NZIER INSIGHT
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Costly investment decisions require improved population forecasts

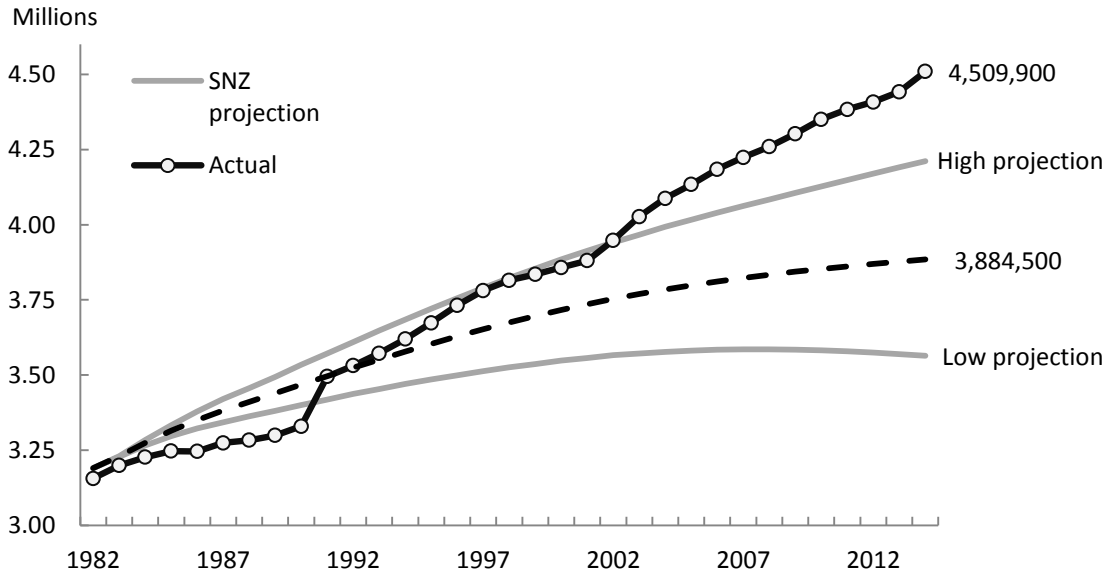
Investing wisely today for the New Zealand of tomorrow requires a detailed understanding of how many people there will be and where we will work and live. Billions of dollars of infrastructure spending are at stake. Yet past estimates of New Zealand's population, on which these investments are based, have been inaccurate. Users should demand more from their population forecasts. New population forecasting methods can make material improvements to the long-term investment decisions crucial to New Zealand's progress.

We have under-predicted our population growth – big time

Figure 1 shows that Statistics New Zealand's forecasts from 1982 under-estimated today's population by 625,000 people – the populations of Wellington, Hamilton, Dunedin, Palmerston North and Napier combined.

A change in population this big requires billions of dollars to fund: 230,000 extra homes, 6,850 nurses and 7,700 extra teachers, as well as billions of dollars of infrastructure spending.

Figure 1 Our long-term planning a generation ago missed 625,000 people
Statistics New Zealand's population estimate vs. several population forecasts from 31 March 1982



Source: Statistics New Zealand

It is not surprising that historical population projections have missed the mark.[1] These estimates are affected by myriad factors, including policy shifts (e.g. immigration policy), technological change that affects healthcare provision and societal changes (such as attitudes towards smoking). Over the last 50 years, other forecasters have persistently missed improvements in life expectancy too.[2]

1 In 1991, Statistics New Zealand projected a 2016 population of 3,972,000 and then in 1999 projected a 2014 population of 4,211,000.

2 For the UK example, see the Economist (2014), "My money of your life", 23 August 2014, who also point out each extra year of life across the world adds $1 trillion to the global pension bill.

