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Population Ageing and Productivity: Implications and Policy Options for New Zealand

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Population Ageing and Productivity: Implications and Policy Options for New Zealand

Ross Guest, Griffith University

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Population Ageing and Productivity: Implications and Policy Options
for New Zealand

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policy, but with a view to inform and stimulate wider debate.

Abstract

This paper critically evaluates the effects of population ageing on labour productivity with particular reference to New Zealand. A number of potential long run mechanisms are considered: complementarity of workers by age, age-specific productivity of individuals, new technology discoveries and adoptions, fertility and human capital investments. Potential short run channels include: the 'second demographic dividend', changes in industry composition, incentives to seek labour saving technologies. Simulations tentatively suggest that workers could become more complimentary by age which would boost labour productivity. The magnitude of this effect on living standards could entirely offset the projected 12 per cent fall in the support ratio over the next 40 years. The most effective policies for mitigating the national economic burden of ageing are policies to boost labour participation of older workers and to boost immigration.

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E20

E62

KEYWORDS

Population ageing; labour productivity; demographic dividend.

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Executive Summary

- 1 This paper critically evaluates the effects of population ageing on labour productivity with particular reference to New Zealand.
- 2 A number of potential long run mechanisms are considered: complementarity of workers by age, age-specific productivity of individuals, new technology discoveries and adoptions, fertility and human capital investments.
- 3 Potential short run channels include: the 'second demographic dividend', changes in industry composition, incentives to seek labour saving technologies.
- 4 A distinction is drawn between the national economic burden of ageing and fiscal costs of ageing. The national economic burden of ageing is less predictable than the fiscal costs; there is little if any accurate empirical evidence for some of the effects on productivity.
- 5 However the evidence on the support ratio, the second demographic dividend and, to a lesser extent, age complementarities of workers is somewhat clearer and point to an aggregate net impact on living standards in New Zealand from these factors in a range from zero to 15% over the next 40 years.
- 6 Policies in OECD countries for dealing with the national economic burden of ageing fall into three categories: promoting labour participation of older workers, promoting immigration and promoting fertility.
- 7 The case for the first of these is probably strongest because it is based on removing disincentives and investing in human capital which should arguably occur irrespective of a concern about the burden of ageing.
- 8 Immigration is effective in raising the support ratio in the short and medium term. For New Zealand this could mitigate the decline in the support ratio by up to 2.5% (points) of the projected 12% decline over the period to 2060.
- 9 Pro-fertility policies however have little effect and are fiscally expensive.
- 10 Policies for reducing the fiscal cost of ageing, in the case of New Zealand, should focus on New Zealand Superannuation since it accounts for roughly two thirds of the fiscal cost of ageing out to 2060.

Population Ageing and Productivity: Implications and Policy Options for New Zealand

1 Introduction

The aim of this paper is to discuss and evaluate the potential effects of population ageing on labour productivity with particular reference to New Zealand. The evaluation draws on available theory and empirical evidence. The paper also seeks to draw lessons for New Zealand regarding public policies that OECD countries have adopted in order to reducing the economic burden of ageing. A distinction is drawn between the national economic burden of ageing and fiscal costs of ageing, since these tend to be conflated and confused in public discourse on the economic effects of population ageing. Similarly, the reason for focussing on the ageing-productivity link is that it tends to be either misunderstood or ignored in public discussion, yet it is so important given that productivity growth is the ultimate source of sustained improvements in living standards.

At first blush, the data on productivity growth and population ageing points to slower growth in living standards for New Zealand. Labour productivity growth is trending downwards, having declined over two decades from 1990 to 2010 from over 3% to under 1% p.a. The ratio of workers to consumers is also trending downwards, having declined by several percentage points since 2005 and projected to decline by around 12 per cent over the next 40 years. However, there are, at least potentially, mitigating factors which make the outcome for living standards far less clear cut. These factors are explored in this paper.

2 Terminology and framework for analysis

New Zealand's trend labour productivity growth declined over two decades from 1990 to 2010 from over 3% to under 1% p.a. (Savings Working Group, 2011). Over that period labour productivity, measured by GDP per hour worked, fell relative to Australia by about 8%.

Productivity matters for public policy because it is a key driver of average living standards which is in turn an important indicator of national economic welfare. The following simple framework is a useful starting point in thinking about the implications of productivity and population ageing for average living standards. We can express national consumption per person as an identity:

$$\frac{C}{N} \equiv \frac{C}{Y} \frac{Y}{L} \frac{L}{N} \quad (1)$$

where C is national consumption (private plus public), N is population, Y is GDP, and L is national employment. Living standards is C/N, the consumption share of output is C/Y, labour productivity is Y/L and the employment to population ratio, or support ratio, is L/N. Population ageing impacts all three of these ratios. The most obvious impact is through the support ratio. Figure 1 plots the support ratio for New Zealand from 1950 to 2060 based on historical and projected data from Statistics New Zealand¹. For the Medium projection the support ratio is projected to drop by 12% from 2013 to 2060, having already fallen by 3% by 2013 from 2005, and by 4.5% from its peak in 1988. This implies that for given levels of the consumption share of output and labour productivity, the 16% fall in the support ratio from its peak in 1988 to its projected level in 2060 would imply living standards about 16% lower than they would otherwise have been.

However the demographic forces behind the fall in the support ratio can impact on the first two ratios in (1): the consumption share of output (C/Y) and labour productivity (Y/L). Our purpose here is to interrogate the effect on labour productivity, but first, a comment on the effect of ageing on the consumption share of output. Population ageing implies slower growth in employment which implies less national resources need to be diverted to capital accumulation in order to maintain a given capital-labour ratio and hence a given output-labour ratio (Y/L). This provides a capital-widening dividend in terms of a higher consumption share of output. In an open economy such as New Zealand's, it becomes a wealth-widening dividend arising from the resources freed up to maintain a given wealth-labour ratio, where wealth is defined as capital stock less foreign liabilities. Guest (2007) calculates this dividend for New Zealand to be 1.5% from 2006 to 2050 which is slightly below the average of 2.2% for OECD countries. It would be possible for a country to allow its capital-labour ratio (or wealth-labour ratio) to decline in order to further raise consumption but this would only be temporary as the lower capital (or wealth) would ultimately reduce national income and force consumption down.

¹ Population projection is Statistics New Zealand's Series 5 projection, assuming medium fertility, medium mortality and medium net migration (12,000 net migrants p.a. from 2015). Labour participation rates for males and females are actual rates for 1987 to 2011 (Statistics New Zealand); the 1987 rates are assumed for years prior to 1987 and the 2011 rates are assumed for years beyond 2011. The 'very high fertility' projection assumes a total fertility rate of 2.5 from 2011-12. The 'very high migration' projection assumes net migration of 25,000 p.a. from 2012.

3 Population ageing and labour productivity

The effect of ageing on Y/L is the critical link that we want to review. Again, it is useful to set up a framework for discussing these effects. Take a simple production function with two factors (capital and labour), constant returns to scale, and neutral technical progress. This implies

$$\frac{Y}{L} = A \left(\frac{K}{L} \right) \quad (2)$$

where A is a total factor productivity parameter and K is capital stock. Equation (2) indicates two sources of labour productivity growth: technical progress (growth in A) and increases in the capital-labour ratio. We will consider the effects of ageing on these two sources of productivity growth. The effect on technical progress can occur through the following channels:

- Variation in productivity of individuals according to age
- The rate of new discoveries and technology adoptions
- Complementarity of workers by age
- Fertility and human capital investments

The effect of ageing on labour productivity via the K/L ratio is a shorter run phenomenon than the effect on technical progress and can occur through the following mechanisms:

- Age-specific saving rates: the ‘second demographic dividend’
- Changes in industry composition
- Higher relative cost of labour is an incentive for firms to look for labour saving technologies. Ageing could promote technical progress if firms face stronger incentives to innovate in the face of scarce labour (Habakkuk, 1962; Romer, 1990).

