



Grow for it

How population policies can promote economic growth

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Key points

New Zealand struggles to grow its economy partially due to its small size and remote location. There is little that can be done to change location, but the size can be increased over time.

It is feasible to adopt a population policy with the aim of the population reaching 15 million in the next 50 years – an annual growth rate of 2.5% per annum. This would bring the size and density of the population to levels closer to more prosperous European countries. Fifteen million – two and a half times current projections – is a good target, too, as it allows for several large cities, fostering competition within New Zealand.

The benefits of such a policy come from increasing scale, where high fixed costs including infrastructure are spread across a larger population. Network effects provide other benefits. With the right selection parameters, more liberal immigration policies could also assist New Zealand with its looming fiscal challenges of an ageing population.

But the choice of policy mix (among higher fertility rates or higher rates of migration) is important. Raising fertility rates would greatly increase the young (dependant) population initially, while migration can directly increase the working age population.

Providing the right conditions is essential to ensure that an increasing population will more than proportionately improve economic activity to raise average incomes. There needs to be flexible labour markets and responsive infrastructure investment mechanisms to allow the economy to grow without adverse impacts.

Issues arise from an increased population, such as more demand on public and environmental services, some of which cannot have their provision expanded easily. Preparation, and or better institutional design though, could offset many of the potentially adverse effects associated with a rapidly increasing population.

Technology may be reducing the tyranny of distance but it is increasing the importance of being enormous. There is an opportunity for an ambitious growth agenda which targets size as a fundamental shortcoming of New Zealand's economy.

Given the potential economic benefits then why not grow for it?

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1. Introduction

A country can achieve high economic growth while being small or remote, but not both. Unfortunately New Zealand is both.

New Zealand is the textbook example of an economy that should have reasonably strong trend growth. It has strong institutions, relatively good regulation, and open markets.¹ Yet it has been sliding down the rankings in terms of growth and productivity.

One set of solutions is to keep on improving the quality of institutions and regulations, so they are considerably better than other economies and compensate for being small and remote.

Considerable attention is also paid to the benefits of bringing the world closer to New Zealand but not so much the benefits of size. There are ongoing debates over submarine cables and broadband access, trade promotion offices and tourism advertising campaigns.²

But if the problem is both distance *and* size, there should also be a discussion about the benefits of size. If there are benefits to being bigger, these should be explored.

In looking for options to improve the growth potential of our economy, we need to look at all reasonable options and examine their costs and benefits with an open mind. The aim of this paper is not to generate a definitive recommendation, but to explore the opportunity and risks to inform debate.

Section 2 sets the scene by looking at how small New Zealand actually is and whether we can expect to get much bigger on the current trajectory.

Section 3 looks at the benefits of being big and asks how much bigger New Zealand might need to be to reap benefits from scale.

In section 4 we present our starting bid for a bigger New Zealand: 15 million residents by 2050. We provide a high level template for what would be needed to get there and show what the age and ethnic composition of the country might look like as a result.

Section 5 concludes with a discussion of some of the policy and practical problems that might arise en route to 15 million.

¹ Although the OECD (2011) has observed that "New Zealand's long standing front runner status in product market regulation has been eroded away over the past decade".

² Distance does matter a great deal. For example, models of trade which incorporate distance to explain trade volumes have been hugely successful empirically; see Law, Genç and Bryant (2009).

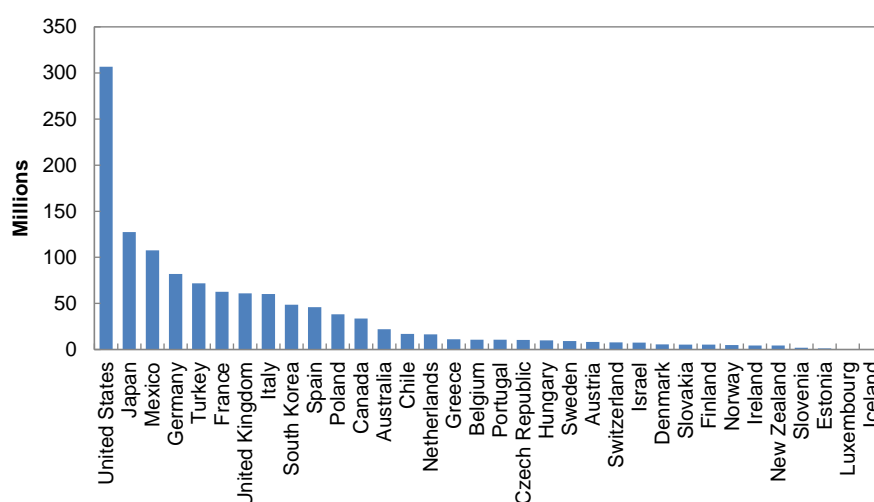
2. Land of the small white crowd?

