEFU) of the Treasury was released in December 2018. The 2018-23 macro-economic outlook underpinning the employment outlook across the broad industries is broadly consistent with the 2018 HYEFU and is informed by the 2019 BEFU. This covers projected growth in export, import, investment along with private and public consumption as well as GDP. The projections are extended out to the long- term to 2028 using a "consensus" view of the impact of projected world and regional economic growth for trading partners on economic growth for 'Other mature economies' which includes New Zealand[16].

The latest Treasury projections provided the macro-economic setting for the medium term (2018-23). This setting included household or private consumption growth of 3.0 per cent, export growth of 2.7 per cent, import growth of 2.8 per cent and Government or public

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[15] https://aiforum.org.nz/wp-content/uploads/2018/07/AI-Report-2018_web-version.pdf

[16] The Conference Board, a global, independent business membership and research association undertakes medium-long-term outlook https://www.conference-board.org

consumption growth of 2.0 per cent, on average, for the 2018-23 period resulting in average economic growth of about 2.6 per cent. The setting was modified for the 2018-28 period, with slightly higher export (3.1 per cent), lower import (2.7 per cent) and lower household consumption growth (2.4 per cent) was used.

Reduced prospects for world economic growth in the short-term (2019-20) already signalled by the IMF in its recent world economic outlook will be impacting on the medium-term (2018-23) projections for New Zealand. The baseline economic growth and the macro-economic setting was moderated slightly due to weaker trading partner growth along with the short-term weakening in some of the domestic factors within New Zealand, such as business investment and moderate consumer spending.

The modelling is focused on the long-term overall (trend) economic growth and growth across industries disaggregated at the national accounts level. Employment growth across industries and occupation groups (summarised into skill groups) are analysed and included in this report. Regional projections are not available for the medium-long term due to the lack of historical regional GDP data by industries for a sufficient period, including for recent years.

The illustration below provides a summary of the key demographic and macro-economic inputs to the MBIE (BERL) CGE model used for generating the results for the new baseline and the scenarios used this report and the corresponding outputs that enable the employment levels at the industry and occupation levels to be derived.
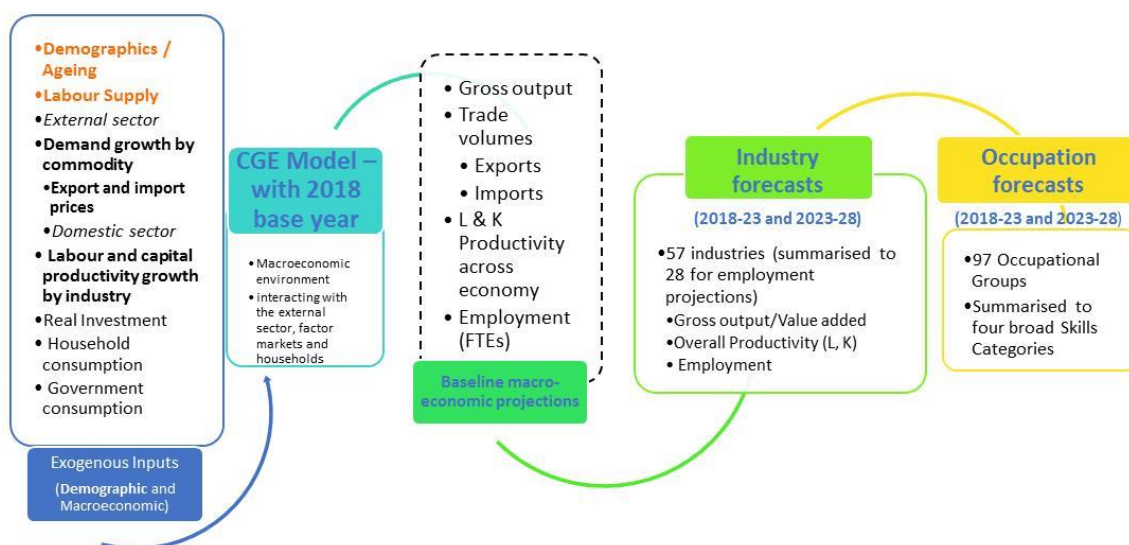
Risks and caveats

The assumptions and judgements underpinning the projections are subject to a range of risks and uncertainties. The main downside risks on the external front are weaker prospects and prices for some of our key export products and uncertainties about economic growth amongst New Zealand's main trading partners. On the domestic front, household consumption and residential investment and infrastructure work will drive growth in the medium-term, but is anticipated to ease over the long-term, as construction activity and population-led consumption growth stabilises.