Population projections drive critical investment decisions

Getting population projections right is crucial for policy-makers and private sector decision-makers. Every year New Zealand spends billions on infrastructure, in part in the expectation of population changes. For example:

- The New Zealand Transport Authority has an annual budget of $4 billion for roading.
- Electricity generation and distribution providers make serious investments in capital right across New Zealand. For example, Transpower lists over $5 billion in assets and invested $267.4 million in capital expenditure in the six months to 31 December 2013. Population projections are also used to set lines company prices and therefore they affect the prices consumers pay for electricity.[3]
- Healthcare providers like Ryman and Summerset also take big positions by developing new facilities. For example, Summerset raised its asset base by $150 million over the past financial year.
- Regional councils point to an 'infrastructure gap' that on paper requires much higher levels of investment than previously thought, based on standard population projections. That means fixing three-lane tunnels in Wellington, providing more enduring solutions than clipping additional lanes onto the Harbour bridge and thinking hard about how to manage the assets we've got.[4]

The scale of these long-run generational infrastructure spending decisions means refining how we think about future population demand and broadening the information base on which investment decisions are made.

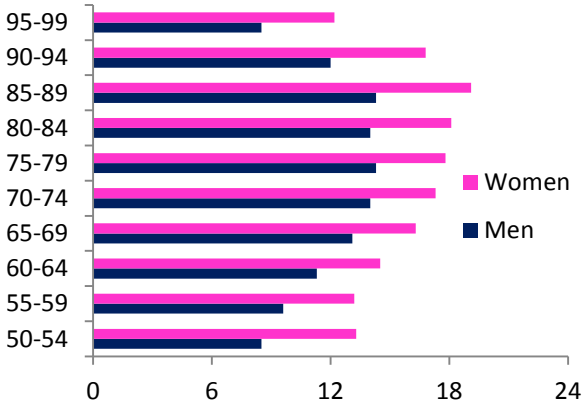
Might there even be a $60 billion hole in superannuation funding?

An example from the US illustrates the potential costs of missing key influences on population projections. King and Soneji (2012) use frontier techniques to estimate the cost of Social Security by 2030, and compare this to the government's estimates based on official population projections.

Their data-driven approach to population projections incorporates health improvements, such as stopping smoking and better treatment of cardiovascular disease, that are slow to impact on mortality statistics. They show traditional judgment-based methods under-predict how long people live and by including health improvements directly, longevity increases by many months over US government estimates (Figure 2), adding $USD 801 billion or a two-year funding shortfall in the US government's Social Security bill (see Figure 3). [5]

Figure 2 Better health adds months...

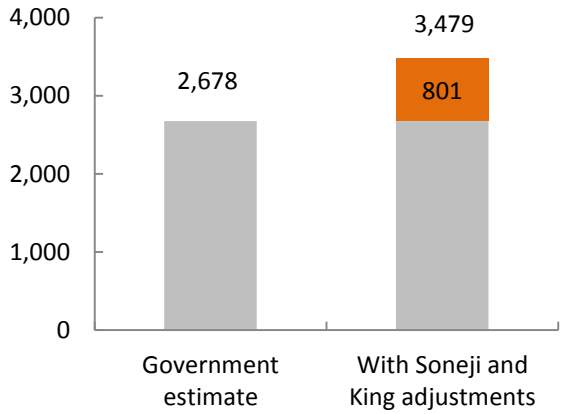
Extra months over US government's 2011 estimate, Age at 2031



Source: Soneji and King (2012)

Figure 3 ...so Social Security costs more

Nominal USD Social Security war chest 2011, $billions



Source: Soneji and King (2012)

[3] The money at stake is significant – more than $2.5 billion each year. Commerce Commission (2012) discusses methods and pricing.

[4] See Haydn Read for Wellington City Council, "Forecasting beyond 30 years, infrastructure asset analytics" at https://www.youtube.com/watch?v=yxC_wiHNcTI

[5] See Soneji and King (2012) on Social Security and King and Soneji (2011) for specific work on mortality. The New York Times provides coverage: http://www.nytimes.com/2013/01/06/opinion/sunday/social-security-its-worse-than-you-think.html?_r=0

By way of illustrative comparison in a New Zealand context, by 2031, paying for an extra two years of superannuation would require the government to find an additional $59.2 billion.[6] So it's well worth testing what better population projection methods imply for the fiscal books.