Size can relate to a number of things. It can mean limited wealth, low income, small population, low population density or limited land area. It is also relative to a country's location. Small countries with nearby neighbours can obtain scale by integrating with their neighbours (McCann, 2009). In this sense they are not necessarily small. Indeed there are many countries which look to be of similar size to New Zealand, but comparisons can be misleading. In New Zealand's case, however, what you see is generally what you get. When New Zealand is counted as small on any number of comparators, there are few extenuating circumstances which moderate the assessment of smallness.

New Zealand is a small both in terms of population and population density, when compared to other countries. Within the OECD, for example, New Zealand ranks 30th out of 34 countries by population and 29th out of 34 for population density. On measures of GDP New Zealand also ranks 29th out of 34.

At a regional scale, Auckland is by far New Zealand's largest and most dense region but it barely scrapes into the top 200 largest regions in the OECD let alone emerging economies.³

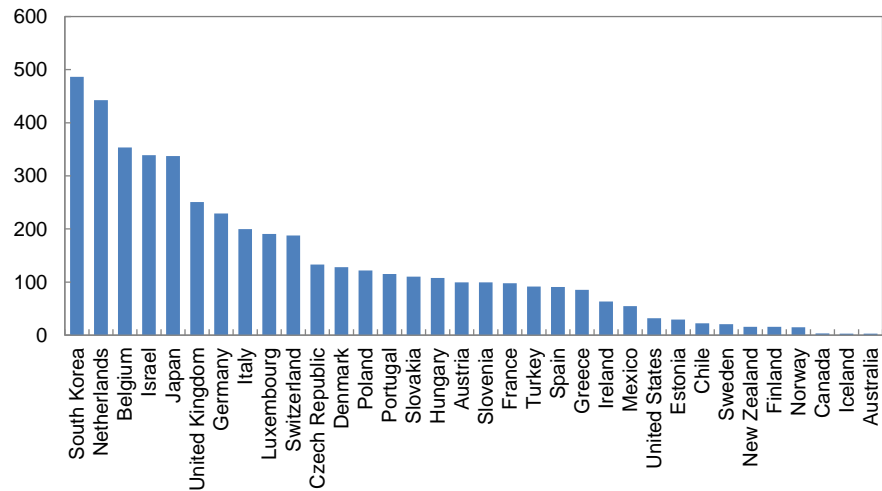
Figure 1 Size: population of OECD countries
Population



Source: OECD

³ Based on OECD population statistics at the TL3 micro region level.

Figure 2 Population density of OECD countries
Population per square km



Source: OECD

On current trends and policy, New Zealand is destined to remain small. Population growth is affected by four things:

- fertility
- longevity
- inward migration
- outward migration.

Birth rates in New Zealand have been relatively steady over the past 20 years. The birth rate is typically about double the death rate, much of which can be explained by increases to life expectancy.

On average, net births represent a positive contribution of 0.8% to the population growth every year. In coming years this is likely to reduce as a greater proportion of the population falls outside child bearing age.⁴

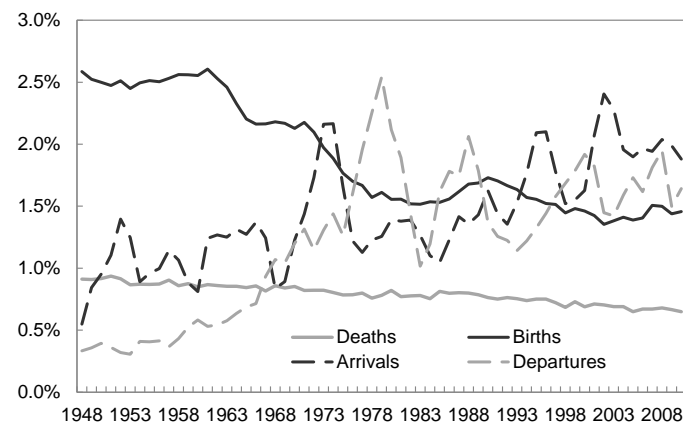
The other major contributor to population growth is net migration. New Zealand has a relatively large number of migrants arrive every year, but an almost as large number leave. Net migration, the difference, tends to fluctuate significantly over time as economic conditions change, particularly in Australia which is the country where much of the interchange takes place. In the past 20 years, net inward migration has averaged 0.3% per annum.