Gomez and Hernandez de Cos (2008) is perhaps the largest recent econometric study of the overall effect of population ageing on labour productivity growth. They studied 144 countries from 1950 to 2000 using the Penn World Tables. They found that an increase in the ratio of the “prime age” population aged 35–54 to the “youth” working age population (15–34) is positive for per capita GDP growth up to a point after which the effect is negative. The critical point is a ratio of prime age persons to youth equal to approximately 0.950. Their sample of countries had a mean prime-youth ratio of 0.845 which means that for the majority of countries in their sample, increases in the prime-youth ratio beyond the year 2000 lead to increases in real GDP per capita. New Zealand is projected to have a prime-youth ratio of 0.98 in 2015, falling to 0.95 by 2045, which would imply a per capita GDP boost according to the Gomez and Hernandez de Cos (2008) analysis. The size of the per capita GDP boost would be about 0.2 percentage points per annum on average using their estimates. Their study does not however identify the mechanisms behind the age distribution-productivity link. The potential mechanisms are reviewed below.

3.1 Age-specific productivity

Numerous studies based on the seminal work by Mincer (1974) have established a positive relationship between income and years of experience (see Heckman et al., 2003,

for a survey). Given experience is positively correlated with age, we should find a positive relationship between productivity and age. Figure 2 plots the relationship between age of persons and their average weekly paid employment income (weighted by labour force size of males and females) for New Zealand in 2011. The inverted U shape truncated at the right is typical and also widely supported by international econometric evidence which controls for other determinants of income such as human capital. Feyrer (2008) reports evidence based on a large number of international econometric studies of “Mincer wage regressions” which essentially regress the wage on a human capital variable and work experience measured in years. He finds that wage rises with age up to about age 50 then declines somewhat, much like the data in Figure 2.

On the basis that relative real wages tend to reflect relative productivity levels (although the relationship is far from precise even in theory), the pattern in Figure 2 reflects an approximate age-specific productivity relationship. However, direct evidence for an inverted U-shape relationship between age and individual productivity is harder to find. Skirbekk (2008) and Productivity Commission (2005) provide comprehensive surveys of the considerable literature. The main points are briefly summarized here.

Several studies show that older workers adopt more efficient working strategies through experience. This effect however diminishes rapidly after only a few years and that the gains from experience are exhausted after 10 years on average. Other studies show the opposite effect, that is, younger workers are more productive in industries facing rapid technical change because younger workers are more adept at assimilating new technologies.

Attempts to directly measure age-specific productivity have found mixed evidence for the inverted U-shape pattern. Studies that use supervisors’ ratings as a proxy for productivity find little or no relationship with age of the employee. Bias however is a problem since supervisors could reward senior colleagues with inflated ratings as acknowledgement of loyalty; inefficient employees also tend to lose their jobs and therefore do not appear in the data.

Somewhat less direct evidence is available through employer-employee data sets which have information on proxies for output at the firm level and the age structure of the workforce. These studies tend to support the inverted U shape pattern. Again, however, biases are quite possible due to omitted variables; and causation is difficult to assess: whether productivity is a result of the age structure or a determinant of the age structure.

Other biases are possible in inferring a productivity-age relationship from income data such as that reported in Figure 2. Seniority based wage systems will tend to inflate the wages of older workers and therefore bias upward the inferred productivity of older workers. And those older workers who are less productive because, for example, they are less able to assimilate new technologies are likely to retire early and disappear from the data.

The management and gerontological literatures also offer inconclusive evidence for the general proposition that labour productivity rises with age until the mid-50s then declines somewhat. For survey of the management literature up see Guest and Shacklock (2005) and for the gerontological literature see Skirbekk (2003). They report findings that common stereotypes (for example, older workers’ slowing performance, having less flexibility or adaptability, greater amounts of illness, less potential, and less ability to learn new skills than younger workers) are not supported by research. On the contrary – the organisational productivity benefits of older workers include experience, reliability/dependability, people skills, loyalty, low turnover, attendance/low absenteeism,

and attention to quality of work. Clearly however younger workers have some characteristics favourable for productivity. These include facility with new technologies, physical strength and agility, mental alertness, and adaptability to change. A reasonable conclusion from this literature is that an age-specific productivity relation of the kind illustrated in Figure 2 is not strongly supported.

Nevertheless the question is important because if there is a relationship between individual productivity and age, the changing age distribution of the population would imply a change in aggregate labour productivity. One way of quantifying this effect is to replace L in (1) and (2) with a productivity-weighted labour force, L^* :

$$L^* = \sum_{i=15}^{70} \alpha_i L_i \quad (3)$$

where α_i is the productivity weight for workers of age i and L_i is the number of workers of age i . The framework for labour productivity in (2) can be adjusted by a labour productivity weighting factor :

$$\frac{Y^*}{L} = \left(A \frac{L^*}{L} \right) \left(\frac{K}{L} \right) \quad (4)$$

Hence the technology parameter is effectively adjusted by the labour productivity weighting factor. An inverted U-shaped individual age-productivity relationship would imply a corresponding inverted U-shape for composite variable $\left(A \frac{L^*}{L} \right)$ which would in turn be reflected in aggregate labour productivity. Despite the inconclusive microeconomic evidence for an age-productivity relationship, the macroeconomic evidence is stronger: it indicates an inverted U-shape between age shares and total factor productivity (Werding, 2008).

Three sets of productivity weights are plotted in Figure 3: (i) weights based on age-specific earnings shown in Figure 2, on the assumption that relative earnings reflect relative productivity levels; (ii) weights used by Miles (1999) originally derived from age-earnings regressions using UK data; and (iii) weights used by Skirbekk (2008) based on a range of international data on ability levels of individuals in the workplace. An important observation from Figure 3 is that the Skirbekk weights in particular (less so for the Miles weights) are flatter than the weights based on the New Zealand age-earnings profile. This is a typical result with standard explanations from the labour market literature. Asymmetric information about characteristics of new employees leads to low initial wages relative to productivity. Paying older workers more than their productivity provides an incentive for workers to stay with the firm which lowers staff turnover costs.

Figure 4 shows the implications for the alternative productivity weights for the support ratios. Compared with the 12% projected fall in the support ratio from 2013 to 2060 for the unweighted series, the fall is only 1 percentage point less (11%) using the New Zealand earnings profile as weights, and half of one per cent less under each of the other weighted series. However from the peak in 1988 to 2060, the difference is several percentage points – however most of that difference is history. Arguably therefore the weights do not make much difference to New Zealand's projections for labour productivity or living standards from 2013 to 2060.

The potential for ageing to affect aggregate labour productivity is much greater than the evidence on individual age-specific productivity suggests. The mechanisms behind such a

relationship are less obvious and are generally not picked up in the public discourse on ageing and productivity. There is great uncertainty about the magnitude and even the overall direction of the effects. We now turn to these mechanisms.

3.2 New discoveries and technology adoptions

Freyer (2008) discusses spillovers or externalities from the change in the age distribution of the workforce. The wider benefits of a change age distribution of employees of a given firm are not all captured by that firm. One spillover occurs through new discoveries and innovations. New discoveries are non-rival and therefore spillover to other firms through innovation. Freyer cites a lot of evidence from the literature that inventiveness varies by age and in general occurs at younger ages. Although it varies a little by disciplines, peak inventiveness tends to occur between ages 30 and 40. Hence the larger the cohort of workers in this age group the greater the rate at which new ideas will be discovered. Freyer cites evidence that this applies not just to industrial discoveries but to creative performance and artistic output.

The rate and effectiveness with which existing ideas are adopted may be just as important for productivity, or more so, than the discovery of the ideas. The parameter A in (2) captures the effect of technology adoption, not the discovery of technology per se. Weinberg (2002) finds some econometric evidence that young workers are better adopters of new technology, proxied by computer use. However he notes that there are opposing forces at work. Younger workers are more willing to adopt new technology – perhaps due to less risk aversion and cultural factors - but on the other hand they have less human capital by way of experience which is required to effectively apply new technologies. Productivity Commission (2005) cites several studies that suggest a youth bias in entrepreneurial activity, measured for example by the average age of CEOs of start-up companies.