What can be done? A better process and improved methodology

Two things can be done to improve the usefulness and accuracy of population projections in New Zealand in order to better inform important investment decisions.

Improving the process

For decades, most official population forecasts have relied on simple time series models and judgment-based assumptions on mortality, fertility and migration. Then, typically, national statistics agencies release forecasts every two years.

But there is no particular reason to be tied down to a two year forecasting release programme or to forecasts by national agencies. This harks back to an era when cranking out the numbers was time consuming and expensive – data was harder to access, the necessary calculations were complex and everything had to be done by hand.

Today we have powerful computers to do the hard work. We can update our population models as often as we like to reflect the most up to date information on policy changes, monthly migration flows and health improvements, for example, and better measure uncertainty.[7]

We can also test our population projection models easily, and refine them as required – we can practice continual improvement.

Consistently recording performance relative to outcomes and updating methods to reflect new information has been shown to improve forecasting performance.[8]

Improving the methodology

One way to improve population projections is by integrating information and beliefs from other sources into the forecasting models. The US example in Soneji and King (2012) incorporates improvements in health outcomes such as reduced rates of smoking.

Other forecasters are also integrating other information sources to produce better, data-driven demographic forecasts.[9] For example, fertility tends to move from a high rate to a low rate of fertility as countries shift from developing to developed countries.

The United Nations models fertility rates for each country in three phases: (i) a high, fertility state; (ii) a transition state; and (iii) a low, post-transition fertility rate. The United Nations forecasts for New Zealand are similar to Statistics New Zealand although the United Nations numbers allow for the possibility of population decline.

The UN uses data on all countries to infer likely fertility rates for specific countries. Drawing on the cross-country experiences of Korea, Japan and others turns out to be useful when thinking about the likely path for fertility for a country like Vietnam that is likely to be transitioning to a low rate of fertility.[10]

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6 There are material differences in the way in which the US funds Social Security and New Zealand funds superannuation that mean we can't make a one-for-one mapping between the two examples.

7 Cameron and Poot (2010) and Dunstan (2011) outline how computers can produce stochastic simulations to construct measure of uncertainty. Bryant and Graham (2013) show how Bayesian methods can be used to estimate the current population level.

8 Predicting the landfall of US hurricanes provides just one example of this continuous improvement modelling approach. Willoughby et al. (2007) offers a good overview of process and model improvements in hurricane forecasting that have significantly increased the lead time, helping promote evacuation times and prevent "66-90 percent of the deaths in the United States that would have resulted from techniques used in the 1950s."

9 More technically, forecasters are using Bayesian techniques to formally bring together prior beliefs and information sets with demographic data. These techniques are common in ecology, medicine and have revolutionised macroeconomics over the past decade (see Gelman et al.2003).

10 Similarly, we might expect the Reserve Bank and New Zealand Treasury to test the usefulness of a wide range of data sources when forecasting GDP.