Recently the population growth rate of New Zealand has been around 1.1%, but is forecast to slow over the next 50 years. Our population forecast suggests that the

⁴ Based on the current population forecasts and fertility rates.

population will only reach 6 million by 2060, due to declining fertility rates with a constant numerical level of net migration.⁵

Figure 3 Changes in population
Percentage change per annum



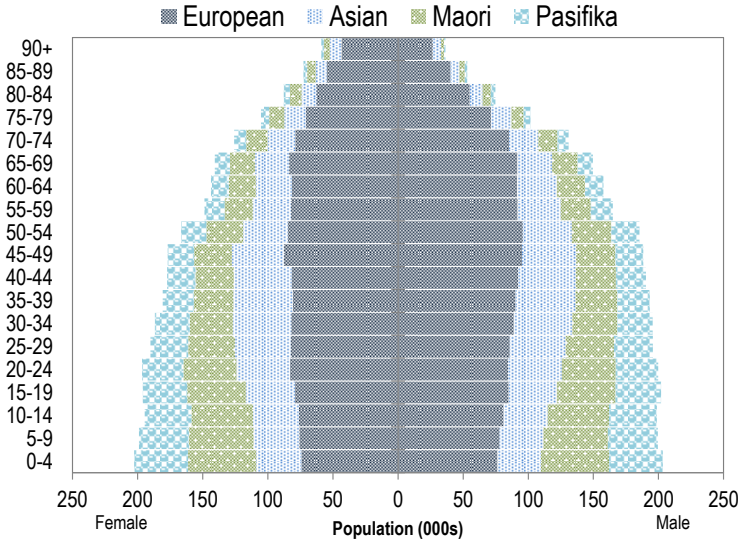
Source: Statistics NZ, NZIER

The demographic profile of New Zealand in 2060 is shown in Figure 4 using current birth, death and migration rates.

As well as growing, New Zealand is ageing. Like so many other countries in the world the average age of our population is rising. With the first of the baby boom generation entering retirement now, the ratio of retirees to working age people is set to surge. This will happen as soon as 2030. This ageing of the population will have significant fiscal implications, as described in detail in the Treasury's Long term Fiscal Strategy documents.

⁵ A description of our forecast "microsimulation" model is in the appendix.

Figure 4 Forecast population in 2060



Source: Statistics NZ, NZIER

3. The benefits of being large

The benefits of a bigger population, and conversely the constraints on growth from a small population, have been discussed at some length in the New Zealand context, though mainly within policy and academic circles; most recently by McCann (2009).⁶

It seems that every time smallness and distance comes up there are a lot of reasons to believe it is a major issue, and few reasons it should be ignored. But almost inevitably the best that is achieved is a short-lived conversation of no consequence. So, let us reprise the benefits of a bigger population once again. They include:

- **Increasing returns to investment** in physical and institutional infrastructure (i.e. lower average costs per capita) which are important determinants of growth (OECD 2001). It is the same as for large firms who have a cost advantage over smaller firms in regard to high fixed cost activities (Skilling, 2001).
- **Specialisation** and higher productivity which results is a function of market size; as Adam Smith once observed "the division of labour is limited by the extent of the market".⁷
- **Higher wages** observed in larger cities where capital to labour ratios tend to be higher.
- **Improved efficiency and effectiveness of knowledge exchange** (see McCann, 2009) through so-called "network" or "agglomeration" effects gained from having people and firms located near each other. Knowledge improvements also lead to high value added goods and services.
- **Job search** is easier in more populous places. When someone loses a job in a small town, for example, the options for alternative employment are limited and searching elsewhere for a job is more difficult.
- **Home market effect:** Stronger competitive pressure in larger markets. Competitive advantage is created by strong, competitive domestic markets (Porter, 1990). Competition leads firms to innovate continuously as competitors are able to imitate. This provides a platform for competing internationally, where the scale is larger still and competition potentially strongest.

⁶ For an older but similar discussion see Skilling, D. (2001). "The importance of being enormous: towards an understanding of the New Zealand economy", Economic Transformation Project, New Zealand Treasury.

⁷ Chapter 3 in Smith, A. (1790) *An Inquiry into the Nature and Causes of the Wealth of Nations*, 3rd edition, vol. I.

These benefits are also benefits of large cities. Large cities are critical engines of growth. The OECD (2006) has investigated competitive cities in the global economy and found a greater than one-for-one relationship occurs between population size and income in metro-regions in the OECD, i.e. larger cities are more prosperous per head of population.⁸

Returns to scale do diminish for the largest cities. The OECD's work (OECD, 2006) found that the relationship between population size and income was less than one when only the very largest metro-regions were analysed. While this suggests there is a limit to the benefits of size it also implies that smaller cities can gain the most from increasing scale (Maré and Graham, 2009).

Scale is not without its costs of course. Environmental and social impacts arise from large populations and reduce the benefits of scale. Some critics see these costs as outweighing the benefits of size. For instance, Birrell (2011) identifies contrasting policy goals in Australia, caused by having to cope with increasing populations in metropolitan areas while trying to maximise the gains from the resources boom. This creates conflict; something New Zealand has not been great at addressing.

Another issue is that, while a positive link to larger cities is observed, there may be a drain in other regions as talent shifts towards the larger cities. Regions close to the central hub may benefit as its reach expands.