3.3 Complementarity of workers by age

The age distribution of a given workforce size can affect average labour productivity if workers of different ages are complementary to some degree, rather than perfectly substitutable as is typically assumed in macroeconomic modelling of demographic change. This effect has been explored only quite recently in the literature (Prskawetz, Fent and Guest, 2008; Guest, 2005).

We can explain this effect in terms of our framework. The labour force index in (3) can be generalized by expressing it in the following form:

$$L^* = \left[\sum_{i=1}^k \alpha_i L_i^\gamma \right]^{1/\gamma} \quad (5)$$

This reduces to (3) if $\gamma=1$ which is the standard assumption in macroeconomic modelling of demographic change. It implies perfect substitution between the L_i in the sense that the marginal change in the value of the labour index, L^* , for an increase in labour of a given age, is independent of that age group's share of the total labour force. The relevance in the context of population ageing is that as the population gets older the marginal product of another younger person remains the same, as does the marginal product of adding another older person. This logic is questionable. A firm with an ageing workforce might put increasing value on an additional younger worker relative to yet another older worker. Equation (5) is a general form that allows for imperfect substitution between workers by age. This implies that the marginal product of an extra older worker depends on the how many older workers are already in the workforce.

As γ in (6) approaches zero we have the Cobb Douglas function in which the elasticity of substitution between two workers of different ages is equal to 1; as γ approaches ∞ , the elasticity of substitution approaches zero (implying the Leontief form). An even more general and realistic form would allow γ to vary across the age distribution. For example, the elasticity of substitution between a 25 and a 30 year old worker may be higher than that between a 25 and a 50 year old worker.

The intuition is that workers of different ages have complementary skills. For example the physical strength, higher education levels and dynamism of young workers are complementary with older workers' skills including more experience, maturity of judgement, reliability, and managing people, including mentoring younger workers. This would imply that even though 35 year olds may have the same marginal productivity as 65 year olds, as reflected in equal wage rates, employing either two 35 year olds or two 65 year olds would yield less output than employing one of each.

It has to be said however that while the intuition is strong, there is not much empirical evidence for the strong complementarity hypothesis. Card and Lemieux (2001) provide some econometric evidence that marginal productivity by age varies with workforce age shares. The Productivity Commission (PC) (2005), however, questions the often-put argument that a more age-diverse workforce enhances business performance (and productivity). This argument says that age diversity enhances team problem-solving abilities; and that businesses with an age-diverse customer base need a comparable age-diverse workforce because workers and customers relate better when they are of similar age. However, the PC cites some empirical evidence that age-diverse workforces are correlated with lower sales, not higher sales as the hypothesis would suggest.

Nevertheless the extant empirical evidence is rather light and altogether inconclusive. And given the rather strong intuition for age-complementarity, it is worth investigating the implications further. One implication is that worker age-complementarity of workers gives rise to the possibility of an optimum age mix of a firm's workforce. It can be shown that, under standard economic assumptions, the optimum age mix of a given workforce depends on two factors: the relative marginal productivity of workers by age and the degree of substitutability (or the inverse: complementarity) between workers by age (Lam, 1989).

What would be the implications of this principle in the face of population ageing and in particular, workforce ageing? As the workforce ages, firms will find themselves employing more older workers. The economic mechanism by which this will occur is the adjustment of relative wages of older and younger workers. That is, relative scarcity of younger workers will force up their wages relative to older workers and lead firms to choose to employ fewer younger workers relative to older workers. In other words, relative wages will adjust to ensure that the available workforce, with an older age mix, will find

employment.² The question therefore arises as to whether an older workforce is closer to the optimum age mix of the workforce or further away from it.

If we are moving closer to the optimum, we will derive a dividend in terms of aggregate labour productivity and therefore economic wellbeing. This would be a free lunch in the sense that it would not cost any resources. On the other hand, if we are moving further away from the optimum, we would incur a loss in terms of labour productivity and economic wellbeing. This would be a deadweight loss to society. The magnitude of the dividend or deadweight loss depends on the same two factors that determine the optimum age mix: the relative marginal products of workers by age and their elasticity of substitution.

Evidence is emerging, based on simulations of calibrated macroeconomic models, to suggest that population ageing is likely to move the workforce age mix closer to the optimal mix, implying a dividend rather than a deadweight loss (Prskawetz, Fent and Guest, 2008; Prskawetz and Fent, 2007; Guest, 2007, 2005). However, that the size of this dividend is very difficult to ascertain because of lack of evidence about the elasticity of substitution between younger and older workers. Guest (2007) for example reports calculations for OECD countries under two scenarios: high and low elasticities of substitution among workers by age. The difference is considerable. The high elasticity case achieves a dividend in terms of aggregate labour productivity (Y/L), on average across all OECD countries, of only 1.24% in total over the 45 year period from 2006 to 2050. This is not surprising since the high elasticity case is close to the typical perfect substitution case where the productivity dividend is by definition zero. However the low elasticity case achieves an average dividend of 38% in total over the same period. The respective figures for New Zealand were 0.5% (high elasticity) and 32% (low elasticity). The low elasticity figure would swamp the average cost of a lower support ratio of 12% for New Zealand in terms of its effect on living standards, implying a net gain in living standards from these two effects.

This modelling suggest that population ageing is moving countries a little closer to their optimum age workforce age distributions. The apparent sensitivity of the size of this dividend to the value of the elasticity suggests scope for further investigation of this potential phenomenon, including the need to obtain reliable econometric estimates of the elasticities.

3.4 Fertility and human capital investments

The decline in fertility rates that has characterised developed economies since the post-WWII baby boom of the 1950s and particularly since the advent of the contraceptive pill in the early 1960s, has potential implications for labour productivity. The period of falling fertility rates coincided with increased prosperity and increased female workforce participation. Higher incomes, especially of women, implied a higher opportunity cost of additional children.³ According to the seminal work of Becker and Lewis (1973), parents in these circumstances adopt a ‘quantity-quality’ trade-off with respect to children. They use their greater financial resources to invest in the ‘quality’ of their children, through education for example, especially if they face constraints on borrowing for education (Galor and Zang, 1997). This in turn boosts productivity which can possibly be sustained in the long run according to new growth theorists (Lucas, 1988; Romer, 1990). In that case the parameter A in (2) is permanently higher.

² Unemployment may still persist, although it is likely that it will be lower than today as the available labour supply falls relative to labour demand in response to population ageing.

³ Galor and Weil (1996) offer a reinforcing argument: productivity growth implies a rising capital-labour ratio which raises women's wages relative to men's wages because female labour is more complimentary with capital than is male labour. This raises the cost of children relative to income and therefore lowers fertility.

The negative link between fertility and productivity could also work in the opposite direction: from productivity to fertility. Technical progress implies a higher rate of discounting of future utility which, given that the utility from children occurs over the very long term, requires a lower fertility rate (Becker and Barro, 1988). Guest and Swift (2008) find econometric evidence for a long run negative fertility-productivity relationship for Australia and the UK.

The following mechanisms impact labour productivity in the short run through changes in the aggregate capital labour ratio.

3.5 Changes in industry composition

Ageing can bring shifts in the composition of demand for goods and services which can impact on aggregate labour productivity where industries have different capital-labour ratios (Guest, 2011). Consider three sectoral shifts in demand that are likely outcomes of population ageing. First, the lower capital widening requirements of a more slowly growing workforce implies lower demand for manufactured goods relative to other goods and services. Second, demand for health, aged care and personal services will increase disproportionately as the population ages. Third, demand for housing construction is likely to decline in relative terms as the rate of household formation slows and the size of households declines.⁴ A myriad of other changes to consumer demand for various types of goods and services can also be expected as the age distribution of consumers changes.

