Coleman, Andrew

Working Paper

To Save or Save Not: Intergenerational Neutrality and the Expansion of New Zealand Superannuation

New Zealand Treasury Working Paper, No. 14/02

Provided in Cooperation with:
The Treasury, New Zealand Government

Suggested Citation: Coleman, Andrew (2014) : To Save or Save Not: Intergenerational Neutrality and the Expansion of New Zealand Superannuation, New Zealand Treasury Working Paper, No. 14/02, ISBN 978-0-478-42112-5, New Zealand Government, The Treasury, Wellington

This Version is available at:
https://hdl.handle.net/10419/205657

To Save or Save Not: Intergenerational Neutrality and the Expansion of New Zealand Superannuation

Andrew Coleman

New Zealand Treasury Working Paper 14/02

February 2014

New Zealand Government

NZ TREASURY WORKING PAPER 14/02

To Save or Save Not: Intergenerational Neutrality and the Expansion of New Zealand Superannuation

MONTH/YEAR

February 2014

AUTHOR

Andrew Coleman
New Zealand Treasury
PO Box 3724
Wellington 6140
NEW ZEALAND

Email andrew.coleman@treasury.govt.nz
Telephone + 64 4 917 6294

ISBN (ONLINE)

978-0-478-42112-5

URL

Treasury website at February 2014:
http://www.treasury.govt.nz/publications/research-policy/wp/2014/14-02
Persistent URL: http://purl.oclc.org/nzt/p-1628

ACKNOWLEDGEMENTS

The author would like to thank Matthew Bell, Aaron Drew, Lucas Kengmana, Nicola Kirkup, David Law, Kirdan Lees, Michael Littlewood, Malcolm Menzies, Paul Rodway, Grant Scobie, and Susan St John and an anonymous reviewer for helpful discussions over the last two years The views of the paper are those of the author and do not necessarily reflect those of the New Zealand Treasury or the University of Otago.

NZ TREASURY

New Zealand Treasury
PO Box 3724
Wellington 6008
NEW ZEALAND

Email information@treasury.govt.nz
Telephone 64-4-472 2733
Website www.treasury.govt.nz

Abstract

Increases in longevity mean the size of New Zealand's public retirement income programme, New Zealand Superannuation, will automatically expand unless the age of eligibility is increased. This paper analyses the consequences of expanding New Zealand Superannuation on a save-as-you-go basis through the New Zealand Superannuation Fund rather than on a pay-as-you-go basis. These funding mechanisms differ in terms of their effects on different cohorts, on long run tax rates, on capital accumulation, and on risk. The paper argues that an automatic pay-as-you-go funded expansion of New Zealand Superannuation is unattractive on many grounds, even if pay-as-you-go funding remains for much of the programme. In addition to reducing long run tax rates, the use of save-as-you-go funding through the New Zealand Superannuation Fund provides households with a means of reducing income risk over the course of their lives.

JEL CLASSIFICATION E21 Consumption; Saving; Wealth
H55 Social security and Public Pensions

KEYWORDS Retirement income policy; prefunding; intergenerational economics

Table of Contents

Executive Summary

Longevity is increasing in New Zealand. If the age of entitlement to the government retirement income programme, New Zealand Superannuation, is not changed, the average length of time recipients will obtain an income will increase, possibly by two years per decade, and thus the total size of the programme will increase. Cohorts who may have paid for their elders to receive 17 years of retirement income might obtain 22 years in turn. Such an increase will increase the total amount of New Zealand Superannuation payments and have implications that reverberate throughout the economy.

This paper surveys the international literature to provide a detailed assessment of the consequences of funding an expansion of New Zealand Superannuation either on a "pay-as-you-go" (PAYGO) basis or on a "save-as-you-go" (SAYGO) basis. If the expansion is funded on a PAYGO basis, taxes will gradually increase as the expenditure on New Zealand Superannuation increases. Alternately, if the programme expansion is funded on a SAYGO basis, taxes will be increased in advance of the increase in expenditures, and the surplus can be used to accumulate funds or reduce debt. The paper primarily discusses the case that the additional taxes are used to purchase assets that would be held in the New Zealand Superannuation Fund.

The relative advantages and disadvantages of funding any expansion of New Zealand Superannuation on a PAYGO or SAYGO basis depend crucially on whether the economy is dynamically efficient or inefficient. An economy is dynamically efficient if capital is relatively scarce and the (marginal) return to capital exceeds the growth rate of the economy. Conversely, it is dynamically inefficient if capital is plentiful and so low yielding that the return to capital is less than the growth rate. In a dynamically inefficient economy, retirement income can be best provided using PAYGO funding, as any funds accumulated earn low returns. Conversely in a dynamically efficient economy a SAYGO-funded system generates much lower long term tax rates than a PAYGO system, as the funds that are saved in advance of expenditure earn a return that reduces the need for high future taxes.

Almost all evidence suggests modern economies are dynamically efficient. There is no evidence that New Zealand has been an exception to this rule, or is likely to be an exception in the future. In contrast, falling birth rates and population growth rates suggest economic growth rates are likely to be lower than in the past. This means it is most appropriate to evaluate the relative merits of PAYGO and SAYGO funding in the context where the returns to capital exceed economic growth rates.

When an economy is dynamically efficient the funding mechanisms entail the following differences.

(i) A SAYGO funded expansion of New Zealand Superannuation would require an earlier increase in tax rates, but long run taxes are likely to increase by significantly less – perhaps half as much - than they would if New Zealand Superannuation were expanded on a PAYGO-basis.

(ii) A SAYGO funded expansion of New Zealand Superannuation is intergenerationally neutral, as each cohort pays for its additional entitlement. A PAYGO-funded expansion provides a transfer to the first generation of recipients at the expense of a large opportunity cost on future generations. Not only would many consider this unfair, but it raises the risk that future generations will suddenly reduce entitlements to New Zealand Superannuation, or that significant outward migration will occur.

(iii) A SAYGO-funded expansion of New Zealand Superannuation is likely to increase rather than decrease national capital accumulation and saving. A PAYGO funding system reduces national capital accumulation as it accumulates no capital and displaces the private accumulation of assets. The difference between the two funding mechanism could be as high as $20 billion for every additional year of longevity.

These criteria suggest SAYGO funding has substantial advantages in terms of intergenerational fairness, lower long run tax rates, and higher capital accumulation. Expanding New Zealand Superannuation on a PAYGO rather than a SAYGO basis would most likely lead to an economy with higher long term tax rates, less capital and worse outcomes for future generations.

If the Government did not wish to expand New Zealand Superannuation on a PAYGO basis as longevity increases, it has a variety of options that are broadly intergenerationally neutral. These options all reduce the size of the taxes needed in the long run relative to a PAYGO-funded expansion, albeit by different amounts, and all are likely to increase capital accumulation. For example, the government could:

(i) raise the age of eligibility

(ii) reduce the average size of payments, or

(iii) maintain the current age of entitlement and payment levels so long as it raised taxes early and invested the proceeds.

PAYGO and SAYGO funding also have different implications for the risk profile of the economy. Until recently, much of the analysis of the risk focussed on the way asset price and capital income volatility may affect individuals in retirement, or the way it affects the government balance sheet. A different approach, however, is to focus on the risks to income over the whole of an individual's life, risks that are dominated by productivity shocks that affect both local wages and local returns to capital. In this case households may benefit from lower exposure to wage growth risk and higher exposure to capital market risk, particularly foreign capital market risk. As a SAYGO-funded expansion of New Zealand Superannuation will increase household exposure to capital income shocks, it may help diversify households' risk of low lifetime incomes that stems from a very high dependence on domestic productivity performance. Moreover, holding assets in a government fund may reduce the capital market risk facing individuals, because a long lived government fund can absorb asset price fluctuations much more easily than a short lived individual fund. Consequently, a SAYGO-funded retirement income may enhance risk management relative to a PAYGO-funded scheme. Offsetting these potential advantages, however, are the governance issues facing the New Zealand Superannuation Fund, and the risk that the government offsets the balance of the fund with higher debt elsewhere.

1 Introduction

Societies have adopted a wide range of methods to provide people with financial resources when they are elderly. In broad terms, these methods can be categorized by the extent they are arranged privately rather than by the government, and the extent they are funded on a save-as-you-go (SAYGO) basis rather than a pay-as-you-go (PAYGO) basis *(Table 1)*. In SAYGO-funded schemes, people accumulate assets while they are working, and exchange them for resources when they are old. This accumulation can be voluntary, it can be done through government-mandated retirement saving accounts, or it can be done through the accumulation of tax-revenues in a government fund. In PAYGO-funded schemes, resources are directly transferred from working age people to elderly people. These transfers can be made privately through families, or they can be made through tax-funded retirement income schemes. If the transfers passed from the young to the old are consumed immediately, no capital is accumulated.

Table 1: Categories of retirement schemes

	PAYGO	**SAYGO**
Privately Arranged	Adults voluntarily provide resources to older parents, and are given resources by their children in turn when they are old. Sometimes the resource transfers are linked through the education adults provide to their children.	Adults voluntarily accumulate assets for their own retirements, selling them to younger adults when they are old.
Government Arranged	Government raises taxes that are transferred to older people as pensions. Taxpayers receive a pension from younger taxpayers when they are old.	Government raises taxes that are accumulated into a Government retirement fund. The contributions are sold, normally to young contributors, to pay pensions. The government mandates people have to buy assets accumulated in private accounts. These assets are sold to fund pensions.