There is also the possibility that scale may not be as large a driver of prosperity for New Zealand as it is elsewhere. Skilling (2001), for example, suggests that the New Zealand economy is driven by commodity demand and production of low value added goods and that such economics do not benefit as much from knowledge spillovers as other kinds of economic activities.

This is ultimately a chicken and egg dilemma. New Zealand does not have the market structure of an economy with scale. Therefore, it will not achieve the benefits that come from greater scale. At the same time, the lack of scale in New Zealand limits certain kinds of economic activities. Small firms are unwilling to make the kinds of irreversible investments that large companies are. So, without scale, the structure of the economy will not change.

Scale is becoming an increasingly important factor in the knowledge economy. Historically, increasing scale was to do with minimising transaction costs. As distance is being shortened by improved communications there are still great benefits of scale. Scale allows networking and coordination between firms, better labour market matching and knowledge exchange of high value added goods and services (McCann, 2009).

While there is a trade-off between costs and benefits, increasing the scale of New Zealand's economy through population growth could be worth exploring as a strategy to increase the individual income levels in the country. The potential from increasing scale is such that ambitious population growth policy warrants careful consideration.

⁸ However, the relationship is not clear as to whether the large population makes the city prosperous, or whether the population migrates to more prosperous areas.

4. Starting the bidding: 15 million by 2060

What could we aim for? Our opening bid is a population of 15 million people by 2060. A population of 15 million by 2060 equates to a growth rate of 2.5% on average over the next 50 years. This figure balances the practicality of achieving a population growth rate needed to produce a much larger population, against achieving a target with the scale benefits looked for. Reaching 15 million would require a step change and would be a challenge. But it represents a population growth rate which is not distant from what has been achieved in the past.

Table 1 Population growth rates over 50 year horizon

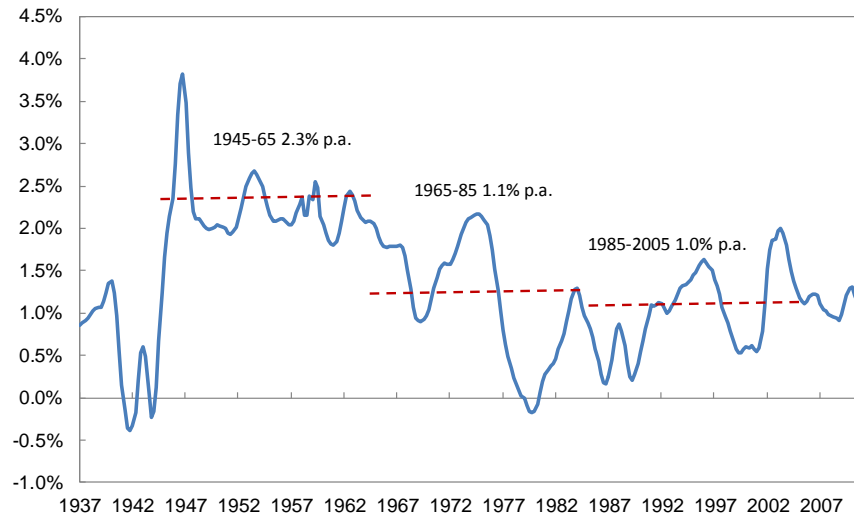
Population target	Required annual growth rate
7,500,000	1.1%
10,000,000	1.7%
12,500,000	2.1%
15,000,000	2.5%
17,500,000	2.8%
20,000,000	3.1%

Source: NZIER

To think about what looks feasible from an historical perspective we looked back at a life time's worth of population growth rates – from the 1930s to the present day. The highest sustained (20 year) growth rate over the period was around 2.3%. Granted this was during the “baby boom” after World War II – a social reaction against years of low birth rates in times of economic upheaval and war – but it shows that such a growth rate is achievable.⁹ A growth rate of 2.3% per annum would bring New Zealand's population to around 13.7 million in 2060; in other words, even a small change in growth rates can have a significant impact on the population over the longer run. The orders of magnitude at issue are shown in Table 1.

⁹ New Zealand has had faster growth – if the population grew at similar rates as were experienced in the 19th century the population would already be bigger than the United States – based on a growth rate of 5% since 1886.

Figure 5 Population growth in New Zealand
Annual % change



Source: NZIER

A population target of 15 million by 2060 (2.5 times that now projected) is not only “feasible”, it is also likely to be sufficient to achieve the benefits from scale. It would allow four main cities with a population of three million or more each. This would foster competition within New Zealand to create conditions amenable to building local firms that can foot it internationally. It would bring New Zealand’s population into close proximity of the Netherlands (but still nowhere near the population density of that country).¹⁰

Options for reaching 15 million

Growing the population to 15 million represents a near four-fold increase over the next 50 years. There are a number of ways to target 15 million by 2060 and they are not created equal because they will affect both the size and the composition of the population – in terms of age and cultural background.