The effect of these changes on the aggregate capital-labour ratio in (2) depends on the relative capital intensity of industry sectors and the GDP shares of those sectors. Health and personal services have a relatively low capital intensity; surprisingly perhaps so do the manufacturing and construction industries (Guest, 2011)⁵. Population ageing will shift demand towards the low capital intensity health and personal services sector but away from the low capital intensity manufacturing and construction sector. The net effect of these two shifts is ambiguous in principle and will depend on the GDP shares of these sectors. The GDP share of manufacturing and construction is higher than that for health and related services. This suggests that population ageing, by shifting demand away from low capital intensity goods and services, raises aggregate capital intensity and therefore labour productivity. Calculations in Guest (2011) for Australia and the United States suggest that this effect could be equivalent to several percentage points of GDP in total over the period 2006 to 2050. Note however that this does not imply a commensurate increase in living standards. If capital intensity increases, capital widening requirements increase in order to maintain a given capital-labour ratio. This turns out to largely offset any benefit to living standards from the effect of the compositional shift in demand on capital intensity. Also, it is difficult to draw welfare implications from any productivity-enhancing effect of compositional changes in demand. These shifts are the natural outcomes of preferences of people as they get older; it would not make sense to deny people their preferences for health and housing in order to maintain labour productivity.

⁴ For an econometric analysis of the effect of population ageing on housing demand and house prices in Australia, see Guest and Swift (2010).

⁵ Guest (2011) presents data on Australia and the United States and models the net effect of population ageing on aggregate capital intensity, labour productivity and living standards for these two countries. Sectors with relatively high capital intensity include utilities, mining, agriculture, transport and telecommunications. Sectors with relatively low capital intensity include health and community services, personal services, retail trade, manufacturing and construction.

3.6 Age-specific saving rates: the second demographic dividend

Strong empirical evidence supports a life cycle bell-shaped life cycle saving pattern for individuals and households. For New Zealand see Scobie and Henderson (2009). Life cycle saving is only somewhat smoother than income – a rejection of the pure consumption smoothing hypothesis in favour of partial smoothing for which the two main explanations are precautionary saving and borrowing constraints (for further discussion see Campbell and Mankiw, 1989). This means that aggregate saving per capita will change in response to changes in the age composition of the population. When the proportions of middle aged workers is rising saving per capita rises. For econometric evidence see Bloom and Canning (2004), Kelley and Schmidt (2005, 1996). The resulting wealth accumulation, or wealth deepening, manifests in some combination of a higher capital-labour ratio and a lower foreign liabilities to labour ratio. The result is higher consumption per capita in the long run than would have been possible without consumption smoothing. Mason and Lee (2004) describe this saving dividend as the “second demographic dividend”.

Calculations in Guest (2007) indicate an average increase in consumption per capita of just over 2% on average across OECD countries over the whole period 2006 to 2050. The figure for New Zealand is 1.5% which is the equivalent of losing about one year’s growth in real GDP over a 44 year period – that is, no growth in one of the 44 years. This equates to a simple average about 0.035% of GDP per year on average over the whole period that is, going from real growth of say 1.5% to 1.465% per year for every year in the period. This is almost a rounding error.

Indeed these are the orders of magnitude of most of the effects of ageing on living standards based on the existing empirical evidence (Table 1). To put these numbers in perspective, the global financial crisis of 2008-9 caused a reduction in real GDP relative to trend of at least 2% over several years. Suppose, as a back of the envelope calculation, this amounts to lost GDP of 6%. Although growth recovered post-GFC, it did not rise above trend in order to recover the loss of GDP; hence the loss has been permanent. This loss would amount to half of the total projected cost from the declining support ratio over nearly 40 years; and that is before subtracting the various dividends which, from Table 1 would sum to at least several per cent of GDP. It is true that some effects lack empirical evidence, such as the effect of ageing on new discoveries and the effect on human capital investments. But if we take the three effects on which we have reasonable evidence: the support ratio, the wealth-widening dividend and the saving dividend, the net effect on living standards appears to be a cost between 7% and 12% over the next four decades. Allowing for at least a few per cent dividend from age complementarity dividends, would bring the projected cost of ageing back to about 6% which equates to the cost of the GFC as a ball park estimate. This is a modest, though perhaps not trivial, effect.

3.7 Rising relative price of labour

Section 2.1 discussed the effect of the workforce age structure on productivity. The workforce age structure and the number of workers can have distinct effects on productivity. In New Zealand the annual growth in number of workers is expected to slow from 0.35% in 2015 to 0.17% under the Medium demographic scenario. The relative shortage of labour relative to capital will raise the price of labour relative to capital (and temporarily increase the capital-labour ratio). The higher relative cost of labour will provide an incentive for firms to look for labour saving technologies (Heer and Irmen, 2008; MacKellar, 2000; Romer, 1990; Habakkuk, 1962).

The empirical evidence for this channel is however unclear. There is econometric evidence for the OECD indicating a negative relationship between total factor productivity growth (growth in A in (2)) and labour force growth (Beaudry and Collard, 2003; Yashiro and Oishi, 1996; Cutler et al. 1990). However it is not clear from these studies how much of the productivity effect is due to rising relative price of labour and how much to other factors that may be correlated with labour force growth as discussed above: the age-specific productivity of individual workers, the rate of new discoveries and adoptions, human capital investments, complementarity of workers by age, not properly disentangle the empirical effects of age structure and labour force growth on productivity.

4 Policies to address the costs of population ageing

4.1 National consumption cost and fiscal cost

Popular discussion of the costs of population ageing tends to conflate the national economic burden of ageing with the fiscal costs of ageing. The former refers to the effect of ageing on national consumption per capita over time, which occurs through the effects on the support ratio, labour productivity and the consumption share of GDP.

The fiscal costs of ageing refer to the extent to which government revenue falls and or expenses (including transfer payments) rise under current policies which refers to existing age-specific public consumption expenditures and tax rates. The way the government responds to these fiscal costs determines the division of the national consumption cost between public sector consumption and private sector consumption, and between present and future taxpayers. If the government adopts a balanced budget response by progressively raising tax rates or cutting spending, then the fiscal costs of ageing are borne by taxpayers on a Pay-As-You-Go (PAYG) basis. If the budget goes into deficit the consumption burden of ageing is back-loaded onto future taxpayers. If the government prepays the fiscal costs of ageing by running budget surpluses then the fiscal cost is front-loaded onto current generations. The fiscal adjustment in any given year can be met by: (i) cutting public consumption and/or increasing transfers; or (ii) raising taxes and/or reducing transfers.

The relationships between current and future consumption, and private and public consumption can be seen more clearly from by re-expressing the identity (1) follows. Let national income be the sum of labour income and capital income:

$$NI = wL + rW \tag{6}$$

and define national consumption as national income minus national saving:

$$\begin{aligned} C &= NI - S \\ &= wL + rW - S \end{aligned} \quad (7)$$

where, NI is national income, C is national consumption consisting of private consumption and public consumption, S is national saving, w is the average wage rate, L is labour supply, r is the interest rate, and W is national wealth which is defined as capital stock (K) minus net foreign liabilities (D). Substituting and rearranging, national consumption per capita is

$$\frac{C}{N} = \frac{L}{N} \left(w + r \frac{(K - D)}{L} - \frac{S}{L} \right) \quad (8)$$

This re-expression of (1) allows a clearer understanding of the role of fiscal policy in shifting the consumption cost of ageing over time. To see the role of labour productivity, express the real wage rate, w, in (8) as a function of the capital to labour ratio as follows. Assume a constant returns to scale Cobb-Douglas production function and that labour is

paid its marginal product. Therefore $w = \frac{Y}{L} - r \frac{K}{L} = A \left(\frac{K}{L} \right)^{\alpha} - r \frac{K}{L}$ where A is a technology

parameter. On substituting into (8), we have: $\frac{C}{N} = \frac{L}{N} \left(\frac{Y}{L} + r \frac{D}{L} - \frac{S}{L} \right)$. The term in brackets

on the right hand side is simply consumption per worker, C/L, which in terms of (1) is equal to (C/Y)(Y/L).