All OECD countries have government retirement income schemes and most of these are funded on a PAYGO basis to some degree. In recent years many countries have debated whether they should increase the extent their retirement income systems are funded on a SAYGO basis.[1] The debate has been driven by the realization that the conditions that made PAYGO-funded retirement systems attractive in the 20th century are unlikely to prevail in the 21st century. During the middle of the 20th century growing populations, high productivity growth rates and relatively short life-spans meant PAYGO-funded retirement incomes could be provided with relatively low taxes. In the 21st century, stable or falling birth rates and increasing longevity mean taxes will need to be increased substantially to maintain the same level of retirement incomes if PAYGO-based funding is continued, or retirement incomes will need to be cut if taxes are not increased.

1 For example, see Diamond (1997), Sinn (2000), Feldstein and Liebman (2002b), Lindbeck and Persson (2003), Barr and Diamond (2006) or, in the New Zealand context, Littlewood (2010).

The argument that increasing the amount of SAYGO-based funding can reduce the long-term cost of a retirement income scheme was developed by Diamond (1965). He showed that the relative cost of funding depends on whether an economy is dynamically efficient or inefficient, that is, whether the rate of return to capital is greater than or smaller than the growth rate of the economy. When the return to capital is higher than the rate of economic growth, retirement incomes can be funded with lower long run contributions under a SAYGO system because the contributions made when a person is working age are invested in productive capital, earning a return that compounds quickly through time. In contrast, when the return to capital is lower than the rate of economic growth retirement incomes can be funded with lower contributions under a PAYGO system.

Empirical evidence suggests that most developed countries were dynamically efficient for most periods of the twentieth century. Economic theory indicates economies are likely to remain dynamically efficient so long as capital can be invested productively. This means that the taxes or retirement income contributions needed to pay for any retirement income system could be reduced in the long run if the system were funded on a SAYGO- rather than PAYGO- basis.

If the long term tax or contribution rates needed to fund a retirement income scheme can be reduced by adopting a SAYGO-funded scheme, does this mean a country should adopt SAYGO-funding? Again the answer is well established. A country adopting a new retirement income system or expanding an existing one will be able to reduce the cost to the first generation of recipients if it funds it on a PAYGO basis, even though this requires higher taxes on subsequent generations. A country with an established retirement scheme seeking to convert it to a SAYGO-funded basis will only be able to reduce future tax burdens if contemporary generations are required to increase their payments by making them "double pay": that they will have to pay taxes to fund the retirement incomes of the currently retired, and make contributions to fund some or all of their own retirements. In both cases, the adoption of a SAYGO-funded system requires that higher current taxes or contributions are needed to reduce taxes or contributions in the future. Such changes are politically contentious even if they can be justified on a variety of dimensions, as the costs fall on current voters while the benefits accrue to future voters.

Currently the New Zealand Government provides a flat rate retirement income benefit, New Zealand Superannuation, to all people aged 65 or more meeting a residency requirement.[2] New Zealand Superannuation is largely funded on a PAYGO basis from general taxation, although it has been partially SAYGO-funded since 2002 when the New Zealand Superannuation Fund was created to accumulate assets to partially prefund future retirement benefits. By international standards the taxes required to fund New Zealand Superannuation are low, as the New Zealand population has a relatively young age structure and average payment levels are relatively low. However, population ageing and increases in longevity mean the size of the New Zealand Superannuation scheme will expand significantly over the next 50 years unless the age of eligibility is changed.

This paper outlines the case for expanding New Zealand Superannuation on a PAYGO or a SAYGO funding basis, assuming that a SAYGO-funded expansion uses the New Zealand Superannuation Fund to accumulate assets. The paper argues that a SAYGO-funded expansion of New Zealand Superannuation would result in smaller intergenerational transfers to current generations from future generations, lower long run taxes, and a greater accumulation of wealth than a PAYGO-funded expansion. The size

---

2 New Zealand's scheme is classified as a Tier 1 scheme as the retirement benefit is independent of contributions or capital market returns. It is unusual as it is funded out of general tax revenues, not a dedicated social security tax.

of the effects is considerable. It is plausible that the tax increases needed to fund an expansion of New Zealand Superannuation on a PAYGO basis are twice as large as those required to fund it on a SAYGO basis. Moreover, while a SAYGO funding structure would change the nature of the risks facing each generation, it is plausible it will reduce each generations' exposure to its greatest economic risk, that of low domestic wage growth.

The scope of the paper is deliberately narrow. The paper discusses the case for expanding New Zealand Superannuation on a PAYGO-basis rather than discussing whether the extent of PAYGO-funding should be reduced, as the issues can be presented more simply because they avoid the transition problem. The wider issues are discussed at length in the international literature (e.g. Diamond (1997), Sinn (2000), Feldstein and Liebman (2002b), Lindbeck and Persson (2003) and Feldstein 2005) and by Coleman (2012a) in the New Zealand context.

In addition, this paper does not directly consider SAYGO-funding options other than an expansion of the New Zealand Superannuation Fund. There is a vast international literature on the advantages and disadvantages of mandatory individual account schemes, which Coleman (2012b) discusses at length in the New Zealand context.[3] Many of these alternatives are very attractive. Nonetheless, as the focus of the paper is the differences between funding mechanisms, and as these differences are most easily understood when the structure of retirement income benefits is the same, SAYGO funding schemes based on mandatory accounts are not analysed in this paper.

2 The economics of funding an expansion of New Zealand Superannuation

This section examines the different economic outcomes that occur when a new or expanded retirement income programme is funded on a PAYGO- or SAYGO- basis. To make the analysis concrete, it is conducted in the context of New Zealand's tier-1 government retirement income programme, New Zealand Superannuation.

The effects of expanding New Zealand Superannuation are most easily considered by tracing out the receipts and payments made to different cohorts in a framework that ignores migration.[4] Suppose that a cohort born in year s initially comprising $N^0(s)$ people is entitled to New Zealand Superannuation at age $k(s)$, and that $p(t)$ is the amount of retirement income paid to each eligible person in year t. Given mortality rates for each cohort at each age, it is straightforward to calculate the total amount that is paid each year to all eligible people, $P(t)$, the total number of years of retirement income received by a cohort born in year s, $K(s)$, and the average number of years that each member of the cohort receives a retirement income, $\kappa(s) = K(s)/N^0(s)$. The average number of years of entitlement will depend on mortality rates and the age of entitlement and typically differs by cohort.

The size or scope of a retirement income programme can be changed in several ways. For example, a government could increase the size of the retirement programme by raising the payment schedule $p(t)$ from some year t^* while keeping the age of entitlement schedule $k(s)$ constant. Alternatively, the government could keep the payment schedule

---

3 See, for instance, Feldstein, Ranguelova and Samwick (2001), Holzmann and Stiglitz (2001), Feldstein and Liebman (2002a), Holzmann and Hinz (2005), or Arenas de Mesa and Mesa-Lago (2006).

4 Migration does not fundamentally alter the analysis, but complicates the nomenclature. The case when there is migration is analysed in Coleman (2012a).

$p(t)$ constant but increase the average number of years $\kappa(s)$ that some cohorts receive a retirement income by reducing the age of entitlement schedule $k(s)$. More subtly, the scope of a programme would expand if the average number of years that cohorts receive retirement income increases because longevity increases faster than the age of entitlement. In this case, later cohorts will get retirement income for longer periods than earlier cohorts: a later cohort may receive a retirement income for 22 years on average, for example, but only have to fund earlier cohorts for 17 years.[5] Given that life expectancy in OECD countries including New Zealand has been increasing by 2 – 3 years per decade because of a decrease in age-specific mortality rates for people over 50, (Christensen et al 2009), the automatic expansion of New Zealand Superannuation payments that may occur if the age of entitlement is held constant is sizeable.[6][7]

The quantity of taxes each cohort pays each year to fund the retirement income system can also be easily calculated. If $T(t)$ is the aggregate amount of taxes paid, and $\tau(m,t)$ is the fraction of the total tax-take paid by people aged m in year t, then in year t people born in year s can be considered to made contributions to the retirement income system of $\theta(s,t)=\tau(t-s,t)T(t)$. In a PAYGO funded system, $P(t) = T(t)$, that is, sufficient taxes are collected to exactly pay for the retirement income payments. In a SAYGO-funded system the two quantities are not usually equal.

This framework directs attention to a key issue in the analysis of PAYGO-funded retirement income polices. In a particular year t, the average ages of the people making payments and the people receiving payments are very different. An example of this can be seen in *Figure 1*, which shows the age profile of tax payments and income support payments (including retirement income payments) made in 2010. The figure indicates that the average age of tax payers was much lower than the average age of benefit recipients. A key insight of the literature on PAYGO-funded transfer programmes is that the overall costs and benefits of a programme to a cohort born in year s can be measured using the differences in the tax payments made and benefits received in successive years over the course of their lives. This literature shows that when a retirement income programme is expanded on a PAYGO-funded basis in a dynamically efficient economy, there is a transfer to the first generation of recipients that comes at the expense of lower life-time consumption of subsequent generations. This is not true if the expansion is funded on a SAYGO basis. Consequently, a key difference of PAYGO-funded and SAYGO-funded systems is the way they distribute costs and benefits onto different generations because of differences in the size and timing of the payments through time.