Just to get a sense of how different the impacts of various options are, we’ve considered three scenarios:

- boosting fertility relates: a “grow your own” scenario
- boosting net migration, the importing scenario
- a 20:80 combination of increased fertility and net migration.

Different scenarios are possible. But this section stays with the three scenarios for the purpose of exploring the different implications for demographics and policy levers.

¹⁰ Projected by the OECD to have a population of 16.7 million.

The age distribution, in particular, differs considerably across the possible growth scenarios. Increasing fertility rates significantly increases the youth population (creating an age profile looking more like a pyramid), while increased migration provides a large increase in the working age population (resulting in a profile that looks more like a barrel). Combinations of the two policies would provide an alternative balance in the demographic profile.

Population growth is the outcome of the interaction of a number of different effects. Aside from the birth and death rates already mentioned, immigration and emigration are the key contributors.

Grow your own

We are a long way short of the kinds of fertility rates that would be required to boost population growth rates to 2.5% per annum. Fertility rates would need to increase from around 2.05 births per woman to over 5 and would have to do so very rapidly. The state could provide incentives to boost fertility rates but, based on the experiences of other countries, a shift to 5 births per woman would be unprecedented and potentially very expensive.

The introduction of a cash payment for having children in Australia (and changes in childcare support for working parents) has shown some success in boosting fertility rates, increasing from 1.73 to 1.97 between 2001 and 2008 after 40 years of decline (Guest and Parr, 2010). However, similar incentive policies in other countries have had varying success in terms of increasing fertility rates.

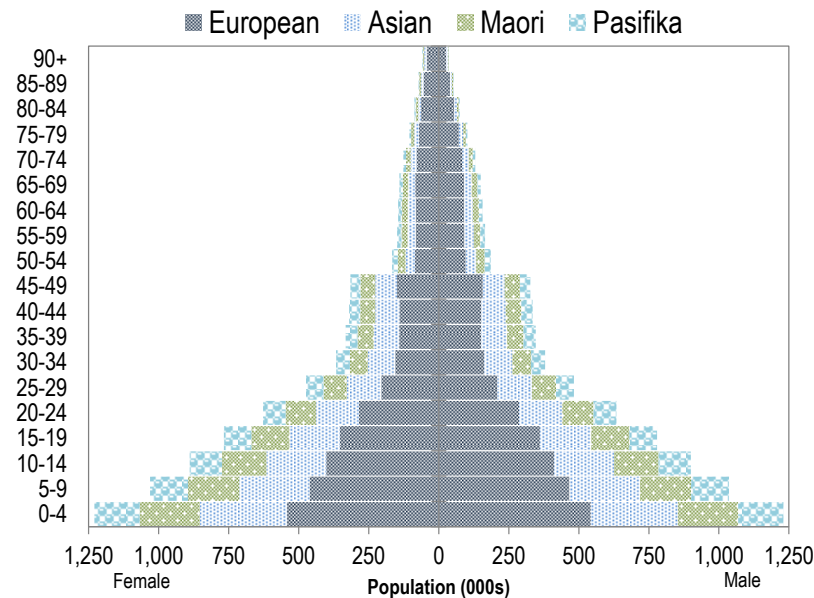
France is among the most fertile of European countries but still has a fertility rate below 2 despite having used a variety of policies to increase fertility rates by giving extra assistance (such as housing allowances and maternity leave) to families with three or more children (Letablier, 2003).

The scale of change required to grow our own seems impossible to achieve. Moreover, increasing fertility rates would have a pronounced impact on the age distribution of the population and would put public finances under considerable pressure.

Our projections for New Zealand show that getting to 15 million via increased fertility would imply 6 million people under the age of 15 by 2060. This would create a very high dependency ratio and generate substantial stresses (and costs) for the education system. The experience of the late 1940s baby boom showed a succession of public policy cost effects as the "boomers" moved through the social services like a donkey passing through a snake (starting at pre-school, school, tertiary training, and now, after a gap, retirement income support and health care costs). Assuming that fertility rates start to climb in 2012, this pressure would start in the schools in 2018 and eventually hit the labour market about 2040.

In respect of the labour market, large numbers of new and inexperienced workers – a new "baby boom" – can present issues. Policy would need to ensure that growth is sustained long term. For example, if fertility rates declined after 2060, this would replicate the same challenges we are currently facing from the mid-20th century baby boom, except on a much larger scale. Increased numbers of retirees relative to working age population would put enormous pressure on publicly funded superannuation and healthcare services.

Figure 6 Forecast population in 2060, increased fertility



Source: NZIER

Importing

The arithmetic of growing the population through immigration is much more feasible than boosting fertility because global migration is large compared to what New Zealand needs to grow to 15 million. In 2008 4.4 million people migrated to OECD countries. Currently, New Zealand captures around 2% of that flow. To get to 15 million by 2060 we would need an extra 200,000 people per year on average over the next 50 years.¹¹ That is an extra 5% out of 4.4 million, setting aside the high likelihood that global migration is going to grow in absolute terms.