Fiscal policy can shift the consumption burden of ageing to future generations by running budget deficits, which arises from attempting to maintain public consumption and/or existing tax revenue as a share of GDP. This reduces national saving per worker (S/L) which, from (8), allows (C/N) to be higher. However lower saving reduces national wealth per worker, (K-D)/L, and hence national wealth by either crowding out private investment (which reduces the capital stock, K/L) or increasing the CAD (which increases foreign liabilities, D/L). A lower capital stock lowers output and therefore future consumption possibilities. Higher foreign liabilities require higher debt servicing costs which also lowers future consumption possibilities. In the opposite case, fiscal policy can shift the consumption burden of ageing to current generations by running initial budget surpluses which raises national saving and hence national wealth, allowing higher future consumption at the expense of current consumption. A middle path is to spread the consumption burden more evenly among generations through a balanced budget response to ageing. Figure 5 illustrates the three fiscal policy responses just described.

4.2 Policies to reduce the national economic burden of ageing

4.2.1 Promoting labour participation of older workers

In OECD countries, considerable policy attention has been directed towards boosting both supply and demand for older workers (OECD, 2006)⁶. Supply-side policies focus on incentives for labour participation through retirement income policies and welfare reform, incentives for older workers to enter labour market training programs, and various forms of careers/employment guidance for older workers. Of these, retirement income policies receive the greatest attention. New Zealand Superannuation has some advantages for labour participation and economic efficiency over some other systems such as the Australian pension system (Guest, 2010). The combination of a low replacement rate - 49.6% for those on median earnings compared with the OECD average of 72.0% and 65.9% for Australia (OECD, 2011) - and universality means that it does not suffer from the work disincentive effects inherent in any means-tested benefit such as Australia's pension scheme, and those that offer high replacement rates. Also it does not cause distorting behaviour to saving and consumption that some older workers pursue in order to qualify for the pension under an assets test.

The New Zealand private superannuation scheme (KiwiSaver) is voluntary on an opt out basis, currently 2% of gross salary. The Australian scheme by comparison has a compulsory component (the Superannuation Guarantee levy (SGL)). The compulsory nature of the SGL amounts to forced saving which tends to reduce other forms of private saving. Allowing for the private saving offset, the net additional saving from the SGL is estimated to be between 50 and 70 cents in the dollar (See Guest, 2010, for a discussion of the literature). The saving offset should be lower in the case of KiwiSaver because employees can opt out instead of reducing other saving. The compulsory nature of the SGL in Australia distorts the choice of saving vehicles for higher income earners while not necessarily increasing their total saving. This represents an economic efficiency loss. It is also a tax on labour which reduces employment, other things equal.⁷

Any net boost to national saving from private superannuation will tend to raise the capital (and/or wealth) to labour ratio which is positive for labour productivity. Also, labour productivity is likely to be higher than if retirement income policy relied more on the public pension.⁸ This is because taxes to fund the public pension fall on both capital and labour whereas compulsory superannuation is effectively a tax on labour only. Hence a shift from the public pension to private superannuation lowers taxes on capital relative to labour which increases the capital stock and labour productivity.

On the demand-side, policies focus on making older workers more productive. Measures include courses to upgrade skills and assistance with job applications, financial assistance with accredited training courses undertaken by job seekers, personal advisers to provide more intensive individual assistance to unemployed people with special difficulties, and training places in information technology for persons aged over 45.

⁶ The OECD is currently (mid 2011 to 2014) conducting a follow up review of its major report: "Live Longer, Work Longer: A synthesis report" which surveys the policy initiatives that have been taken, and are planned to be taken, to boost the employment of older workers. <http://www.oecd.org/employment/employmentpoliciesanddata/ageingandemploymentpolicies.htm>

⁷ The incidence of the effective tax falls on both the employer and the employee. That is, labour costs are higher, employee income is lower and employment is lower. The incidence falls more on the employer the lower is the employer tax rate relative to the typical personal income tax rate and the less substitutable is superannuation for wages in the minds of employees (see Freebairn, 1998 for further analysis).

⁸ Freebairn (2007) makes this argument.

Even without policy drivers, the participation rate of older workers is likely to increase in the coming decades. Day and Dowrick (2004) provide evidence that the decline in fertility since the 1960s has been associated with a substantial increase in female labour participation. They argue that this will continue - in particular with respect to older women, as the higher education attainments of young women today will result in much higher labour participation of older women in the future.

Empirical evidence for Australia suggests that higher employment rates of older workers could significantly offset the effect of ageing on the support ratio. Simulations in Gruen and Garbutt (2003) and Guest (2005) indicate that relatively modest increases in labour participation of workers older than 55 could easily reduce the fall in the support ratio by about half for Australia. This would amount, in the case of New Zealand, to a drop in the support ratio of only 6% between 2013 and 2050 compared with the simulated 12% (see Section 2 above).

4.2.2 Promoting fertility

Policies to promote fertility are aimed at arresting the decline in the support ratio. However, as the projections in Figure 1 illustrate, higher fertility reduces the support ratio for at least several decades. In fact using the “Very High Fertility” projection of New Zealand Statistics (Fig. 1) the support ratio remains below that for the Medium projection until 2060. This implies lower consumption per capita until 2060. For that to be a socially preferred outcome in terms of discounted consumption per capita would require an extremely low discount rate on future consumption per capita.

Nevertheless, pronatalist policies have been introduced in many OECD countries (Gauthier, 2007; McDonald, 2006) consisting of family benefits of various kinds, from cash payments to new mothers, tax benefits for dependent children, to work-related benefits designed to make simultaneous child-raising and participation in the labour market more attractive to women including parental leave and child care subsidies.

Most studies find that family benefits have a positive but very small effect on fertility (Gauthier, 2007; Milligan, 2005; Duclos, 2003; Gauthier and Hatzius, 1997) although a significant minority of studies find no effect at all (Martin, 2003; Moffit, 1998). Couples may bring forward the timing of births in the reproductive life cycle, rather than increase the quantum of births (Guest and Parr, 2010; Martin, 2003). Australia’s total fertility rate increased from 1.73 to 1.97 between 2001 and 2008. The consensus is that most of this was not due to cash benefits to new mothers (the so-called ‘Baby Bonus’) but rather due to fertility catch up – that is, women aged 30-39 giving birth at higher rates having delayed childbirth when they were younger (Lattimore and Pobke, 2008; Guest and Parr, 2010).

Like family benefits, work-related benefits such as child care costs are often seen as a dual welfare/pro-fertility measure. The latter tend have the additional effect of increasing mothers’ labour supply according to some studies (for a survey of the extensive literature, see Guest and Parr, 2013, forthcoming). A given increase in labour participation of mothers has a potentially greater impact on the support ratio over time as the same increase in labour participation of older workers. Mothers are younger and attachment to the workforce while their children are young reduces the depreciation of their human capital which has long term benefits for the support ratio and for labour productivity. Simulations and econometric estimation in Guest and Parr (2013, forthcoming) for Australia found that a 50% child care subsidy would increase the average couple’s labour supply by approximately 1 hour per week whilst children are of pre-school age. By comparison they estimated that cash family benefits have a negligible effect on labour supply.

4.2.3 Promoting immigration

Increasing immigration is a more feasible and more effective policy for lifting the support ratio than increasing fertility. The ‘Very High Migration’ projection illustrated in Figure 1 is based on 25,000 net migrants per year compared with 12,000 in the Medium projection. A migrant intake of 25,000 represents only 0.55% of the population of New Zealand in 2012 and this would decline to 0.43% of the population in 2061 (for the Medium projection). This is well below Australia’s net migrant intake of 0.78% of the population in 2011, based on a 170,000 net migrant flow which is expected to be approximately maintained. The Very High Migrant projection results in a support ratio roughly 2.5% higher on average per year between 2025 and 2060. The reason naturally is that migrants tend to be younger than the resident population and a higher proportion are of working age. For example in New Zealand in 2011 83% of migrant arrivals were between the age of 15 and 64, compared with 46% for the total New Zealand population.

This suggests that increasing immigration levels can reduce the extent of population ageing. However at some point beyond 2060 the support ratio under the higher immigration projection will begin to converge as the larger cohorts of ageing migrants increase the dependency ratio.

