The future of workforce supply

250,000 shortfall by 2048

Key points

Record labour shortages will worsen with ageing

- The New Zealand labour market is very tight and will get tighter with an ageing population.

- The share of the working age population in work is the highest on record, and higher than comparable OECD countries. There are however gaps: Māori, Pasifika, women, and some older workers could be better utilised.

- New Zealand is not alone. Labour shortages are intense in OECD countries, but New Zealand stands out for the intensity of our shortages. Other countries also face ageing populations and will be in direct competition for global talent.

- Core working age population (15-64) will shrink over coming decades, But the total population will still grow and demand for workers will increase.

- New Zealand's need for workers will outstrip supply by 250,000 people by 2048. But the shortages will not be even.

  - Oversupplied with Management and Commerce, Creative Arts, Food Hospitality and Personal Services

  - Undersupplied in Education, Engineering and related technologies, Health and Society and culture.

  - There will be a significant shortfall of people with no post-school qualifications.

The labour market will not balance on its own

- In a slow population growth scenario (that is without migration), wages will rise by around 7% versus our baseline scenario, but older people are unlikely to retire much later. Rather, while wages will rise for younger people, and businesses will invest in labour saving capital, the economy will be weaker because older people – who will make up a large portion of the population – will be spending less.

- That means the economy will be smaller as a result an ageing population, in a no migration scenario.

The deficit can be met

- The labour deficit could be addressed through three levers:

  - Inflow of people through net migration

  - Increased participation and employment of Māori, Pasifika, women, and some older people.

  - Easier capital investment in labour saving technology by firms

- Each lever requires stable and long-term policy setting and business approaches.

Contents

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1. Introduction

Business New Zealand asked Sense Partners to summarise the current state and outlook for New Zealand's pipeline of talent, related issues, and opportunities. We found that labour shortages have intensified over time and will intensify further with an ageing population.

The issue is global and hence the competition for talent will also be global. While we have used immigration as an important source of labour in the past, we will need to be more consistent and deliberate on our immigration policy in the face of global demand for talent.

We have a record share of working age people in work. But there are some groups who may work more or work in jobs better matched to their skills: women, disabled and older people, Māori, Pasifika and other ethnic minorities. Making better use of currently underutilised pools of people will need resolving myriad issues from childcare, flexible working arrangements (time of day and school term time for example), discrimination, recognition of qualifications and higher pay. Our modelling work on ageing shows that higher pay on its own will not be enough to draw older people into work.

2. Context

2.1. Tightest labour market, will get tighter

It is the hardest it has ever been to hire workers, according to business surveys (Figure 1). Labour shortages are not new. While they cycle with the state of the economy, the underlying trend has been towards getting harder to hire staff since the 1970s. This is consistent with a rising share of adults in work, which now at the highest rate ever (Figure 2: More New Zealanders are in work then ever

Employment rate

Source: NZIER *Data 1850*, Statistics New Zealand, Sense Partners

Figure 3: More working age people are working around the OECD, but New Zealand stands out

Employment Rate: Selected OECD Countries

Source: OECD

2.2. Labour market will get even tighter

Labour shortages are acute around the world. However, the New Zealand experience is particularly intense in the OECD (Figure 3). New Zealand employed share of the working age population is the highest in the OECD. This means that New Zealand has greater labour shortages than comparable OECD economies, and that the causes and prescriptions for dealing with labour shortages in other places may not be suitable.

The international context however shows that the demand for talent is global in nature, and this competition will increase in the future with ageing populations across the developed world.

3. Drivers and characteristics of past growth in workers

Employment has increased in New Zealand by 50% in the 20 years to 2022. This was made possible to by two things:

- the working-age population grew by 36% (that is there were more working age people), and

- more of the working age population was working (69% of the working age population vs 63% in 2002).

Both population growth and utilisation in the workforce were driven by different factors.

3.1. A growing population

Population growth was driven primarily by natural population growth. That is, births exceeded deaths. Net migration boosted that population growth (Figure 4).

Natural population growth patterns are slow moving, but inexorable. Migration patterns are more volatile which are subject to policy settings which affect who and how many people can come to New Zealand, immigration policy settings that affect where New Zealanders can work and live, and relative economic conditions, which affect how many New Zealanders choose to emigrate.

Net migration of New Zealand citizens tends to be negative, averaging a little over 4,000 per year in the five years before the pandemic. Net migration of non-New Zealanders averaged a little over 60,000 a year.

The movement of New Zealanders cannot be easily controlled by policy. Departures of New Zealanders is affected by both the culture of 'overseas experience' and economic pull of income and career opportunities in key destinations, such as Australia, UK, USA, and Canada.

The arrival of non-New Zealanders is controlled by policy. Our biggest sources in 2019 were Philippines, India, China, UK, and Australia (Australians do not need a visa).

Almost 94% of net migration is aged under 65 and migration is particularly strong for those between 23 and 40 (see

Figure 5), meaning net migration boosts our supply of workers.

The inflow of migrants is via a range of visas: work, visitor (which may be a working holiday, or one that is later changed to a different visa), student, and residency. A small number also come on other visas, such as refugees and family reunification.

Immigration discussions often focus on Residence policy, which made up 12% of arrivals in 2019. Immigration discussions and policy attention need to be wider in scope, to include other sources of migrants.

Figure 4: Net migration has been an important top up to population growth

Drivers of population growth

Source: Statistics New Zealand

Figure 5: 94% of net migration is population aged 64 or lower.

Age profile of net migration: 2019

■ Under 65 years   ■ 65 years+

Source: Statistics New Zealand

Figure 6: Migrant arrivals is made up of around 20% NZ citizens; majority come via work, visitor, and student visas

Composition of migrant arrivals: 2019

Source: Statistics New Zealand

3.2. Growing employment within age cohorts and other groups

Employment growth in New Zealand has been supported by a natural increase in the working age population (people reaching working age), retirements, and net migration. Within this people move in and out of the labour force for various reasons, including study and training, family care, sickness and disability, and retirement.

3.2.1. More older people in work

Employment has trended higher for most age groups (Figure 7) over recent decades. The employment rate for the 15-24 year age group has not increased much until recently, reflecting a high share in education and training.

There has been remarkably strong growth among older workers (Figure 8). Between 2012 and 2022: 55-64 year age group has increased from 52% to 73%; 65 and over age group has increased from 5% to 20%.

However, these increases cannot keep increases for all. Some, especially those in physical jobs, can no longer do those jobs. For others, the value of their leisure time in retirement may be too high to give up for being back in work.

Figure 7: All age groups are more likely to be in work now than in the past

Employment rate by age group

Source: Statistics New Zealand

Figure 8: Over the last two decades employment has increased most for over 55 year olds

Employment rate by age
2012 and change to 2022

■ Growth/(decline) to 2022　■ 2012

Source: Statistics New Zealand

3.2.2. More women in work

The increase in employment across age groups has been supported by more women in work (Figure 9).

New Zealand experienced a deep economic shock during the reforms of the mid-1980s. This concentrated job losses in men (especially Māori and Pasifika). Employment has recovered over the last three decades but remains lowers than in the mid-1980s. Over the last two decades, male employment has increased across all age groups, but most in over 55 years age groups (Figure 10).

There has been a much steeper increase in female employment over time (Figure 8Figure 9) and across all age groups (Figure 11). The current employment rate for 15-24 year old females is the same as male employment, but is lower for all other age groups, despite substantial increases over the last two decades.

This suggest that more women may want to, and be able to work, if barriers to work are removed or reduced. There is a large body of literature that show barriers to work for women include discrimination, flexibility to balance family and leisure, and lack of mentors and role models. This suggests business and government policies around maternity leave, flexible working arrangements (for example school term time and time of day), deliberate mentoring programmes, etc. will help.

Figure 9: Over the last two decades there has been a big increased in women in work, across all age groups

Employment rate by sex

Female —— Male ——

Source: Statistics New Zealand

Figure 10: More older men in work

Male employment rate: 2002 and change to 2022

2002 ■ Change to 2022

Source: Statistics New Zealand

Figure 11: More women in work across all age groups

Female employment rate: 2002 and change to 2022

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3.2.3. Improvement across all ethnic groups

There has also been increasing employment across all ethnic groups, although ethnic differences are often persistent (Figure 12). Employment rates have improved across all age groups for all reported ethnicities over the last two decades (Figure 14, Figure 15, Figure 16, and Figure 17).

Māori and Pasifika employment rates remain below the total, and the gap prevails across all age groups (Figure 13). This suggests there are opportunities to increase participation.

Asian and MEELA ethnicities have massively increased employment rates, to be above the total. Research based on the 2018 Census suggests that these migrant dominated ethnicities may earn less than average, even after accounting for age, industry, and occupation. This suggests that while ethnic communities may be more likely to be in work, there may be an opportunity to better match their skills and qualifications to higher paying jobs to meet skills shortages.

Figure 12: Employment rates have improved significantly over recent decades across all ethnicities…

Employment rate by ehtnicity

Source: Statistics New Zealand

Figure 13: …although differences remain between ethnicities, with Māori and Pasifika less likely to be in work, and older Asians

Employment rate by ethnicity: 2022

Source: Statistics New Zealand

Figure 14: European ethnicity employment rates are higher than the total, and has increased for all age groups

European ethnicity employment rate
2012 and change to 2022

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Figure 15: Māori employment has improved across all ages, but remains below the total

Māori ethnicity employment rate
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Figure 16: Pasifika employment has increase across all age groups, but remains below the total

Pasifika ethnicity employment rate
2012 and change to 2022

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Figure 17: Asian employment is higher than the total, and is improving across all age groups, particularly older Asians

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3.2.4. Opportunities to do more with policy and business approaches

Despite the improvements, the rates of employment remain lower among non-Pakeha men. This suggests that there is potential to further increase employment in New Zealand, but it will require addressing issues around childcare and working hours (especially important for women), and other barriers to work, including discrimination related to ethnicity, gender, disability and age, and difficulty many immigrants face around matching their overseas qualifications to local work.

Box A What drives ethnic employment gaps?

There are persistent ethnic differences in unemployment. Some of it can be explained by education, skills, and work experience, but that does not explain all the difference. There are also causes like discrimination (racism) and social and spatial dislocation. Higher incarceration rates and child support burdens may also hinder.

Ethnic disadvantage can cumulate across both hiring and firing decisions. Evidence for discrimination is stronger in hiring than firing.

For example, black Americans are not the first fired when the economy weakens but they are the last hired.[3] A study of early-career British graduates found that, although ethnic minority graduates are less likely to find a job in a recession, those who do have a job do not experience ethnic wage differentials.