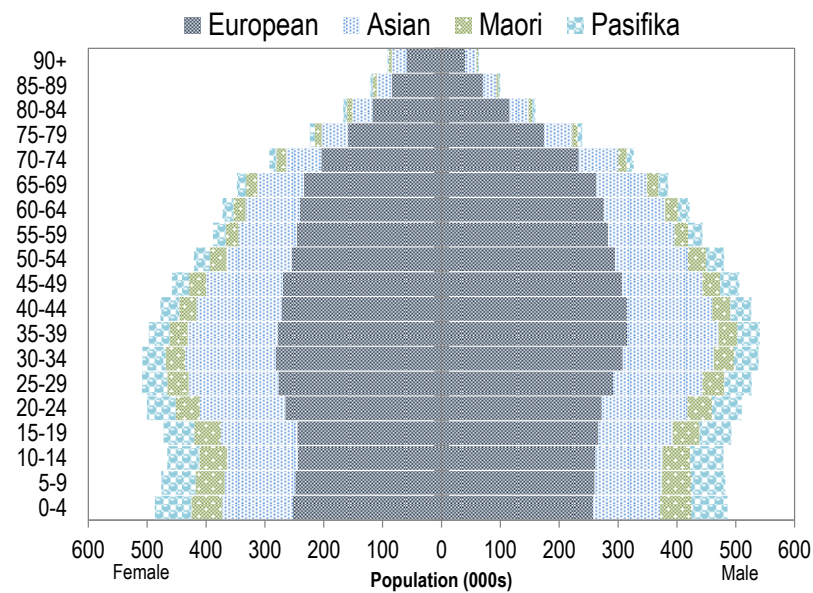
If the total flow of inward migration to the OECD grew at 4.5% per annum New Zealand could achieve an extra 200,000 immigrants per year on average simply by maintaining its 2% share of OECD inward migration flows. These kinds of numbers are somewhat artificial given that migrant numbers are heavily dependent on government policies and economic trends. However 4.5% growth in OECD inward migration is not large when we consider that between 2003 and 2007, migrant inflows to the OECD averaged 11% growth per annum.

Migrants entering New Zealand typically increase the size of the working age population. New Zealand's existing migrant policy means a majority of migrants are already adults, selected to be work-ready. And the social reality is that they often bring children with

¹¹ Note that the increased migrants' forecasts are based on current migrant relative intake volumes, which are predominately European and Asian. If migration levels were to increase, there may be a higher proportion of migrants of Asian descent, but the shift is difficult to quantify. This would slightly reduce fertility rates and require more migrants to meet the 15 million target.

them, or are of child bearing age. This tends to “future-proof” the intake, as they bring their own potential labour force supporters for retirement, avoiding a blow out of the dependency ratio.

Figure 7 Forecast population in 2060, increased migration



Source: NZIER

To sustain the volume of recruitment of new migrants at rates needed to support the population growth rate targeted, the rules already surrounding migrant entry may need to be altered considerably.

Immigrant eligibility rules are currently focused on bringing in trained and skilled migrants to fill shortages. Attracting more people will require a lowering of standards. Quite how much is an open question.

Suffice it to say that a change to standards may not need to be large. It depends on the elasticity of supply in the potential immigration market New Zealand faces. If the supply curve is relatively flat against entry requirements only small changes would be needed.

Currently there does not appear to be a large surplus of applications in the immigration pipeline. But it may be that the effective supply – the applications – is influenced by numbers of places available. If the chances of being accepted are higher, more might apply.

If demand to migrate to New Zealand is a matter of perceived difficulty of entry, other signals may be effective. So an announced policy of actively seeking greater numbers coupled with increased marketing may substantially change the number of high quality applicants.

Further, immigration policy changes would not need to take place over night and there would be both automatic adjustment mechanisms and an opportunity to adjust policy settings as the scale of immigration changes.

We can reasonably expect a snowballing effect. This would work in two ways. First, as migrant numbers increase, information is shared through non-traveling friends and family, reducing the cost of migration and increasing the chances of them visiting or migrating themselves (Massey, 1990).

Secondly, if increasing scale makes New Zealand a more prosperous country, then as the population grows we can expect increasing interest from people who want to live here. This includes people with the skills and wealth our immigration already targets but cannot attract.

The gains from migration, setting aside scale, could add to the snowballing effect. Immigrants can enhance the potential for growth by bringing valuable skills, practical know-how and additional entrepreneurship (Kasper, 1990). Migrants bring with them connections and knowledge of their country that reduce the transaction costs of trade and help boost exports (Law, Genç and Bryant, 2009).