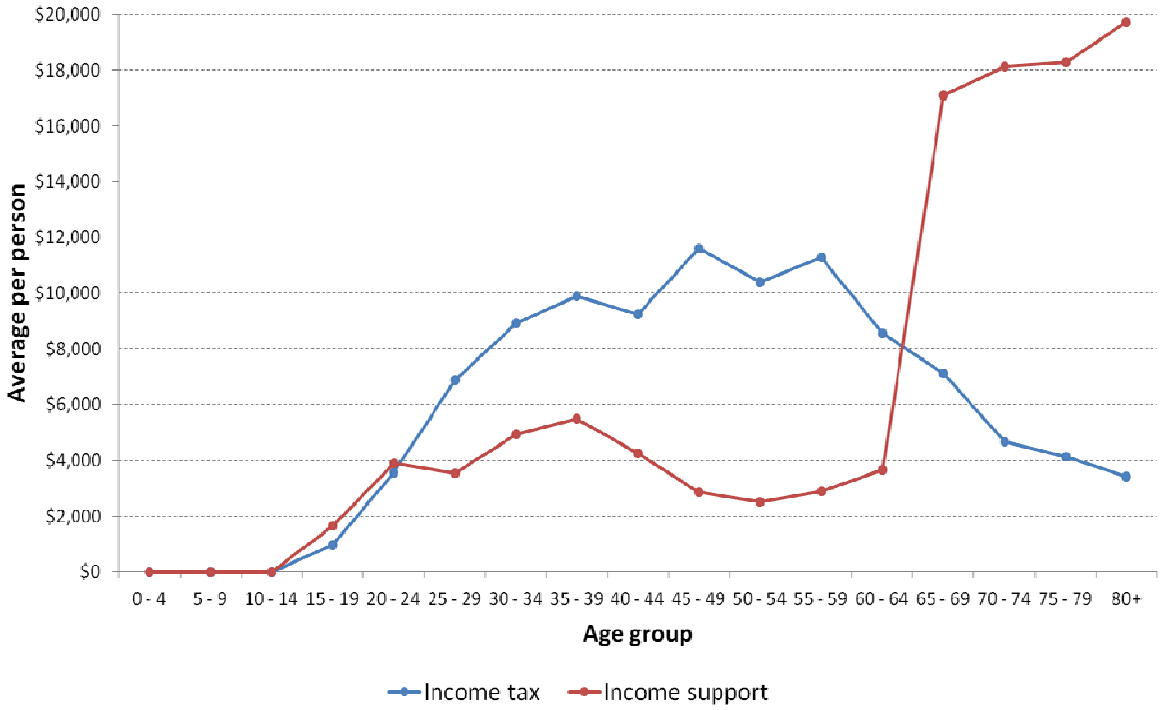
---

5 These calculations are based on Statistics New Zealand population projections using the methodology used in Coleman (2012a) to calculate the expected length of time different cohorts would receive a pension if the age of eligibility were 65. That paper calculated the number of person-years a cohort spent or is projected to spend aged 20 – 64 and aged 65+, and used the ratio to estimate of the average fraction of its working-age life that it would be aged 65+. The cohort born in 1931 is projected to spend 38% of its working age life, or 17 years, aged 65+; the cohort born in 1961 is projected to spend 50% of its working age life, or 22 years, aged 65+.

6 There is ongoing debate about whether age-specific mortality rates are likely to continue to decrease, and whether life-expectancy is likely to continue to increase, at the rates that occurred during the previous century. Wilmoth (2000) argues that as age specific death rates are continuing to decline, and as there is no evidence that the rate of decline is decreasing, there are no reasons to believe the increases in life expectancy will stop. The rate of increase will be slower than in the early parts of the twentieth century, however, as there are fewer gains to be had at very young ages. See the review by Sonnega (2006).

7 Coleman (2012a) uses Statistics New Zealand census data and population projections to show that the cohort born in 1951 can expect to have the same average number of years of entitlement as the cohort born in 1916, even though the age of entitlement was five years lower for the earlier cohort. If the age of eligibility had not been increased, the members of the cohort born in 1951 would have received 25 percent more superannuation payments than the cohort born in 1916. Cutler, Liebman, and Smyth (2007) have similar calculations for the U.S.A.

Figure 1: Average tax and spending per person (2010)



Source: The distributional Impact of Population Ageing (2012), The Treasury

These funding choices have four major consequences.

(i) A SAYGO-funded expansion of New Zealand Superannuation requires tax rates to be increased earlier than a PAYGO-funded expansion, but long-term tax rates increase by a smaller amount.

(ii) A SAYGO-funded expansion of New Zealand Superannuation is largely intergenerationally neutral, as cohorts contribute the funds that pay for their own retirements. In contrast, a PAYGO-funded expansion transfers resources from future generations to the first generation[8]

(iii) A SAYGO-funded expansion of New Zealand Superannuation accumulates additional capital assets. While a reduction in private capital accumulation can be expected to offset some of the increase in funds in the New Zealand Superannuation Fund, overall domestic wealth is likely to increase. In contrast, a PAYGO-funded expansion of New Zealand Superannuation can be expected to reduce a country's wealth.

(iv) A SAYGO-funded expansion of New Zealand Superannuation changes the risk profile of the economy

The first three of these differences are discussed in sections 2.1 and 2.2, while risk is discussed in section 2.3.

[8] When there is migration, a SAYGO system also involves transfers away from outward migrating agents and transfers to inward migrating agents that, ceteris paribus, favour older generations. New Zealand has agreements with various governments around the world that are aimed at offsetting some of the fiscal effects of these transfers, meaning they are likely to be of second order importance unless migration flows are particularly large, or many immigrants arrive in middle age (so are entitled to retirement income benefits, but contribute relatively little).

2.1 The effect of a PAYGO-funded retirement income system on different cohorts

2.1.1 The Samuelson-Diamond-Phelps framework and dynamic efficiency

The standard framework for measuring the costs and benefits of funding a new or expanded retirement income programme on a PAYGO basis was developed in the 1950s and 1960s by authors including Samuelson (1958), Diamond (1965) and Phelps (1965). They analysed what happens when a society adopts a policy that transfers additional resources from younger to older people every year beginning some year t^*. In the year that the policy begins, the older generation gets a net resource transfer, for they have previously not been required to make payments, while the working age people making the transfer have lower disposable income, as they pay more taxes.[9] The elderly are likely to increase their consumption by nearly the amount of the government transfer.[10] In contrast, working age people are likely to reduce their consumption by less than the amount of the transfer, as they will need to make less private provision for retirement as they will receive a government retirement income when they are old. Consequently, aggregate consumption can be expected to increase. The overall increase in consumption means savings falls when the policy is introduced, and the amount of capital accumulated by the economy's residents is smaller than otherwise.

The costs and benefits to each generation, and the economy overall, depend on the effect of the reduction in capital. There are two distinct cases depending on whether an economy is dynamically inefficient or dynamically efficient. A dynamically inefficient economy has too much capital, essentially because it takes a lot of effort to produce and maintain capital goods that depreciate. If there is no productivity growth, an economy is dynamically inefficient if the marginal return to capital net of depreciation (r) is less than the population growth rate.[11] If there is productivity growth, an economy will be dynamically inefficient if the marginal return to capital is lower than the economic growth rate (g), the sum of the population growth rate plus the productivity growth rate. When an economy is dynamically inefficient, the members of an economy are better off if they adopt a PAYGO-funded retirement income system as it offers a better return than accumulating capital. In this case, the consumption of some cohorts could be increased without lowering the consumption of others, so Pareto-improving welfare improvements are possible.[12]

In contrast, capital goods are scarce in a dynamically efficient economy and the marginal return to capital is greater than the economic growth rate. In this case, a PAYGO-funded retirement income system will raise the consumption of the first generation of recipients, but impose reductions in consumption on subsequent generations. The reduction occurs because the taxes subsequent generations pay to fund retirement income payments could

---

9 This assumes there are not fully offsetting reductions in the private PAYGO-funded transfers received by the elderly, such as gifts from children. While it can be expected there will be some reduction in private within-family transfers, the reduction in elderly poverty that has typically occurred when social security is introduced suggests not all elderly have been in receipt of private transfers. See Englehardt and Gruber (2006) for a discussion on the effect of social security on elderly poverty rates.

10 This assumes the marginal propensity to consume for older people is near one. The value of the marginal propensity to consume out of income or wealth for elderly people is a contentious topic, as many studies indicate that elderly people dissave much less out of wealth than can be expected on the basis of life-cycle considerations alone (e.g. Dynan, Skinner and Zeldes (2004) or Poterba, Venti, and Wise (2011)). Nonetheless, the evidence suggests most elderly do dissave slowly, indicating a marginal propensity greater than one, and there is little if any evidence that they save large amounts of current income.

11 A growing population dilutes the amount of capital per person so additional capital has to be built merely to maintain per capita levels.

12 This rule assumes that there are diminishing returns to capital, so that increases in the capital stock (holding other inputs equal) lead to reductions in their marginal returns.

have been saved and invested in productive capital, generating higher returns and greater consumption than those available from the government pension scheme.