There is a smaller volume of evidence of discrimination in firing. However, a UK longitudinal survey found ethnic women were more likely to lose jobs than white peers.**Error! Bookmark not defined.** Black Americans are more likely to enter and less likely to exit unemployment than whites, with disadvantages in both transitions amplified by economic downturns.

A study of COVID-19 impacts in the UK finds intersectional disadvantages faced by Black, Asian and minority ethnic (BAME) groups, even when controlling for higher self-employment rates. BAME migrants were three times more likely to lose their jobs than UK-born white British, and UK-born white British were 1.7 times more likely to be furloughed than native BAME groups.

Discrimination may not explain all ethnic differences in unemployment. Rather, they may be more affected by fundamental factors like education, sector of work and so on, but discrimination and stigma may cause ethnic groups to spend longer in unemployment than other. Queuing theory explains some of this phenomenon – if white applicants are preferred, non-white applicants are pushed back in the labour queue.[3] This creates more time out of work, leading to scarring effects.

). This means the pool of available working-age people is shrinking over time.

Figure 1: Finding labour is the hardest it has ever been

Difficulty Finding Labour
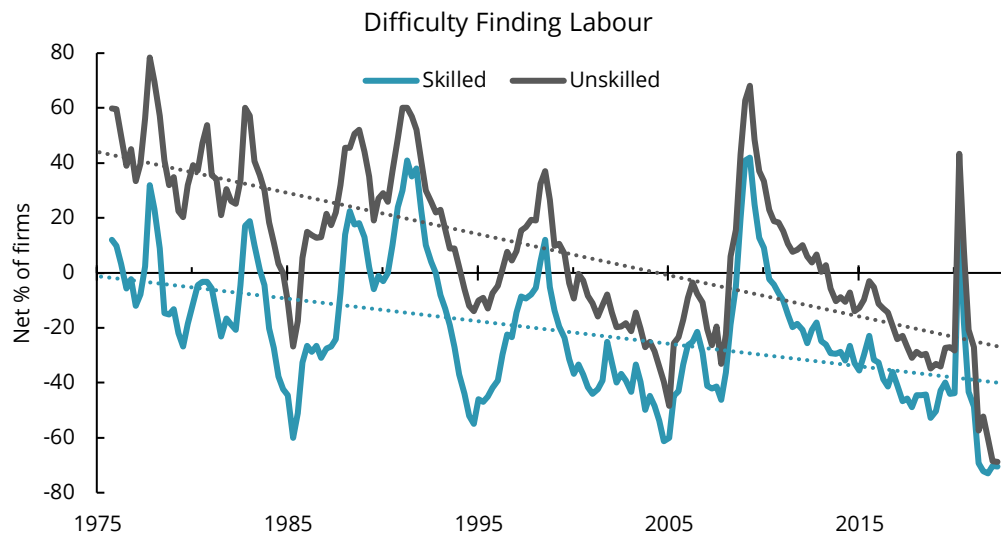
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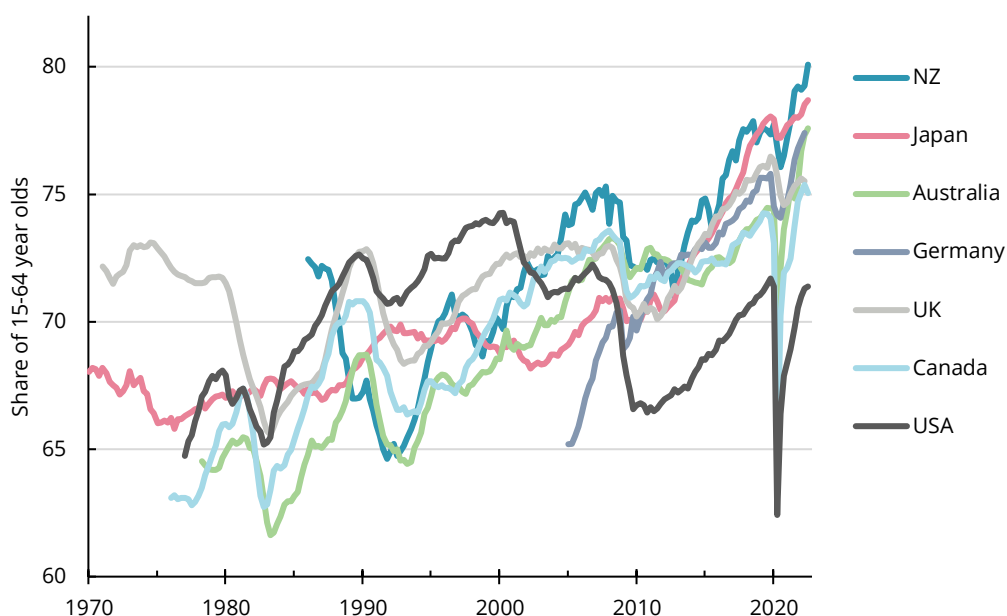
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[1] Except during exceptional circumstances, such as during the pandemic, when returning New Zealanders had to come through quarantine.

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[2] https://waitakereethnicboard.org.nz/waitakere-ethnic-board-ethnic-economic-contribution-report/

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[3] Yu, W. & Sun, S. (2019). Race-ethnicity, class, and unemployment dynamics: Do macroeconomic shifts alter existing disadvantages? *Research in Social Stratification and Mobility*, *63*, 100422. doi: 10.1016/j.rssm.2019.100422

[4] Couch, K., Fairlie, R. & Xu, H. (2018). Racial differences in labor market transitions and the Great Recession. In S. W. Polachek & K. Tatsiramos (Eds.), *Transitions through the labor market: Work, occupation, earnings and retirement* (pp. 1–53). Bradford, UK: Emerald Publishing.

[5] Hu, Y. (2020). Intersecting ethnic and native–migrant inequalities in the economic impact of the COVID-19 pandemic in the UK. *Research in Social Stratification and Mobility*, *68*, 100528.

5. Outlook for the labour force

5.1. Ageing will shrink the core working age population

As the population ages, this tailwind will become a headwind. Historically, we have had far more people coming of working age, than those approaching retirement. But an ageing population and declining birth rates means that this will reverse (Figure 18).

As a result, the population aged 15-64, the prime working age population, will shrink without immigration from the early 2030s. With immigration, the prime working age group will continue to grow, albeit more slowly than in recent yearsFigure 19. As a share of the total population, which is a good proxy for overall demand for workers, the 15-64 age group will shrink from now, even with immigration (Figure 20). This matters because a growing, older population will still require more workers. We discuss this in greater detail in Section 4.

In Box B, we summarise our results of an OLG model (and detailed in Appendix A), which is used to assess the effects of an ageing population. We found that under a no-net migration scenario, older people would still choose to retire around current levels, but the economy would be smaller as a larger older population would consume less, affected by lower interest rates, but businesses would invest more in labour substituting technology and younger workers would earn and save more.

Figure 18: Ageing and reducing birth rates mean that we will soon have more approaching retirement than joining the workforce

Crude workforce in and out age cohorts
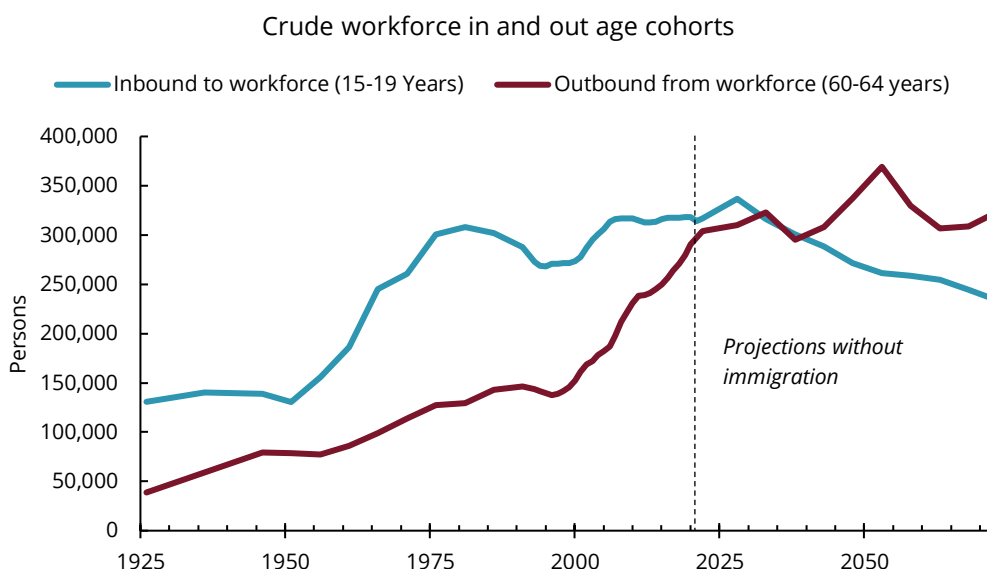
Source: Statistics New Zealand, Sense Partners

Figure 19: The 15-64 age group population has peaked, unless there is more immigration…

Core working age population (number): 15-64 years
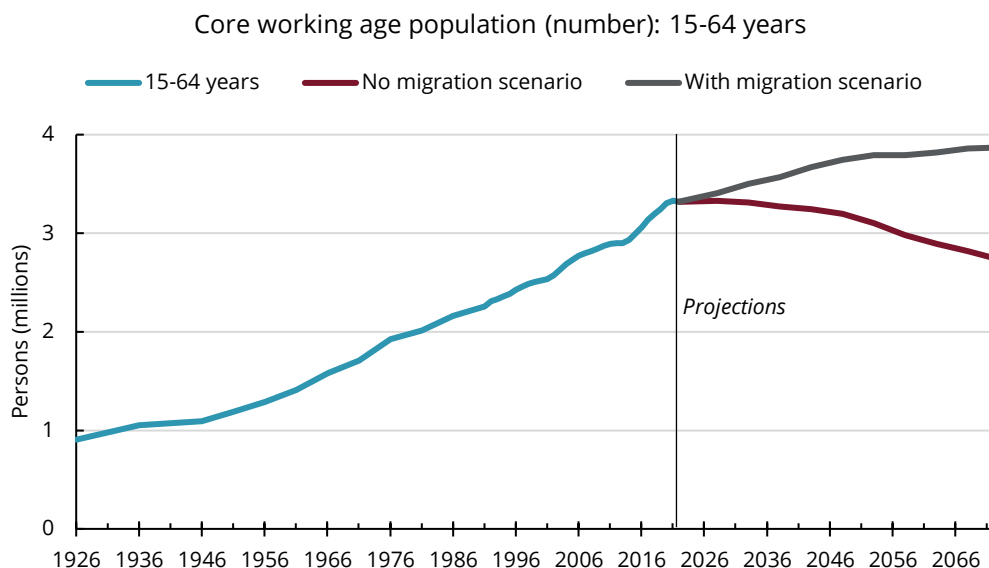
Source: Statistics New Zealand, Sense Partners