Immigration policy can also reduce dependency ratios and contribute to a healthy fiscal position. BERL (2007) found that the contribution of migrants in New Zealand is positive, and increasing the longer they stay.¹² The age of migrants also has a large bearing on their benefits, with middle aged migrants the least likely to consume expensive public services (schooling, healthcare and pensions) without first "giving back" to the economy through labour and taxes.

If it turns out that all is not going to plan and New Zealand's prosperity is not increasing along with population growth then fewer migrants will come and this will provide a partial automatic adjustment against too many people with too few benefits. This will be observable and can also be changed if need be.

The key thing is that, due to potential snowballing, policy changes could start relatively small and be boosted over time as needed.

Increased immigration and fertility rates

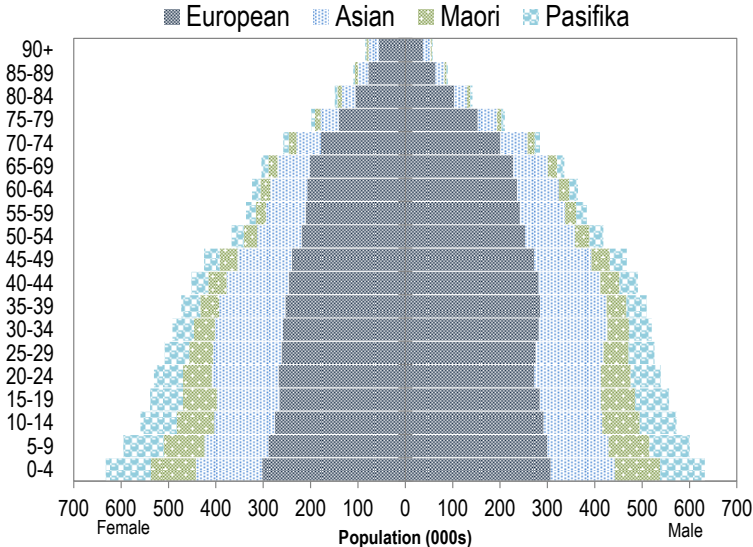
There is no one size fits all approach to increasing population growth. The target from increasing fertility rates alone is not a realistic goal in such a short time frame. There is potential to combine both policies. Here we examine the age structure of increasing the population with 20% growth coming from increased fertility rates and the remaining 80% coming from increased migration.

Figure 8 shows what the age structure would look with a mix of the two policies. In contrast to the barrel shape of pure migrant growth, there are now more people aged 0-19 than 20-39.

¹² The net fiscal impact per migrant was \$2,680 for recent migrants, \$3,470 for intermediate migrants and \$4,280 for earlier migrants. The New Zealand-born population only contributed \$915 per person.

This suggests that with some planning, the ideal age distribution of the country could be targeted with a mix of policy settings. However, attempting to pursue both policy options may lead to difficulties in implementation.

Figure 8 Forecast population in 2060, mix of policies



Source: NZIER

5. Growing for it: challenges ahead

Economic benefits of scale could be achieved in New Zealand, with a helping hand from a population policy targeting a rapid increase in New Zealand's resident population over the next 50 years. Our opening bid for such a target is 15 million by 2060 and we believe this is feasible with an ambitious mix of incentives to increase fertility rates and more active and open immigration policy.

Along with the opportunities that come with a bigger population there are challenges that need to be surmounted and trade-offs to be evaluated.

All else being equal, the quality of the environment may be affected negatively by the impact of an increasing population via its effect on ecosystems. At the same time, economies of scale might allow investments in environmental damage-minimising technology that are not currently cost-effective.

Careful consideration needs to occur in planning for large scale population growth. New Zealand's infrastructure, for example, has been designed and built to support a small(er) population base. Large increases in the population will require big improvements across all infrastructure. Due to the time it takes to complete projects, they will need to be planned well in advance. Large increases in capacity will be required to handle the increase in the population.

Traffic is already an issue in major cities, particularly at the broadening peak times in Auckland, where lengthy delays are common. Major investment in transport is required to support increases in the population. This includes the effects on air and sea transport where infrastructural investment will have to reflect the increased demand. To maximise growth opportunities, international transport will need to improve considerably to allow access to enlarged export markets.

Pressure on infrastructure will also be uneven with bottlenecks being most prevalent in the major urban centres (Auckland in particular), where work opportunities are the greatest (Stillman and Maré, 2007). These issues need to be addressed in New Zealand irrespective of policies targeting faster population growth, because internal migration is also driving population growth in the main centres (Yeabsley, 1997), but a rapid increase in population will increase the costs from failing to respond adequately to demographic pressures.

Public and social service provision would also need to adapt to unprecedented pressures. The school system, for example, coped with the baby boom when population growth was near 2.5%, but then it was common to leave school at a much earlier than people do today. Population growth in the future will put much greater strain on the secondary and tertiary education sectors than has been experienced in the past.