The level of the capital stock at which the rate of return to capital is equal to the growth rate of the economy is the "golden rule." It is one of the key benchmarks for interpreting intergenerational transfers since a new PAYGO-funded retirement income scheme is potentially Pareto-welfare improving if the rate of return to capital is less than the growth rate but not if it is greater than the growth rate. If the economy is dynamically inefficient, a PAYGO-funded system will be better than a SAYGO-funded system. If the economy is dynamically efficient, a PAYGO-funded system involves *expected* transfers between generations that are not Pareto-welfare improving, although may be warranted on other grounds.[13]

2.1.2 Is the economy dynamically efficient?

Is it realistic to expect the marginal return to capital to be less than the growth rate in an economy? It is difficult to be completely sure because the average return to capital rather than the marginal return is typically measured, and because the returns to capital can be split several ways including interest payments, dividends, retained earnings, capital gains, and tax payments.[14] Nonetheless, international evidence suggests that most developed economies are dynamically efficient, and New Zealand appears not to be an exception.

The best international evidence is from Abel et al (1989) who test an indirect implication of the golden rule rather than directly testing whether the return to capital has exceeded the growth rate of the economy. Following Phelps (1961), the test relies on the observation that, in the long run, investors will invest more in firms than firms make in profits if the economy is dynamically inefficient. Conversely, if firms return more in profits to investors than they invest, the economy is dynamically efficient. Using data from the United States for the period 1929-1985 and from the other G7 economies for the period 1960-1984 they conclude that the dynamic efficiency criteria was comfortably satisfied for each country for every year.

Longer term, Seigel (1999) estimates U.S. stocks have returned 7 percent in real terms during the last 200 years. This rate of return needs to be averaged with the return to debt claims over the period, reducing the real return to capital to 4 – 5 percentage points, but even this rate is comfortably higher than the average economic growth rate over the last two centuries.

Reserve Bank of New Zealand estimates show annual nominal returns to various forms of capital invested in New Zealand since 1989 have been 8.8 percent for fixed interest investments, 6.8 percent for shares, 8.8 percent for listed property companies, and 11.9 percent for farms. All of these returns compare favourably to nominal GDP growth of

---

13 Note that a PAYGO system can be Pareto improving even if some cohorts have lower expected consumption if it reduces consumption risk by offering insurance possibilities not otherwise obtainable. Section 2.3 discusses how a PAYGO system can offer these insurance possibilities.

14 This point often causes some confusion. First, the condition that the marginal rate of return to capital exceeds the economic growth is *not* the same as the condition that the real interest rate exceeds the growth rate, or that sharemarket returns exceed the growth rate. Both interest rates and equity returns reflect the returns to different classes of claims on firms, and can differ for long periods of time from the marginal return to investing an extra unit of capital. The condition is a statement about the average profitability of additional investment goods, not the size of individual investment returns. Secondly, the condition that the return to capital exceeds the economic growth rate does not require capital incomes to grow faster than economic output in the long run (an impossibility), as the capital incomes need not need be reinvested in new capital goods. Finite lived individuals can earn compound returns without requiring the capital stock to grow indefinitely because they purchase claims on capital goods from older generations when they are working, and sell them to younger cohorts when they are old.

4.8 percent per annum.[15] This evidence suggests the New Zealand is likely to have less private capital than the golden rule level. In this case, government interventions that increase the consumption levels of current generations and reduce private capital levels are likely to reduce welfare levels of future generations.

2.1.3 Will the economy be dynamically efficient in the future?

Even if the return to capital has exceeded the economic growth rate in the past, the relevant questions for a society considering whether or not to adopt SAYGO funding are:

(i) is the economy likely to be dynamically efficient in the future: that is, will the return to capital exceed the economic growth rate; and

(ii) is it likely that a Government managed fund can earn a return that is greater than the economic growth rate?

Obviously, no one can predict either the return to capital or the growth rate with certainty. However, there are a variety of reasons to expect the return to capital to be greater than New Zealand's economic growth rate in the future, and few reasons to expect it will be lower.

New Zealand's economic growth rate can be decomposed into two factors: the growth rate of the workforce; and the growth rate of labour productivity. In the past five decades, the growth of each component has been large. The size of the workforce increased in response to the post-war baby boom, the increasing participation rate of women in the workforce, and the high inward migration that occurred between 1950 and 1975. These factors are unlikely to be repeated. The natural population increase is likely to be small, reflecting a net reproduction rate that has been remained very close to one since 1977, and which shows no sign of increasing. The big increase in female participation rates has already occurred. This means long term labour force growth will depend on migration flows. While these have been intermittently high since 1990, average inward flows are considerably lower than those that occurred prior to 1975. For all of these reasons, both the labour force growth rate and the population growth rate are forecast to be much lower in the next 50 years than in the last 50 years. Projections made by Statistics New Zealand suggest the working age population growth rate can be expected to be 0.3% per year, more than a percentage point lower than the 1.5% growth rate recorded since 1961. In turn, this decline will directly reduce the economic growth rate, making the condition for dynamic efficiency easier to achieve.[16]

It seems unlikely labour productivity growth rates will be higher in the future than the past either. Labour productivity depends upon, amongst other factors, technological progress, management practices, the education levels of workers, and the degree of specialization in the economy. The large increases in education levels that occurred after 1980 are unlikely to be repeated, given that education enrolment rates have now been high for two decades. Similarly, the improvement in productivity stemming from the greater participation of women in the workforce, and the changing specialization of the economy that followed the reforms of the 1980s, are unlikely to be repeated. While there is scope for continued managerial improvements, and for technological progress, the latter is largely determined by overseas factors and there are no good reasons to expect the rate

---

15 During this period the population increased by 1.2 percent per annum and the consumer price index increased by 2.4% per annum.

16 Note that if net inward migration were to significantly increase, resulting in much faster rates of population growth, the economic growth rate would increase and the golden rule condition would be easier to satisfy unless the rate of return to capital also increased. It is likely the *local* rate of return to capital would increase in these circumstances, however, due to the declining per capita capital ratio.

of technological progress to suddenly increase. In short, several of the positive factors behind the rates of productivity growth achieved in the past are unlikely to occur again, so there are no good reasons to expect future productivity growth rates to exceed those of the recent past.[17]

If the rate of economic growth is likely to be lower in the future than the past, what about the return to capital? This issue is complex, not just because the return to capital depends where the capital is invested (New Zealand or overseas), but on the level of technological growth, and on the size of the capital stock. For risk diversification reasons discussed in section 2.3, the optimal strategy would be for the New Zealand Superannuation Fund to primarily purchase foreign assets, implying the relevant rate of return is that earned on overseas capital. In most OECD countries, rates of returns have exceeded local economic growth rates over the last century; since local returns and growth rates are correlated across countries, because they are driven by global technological and demographic shocks, if they continue to exceed local growth rates they are likely to exceed New Zealand economic growth rates.

Are global rates of return likely to remain high? Excluding disasters, they are likely to fall only if capital becomes very plentiful, or the development of new technologies slows. Several papers have examined how the size of the capital stock may affect capital returns, normally by examining the general equilibrium consequences of switching the funding of a retirement income policy from a PAYGO-basis to a SAYGO-basis. These papers indicate there is likely to be a reduction in marginal capital returns, but the reduction is unlikely to exceed 1 percent per annum even if there is a substantial increase in the capital stock (see Feldstein and Liebman (2002a) for a discussion). In these circumstances, returns will still comfortably exceed economic growth rates. There is less formal literature

---

17 The relationship between population growth and economic growth is the subject of a large literature going back to Malthus. All developed countries experienced a demographic transition during which life expectancy increased, birth rates declined, the total size of the population and the level of per capita incomes increased sharply. This experience suggests that at some stage decreases in birth rates and ultimately a reduction in the population growth rate generated such a large increase in per capita incomes that the economic growth rate increased as the rate of population growth declined. This raises the question: could a further decrease in birth rates or population growth rates lead to a sufficiently large increase in per capita incomes that the economic growth rate increases?

The literature suggest this is unlikely. The leading theoretical explanations for the relationship between population and economic growth rates suggests a transition between undeveloped and developed economies takes place during which time parents choose to have fewer children, but invest more heavily in education (Becker, Murphy and Tamura 1990; Galor and Weil 2000). During this transition phase birth rates fall, the fraction of the population that is working age increases, the fraction of the working age population in the labour force increases, the return to education increases, there is a large increase in per capita incomes, and the growth rate of the economy increases. However, when this transition phase finishes and the economy is developed, there relationship between birth rates, population growth rates, and economic growth rates changes and a decreasing relationship between population growth rates and per capita income growth rates cannot be presumed. Galor and Weil (p825) argue that "if population growth is positive in the Modern Growth Regime and if its effect on technological progress remains positive, then education and technological progress will continue to rise, and, similarly, if population growth is negative they will fall." Becker, Glaeser, and Murphy (1999) also make the counter argument, that a larger population increases the returns to specialisation and knowledge acquisition by a sufficient amount that higher population growth rates will lead to higher per capita incomes.