Figure 20:…but even with immigration, the older population is simply too big, and the share of 15-64 year olds in the country will be shrinking from now

Core working age population (% share of total): 15-64 years
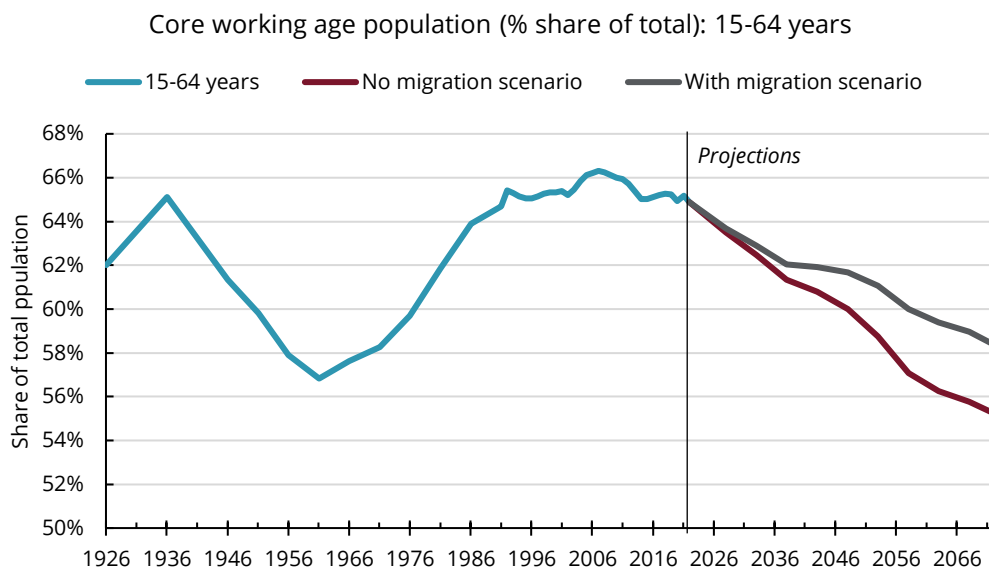
Source: Statistics New Zealand, Sense Partners

Box B: An ageing population will lead to a smaller economy

We estimated an Overlapping Generations (OLG) model for New Zealand. This model maximises utility for given wage rates and retirement savings needed for each stage of life. This helps us understand the motivations for people who are in work, when they become a smaller share of the total population due to an ageing population.

As populations age, the dynamics and decisions producers and consumers make change.

To investigate this more Appendix A details an Overlapping Generations (OLG) model we have adapted, and translated to the New Zealand economy, from the economic literature. OLG models are widely used for understanding the implications of ageing.

OLG models allow investigation of the work-leisure decisions of people at each stage of their working life. They maximise their overall happiness given wage rates and savings obligations for retirement at each stage of life.

We analyse a scenario in which the growth rate of the population of new people entering the work force falls. This is already happening and will accelerate without net migration. For New Zealand, this would mean:

- A declining core working age population will require firms to use more capital-intensive approaches, as labour shortages worsen. Wages rise by 7% above baseline levels because of this labour shortage.

- But there will still not be enough resources for the economy, meaning economic growth will falter and interest rates will fall. This will make it easier for businesses to invest in capital.

- Older people will spend less, as lower interest rates are likely to reduce their retirement incomes.

- Young people can spend and save more, because of higher wages and incomes.

- In our OLG model, the increase in wages is not enough to encourage older people to work. That is, they do not delay their retirement, instead choose to consume less.

Figure 21 shows the impact of declining inflow of younger people on capital intensity of the economy, real wages, and real interest rates. Figure 22 shows the impact on wealth, decision to retire, and spending.

Figure 21: Impact of declining population on capital intensity of the economy, real wages, and real interest rates
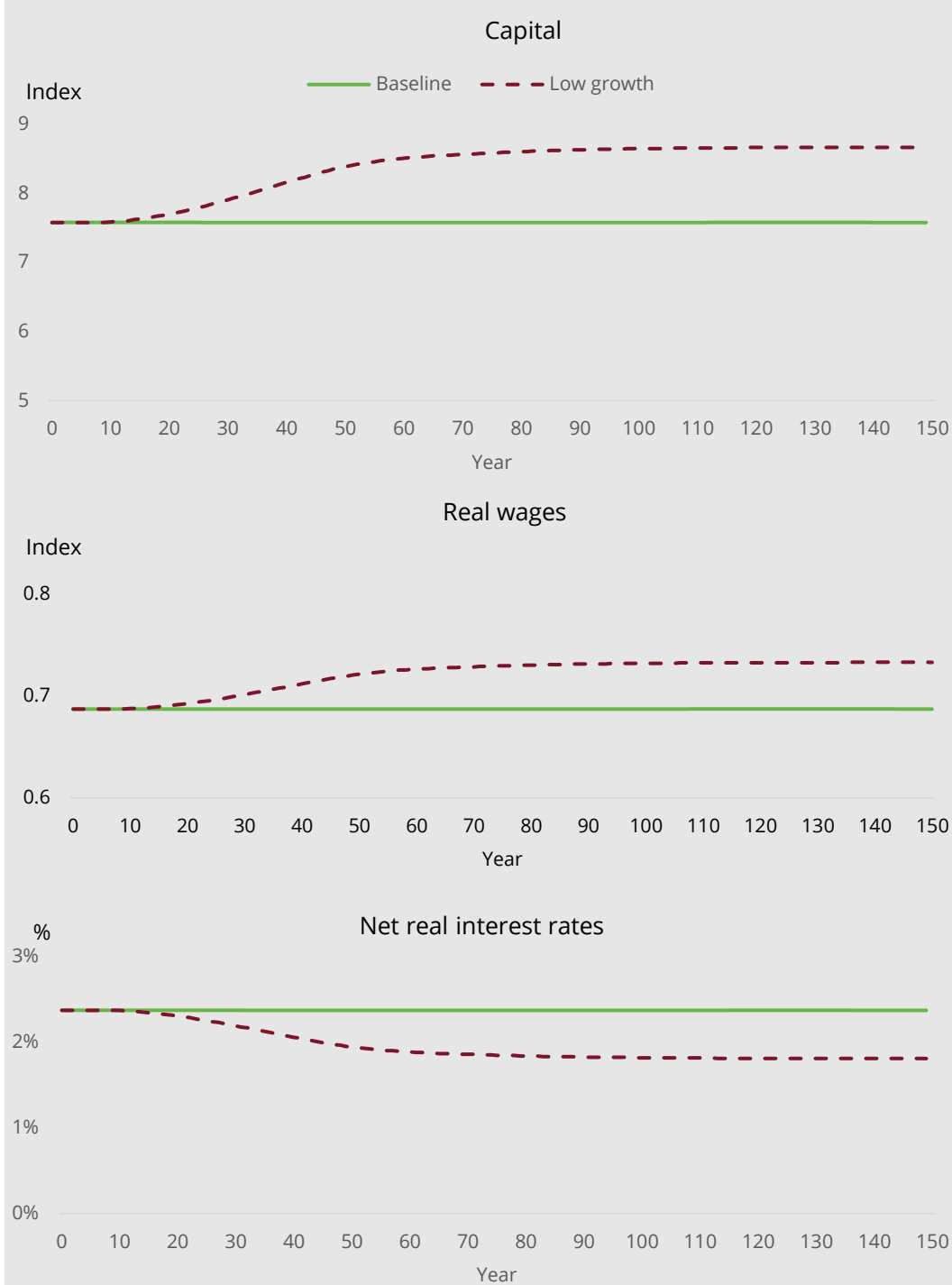
Source: Sense Partners estimates

Figure 22: Impact of declining population on wealth, leisure and consumption by years worked

Source: Sense Partners estimates

5.2. Some sectors are very exposed to ageing

Some sectors are very exposed to ageing. This is because very few young people choose to train in relevant qualifications and because it has older existing workforce.

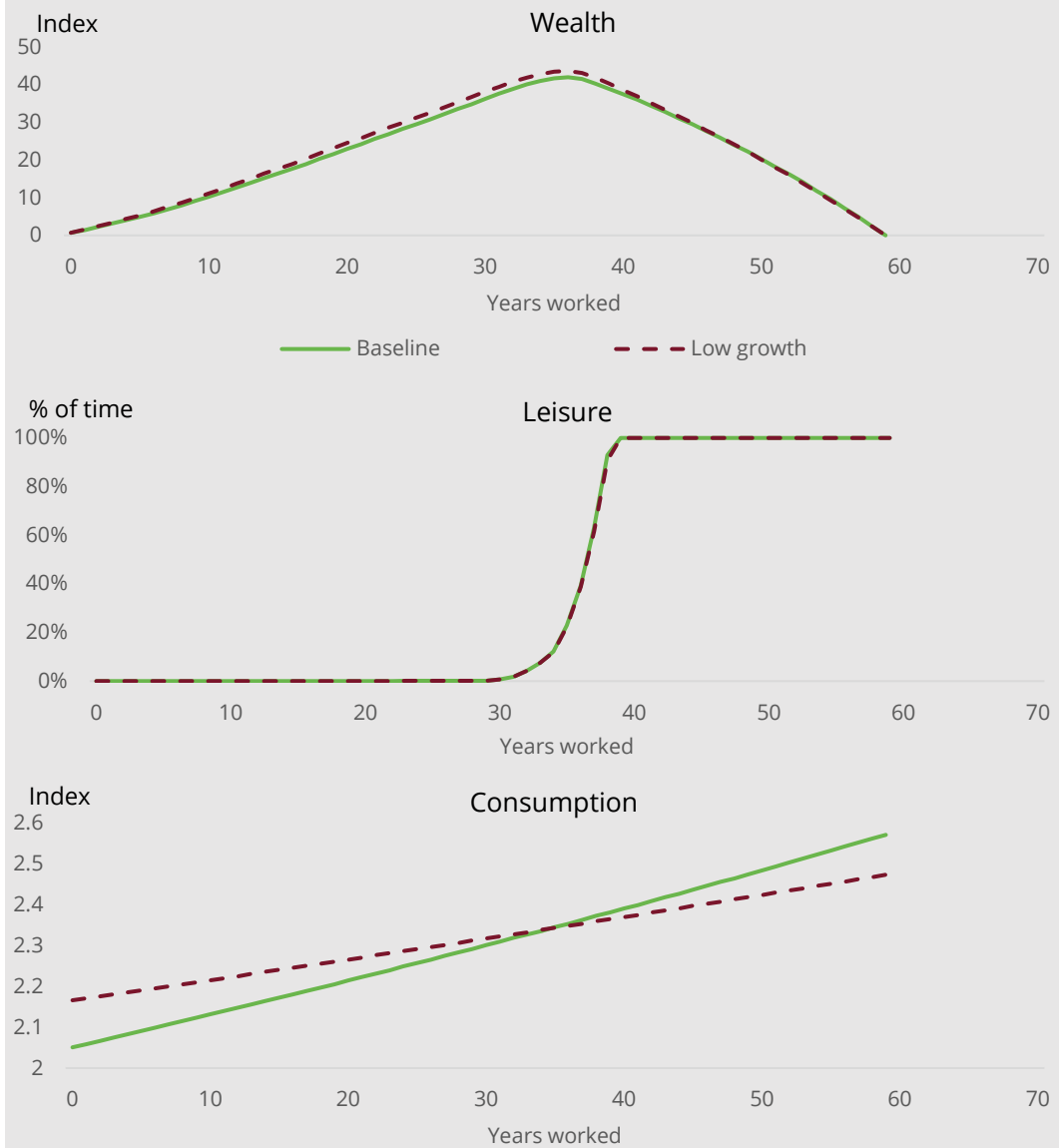It is helpful to look at the total population of qualifications, even if those people are not in work. It gives us a good picture of the total size of the qualified pool of people in New Zealand, who may be enticed to work for the right conditions.