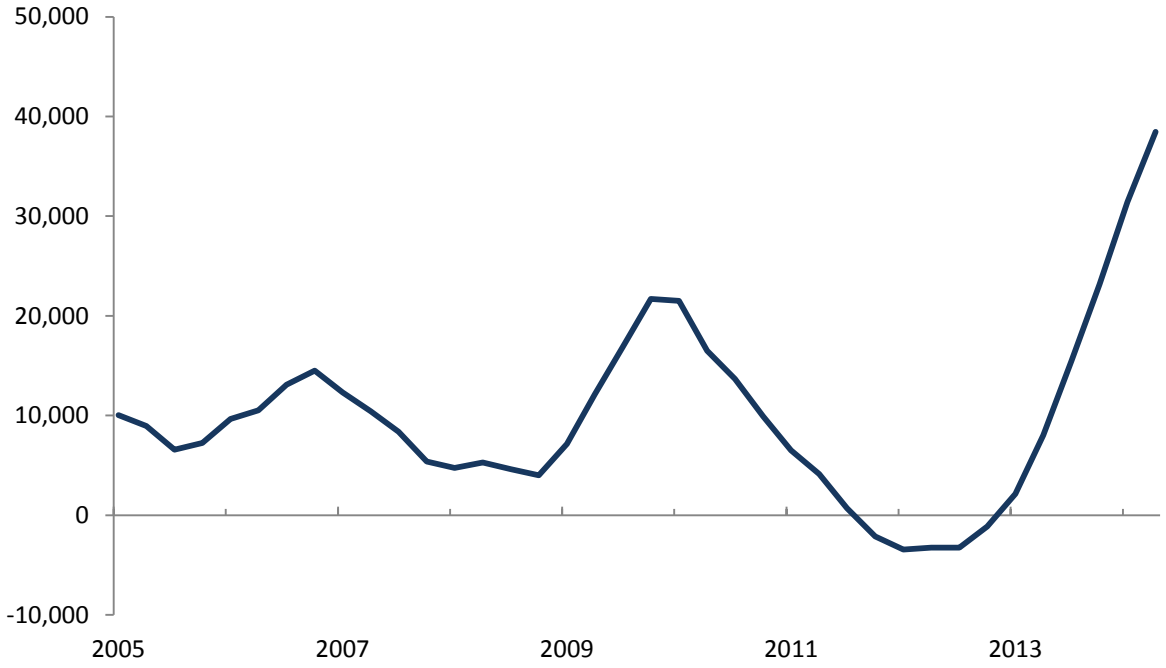
The technical details

Of course, the UN's multi-country approach might miss important New Zealand specific details. For example, we want forecasts that account for the strong influence of trans-Tasman migration fluctuations.[11]

Figure 4 shows just how cyclical our net migration can be. So including trans-Tasman relative house prices and labour market outcomes could help improve our population forecast models. Including the 0.9 percent population growth from migration in the past year improves the forecast by getting the starting point right.

Figure 4 New Zealand's migration is highly cyclical

Annual net migration



Source: Statistics New Zealand

How do we incorporate data and information from outside the model? Bayesian methods can help formally incorporate other information, policies and beliefs while retaining a data-driven approach.

The key advantage of using Bayesian techniques is our ability to learn about and continually update our beliefs rather than impose these beliefs on the forecasts in an ad-hoc manner at the end of the forecast process. Table 1 lays out the key differences in approach compared with traditional techniques.

[11] Gorbey et al. (1999), Abel and Sander (2014) and Statistics New Zealand (2008) note the importance of incorporating feedback effects on migration flows.

Table 1 New Bayesian methods have much to offer over traditional techniques

Factor	Traditional techniques	New Bayesian methods
Process	• Judgment orientated, tends to be deterministic • Update every two years	• Data-driven • Can update at any frequency
Information	• Narrow – based on past demographic characteristics such as fertility, mortality and migration	• Wide-ranging – can include info on better health • Can include data on economic performance
Outputs	• Tend to be based on assumptions or stochastic simulations	• Full distribution of any variable of interest • More realistic treatment of uncertainty
Testing	• Seldom tested	• Easy to test
Treatment of migration	• Constrained by limited toolkit and historic precedent	• Can incorporate economic information for predictions
Treatment of policy	• Cannot easily incorporate policy	• Can incorporate policies

Source: NZIER

Next steps

Consumers of population forecasts – central government agencies, local government and private sector organisations – should demand forecasts that incorporate the latest data, draw on industry-specific knowledge, can be rapidly updated and are tested for accuracy. There is no need to wait two years for official forecasts that influence critical investment decisions.

Forecasts should also incorporate uncertainty in a manner that is transparent and plausible. That helps frame appropriate risk management questions such as: how likely is it that Auckland will need 50,000 more houses by 2031? What happens to healthcare demand if health technology improves much faster than we expect?

Modern Bayesian forecasting techniques provide an opportunity to improve the quality of the population forecasting process and outcomes and the infrastructure investments that depend on these figures.

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