Withers (2002) points out that that it is not just the levels of immigration but the cultural mix and the age of immigrants that matters. Withers presents evidence that a change in the immigrant composition toward those from non-English speaking backgrounds who have higher fertility rates, could double the impact of immigration on population ageing. However there are clearly political and social obstacles to major changes in the cultural mix of immigrants.

The fiscal effects of immigration are likely to be positive because immigrants are younger and therefore have higher LFPRs and pay higher taxes than the average of the resident population, although this is offset to some extent by the higher call on social outlays (education and health mainly) as a result of their higher birth rates. Guest and McDonald (2000) calculated that the net effect of reducing immigration (to zero in their projection) would be to increase total social outlays by 2050 by several per cent of GDP.

The net effect of immigration on productivity is unclear from the literature. The Productivity Commission (2006) conducted a study on the economic effects of immigration for Australia including detailed effects on a wide range of industries and occupations using the MONASH CGE model. However, the modelling did not say much about the effects on aggregate labour productivity. Nevile (1991) found that the rate of population growth that maximises growth in output per capita for Australia is between 1.1 and 1.6% per annum. He concludes that this rate can only be achieved with immigration levels around the historical average for Australia, but the precise mechanisms by which immigration boosts per capita growth were not specified. A number of effects are plausible in theory but empirical support is hard to find.

On the positive side, immigration could boost innovation, since skilled migrants bring knowledge, international linkages and networks for expanding business opportunities. Another channel is simply a scale effect: a larger workforce requires increased capital investment and this new capital embodies the latest technology which boosts productivity. Similarly, migrants expand the potential domestic market for goods and services which encourage new firms to set up and this increases competition which is good for productivity. On the other hand, some of the potential productivity gains from ageing discussed above could be thrown into reverse by higher immigration. For example, the spur to innovation through the higher relative price of labour would be dampened by immigration since

immigration tends to lower the price of labour. The same could apply to the effect of workforce age complementarities – if an older workforce is good for productivity then immigration, which makes the workforce younger, would negate this benefit.

4.3 Policies to reduce the fiscal burden of ageing

This section is brief – a detailed analysis of fiscal effects of ageing is beyond the primary focus of this paper which is about the effects of population ageing on productivity, labour participation and living standards.

According to projections by New Zealand Treasury, based on Treasury's Long Term Fiscal Model (LTFM), aggregate government spending excluding financing costs⁹ will increase by 6.4% of GDP from 29.6% to 36.0% over the 45 year period from 2014-15 to 2059-60.¹⁰ Health spending grows by 5% of GDP and New Zealand Superannuation (NZS) grows by 3.6% of GDP. However whereas all of the growth in NZS is due to demographic change, almost all of the health spending is due to “non-demographic volume growth” – income growth and input costs. Demographics accounts for roughly 1% of the 5% of GDP increase. In other words if the age distribution remained unchanged from 2012 to 2060 spending on health would still increase by roughly 4% of GDP. This is not widely appreciated, yet is consistent with the pattern in recent decades during which population ageing has accounted for only 10 to 15% of the growth in health spending in New Zealand (Bell et al., 2010). Hence the projected fiscal burden attributable to population ageing is somewhat less than the 6.4% of GDP of projected growth in total spending – approximately 4.5% to 5%.¹¹ At least two thirds of this burden is attributable to NZS. For perspective, the projected total fiscal burden over the next 45 years is less than the fiscal cost of the global financial crisis of 2008-9. A 5% fiscal cost over 45 years amounts to 0.1% of GDP each year.

Net Crown debt is projected to increase from 35% to 223% of GDP from 2014-15 to 2059-60 given “no policy change”. Some of this increase in debt to GDP is due to passive growth of debt to GDP arising from the difference between the assumed government bond rate of 6% and average nominal GDP growth of 4%¹², and some is due to rising health spending due to rising costs on an age-specific per capita basis. Treasury views 20% of GDP as a sustainable net debt ratio and has projected such a sustainable debt path based on across the board cuts in spending (Bell et al., 2010; and subsequent projections provided to the author). This objective is the motivation for considering options to reduce the fiscal costs of ageing.

The brief comments below focus on options for reducing the fiscal costs of retirement income policy, given most of the fiscal burden of ageing is attributed to NZS.

4.3.1 NZS: Means testing? Cut pension level? Raise eligibility age? Deferral?

NZS is a publicly provided Pay As You Go (PAYG) pension scheme. Its unique feature is that it is universal (not subject to means testing through income or assets). The pension

⁹ Defined in the “cost pressures” projections as “core crown expenses excluding financing costs”.

¹⁰ Based on spreadsheet projections, derived from the LTFM, provided to the author by NZ Treasury officers.

¹¹ There are small reductions in other spending items as a share of GDP such as education and some welfare expenses.

¹² Approximately 82% based on an initial debt ratio of 35%. The calculation is $35\% \left(\frac{1.06}{1.04} \right)^{45}$.

level for a couple is set at a minimum of 66% of the net average wage; the replacement rate is 49.6% for those on median earnings. The scheme accounts for at least two thirds of the fiscal burden of population ageing up to the year 2060 (figures given above). The scheme is partially pre-funded through the NZ Superannuation fund.

One option would be to introduce means-testing of NZS¹³ as in Australia for example, which has both an income and an asset test. This would be unlikely to impact on the old age poverty rate in New Zealand which is one of the lowest rates of old age poverty in the OECD and much lower than in Australia (OECD, 2011). However as discussed above in the Section on labour participation, means-testing creates work disincentives and distorts saving choices.

Another option would be to cut the pension level. But the current replacement rate is already low international standards - 49.6% for those on median earnings compared with the OECD average of 72.0% and 65.9% for Australia (OECD, 2011, p. 125).

Raising the eligibility age is another option. The current age of 65 is typical of OECD countries but a number of OECD countries have legislation, existing or proposed, that increases the eligibility age to 67 over coming decades, including Australia, the United States and the United Kingdom (OECD, 2011). Increasing longevity and health among older people supports an increase in the eligibility age. Analysis by the New Zealand Retirement Commission (2010) found that this option had the potential for “significant cost reduction” (p.115). The Commission found that the combination of a gradual increase in eligibility age to 67 and a lower rate of indexation of the pension level would reduce the fiscal cost by at least 1.5% of GDP by 2035.

Allowing people to defer NZS income in return for a higher rate of payment later is a further option. Australia for example introduced such a scheme in 1998 called the Pension Bonus Scheme under which people who worked beyond pension eligibility age received a tax-free bonus on retirement. This scheme was, however, closed to new entrants from September 2009.¹⁴ The New Zealand Retirement Commission considered such a scheme in their 2010 Review but did not in the end recommend it on the grounds that initial cost saving could be subsequently offset and that it could “test social cohesion” (p. 116).

4.3.2 KiwiSaver: reduce subsidies? Make it mandatory?

KiwiSaver is voluntary on an opt-out basis and it is significantly subsidised by government.¹⁵ Both of these aspects could be addressed. However making it mandatory would only save fiscal costs if the subsidies were substantially reduced at the same time and if it were combined with a means-testing of NZS, in which case it would become more like the Australian system. However the economic arguments against mandatory NZS, noted above, are significant and indeed the 2010 Retirement Commission Review recommended against this option. Removing subsidies at least for high income earners who are more likely to reduce saving in other ways as a result of the subsidies.

¹³ NZS is effectively partially means-tested in that it is included in taxable income.

¹⁴ It was replaced by a Work Concession scheme under which, for a person over pension age, half of the person's employment earnings up to \$500 a fortnight are ignored under the income test.

¹⁵ Government contributes \$1000 on joining the scheme, then gives an annual tax credit of \$1042 provided that the person contributes at least that amount over the year.

4.3.3 Notional Defined Contribution Pension Accounts

An option not apparently considered by the 2010 Retirement Commission Review is Notional Defined Contribution (NDC) schemes. Several European countries have such schemes (Holzmann and Palmer 2006). They can be designed to automatically insulate the fiscal costs of the public pension from the effects of population ageing. Each worker has an individual account, but they do not actually put any money into it. The contributions into their accounts are purely 'notional' and based on their income. The notional balances earn 'interest' at a rate roughly equal to the growth in the national payroll or GDP. Population ageing reduces the growth of individual balances. The final pay-out is paid by the current generation of workers in the same way as a PAYG scheme except that each retiree gets a share based on the relative size of their notional capital. A potential problem however is the removal of the redistributive function of the public pension, as pay-outs are based on relative contributions rather than current income or assets.