The empirical literature also suggests that developed economies are unlikely to have a significant increase in per capita income growth rates when birth rates decline or the rate of population growth decreases. Brander and Dowrick (1994) using cross country data from developed and developing countries suggest that reduced population growth can lead to an increase in economic growth, but that the direct effect from population growth to economic growth is minor. Most of the effect occurs because of a significant increase in the fraction of the population in the workforce – a factor not likely to be relevant to New Zealand. (The Statistics New Zealand population forecasts used in the Treasury Long Term Fiscal Statement (2013) predict almost no change in the fraction of the population in the workforce over the next half century.) If there is no change in the fraction of the population in the workforce as population birth rates fall, the estimates from Brander and Dowrick suggest the rate of economic growth is increasing in the population growth rate, as this paper assumes. Horlacher and Mackellar (2003) provide an analysis of Japan, the country with a birth rate below replacement rate and the fastest rate of population ageing in the world. They observed that while the population and labour force stabilised after 1990 and then started to shrink, there has been a decline rather than an increase in the total factor productivity growth rate.

explicitly asking how future rates of technological progress will affect capital returns, but theoretical models suggest returns will remain high so long as technological progress continues and new types of capital equipment continue to be produced.[18]

Other theoretical considerations support this view. Standard saving and investment models dating back to Ramsey (1928) suggest agents will save until they equate the discounted value of marginal utility in successive periods. To a first approximation, this implies the rate of return to capital should equal the sum of the intertemporal preference rate and the rate of consumption growth multiplied by the elasticity of marginal utility with respect to consumption. When the rate of consumption growth is equal to the per capita economic growth rate, and the elasticity of marginal utility with respect to consumption exceeds one, it follows the quantity of saving is adjusted to ensure the return to capital exceeds productivity growth rates.[19] Under these circumstances, the return to capital is likely to exceed the economic growth rate in perpetuity if the population growth rate is sufficiently low.

The second question concerns the ability of a government fund to earn a return on its investments that is greater than the economic growth rate. This question has two components: will the average market return on investments exceed the economic growth rate; and can a government fund earn sufficiently close to or above the average market return that it also earns more than the economic growth rate?

Somewhat surprisingly, the answer to the first part is not "yes" even if the return to capital exceeds the economic growth rate in the long run. This is because investors typically purchase existing assets, and in the short or medium terms the returns to existing assets do not have to equal to the marginal return to new capital. Rather, the prices of existing assets tend to fluctuate substantially, by an amount considerably greater than the change in the underlying earnings of these assets (Shiller 1981). For this reason there can be long periods where investment returns are lower than the economic growth rate even if they exceed it in the long term.[20]

Various authors have examined the likelihood of investment returns being lower than the economic growth rate over the 40 or 50 year horizon that is relevant to retirement saving. These calculations suggest the likelihood is low, but neither zero nor constant. The likelihood is low because the average excess return is quite high, and, because a component of the fluctuations is mean returning. The likelihood is not constant because the risk premium varies through time, resulting in a systematic relationship between asset prices and subsequent returns (Campbell and Shiller 1989, Arnott and Bernstein 2002). When risk premiums are low, asset prices are high and subsequent returns tend to be low. In circumstances like these – circumstances that appear to prevail in 2013 – the probability that investment returns (but not the rate of return to new capital) will be lower than the economic growth over a ten or twenty-year period is much higher than normal.

---

18 At least two different literatures are relevant here. The first notes that much technical progress reduces the price of capital equipment. These reductions mean additional capital can be purchased without reducing the return to capital, because the decline in the marginal productivity of capital is offset by a decline in its costs (Gordon (1990); Greenwood, Hercowitz, and Krusell (1997)). The second literature concerns the diversity of capital equipment and technologies, and notes that investment in new technologies can lead to persistently high rates of returns due to the scarcity of these types of capital (Gilchrist and Williams (2000), (2004)). Once inventions are brought to a workable stage, lengthy periods of capital investment with high returns typically follow (Harberger 1998).

19 If the mandatory contribution rates for a government saving scheme were sufficiently high, it is possible that capital accumulation rates would exceed the golden rule level if households could not offset this saving by decumulating privately held assets. However, New Zealand is such a small country it seems far fetched to believe its saving rate will have any noticeable effect on global capital levels.

20 As discussed in section 2.3, this provides one reason why households may like the government to hold the assets on their behalf. Since the government has a longer horizon than an individual, it can absorb fluctuations in asset prices more easily.

Decade long investment returns were very poor in the United States in the 1930s, 1960s, and 1970s, for instance. Nonetheless, two centuries of data on U.S. capital markets, and a century of data on international markets reveal few occasions local returns have been lower than local economic growth rates over 40 or 50 year horizons.[21] Moreover, world average investment returns have typically exceeded local growth rates except when a country has experienced very high growth when making the transition from under-developed to developed status.[22] These experiences suggest the risk that investment returns (rather than the return to new capital) are lower than the growth rate over long horizons is low.[23]

Can a government fund earn sufficiently close to or above the average market return that it also earns more than the economic growth rate? This question has been analysed in various guises in the literature. The answer appears to be "yes": properly managed, transparent funds can earn a return sufficiently close to, or above, market averages that they can generate returns that exceed the economic growth rate. Interesting, much of the analysis has compared the returns to government-managed funds and privately managed funds, and have found government funds to have better returns than private funds (Diamond 1996, 2011). The primary reason for this outperformance is the much higher fee and costs structure of private funds. In the context of the current paper, it is perhaps worth noting that the New Zealand Superannuation Fund has outperformed its market based reference portfolio since inception, and routinely outperforms the returns earned by private sector Kiwisaver providers.[24]

To summarise, there are no good reasons to suspect that the economy will be dynamically inefficient in the future, given the likelihood for lower economic growth rates and the long international history indicating profitable investment opportunities are usually available. There are reasons to believe New Zealand growth rates could exceed the returns from investments in existing assets over the next two decades, particularly as asset prices were at very high levels at the end of 2012, but the probability of such outperformance is low. It is even lower over the 40 or 50 year horizon usually associated with retirement planning. Only time will tell if investment returns are greater than or lower than the economic growth rate over the next 40 years. Nonetheless, historical evidence means it is better to plan on the basis that the economy will be dynamically efficient rather than dynamically inefficient. Moreover, as discussed in section 2.3, when risk is considered from a whole-of-life perspective, while the adoption of a SAYGO-funded rather than PAYGO-funded retirement income policy alters risk, it is not clear it increases risk.

---

21 See Goetzmann and Ibbotson (2008) for a discussion of the U.S. evidence, and Dimson, Marsh and Staunton (2003) or Dimson, Marsh, Staunton and Garthwaite (2013) for a discussion of the international evidence. Dimson et al (2013) discuss the case of countries like Russia or China where revolutions meant the private returns to capital were essentially zero; however, even these cases do not necessarily mean the social return to capital was zero, as much of the capital was used by the new Government owners.

22 When a country goes through a rapid growth phase, the growth rate of GDP is often greater than average global investment returns, but not necessarily greater than local investment returns. Gilchrist and Williams (2004) provide evidence on the post-war Japanese and German cases.

23 In the New Zealand context, simulations by Lees (2013) suggest there is an extremely low chance of a SAYGO scheme producing returns lower than a PAYGO scheme, even if mean returns are 0.5- 1.0 percent lower than those observed historically.

24 The New Zealand Superannuation Fund reports its returns on its website on a regular basis. www.nzsuperfund.co.nz . Craig Simpson published a comparison of the New Zealand Fund and private Kiwisaver returns on April 30 2013. www.interest.co.nz/kiwisaver/64183/craig-simpson-examines-how-new-zealand-super-fund-stacks-against-sample-top-performi

2.1.4 The opportunity cost of a PAYGO-funded retirement income system in a dynamically efficient economy

When a PAYGO-funded retirement income system is expanded, there is a transfer to the first generation of recipients that comes at the expense of reduced consumption for all subsequent generations even if these generations are also entitled to the expanded retirement income payments. The reduction in consumption occurs because of the opportunity cost of having to pay taxes to fund pension payments rather than saving the equivalent sum and earning interest and dividends. The exact costs depend on the structure of the tax system and the retirement income payments, but generally are calculated for the case that retirement income payments *p(t)* increase at the rate of economic productivity growth, and that there is constant population growth. In the simplest overlapping generations model, in which a cohort living for two periods pays taxes in the first period and receives a transfer benefit that increases at the rate of productivity growth in the economy in the second, the opportunity cost on subsequent generations is $(r-g)/(1+r)\ T$, where T is the size of the additional tax payments that have to be made when the retirement income programme is expanded, and the term $r-g$ is the difference between the return to capital and the growth rate of the economy measured over the average length of time between when payments are made and when benefits are received. The opportunity cost has a more complex formula in more realistic models that incorporate a large numbers of cohorts, such as those developed by Auerbach and Kotlikoff (1987), but in all cases it is an increasing function of the difference between the rate of return on capital and the growth rate of the economy.[25]

Five observations can be made about this opportunity cost.

First, the cost is large. If the return to capital is 2.5 percentage points higher than the growth rate - a gap similar to that experienced in the last two decades – in the long run the taxes needed to fund New Zealand Superannuation payments on a PAYGO basis are over twice as large as the taxes needed to fund it on a SAYGO basis.[26] If the return to capital is only 1.25 percentage points higher than the growth rate, the long term taxes needed to fund New Zealand Superannuation payments on a PAYGO basis are still 50 percent higher than the taxes needed to fund it on a SAYGO basis. Lower taxes are possible in a SAYGO-funded scheme because taxes are paid earlier and earn high investment returns. Depending on how they are invested, the additional assets either increase the size of the New Zealand economy, reduce foreign claims on domestic production, or increase claims on foreign production; but in each case resources can be transferred to retired people without requiring the high long run taxes needed in a PAYGO-funded system.