We look at the population of each field of study to understand the entries and exits from training, net migration, and mortality. As an example, Figure 23 shows the population who had their highest qualification in the *Architecture and building* field of study. The grey bars show the population with the qualification five years earlier. The blue bars show the additional people who have that qualification (inflows through training and education, and net migration). The red bars show exits (mainly concentrated in older age groups, related to mortality, net migration, and gaining other qualifications).

Figure 23: The architecture and building field of study tends to see new entrants in the 15-39 age groups, from young people training to enter the workforce and migrants, and exits of people aged 40+, due to higher qualifications in another field of study, emigration from New Zealand, or death
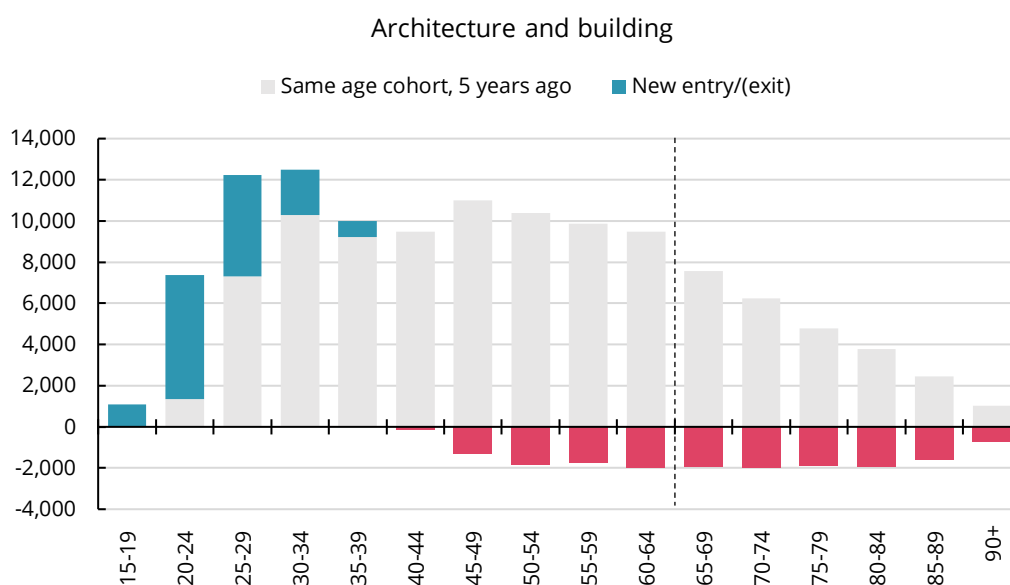
Source: Statistics New Zealand, Sense Partners

We have replicated this exercise for each field of study in Figure 24 to Figure 33. Each sector faces different conditions, although the challenges are broadly the same: there is a small pool of young people training, and there is a large cohort of people approaching retirement.

Figure 34 shows the population without any post-school qualifications. In early ages, this groups shrinks as young people gain qualifications. But there are over 200,000 people aged 30 to 40 years who have no post-school qualifications. This presents a potential pool of workers

who can be upskilled. Figure 35 shows that Education, health, engineering, and agriculture are already at below replacement levels for new entry versus nearing retirement cohorts and must rely on attracting workers across a wider age band through training and immigration.

Figure 24: Agriculture, environmental and related studies lose people from their 40s

Agriculture, environmental and related studies
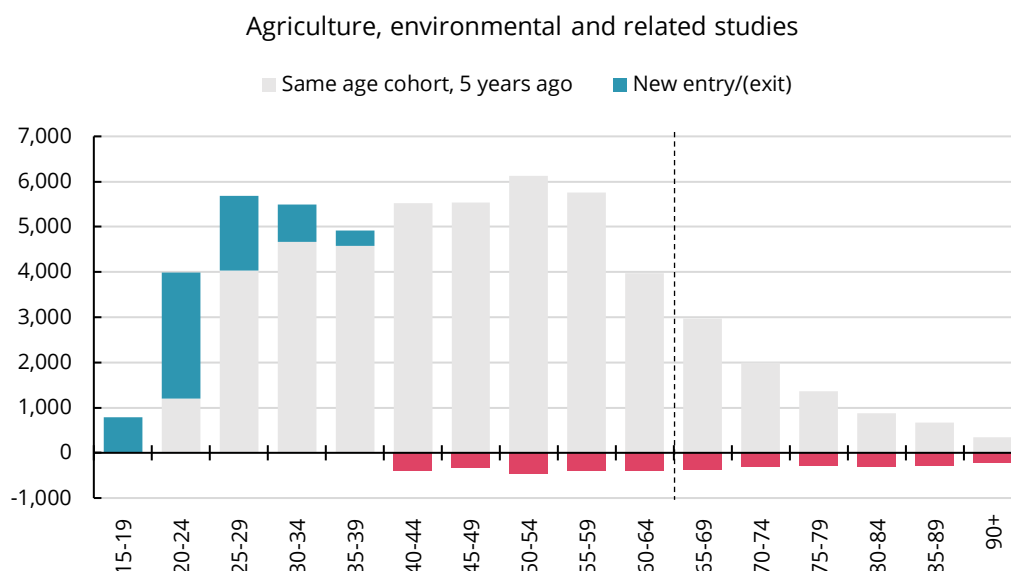
Source: Statistics New Zealand, Sense Partners

Figure 25: Engineering has a rapidly aging population, but new entrants are high through training and immigration

Engineering and related technologies
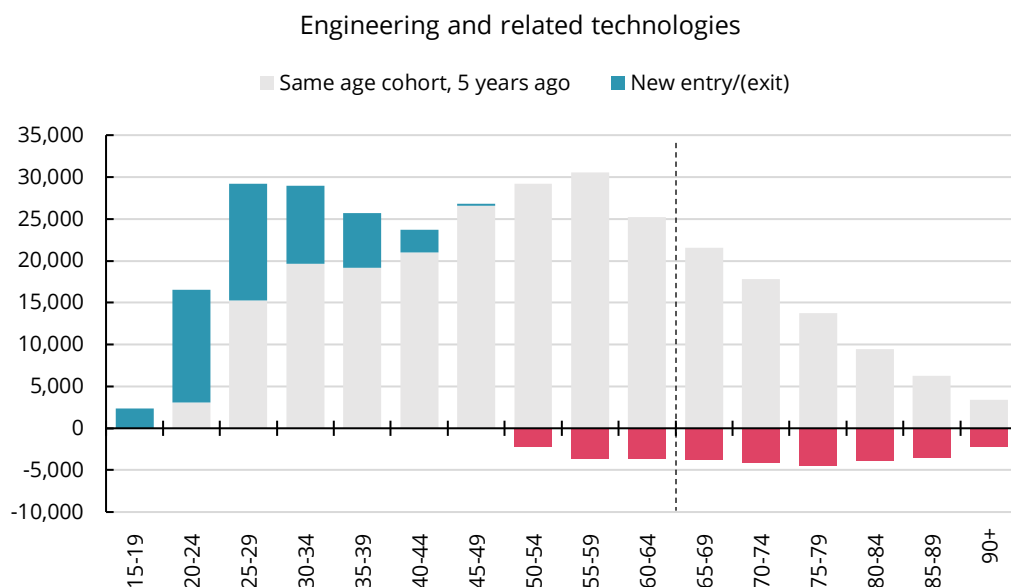
Source: Statistics New Zealand, Sense Partners

Figure 26: Health relies on immigration across a wide age group

Health
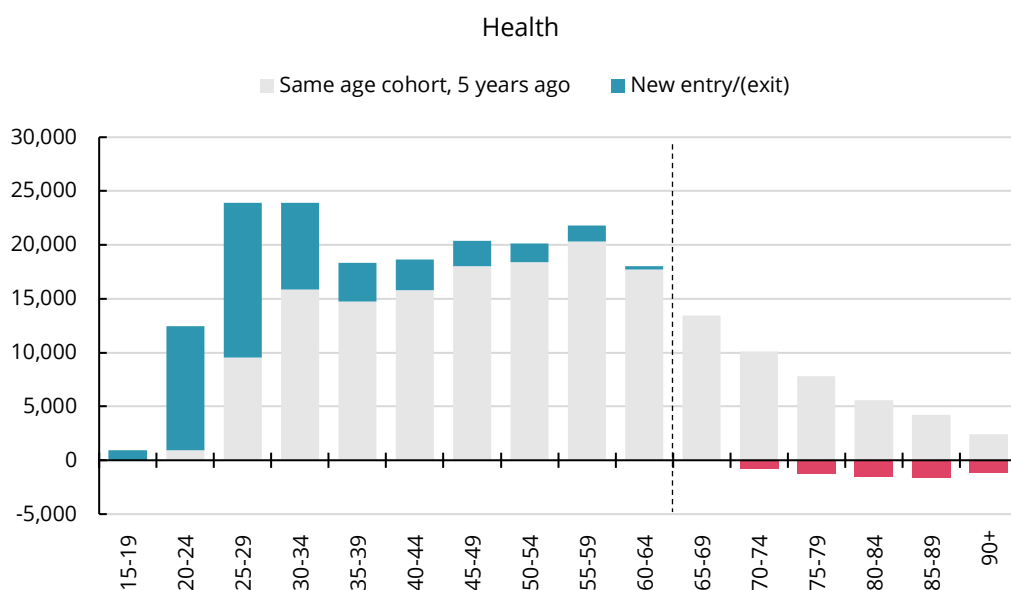
Source: Statistics New Zealand, Sense Partners