In healthcare, resources are already seen as stretched and increasing the population could only serve to amplify the problem. To support a higher population an appropriate growth in healthcare services will be needed to avoid labour or skill "shortages". Targeting

clinical skills may be necessary in any case given the projected rising demand for healthcare services.

Increasing net migration could also stretch social welfare, if immigrants are unable to find work. That said, while migrants can potentially exert financial strain on welfare services in the short run, migrants tend to pay their own way over their lifetime (Kasper, 1990).

The make-up of population growth can also attenuate some of these challenges. Age-based selection for migrants and health checks may mean that migration driven demand from health services is significantly lower than demand from a "typical" person in the existing population. Furthermore, economies of scale from a larger population could make the provision of health technologies and specialist medical services more cost-effective.

In the education sector, increasing the population through immigration will bypass many of the potential pressures on the school system, as many migrants arrive in New Zealand as adults.

The impact of immigration on the labour market could, however, be quite significant. In particular, it is important to select the right migrants who will contribute to our economic growth. There is a risk that by allowing the wrong migrants into New Zealand then they will struggle in the labour market and may wind up as part of the unemployed. Generating the right mix of skilled and unskilled labour is important to improve economic conditions in New Zealand.

New immigrants to New Zealand do face some barriers in the labour market. Evidence suggests that immigrants from English speaking backgrounds perform the best, but still on average have lower income than natives. Income parity is reached after 20-30 years residence (Winkelmann, 1999).

Norman and Meikle (1985) found in Australia that migrants experience high short-term unemployment, which is a (relative) benefit for locals¹³. There are negligible effects on inflation and increasing returns as capital becomes more scarce. Migrant households spend more per head than Australians, creating sufficient employment in the economy. Migrants face initial set up costs and have a larger proportion in high income earning age groups.

Immigrants do tend to have high labour market participation rates and work longer hours. On the other hand, new immigrants can also be less productive, because they lack relevant know-how of the particular country. Job replacement by migrants is typically kept within low-skilled employment (Kasper, 1990).

This can be overcome by selecting immigrants based on their short term work prospects. Having a pre-arrival job offer is one idea; another is meeting existing skill shortages – these feature in New Zealand's current system. However, with high population growth targets, criteria may need to be loosened to reach the target numbers, although a more active broking system might be useful. The high level trade-off is between pre-arrival

¹³ The intuition is that in the local economy as a whole new immigrants demand a series of goods and services, which can be thought of as "meaning" jobs. If the migrants are not immediately employed their extra demand flows into locally filled jobs.

requirements which may depress applicant volumes or quality, and the need for post-arrival resources and assistance to bed the newcomers efficiently into the local scene.

The quality of our immigrants' home country education and training systems also raises comparability questions for migrants from some countries. Increased exposure to foreign trained professionals would require a loosening of regulations for officially recognising overseas training.

These are just some of the issues that need to be grappled with if we are to achieve greater scale in our economy and a more prosperous New Zealand. The choice is between an ambitious growth agenda which targets size as a fundamental shortcoming of New Zealand's economy, or burying our collective heads in the sand and deciding it is all too hard. If Philip McCann and other experts in economic geography are correct, we ignore this issue at our peril. Technology may be reducing the tyranny of distance but it is increasing the important of being enormous.

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Appendix A Microsimulation model

NZIER has developed a microsimulation model of the New Zealand population. Microsimulation modelling is an advanced computational methodology that allows us to model the life paths of the population. We base our model on the Statistics Canada Population Health Model (POHEM), and have used the Modgen¹⁴ software to develop a model specifically for the New Zealand context. Microsimulation has several applications but has been developed to investigate health policy interventions on the early start to life. The model represents the population over the following demographics:

- sex (male, female)
- ethnicity (Māori, Pacific, European, Asian)
- age cohort (0-89+)
- income quintiles (1,2,3,4,5).

The population models the expected demographic change forecast over the next 50 years. We use fertility, mortality and migration data from Statistics New Zealand to calibrate the model's population over the next 25 years.

The model has been adapted to allow for increases in migration and fertility rates. This has been achieved through relative risk adjustments using scalar multiples. For example, if a 20 year old European female has a 0.5% of having a child in a given year, then doubling fertility rates will result in 20 year old European females having a 1% probability of bearing child during the year. There has been no adjustment for changes in the composition of migrants from the current observed levels.

With the probability of emigrating from New Zealand fixed, increasing the population also increases the numbers leaving New Zealand, offsetting growth in the population. However, from a population perspective, increasing the number migrating to New Zealand or reducing the numbers leaving will have a similar impact (other than composition). Because of this, increased levels of migration are required for a higher population to be sustained.

¹⁴ Modgen is provided and licenced from Statistics Canada. Full documentation of Modgen is available from <http://www.statcan.gc.ca/microsimulation/modgen/doc-eng.htm>