Secondly, the opportunity cost is rising. The 2013 Long Term Fiscal Statement (New Zealand Treasury 2013) estimates that the size of the tax payments needed to fund the current form of New Zealand Superannuation will steadily increase from 3.8% of GDP (net of tax) in 2011 to 6.6% of GDP (net of tax) by 2060 if the age of eligibility is not increased as longevity rises. This means the term T is going increase by nearly 3 percent of GDP so that if the taxes in a SAYGO-funded system are half of those in a PAYGO-funded system, the annual opportunity cost on future generations will *increase* by approximately 1.5 percent of GDP, or $3 billion per year in current terms. In this case the total *annual* opportunity cost imposed on future generations by the need to fund New Zealand Superannuation payments will be in the order of 3.5 percent of GDP, or $7 billion dollars in current terms. In addition, changes in demography mean the growth

---

25 See Appendix 1 for an example.

26 See the calculations in Appendix 1.

rate of the population is likely to reduce over time, suggesting the term *(r-g)* will also increase. Thus a "back of the envelope" calculation suggests the opportunity cost of the current system will be approximately twice as large for future generations as it is for current generations.

Thirdly, when a PAYGO-funded retirement income scheme is expanded, the value of the transfer to the first generation (those receiving without having to pay earlier cohorts) is exactly equal to the discounted sum of the opportunity costs on all subsequent generations, when the discount rate is the return to capital. In a significant sense, this is what "dynamically efficient" means: transfers that increase the consumption of one generation come at the expense of reductions in the consumption of other generations. The intuition of the result is that if the first cohort invested the resources they were given, and earned the rate of return to capital, the amount they would earn is equal to the opportunity cost imposed on subsequent cohorts. A simple proof of this result is shown in Appendix 1.

Welfare is not usually calculated in this manner, however. Rather, transfers are valued in terms of the discounted value of the change in the utility of consumption, where the discount rate is the rate of time preference (see Arrow et al (1995) for a discussion). This changes the calculation two ways. First, the welfare cost of future consumption losses will be smaller if the marginal utility of consumption is decreasing in income. Secondly, the welfare cost of future consumption losses will be higher if the discount rate is lower than the real return to capital. The two effects exactly offset each other when the real return to capital equals the time preference plus the elasticity of marginal utility multiplied by the growth rate of consumption. A proof of this result is also provided in Appendix 1, for constant elasticity of substitution utility functions. Because the real return to capital should equal this sum in the long run, intergenerational transfers to current cohorts should not *ordinarily* increase net welfare. They should increase aggregate welfare only if the social discount rate is higher than its normal long run value. This, of course, is the justification in times of enormous stress.

Even if the aggregate benefits of adopting a PAYGO-funded retirement income system are zero when the real return to capital equals the time preference plus the elasticity of marginal utility multiplied by the growth rate of consumption, this does not mean the scheme is welfare neutral. First, it involves a redistribution from one set of cohorts, including those yet born, to others, which has welfare implications.[27] Secondly, while the after tax return to capital will tend towards the social discount rate in the long term (Ramsey 1928), the pre-tax return to capital is likely to be higher than the social discount rate when capital incomes are taxed.[28] In this case, the expansion of a PAYGO pension system would reduce welfare overall, even though it increases the welfare of the first generation receiving the transfer. Thirdly, there are reasons to query whether the aggregate discounted sum of changes in marginal utility is an appropriate way to calculate welfare. If an alternative metric placing greater weight on the utility of future generations is

---

27 Transfers from future cohorts are likely to be acceptable if they are made when circumstances are very difficult and there is considerable need amongst the first generation of recipients. For example, both the U.S. and New Zealand expanded their retirement income schemes significantly during the Great Depression as a means of transferring resources to desperately poor elderly people. Nonetheless, in 2013 one has to wonder about the legitimacy of reducing the consumption possibilities of future generations by increasing transfers to what is the highest income generation in New Zealand history.

28 If individuals invest until the *after tax* return to capital is equal to their rate of time preference adjusted for consumption growth, the pre-tax return will exceed the social discount rate. See the discussion in Linbeck and Persson (2003) or Feldstein and Liebman (2002b).

adopted, the welfare consequences of adopting a PAYGO-funded retirement scheme are worse.[29]

Fourthly, the calculations of the costs and benefits for each cohort are predicated on the assumption that the programme is continued indefinitely. If a programme imposes a very large opportunity cost on future generations, this assumption may prove untenable. Indeed various authors including McHale (2001) and Shoven and Slavic (2006) have demonstrated that various countries have changed their retirement programmes in response to predicted steep increases in the future costs of these programmes. For this reason, it may be tempting to claim that the calculations of future cost and benefits are inherently pointless because of the ability of future generations to change the programmes should the opportunity costs become too high.

In one sense this criticism is valid: It is probably unrealistic to believe a particular programme will continue if the opportunity costs it imposes on some future generations are very high. Indeed, McHale (2001) also suggests that changes to retirement income programmes are often done in a manner designed to enhance their future sustainability by reducing the incentive of future generations to make changes. But such criticism also missed the point of making the calculations. There are clear advantages to adopting retirement income policies that are unlikely to be suddenly changed at a future date, given the limited ability of retired people to change their incomes to compensate. Put differently, there are clear advantages for a generation to adopt time consistent policies, one that are unlikely to provoke change by future generations (McHale 2001; Rangel 2003). Calculating the implied opportunity costs on future generations is one way of ascertaining whether a new or expanded policy is likely to be sustainable.

Fifthly, the use of opportunity cost to measure the size of intergenerational transfers is not limited to retirement income programmes. Whenever there is a difference in the average age of taxpayers and the average age of the recipients of a government programme that is funded on a PAYGO basis, there is an implicit intergenerational transfer. When the average age of the recipients is older than the average age of the taxpayers, the opportunity cost falls on future generations of taxpayers. When the average age of the recipients is younger than the average age of the taxpayers, as is the case with education programmes, there is a benefit to future generations of recipients. Whether the combined effect of government programmes is net positive or negative to future generations is thus an empirical question, and a society may not care that the expansion of a retirement income programme imposes costs on future generations if it believes that it is otherwise providing them with immense benefits.

---

[29] In broad terms, the economics literature tackles the issue from the perspectives of "utilitarian discounting" and "sustainability". The "utilitarian discounting" approach examines how transfers alter the total sum of all generations' welfare, with the consumption of later generations discounted to take into account their likely higher levels as well as their delayed nature. In contrast, the "sustainability" approach focuses on the average size of the transfers made by current and future cohorts, without discounting future transfers simply because they occur later. In this approach, policies that impose large costs on *all* future cohorts are valued poorly, because they lower average consumption levels of large numbers of people evaluated in their own time frames. A PAYGO-funded expansion of a retirement income policy has fewer positive aspects if assessed through a "sustainability" lens, because the increase in consumption of the first generation is offset by lower average consumption of all future generations, and the latter are not discounted simply because they occur in the future. Moreover, since these future generations are young or unborn, they do not have voting rights and the decision to transfer resources from them essentially involves an expropriation of their resources. Thus if "sustainability" is an important component of equity, equity is reduced when PAYGO-funded transfers to older generations are expanded. Chilchinisky's (1996) axiomatic approach to social welfare raises an additional wrinkle. She argued that any admissible welfare function should balance the "utilitarian discounting" and "sustainability" approaches. Since a PAYGO-funded expansion of retirement income is likely to generate zero welfare benefits by the utilitarian metric, unless consumption for the first generation is unusually low, and since it generates negative benefits by the sustainability metric, any combination is negative. It follows that the expansion can only be justified using standard welfare economic approaches in circumstances that a society is particularly concerned about the welfare of the current generation, such as in the aftermath of a war or natural disaster, or immediately prior to a dramatic economic transformation.

Recent analysis suggests that the average age of transfer recipients is lower than the average age of payers in traditional and less developed societies, so that in these societies PAYGO-funded transfers overall represent a transfer to future generations.[30] However, the rapid expansion of public health and retirement schemes means the average age of recipients in modern industrial countries is greater than the average age of payers, so PAYGO-funded transfers represent an opportunity cost on current working age and future generations. This has been one of the major effects of the demographic transformation experienced in the seventy years (Lee 2007; Mason et al 2009.)

2.1.5 The effect of PAYGO-funding retirement income programmes on capital accumulation

There is a compelling logical case that a retirement income programme funded on a PAYGO basis should reduce wealth accumulation in an economy.[31] The first generation of recipients receives a transfer that raises their consumption above the levels it otherwise would have been. Other generations receive a retirement income payment, but also pay higher taxes. Since a tax-funded government retirement income scheme is a substitute for private retirement saving, working-age households can be expected to reduce their private working-age saving as well as their consumption when a retirement income system is adopted.[32] The extent that wealth accumulation decreases overall depends on the extent that the first generation of recipients saves the retirement income payments rather than increases its consumption, and the extent that working-age cohorts reduce their consumption rather than their private saving. Only in the case that working age households reduce their consumption by exactly the same amount as older households increase their consumption would there be no decrease in wealth accumulation.[33] In the likely case that working age people reduce their saving in response to a combination of higher taxes and higher future retirement incomes, the aggregate wealth held by residents of the economy will decline.

There is not much empirical evidence directly testing whether the expansion of PAYGO-funded retirement income systems reduces saving rates or capital accumulation. Schmidt-Hebbel (1998) provides a survey. Feldstein (1974) estimated the U.S. social security system reduced voluntary saving by 40 – 50%, a higher reduction than estimated for other OECD countries. Samwick (2000) provides cross-country panel data evidence that countries with PAYGO retirement income schemes have lower saving rates than other countries, and that the difference is larger for countries with more comprehensive schemes. In a different context, Gokhale, Kotlikoff, and Sabelhaus (1996) show that the post-war decline in the U.S. saving rate is associated with an increase in medical

---

30 The studies have focused on health, education, and social welfare transfers including government retirement income schemes. The beneficiaries of other government programmes, such as defence, the justice system, or some infrastructure have been more difficult to distinguish by age.