Figure 27: Creative arts is a very young sector

Creative arts
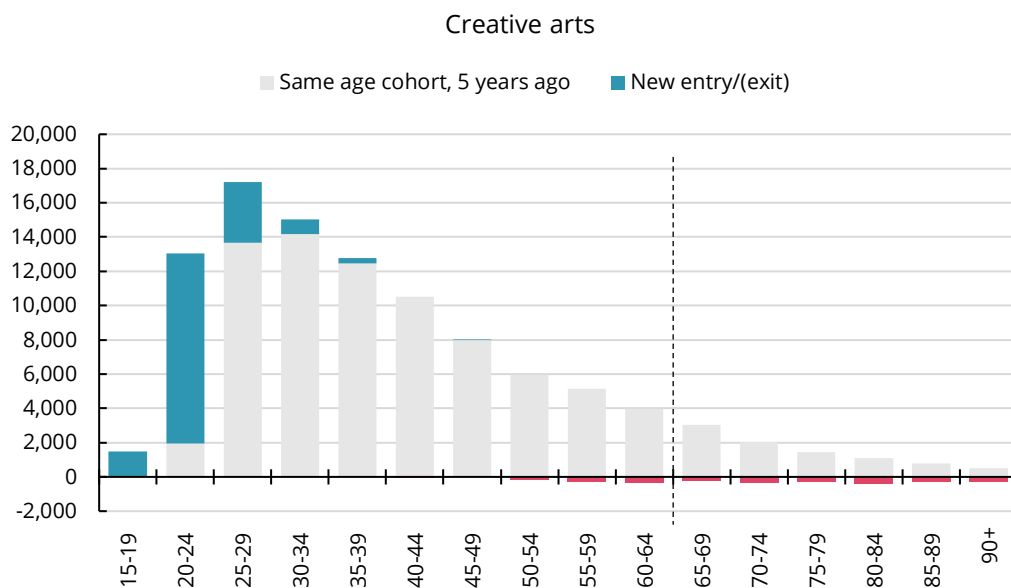
Source: Statistics New Zealand, Sense Partners

Figure 28: Education is growing across all age groups to deal with large retirement cohorts

Education
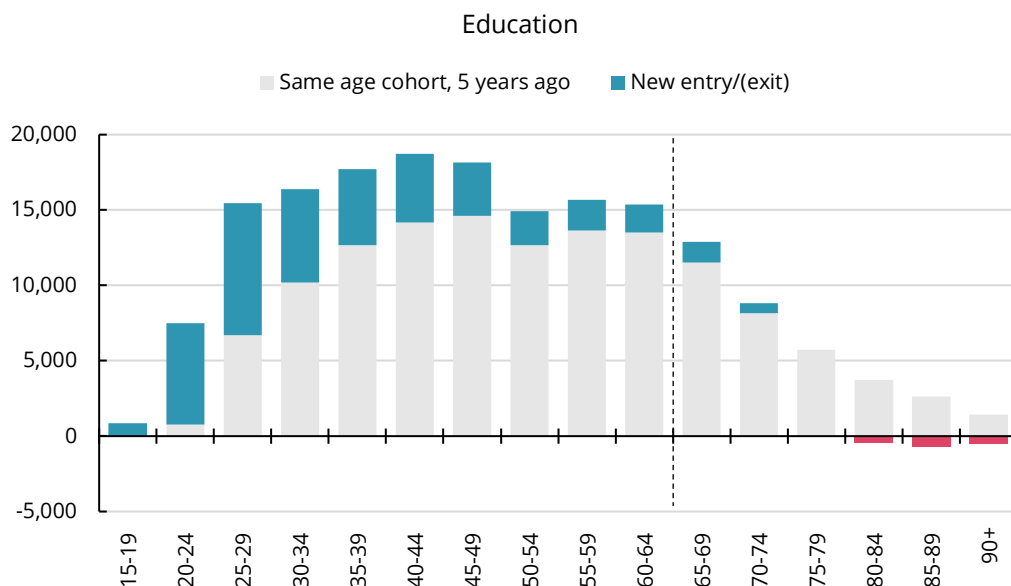
Source: Statistics New Zealand, Sense Partners

Figure 29: Hospitality and personal services sector relies on younger people

Food, hospitality and personal services

Source: Statistics New Zealand, Sense Partners

Figure 30: Information technology is a very young profession

Information technology
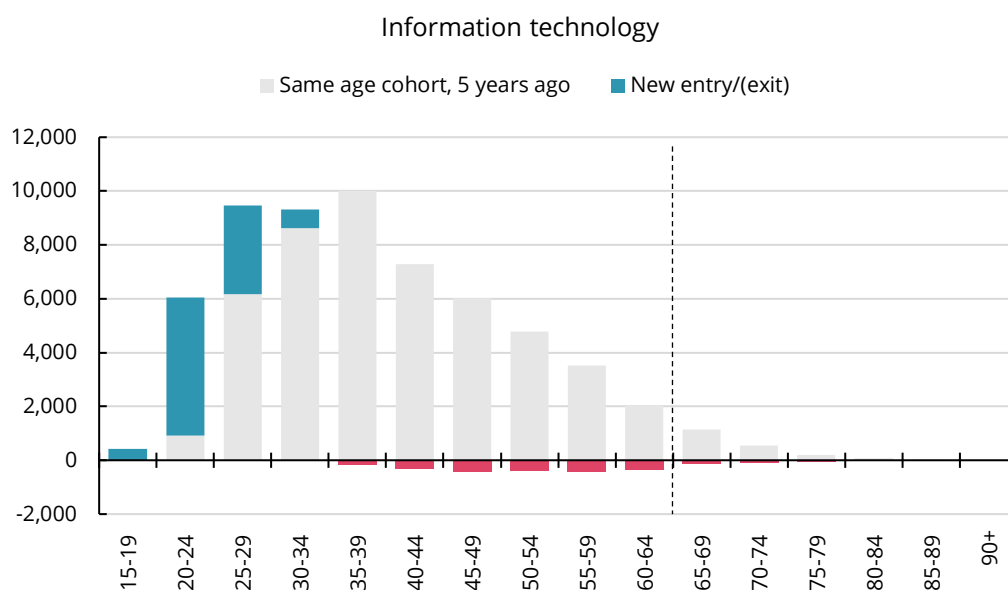
Source: Statistics New Zealand, Sense Partners

Figure 31: Management and commerce is a popular field of study

Management and commerce
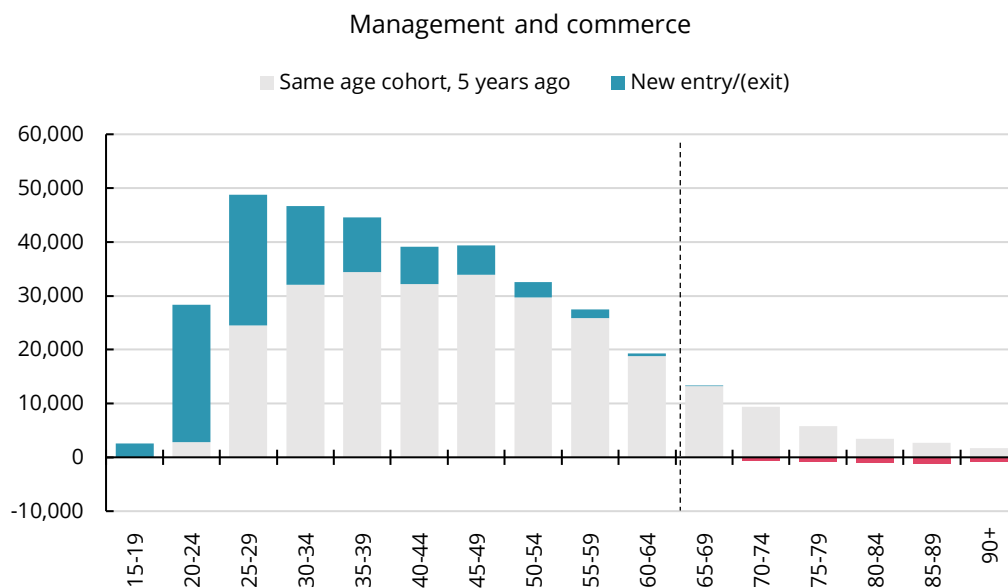
Source: Statistics New Zealand, Sense Partners

Figure 32: Natural and physical sciences is attracting new entrants

Natural and physical sciences
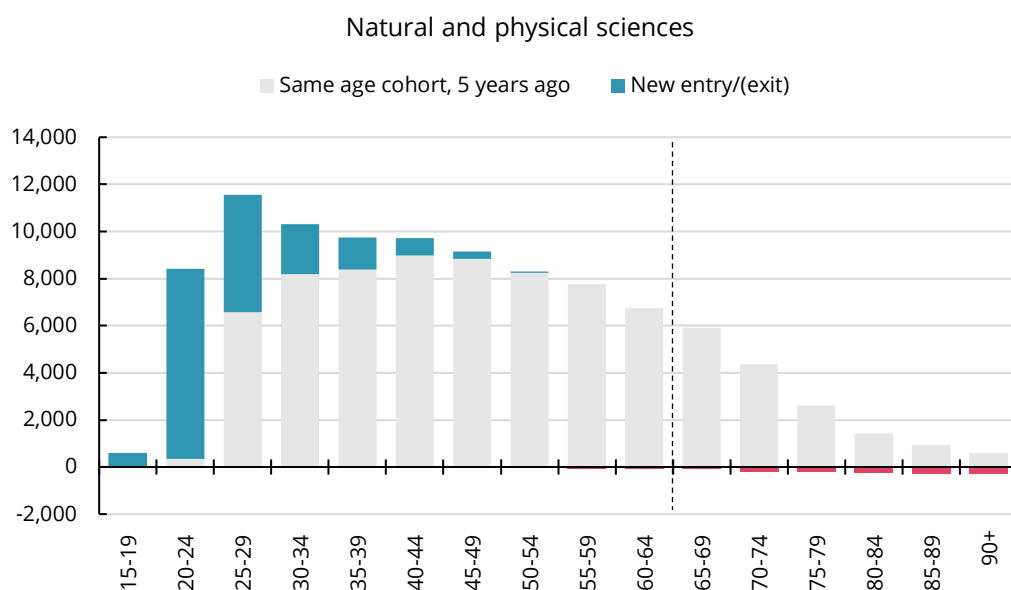
Source: Statistics New Zealand, Sense Partners