5 Conclusion

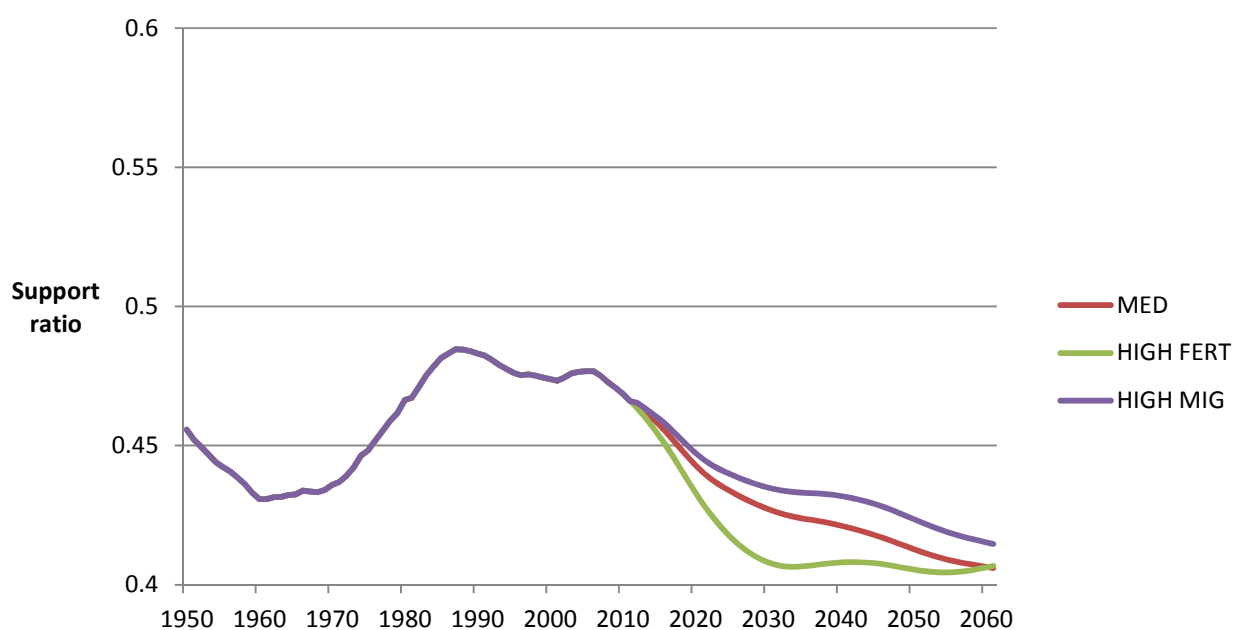
Population ageing could affect productivity through a number of mechanisms. But the magnitude and even direction of some of these effects are unclear in theory and evidence. The age complementarity of workers, for example, is one potentially important channel which the tentative empirical evidence suggests could range anywhere from zero to a positive 30% over the next four decades. Productivity is only one of the channels through which ageing can affect the national economic burden. The evidence on the other channels - the support ratio effect and the capital (or wealth) widening effect – is clearer. For New Zealand, the net effect from these factors appears to be in the range of 7% and 12% over the next four decades. This is a modest, though perhaps not trivial, magnitude.

Public policies directed at the costs of ageing should be evaluated in terms of accepted principles of public finance. That is, they should stand or fall in terms of their effect on national wellbeing, not in terms of narrow measures such as support ratios or even labour productivity. National wellbeing depends on the costs as well as the benefits. For example, tax expenditures designed to encourage older workers to work longer, or to encourage firms to employ older workers, or to promote fertility, have costs in terms of economic efficiency because they increase the tax burden. This paper has not attempted a full national cost benefit analysis of such policies. The same applies to policies directed at the fiscal costs of ageing. The ultimate aim of such policies is to achieve a sustainable path of public debt. Policies to reduce particular ageing-driven outlays such as New Zealand Superannuation need to be evaluated against all alternative policies to achieve sustainable debt. Simply because fiscal costs are increasing in a particular area does not mean that fiscal consolidation needs to be achieved in that area.

Table 1 - Summary of calculations (approximate magnitudes) of effects of population ageing on living standards in NZ over the period 2013 to 2050

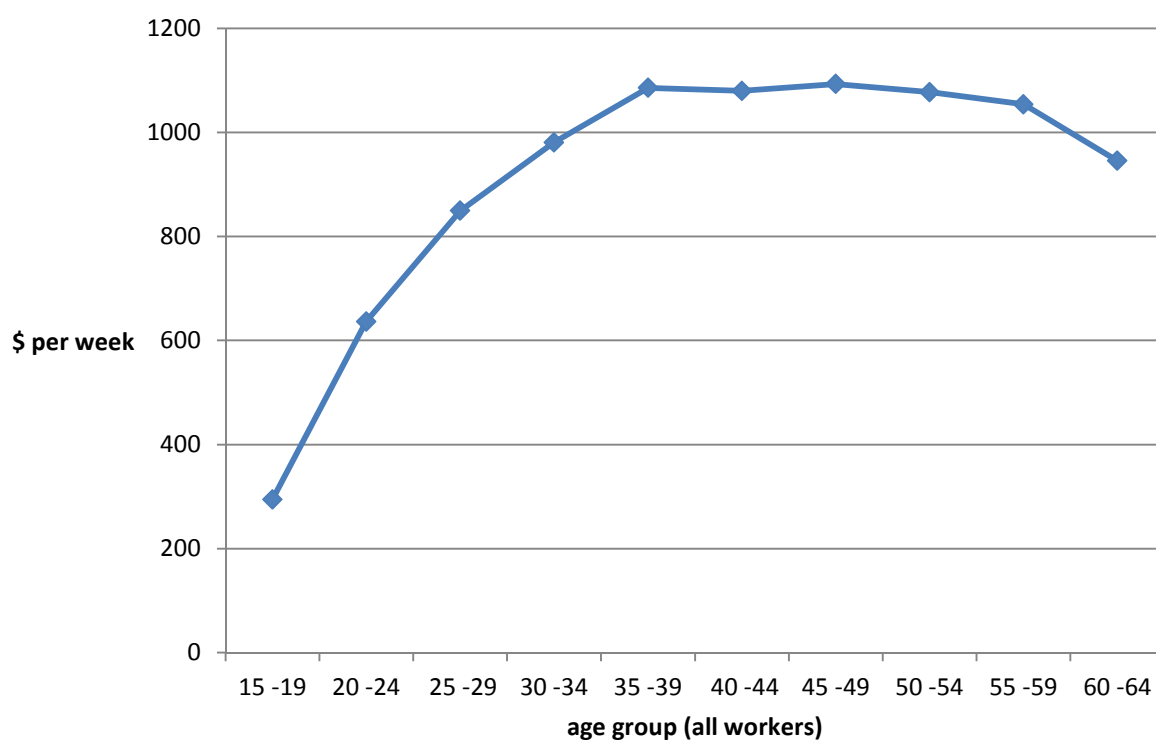
Effect of ageing	Magnitude ('+' denotes a dividend; '-' denotes a cost)
Decline in support ratio	-10% to -15%
Wealth widening dividend	+1.5%
Saving dividend ('2 nd demographic div.')	+1.5%
Complementarity of workers by age	? (probably positive, but a wide range, from 0.5% to 30%)
Change in industry composition	? (probably positive, up to 3%)
Human capital investments	? (unknown)
New discoveries	? (unknown)

Figure 1 - Support ratios, New Zealand



Source: Statistics New Zealand and author's calculations.

Figure 2 - Average weekly paid employment earnings in 2011
(persons, weighted by male/female labour force size)



Source: Statistics New Zealand.