31 For an elaboration of the result, see the text by de la Croix and Michel (2002).

32 Households also have the option of changing their working hours. If a PAYGO system is expanded, by raising the period each person is entitled to a pension, the first generation of recipients can be expected to reduce working hours as they are gifted additional resources. The situation facing subsequent generations is more complex. The expansion of the system lowers their disposable income while working age, but raises retirement income. While the income effect (reduced lifetime income) may induce people to work longer, it seems unlikely that a reduction in the age of eligibility would induce them to work longer. (Indeed, after the age of eligibility was increased in New Zealand in the 1990s, workforce participation of people over 60 increased, not decreased.) Only if the increase in taxes and reduction in their disposable income makes them increase hours while they working age are total hours of work likely to increase. Most likely, working hours will reduce overall, reinforcing the decline in capital accumulation. Conversely, if a PAYGO system were reduced in size, by raising the age of eligibility, it is likely that workforce participation would increase, both among working age and older people. If this increase in production exceeds the increase in consumption, capital accumulation will increase.

33 Even in this case wealth would reduce over time unless subsequent cohorts also behaved in the same manner.

expenditures on elderly people associated the expansions of the U.S. PAYGO-funded medical system.

While this evidence is not particularly strong, the data do not contradict the contention that PAYGO-funded retirement schemes reduce capital accumulation. The absence of strong evidence may reflect many factors. First, standard theoretical arguments suggest a PAYGO-funded system will reduce saving rates more in the short run than the long run, but that there will be a decline in wealth accumulation in the long run.[34] This means that any negative relationship between saving rates and the size of a PAYGO system may be transitory, and will typically decline through time. Empirical work has typically ignored the time-varying nature of the relationship. Secondly, cross-country studies do not provide directly comparable data, given the enormous variety in the size and structure of schemes. Thirdly, government PAYGO-funded retirement schemes may crowd out private transfers from children to their parents, resulting in only a small increase in the consumption of the elderly. This is more likely in less developed countries than in developed countries, but it may have been important historically when government PAYGO schemes were first introduced in developed countries.[35] Fourthly, PAYGO-funded retirement income systems were often introduced or expanded in response to difficult macroeconomic circumstances, such as the Great Depression, meaning that there are compounding factors to take into account. These reasons collectively suggest cross-country saving data are not ideally suited to uncover long-term relationships between wealth accumulation and the size of a PAYGO-funded retirement income systems. Failure to find strong evidence in these circumstances should not be surprising.

2.2 The effect of a SAYGO-funded retirement income system in a dynamically efficient economy

A society adopts SAYGO-funding when it creates or expands a retirement income policy if it requires all cohorts who receive retirement incomes to fund the payments in advance. For this reason, not all changes to retirement policies can be funded on a SAYGO basis – in fact only those that are announced sufficiently far in advance that the first cohorts to receive the benefits have time to save for them. For example, a government could announce at time t an increase in the retirement income schedule $p(t)$ taking place at some future date t^*, or it could change the average length of time a cohort born in year s receives a retirement income, $\kappa(s)$, so long as the commencement date for the additional payments occurred in the future.

A change to a retirement income system is fully funded on a SAYGO-basis if the funds each cohort contributes prior to receiving retirement income benefits are invested and accumulated and the total, including capital earnings, is sufficient to pay the expected value of retirement income benefits. To enable the clearest comparison with a PAYGO-funded expansion, this subsection considers a proposal to increase the average number of years each cohort born after year s^* receives New Zealand Superannuation by one, with the increase taking place at a future time t^*. These cohorts will have paid taxes to provide earlier cohorts with, say, 17 years of retirement income, but they will receive 18 years. If PAYGO-funding is adopted, the taxes are increased when the additional

---

34 In an economy with a stable population composition and no growth, saving rates will reduce in the short term but there will be no change in the saving rate in the long term as the reduced saving of working age people is offset by the reduced dissaving of older people. In an economy with population or economic growth, the dissaving of older people is less than the saving of younger people, so that the introduction of a PAYGO scheme should reduce long run saving rates because of this growth effect.

35 However Englehardt and Gruber (2006) argue that the increase in U.S. social security payments in the 1960s was causally responsible for the decrease in elderly poverty in the US. This suggest that there were not offsetting transfers for the lower half of the income distribution when social security payments were increased.

payments are made. If SAYGO-funding is adopted, the taxes required to fund the additional year of entitlement are increased immediately and that the funds are accumulated in the New Zealand Superannuation Fund and used to provide retirement income at a subsequent date. Thus the SAYGO-funding proposal uses PAYGO funding to provide all cohorts with the equivalent of 17 years retirement income, but additional taxes are levied immediately to provide the additional year. It is further assumed that when taxes are increased the contributions to the New Zealand Superannuation Fund are not offset by changes elsewhere in the Government budget that increase the government deficit and lead to subsequent increases in government debt levels. (This assumption is discussed in more detail below.)

The SAYGO-funded and PAYGO-funded expansions of New Zealand Superannuation can be compared in terms of their intergenerational effects, their effects on tax rates, and their effects on capital accumulation.

First, a SAYGO-funded expansion is, by construction, intergenerationally neutral. Those cohorts obtaining a longer period of retirement income than that provided to others are levied with higher taxes; those who do not obtain the increase are not. In practice, of course, it may be difficult to implement the policy perfectly when it is introduced without age specific tax surcharges, but over time all cohorts would be included in the system, simplifying its implementation.[36]

Secondly, the long term tax rates needed to fund the expansion would be reduced by approximately 50 percent compared to those under a PAYGO system, assuming that the return to capital exceeds the growth rate by 2.0 percent.[37] These lower tax rates are possible because under PAYGO funding taxes would not be collected until the year t^*, whereas under SAYGO funding they are collected immediately and invested. Details of these calculations are presented in Appendix 1.

Thirdly, the increase in the quantity of public owned assets is likely to increase the total quantity of assets owned by New Zealanders. The increase in public held assets will be offset by a reduction in the private asset holdings of households as the latter reduce their private saving in response to the increase in taxes and the promise of higher retirement incomes. Evidence from other countries suggests that crowding out could be considerable but not complete, although international evidence is surprisingly contentious.[38] Studies of countries that have moved from PAYGO-funded systems to mandatory accounts are also far from unanimous, although the evidence suggests private crowding out was far from complete in Switzerland or Chile so that in both cases saving increased (see Bosworth and Burtless (2004), Samwick (2000) or Schmidt-Hebbel (1998)). Thus, even though there is no evidence that a reduction in private saving fully offsets public saving, the total effect of a SAYGO-funded expansion of a retirement income scheme on national saving may be modest. Most studies argue that the extent additional savings are accumulated will depend on the number of households who have little saving, either because they are liquidity constrained or because they are myopic.

While any increase in capital from a SAYGO funded expansion of a Government retirement income system may be modest, because of offsetting reductions in private capital accumulation, total capital accumulation under a SAYGO funded scheme may be

---

36 The Swiss retirement income system has a system of age specific contribution rates. New Zealand experience with student loan levies suggests age specific taxes should be straightforward to implement.

37 In the 9 years to 2012 the NZ Superannuation Fund had average returns of 7.05 percent, compared to average growth in nominal GDP of 4.9 percent. This margin is small by historic standards.

38 For instance, the reviews by Poterba, Venti and Wise (1998) and Engen, Gale, and Scholz (1996) come to quite different conclusions.

considerably larger than under a PAYGO funded scheme as the latter reduces capital accumulation. In the long run, the difference can be substantial. An upper bound can be estimated by calculating the amount that needs to be accumulated in a SAYGO system to meet the retirement income payments of the elderly.[39] When the real return to capital is 3 – 4 percent, a sum 13 – 15 times as large as the average pension must be accumulated by age 65 to provide an individual with 17 years of New Zealand Superannuation; in today's terms, this is approximately $220,000.[40] The total capital held in the economy by people of different ages as they save this sum amounts to approximately 140 - 160 percent of GDP, or approximately $300 billion in current terms. Consequently, if New Zealand Superannuation were to be expanded on a SAYGO basis rather than a PAYGO basis to provide an extra five years of retirement income, it seems not unreasonable to expect long run wealth accumulation to differ by a sum of $80-$100 billion.