Figure 33: Society and culture studies training is popular among young people

Society and culture
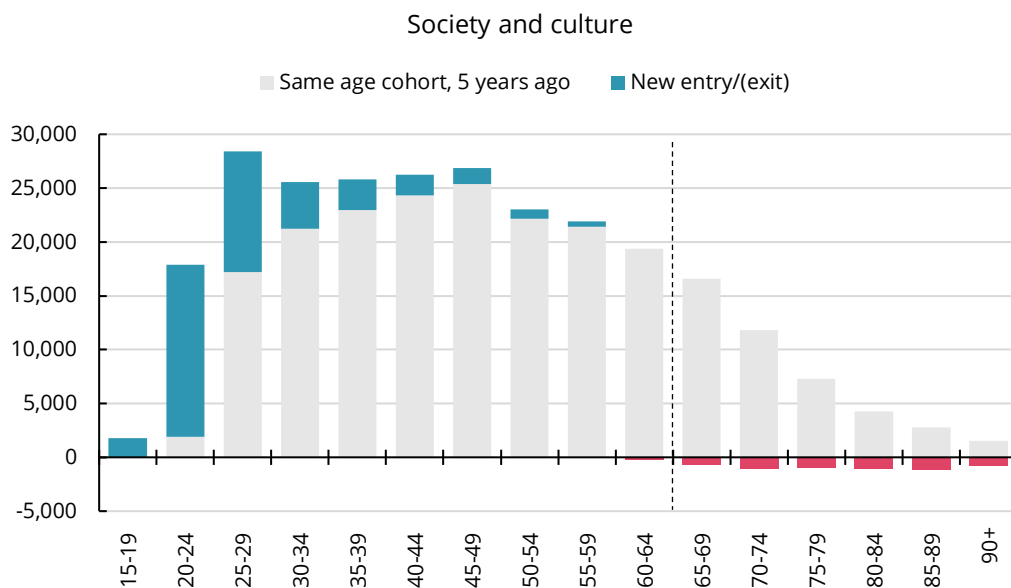
Source: Statistics New Zealand, Sense Partners

Figure 34: People without post-school qualifications is a potential source of people to train up for high demand areas

No post-school qualification

▨ Same age cohort, 5 years ago   ▨ New entry/(exit)
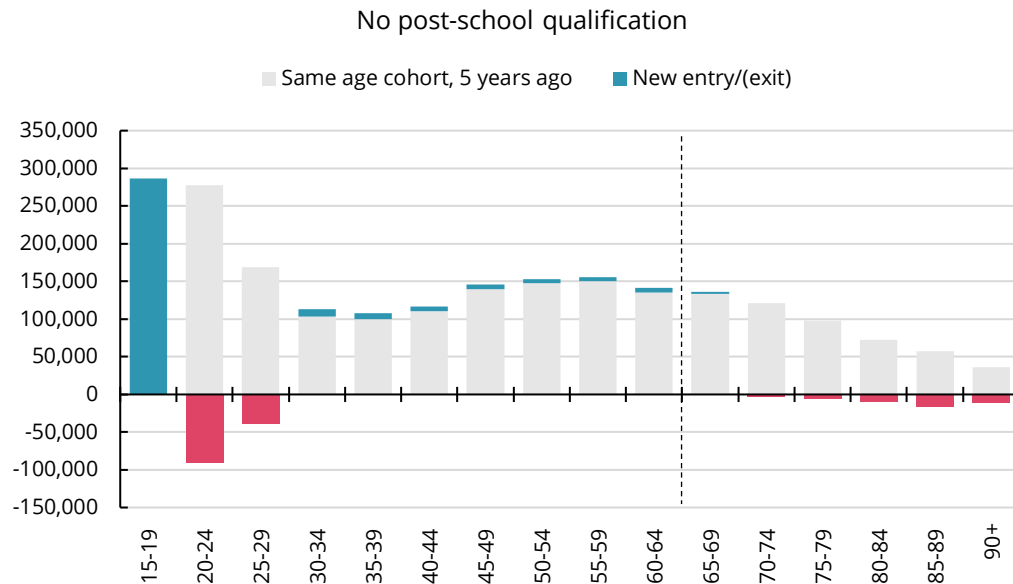
Source: Statistics New Zealand, Sense Partners

Figure 35: Education, health, engineering, and agriculture are already at below replacement levels for new entry versus nearing retirement cohorts

Entry & exit cohorts by Field of study

■ Gap   ▨ Approaching retirement (55-64)   ■ Training age population (15-29)
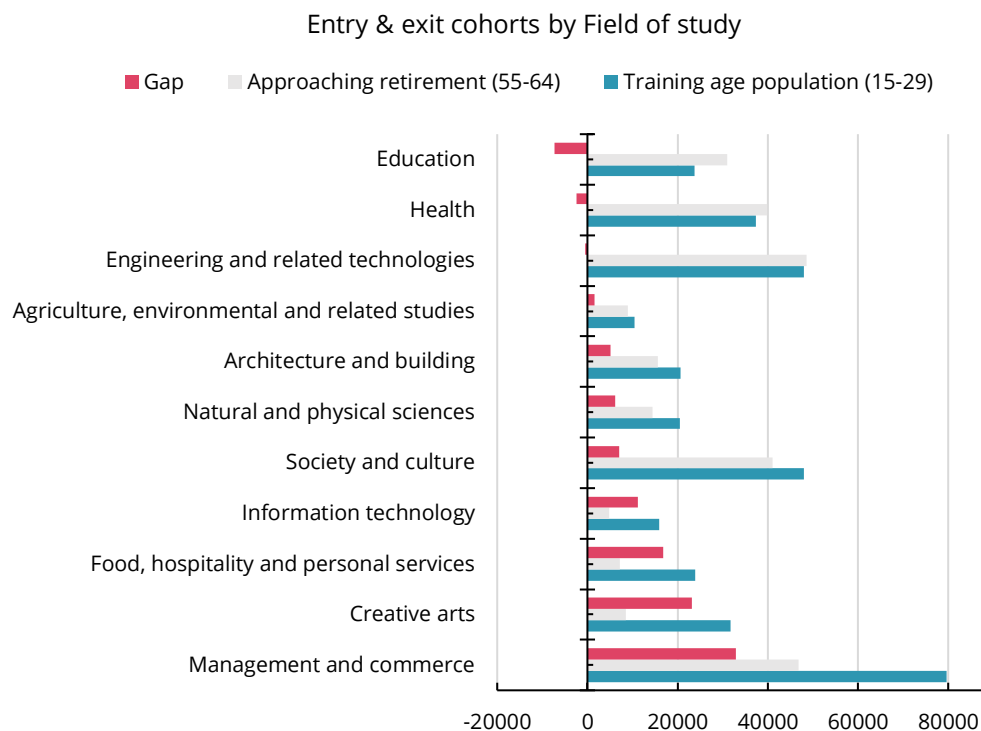
Source: Statistics New Zealand, Sense Partners

5.3. Ageing will lead to a 250,000-worker shortfall by 2048

While the supply of new workers is set to slow, the demand for workers, from a still growing (but ageing) population will continue to increase. In part, this is because older people tend to consume more services, which are more labour intensive.

We constructed a simple exercise to look at the outlook for workers by major fields of study, which is a good proxy for qualifications and various types of skills:

- We looked at what happens if there is no net migration, and training choices for new entrants (aged under 25 years) fields of study remain proportionately the same as 2018, and we simply age the population, less mortality.

- The resulting population in 2048 is made up of much older people. We repeat this exercise for each field of study and compare the supply of workers to demand for workers, assuming demand grows in line with population.

- We then estimate the capacity of different source of workers to supply these workers. For net migration, we include the estimates of additional employment generated by additional net migration.[6]

Figure 36: By 2048, the ranks of older people will have increased significantly

2048 population with zero net migration
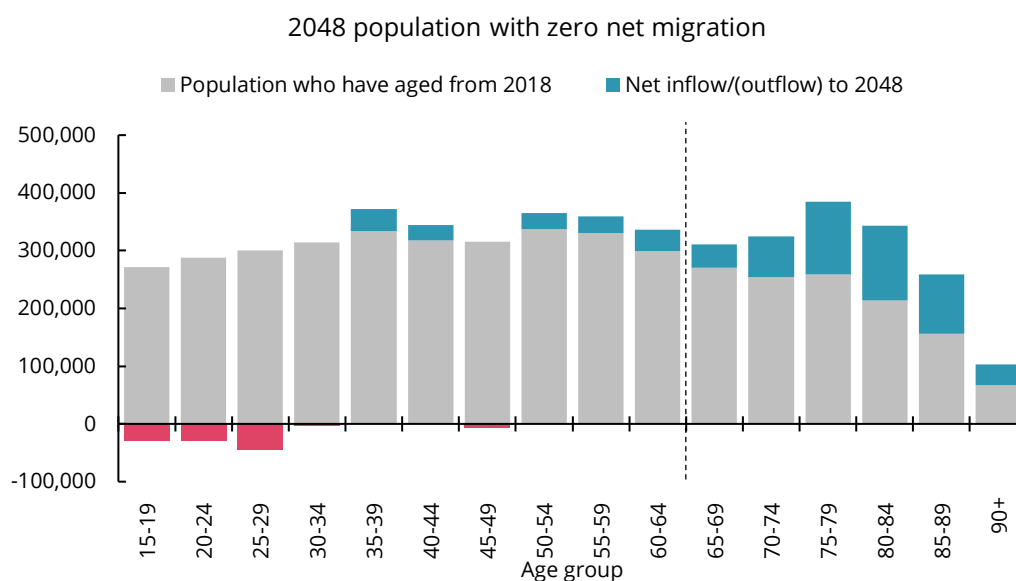
Source: Sense Partners

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[6] https://econpapers.repec.org/paper/nzbnzbans/2016_2f02.htm

Our scenario analysis found that by 2048:

- The total population of New Zealand will increase by 15% (550,000 people), but as peopled retire employment will only increase by 4% (110,000 employed people), if we maintain current high levels of employment rate in each age cohort (**Error! Reference source not found.**).