Figure 3 - Age-specific labour productivity weights

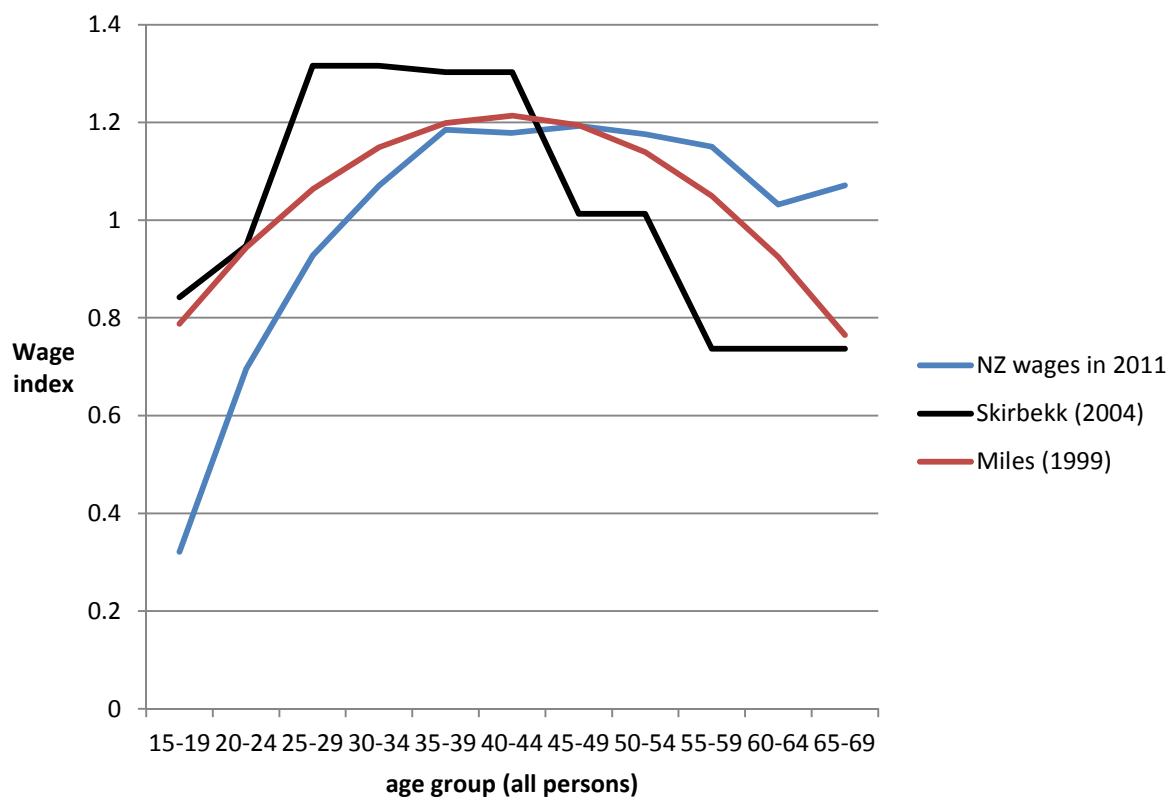
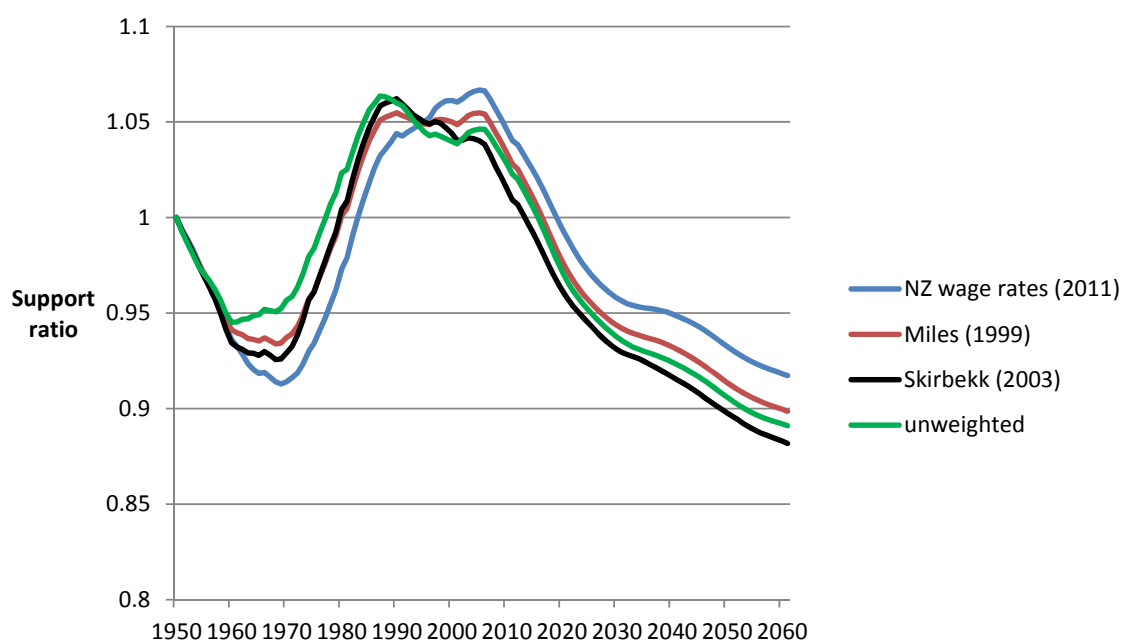
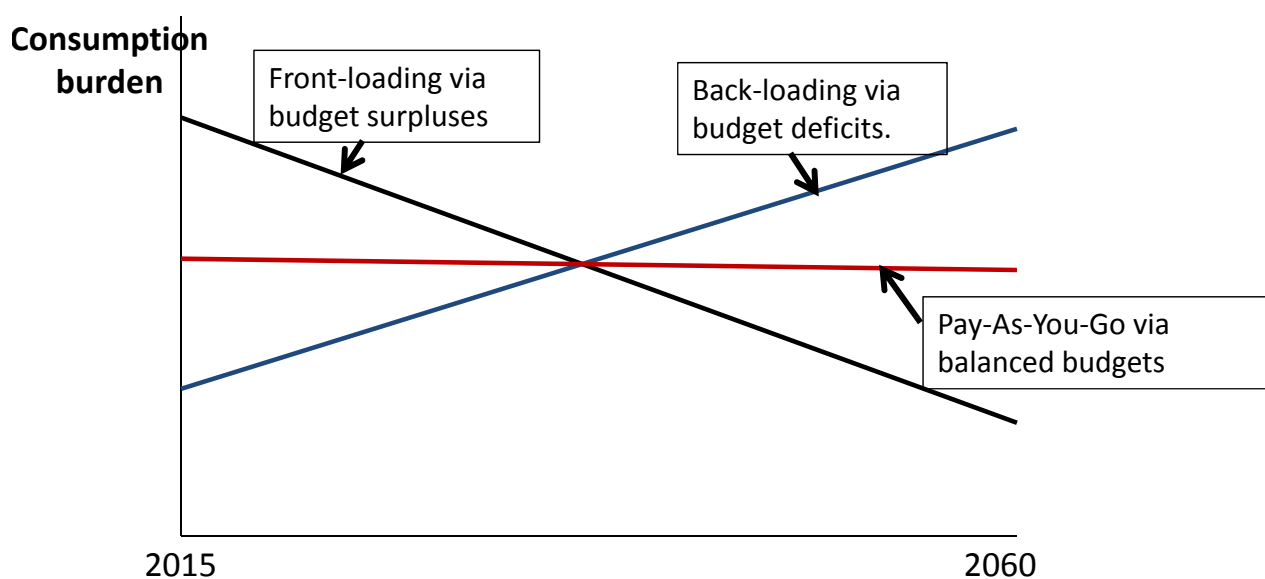


Figure 4 - Support ratios, New Zealand, productivity-weighted
(Medium demographic projections)



Source: Statistics New Zealand and author's calculations using productivity weights.

Figure 5 - Role of fiscal policy in intergenerational allocation of the economic burden of ageing



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