- The inflow of young people is offset by retirees for many fields of study, but not all. On current trends, we will be:

    o Oversupplied with Management and Commerce, Creative Arts, Food Hospitality and Personal Services

    o Undersupplied in Education, Engineering and related technologies, Health and Society and culture.

    o There will be a significant shortfall of people with no post-school qualifications.

Figure 37: If demand for workers increase in line with population, we will have a shortfall of 250,000 workers by 2038

Employee excess/(shortfall) by 2048
(with no net migration)
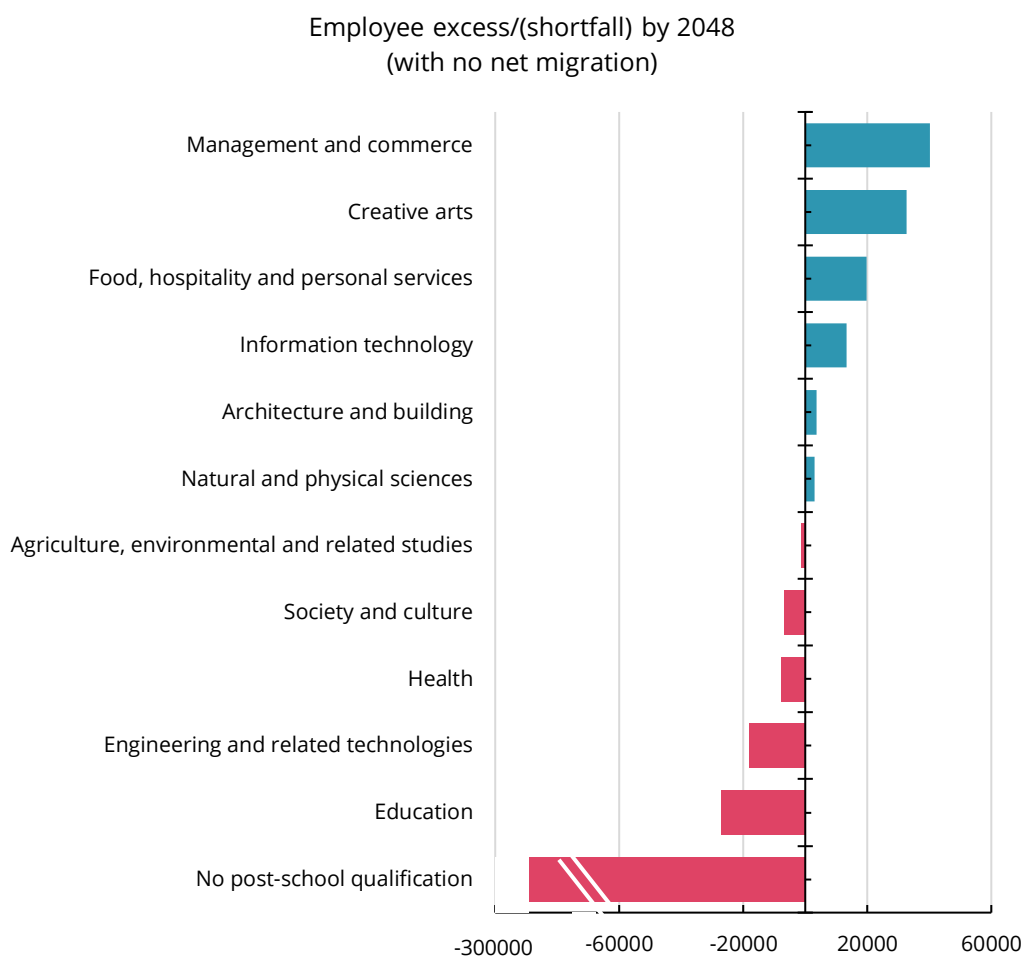
If demand for workers increases with population growth, then there will be a shortfall of around 250,000 workers by 2048, if the economy did not adjust between now and then. This shortfall can be met through one or combination of ways:

- **Net migration**, which also adds to demand. So, the increase in net migration will need to be around 700,000 over the projection period. Appendix B shows our estimates of net migration shocks in a simple VAR model. It shows that a migration shock boosts demand for workers, that is, it creates its own demand for additional workers.

- If we **utilise our workers better**: The following estimates show the potential size of workers available in 2022: -

  o If we closed the ethnic employment gaps, adjusting for age, that equates to 100,000 additional workers

  o If we closed the gender employment gap, that equates to 175,000 additional workers

  o If 5% more over 65s worked (25% now), that equates to 40,000 additional workers

  o Make capital investment easier, to increase productivity of fewer available future workers.

- All these require stable long term policy settings on immigration, investment in training and education (especially for Māori and Pasifika), better matching qualifications with employment through accreditation verification and recognition for migrants, better childcare support for women, more flexible working conditions, and a tools to address discrimination (age, gender, ethnicity, etc), and greater ease of capital investment (expensing smaller value investments, bigger tax incentives for large capital investments, etc). These are examples of policy choices that will affect future need for workers because of an ageing population.

6. Conclusion

We found that our population is already ageing. If there is no net migration, it will age faster. Slowing inflow of new younger workers and retiring older workers will mean the number of willing workers will likely not keep pace with demand. We calculate a 250,000-person shortfall by 2048.

Meeting this gap is possible, but it will be best met via a combination of policy efforts. Net migration is the most direct, requiring a plan to accommodate around 700,000 additional people. But we also have a large pool of available workers now, seen in low employment rates among Māori, Pasifika, women and, possibly, older workers. We can also invest more in labour saving technology to improve productivity of our workers.

Each of these requires stable and long-term policy.

Appendix A: Overlapping generations model and an ageing population

We construct an overlapping generations model to investigate the impact of ageing and longevity on household and business decision making.

OLG models capture the impacts of both changes in fertility and longevity and allow the behaviour of each cohort or year-group to respond to the incentives the fall in fertility and longevity generate.

They combine individuals' decisions on when to consume and how much to work with simple models of how firms aggregate labour and capital to produce goods.

The benefit of OLG modelling is that it allows closer analysis of decision making of different age cohorts through time.

That makes OLG models more appealing than standard macroeconomic models that have only a single decision-maker representative of all individuals.

We follow the approach in Kulish, Kent, and Smith (2010) who analysed the same model for the Australian market.

We calibrate the model parameters based on New Zealand data to reflect local conditions.

We find that:

- A fall in the population growth rate results in increased capital intensity of firm and a rise in wages as firms compete for staff.

- However, the expectation of longevity is the key driver of the retirement decision. So, unless people expect to live longer, they will not be easily tempted to work in older ages.

- The two scenarios are together larger than the sum of the parts, due to interaction effects. In this case we estimate that real wages rise by 21% over the estimation period.

Technical modelling adopted

People, or agents, in the model maximise their lifetime utility of,[7]

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[7] T is the maximum life of the agent and s works through each age from when an agent begins working until they die. β is the discount factor at each point in an agent's life and C is the optimal consumption given past work and leisure decisions. l is leisure and the function $v(s,T)$ is the utility of leisure or disutility of working. This function is increasing in age relative to lifespan reflecting growing dislike for working reflecting health deterioration from older ages.

$$\max \sum_{s=1}^{T} \beta^{s-1} \left(\frac{1}{1-\rho} c_{s,t+s-1}^{1-\rho} + v(s,T) \frac{1}{1-\rho} l_{s,t+s-1}^{1-\rho} \right)$$

Subject to a lifetime budget constraint of wealth and time involving earnings and consumption decisions through time, detailed further in Kulish, Kent, and Smith (2010).

People in the model maximise this equation by deciding when to consume and how much to work to fund their optimal consumption.

The key drivers of the behaviour we are interested in are determined by two critical relationships, the consumption decision, and the leisure decision households face.[8]

The modelled consumption decision is,

$$\underbrace{c_{s+1,t+s}}_{\substack{consumption\ at\ time\ t+s \\ of\ a\ person\ s+1\ years\ old}} = \beta R_{t+s}^{1/\rho} \underbrace{c_{s,t+1-s}}_{\substack{consumption\ at\ time\ t+s-1 \\ of\ a\ person\ s\ years\ old}} \qquad s = 1, 2, \dots, T$$

Consumption decisions through time is traded off between the present and future. β is the discount rate and R is the return on capital. $1/\rho$ is a level of risk aversion, comparable to an intertemporal elasticity of substitution for consumption.

High returns from investments and low discount rates encourage consumption today. As do higher values of ρ.

The leisure decision is,

$$\underbrace{l_{s,t+s-1}}_{\substack{labour\ at\ time\ t+s \\ of\ a\ person\ s+1\ years\ old}} = \left[\underbrace{v(s,T)}_{\substack{disutility\ from \\ working}} \Big/ \underbrace{e_s w_{s,t+s-1}}_{\substack{age-specific \\ productivity\ wages}} \right]^{1/\rho} \qquad s = 1, 2 \dots T$$

The leisure decision is driven by the ratio between how much agent's dislike working relative to the wages they receive scaled by their level of human capital (es) at each age.[9]

A representative firm then employs labour and capital to maximise profit typical in economic models.[10]

Given the population the model solves for the optimal decision and interaction between the population who supply labour and the firm that employs them.

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[8] These relationships come from first order conditions within the in Kulish, Kent, and Smith (2010) model.
[9] The FOC for leisure is also dependent on consumption but it has been removed here for simplicity and communication.
[10] Cobb-Douglas production is assumed, as is typical in the literature.

Calibration of the model

Parameter	Description	NZ calibration
β	Discount rate	0.99
ρ	Relative risk aversion	3.5
δ	Capital depreciation rate	0.06
$(1 - a)$	Labour share of income	0.52
n	Steady-state Population growth rate	0.6%
TFP	Steady-state Total Factor Productivity	0.5%
Working life (T)	Working life	60

For the discount rate we adopt a β of 0.99, consistent with other macroeconomic general equilibrium models.[11]

For the macroeconomic depreciation rate δ we adopt 6%.[12] For labours share of income we adopt 0.52[13] and for the steady state population growth rate we set to 0.6%, all based on Statistics New Zealand[14] historic and forward-looking data.

Total factor productivity (*TFP*) we assume 0.5% growth and risk aversion we set to 3.5, consistent with past analysis.[15]

The working life assumption is 60 years. This is the same as past literature and is comparable to a life expectancy of 80 years, close to that in New Zealand.

Scenarios

We estimate the baseline case and then consider 3 alternate scenarios to investigate the impact of changes in expectations.

Scenario 1 is a reduction in the new population growth rate. In the modelling framework this is comparable to a permanent fall in fertility rates domestically, however this has the effect of reducing the labour force, comparable to low or no net migration.

Scenario 2 is an increase in life expectancy. An unexpected increase in agents' lifespan ages a population by increasing the increasing the number of people in the older cohorts.

Scenario 3 is scenarios 1 and 2 combined.

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[11] P 13 https://www.rbnz.govt.nz/-/media/6ffbb24257d8460eba0970294ed73982.ashx
[12] Table 3.6 and 3.7 https://www.stats.govt.nz/information-releases/national-accounts-income-and-expenditure-year-ended-march-2021
[13] Table 1.2 https://www.stats.govt.nz/information-releases/national-accounts-income-and-expenditure-year-ended-march-2021
[14] Statistics New Zealand population projections. https://www.stats.govt.nz/topics/population-estimates-and-projections
[15] https://www.nzier.org.nz/publications/water-management-in-new-zealand-a-road-map-for-understanding-water-value-nzier-public-discussion-paper-201401

Scenario	Population growth rate		Working lifespan	
	Initial (T1)	Final (T2)	Initial (T1)	Final (T2)
Baseline	0.6%	0.6%	60 years	60 years
1 Reduced population growth	0.6%	0%	60 years	60 years
2 Increased longevity	0.6%	0.6%	60 years	70 years
3 both increased longevity and reduced population growth	0.6%	0%	60 years	70 years

Results

Reduced population growth

- Reduced population growth increases capital intensity in the production process and the increases real wages as businesses compete for workers.

- This has a disproportionate negative impact on older people.

- Younger cohorts of people with low savings and long-life budgets remaining, see increased real wages and can increase consumption in the near-term

- However, for older cohorts who have reached late in their working life, reduced rates of return and a higher dependency on past savings to fund their retirement with limited ability to benefit from increased wages.

- Under this senecio, the retirement age is not impacted and the total wealth profile across the different age cohorts.

Increase in life expectancy

An increase in longevity increases wealth, as savings and optimal retirement age both rise. Under this scenario:

- As agents are healthier and live longer, they retire later in life, increasing the aggregate labour supply. In response, wages jump down, and interest rates jump up. However, these initial effects on factor prices are gradually unwound, so that eventually, wages rise, and interest rates fall, relative to the initial steady state.

- A longer lifespan raises the absolute number of years spent in retirement. Agents must save more for this longer retirement, and these additional savings raise the aggregate

capital stock. This in turn raises the marginal product of labour, which pushes up wages, and reduces the return on capital.

Both: Increase in life expectancy and reduced new population growth

Under this scenario the impact of the first two scenarios is compounded, resulting in an effect that is more than additive.

Real wages increase by to be 21 percent higher in this scenario.

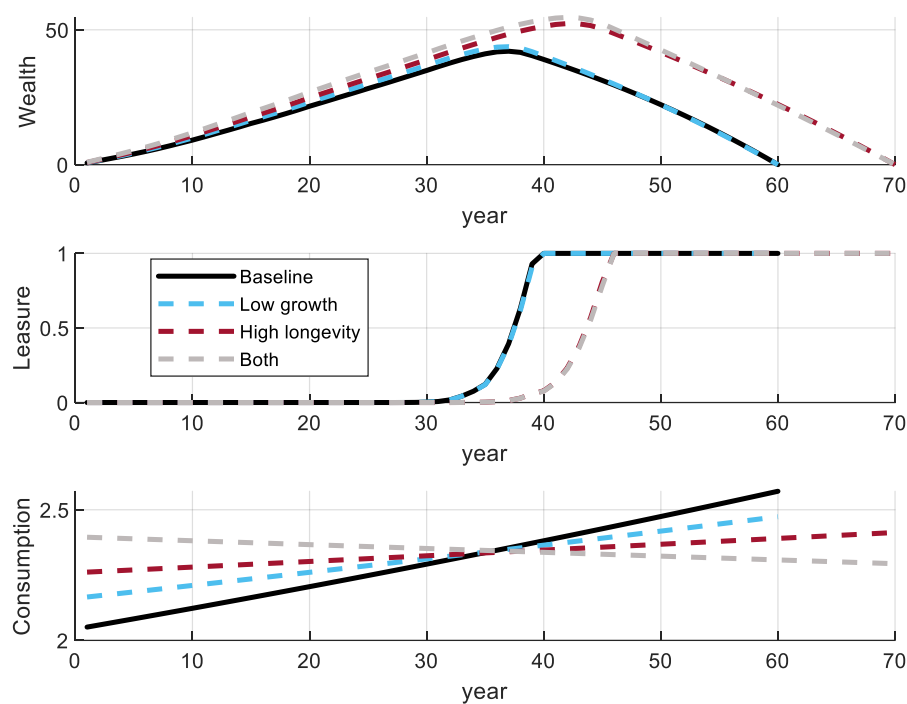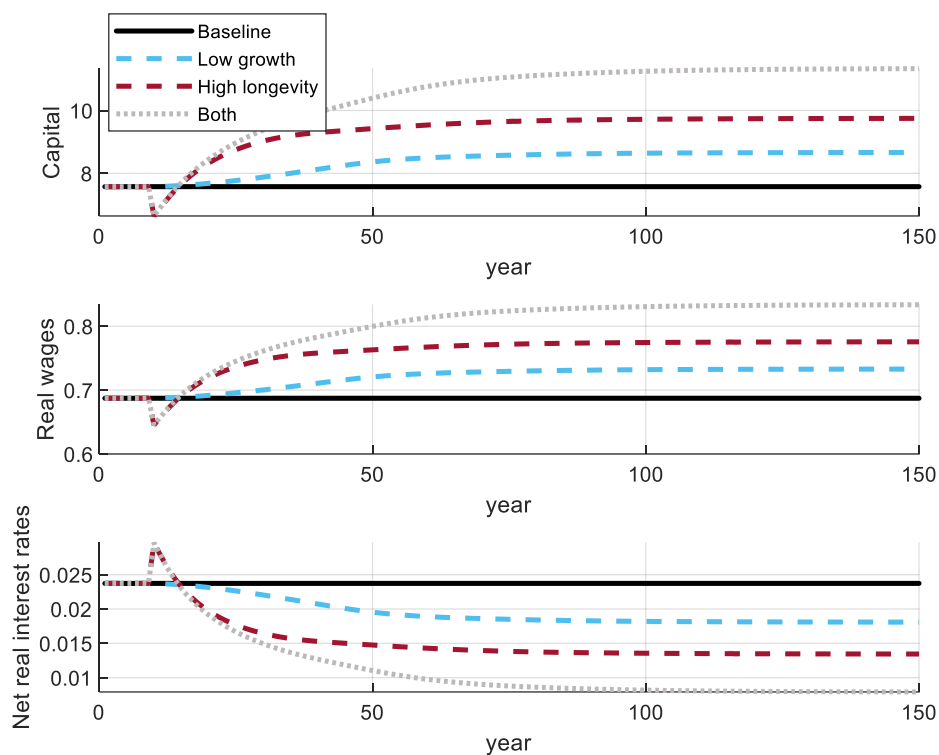Figure 38: Impact of population assumptions on wealth, leisure, and consumption

Figure 39: Impact on capital, real wages and real interest rates by years worked

Appendix B: Vector Autoregression of migration and the NZ economy

We estimate a vector autoregression of the macroeconomy including labour market variables, output, and net migration.

We follow the approach of Furlanetto and Robstad (2019) exactly who develop an identification scheme for the structural VAR.

Furlanetto and Robstad (2019) enables the ability to disentangle immigration shocks from other macroeconomic shocks in a sign-restricted SVAR model. This furthers technical identification techniques in typical macroeconomic analysis aimed at isolating impacts of macroeconomic variables influenced by many factors.

Furlanetto and Robstad (2019) analyse Norwegian data over the period 1990Q1 -2014Q2. We use their model approach and calibrate the model to New Zealand data of unemployment, wage growth, labour force participation, migration, and GDP between Q1 1991 to Q4 2019 in order to remove the impact of COVID-19 induced restrictions.

We find similar behaviour in the New Zealand data as presented in Furlanetto and Robstad (2019) of the Norwegian case. However, the impact of a positive migration shock is much more pronounced and sustained for New Zealand market, because a one standard deviation is a bigger population impulse than in Norway.

Figure 40: New Zealand identified impulse responses (1 s.d. shock to migrants)
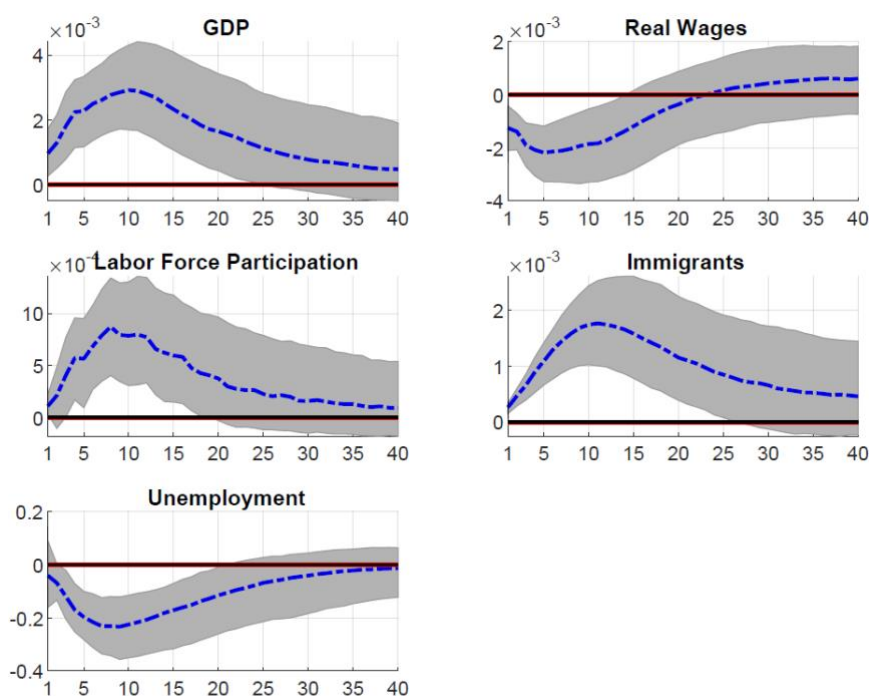
Figure 41: Norwegian identified impulse responses (1 s.d. shock to migrants)