The above calculations indicate the amount of capital that would be accumulated if retirement households completely prefunded enough capital to provide themselves with retirement incomes, either voluntarily by themselves or through a public SAYGO-funded scheme. In practice, the amount accumulated in the absence of a PAYGO-funded public scheme would be smaller than this, as households may choose to work more when elderly, or consume less, or rely on family based PAYGO transfers. Nonetheless, as a PAYGO system accumulates zero capital, a country with a government retirement income system funded on a PAYGO basis can expect to accumulate a lot less capital than a country that primarily funds retirement income on a SAYGO basis, either by the government or through private means.[41]

The above discussion assumes that a decision to expand the SAYGO-funding component of New Zealand Superannuation would lead to an increase in contributions to the New Zealand Superannuation Fund that are not offset by an increase in the government deficit because of reductions in taxes or increases in expenditure elsewhere. Is this assumption defensible? Here the evidence is mixed. Several national governments that have accumulated "Provident funds" have run offsetting deficits, so that no net accumulation of assets has occurred.[42] In contrast, state governments in the U.S.A. have typically made contributions to their state employee retirement income funds without any offset in the rest of their budgets, so in these jurisdictions publicly accumulated funds are not offset by greater deficits (Bosworth and Burtless 2004). Bosworth and Burtless argue that these differences reflect the different institutional arrangements facing politicians in state-level governments than national-level governments. State level politicians have much less ability to run offsetting deficits than national-level politicians. Nonetheless, they also argue that since state governments can prefund their state employee pension systems, it should be possible to design institutions that enable national level governments to do the same.[43]

---

39 For an example, see the calculations in Appendix 1.

40 See Appendix 1.

41 Parenthetically, several authors such as Barr (2002) have been interpreted as arguing that there may be little increase in saving if a country switches to a SAYGO based system, as private voluntary saving may fall as public saving increases. This interpretation is not correct. While there may be little *short run* increase in national saving if a government changes from a PAYGO-funded to a SAYGO-funded scheme and if households respond by reducing their saving rather than their consumption, in the long run consumption (or inheritances) will have to fall as households have fewer private assets.

42 It can be noted that after 14 years of government surpluses, the Government elected in 2008 ended contributions to the New Zealand Superannuation Fund and reduced tax rates. In the four years to 2011/2012 deficits of $33 billion were amassed, more than the $22 billion accumulated in the fund since its inception.

43 McCulloch and Frances (2004) discuss governance issues related to the New Zealand superannuation Fund at length. They argue that the New Zealand Superannuation Fund is set up in a manner that overcomes these difficulties.

If governments cannot find institutional arrangements to restrain deficits in the rest of their budgets when they accumulate retirement income funds, there is a significant sense that the expansion in the retirement income is not funded on a SAYGO basis. This is because early generations are getting a transfer, as they are not contributing sufficient taxes to fund the non-retirement income government programmes they use, which will necessitate a subsequent large increase in taxes.

Summary

The above discussion suggests that a SAYGO-funded expansion of New Zealand Superannuation would result in less intergenerational redistribution, lower long-term taxes, and greater capital accumulation than a PAYGO funded expansion of New Zealand Superannuation, although the tax increase would need to be implemented earlier. The lower long term taxes and greater capital accumulation are likely to improve long run economic performance. On balance, therefore, on these criteria a SAYGO-funded expansion of New Zealand Superannuation appears better than a PAYGO-funded expansion. Indeed, there only appear to be three reasons to contemplate a PAYGO-funded expansion. First, the return to capital might be less than the economic growth rate. Past evidence suggests this is unlikely to be true in the long run. Secondly, there may be concern that an expanded New Zealand Superannuation Fund may not be appropriately managed. This is really a question about the governance of the Fund; the above analysis of the relative merits of SAYGO and PAYGO funding structures suggests there are considerable benefits from getting governance right. Thirdly, PAYGO-funding may be favoured as a deliberate attempt to transfer resources from future generations to current generations.

Coleman (2012b) discusses other aspects of the comparison in more detail. The first issue concerns equity. Since, by construction, the two policies have identical retirement income benefits, the only differences concern the different tax paths. A SAYGO-funded scheme requires taxes to be increased sooner, but the final level is much lower. Thus the major equity issue concerns a trade-off between lower taxes on current cohorts and higher taxes on future cohorts. The second issue concerns risk.

2.3 Government pension polices as risk sharing devices

2.3.1 Risk and missing markets

Individuals in an economy face risks. While financial markets can be used to share some of these risks within cohorts, and others can be shared within families, many of the most important risks cannot be shared within a cohort. For example:

i the average life expectancy of a cohort may be different than expected;

ii average working-age incomes may be different than expected because of aggregate productivity outcomes linked to the rate of technological growth;

iii average capital returns may be different than expected; and

iv the government may expropriate the cohort's resources.

One way a cohort could potentially mitigate this risk would be to contract with younger generations to insure it against financial misfortune in retirement. Contracts requiring transfers between generations that provide insurance are innately appealing as they can raise the welfare of all cohorts irrespective of the direction of the transfers. Merton (1983) uses as an example the investment problem facing a cohort saving for retirement. Ideally they would like to invest in local capital assets, foreign capital assets, and an asset correlated with local labour incomes, as they will consume in their retirement a mixture of foreign and local goods and services. Assets providing a return linked to local labour

incomes typically do not exist, however, because of the difficulty of enforcing such contracts.[44] This means the cohort will be less well diversified than is optimal, and will have much greater exposure to the fluctuations in capital markets than it may desire.

Merton (1983) argued that it is inherently difficult to make intergenerational contracts, not just because contracts cannot be signed with cohorts not yet born, but also because contracts that require younger cohorts to make large transfers to older cohorts may be difficult to enforce, particularly if the younger cohorts can migrate. However, Governments can use their coercive powers of taxation and redistribution to alter this situation. They can force successive cohorts to enter "implicit" contracts with previous cohorts to share risk. For example, governments can tax younger workers to provide pensions that are proportional to wage incomes and unrelated to investment outcomes or average life expectancy. These pensions share risk in a manner not otherwise possible, and thus have the potential to raise the welfare of all generations. In the case that a cohort's life expectancy is higher than expected, for example, the financial burden is transferred to younger workers in the form of higher taxes, rather than taken as a reduction in annual retirement incomes.

Merton's insight suggests that PAYGO-funded retirement income schemes have a role even if the average return of these schemes is lower than SAYGO-funded schemes, because they provide insurance against a different set of risks. This contention is widely shared (e.g. Diamond (1996), Diamond (1997); Shiller (2003b); Feldstein (2005)). The relevant question therefore concerns how the optimal size and structure of PAYGO-funded schemes depends on the risk environment and the availability of alternative SAYGO-funded arrangements.

When PAYGO-funded and SAYGO-funded schemes offer identical benefits there are relatively small differences in the way they transfer risk. In contrast, there can be large differences in the way risk is transferred by defined benefit retirement income schemes (schemes whose benefits are defined in terms of set of exogenous criteria such as wage levels) and defined contribution retirement income schemes (schemes whose benefits are linked to investment returns). For this reason, this sub-section compares the way risks are transferred in public PAYGO-funded defined benefit systems and private SAYGO-funded defined contribution systems before comparing the way they are transferred in PAYGO-funded and SAYGO-funded defined benefit schemes.

2.3.2 The fundamental risks

Following Bohn (2005), *Table 2* summarizes the effect of four different types of risks on retirement incomes: demographic risks; productivity risks; investment return risks; and the risk of government expropriation. The first column shows the effect of shocks on a defined contribution SAYGO-funded retirement plan in which benefits are linked to investment returns. This plan could be a mandatory defined contribution SAYGO plan or just voluntary savings. The second column shows the effect of shocks on a PAYGO–funded defined benefit retirement income linked to average contemporaneous wages.

---

[44] Individual contracts providing a young person a sum of money in exchange for a fraction of their future income do not exist because of potential monitoring difficulties, as well as a reluctance to impose penalties to ensure people do not alter their labour supply. In New Zealand young people can get a state-contingent student loan which reduces their repayments in the event of low income, but there are no contracts (other than marriage contracts) which provide the counterparty with higher outcomes in the event that a young person does better than expected in later life.

***Table 2*:** Effect of different macroeconomic risks on pension schemes

Risk	Effect on SAYGO pension	Effect on PAYGO pension
Higher than expected longevity	Cohort may run out of capital resources if it has high longevity and annuities are not available.	Higher pension contributions if preceding generation has high longevity. Length of pension payments automatically extended if contemporaneous cohort lives longer than expected.
Large contemporaneous cohort causes low wages when working age	Low wages reduce retirement saving when working age. Low retirement incomes due to low saving. If the large cohort increases the capital stock and reduces investment returns, low pension in old age.	Low wages offset by small per capita pension contributions when working (due to large cohort). Normal retirement incomes as pension linked to contemporaneous wages.
Low capital investment returns, but normal wage growth	Low retirement incomes due to low capital returns.	Normal retirement incomes as pension linked to contemporaneous wages.
Normal capital investment returns, but low wage growth	Low wages reduce retirement saving when working age. Low retirement incomes due to low saving.	Low wages offset by reduced contributions when working age. Low retirement incomes as pension linked to contemporaneous wages.
Low productivity growth reduces capital returns and wage incomes	Low wages reduce retirement saving when working age. Low retirement incomes due to low capital returns and low savings.	Low wages offset by reduced contributions when working age. Low retirement incomes as pension linked to contemporaneous wages.
Government expropriation	Low retirement benefits because the Government imposes high taxes or means tests on private funds.	Low retirement benefits because the Government imposes high taxes or means tests on private funds.

Much of the traditional literature has focused on the effect of investment risk on retirement incomes, for the volatility of investment returns makes many people wary of being too reliant on capital incomes during their retirement. This literature has typically examined the relative riskiness of retirement incomes linked to capital market returns and labour market returns. More recently, however, the emphasis has changed to the fundamental demographic and economic risks facing households over their whole lives, of which investment risk is a smaller component. The largest macroeconomic risk facing an economy is long-term productivity risk. If a country experiences poor productivity, both labour incomes and local capital incomes will be poor, and lifetime incomes will be low. This will generate low retirement incomes in both SAYGO- and PAYGO- funded retirement income schemes, either because of poor investment returns or because pensions amounts are linked to low wages.

Bohn (2005 p13) argues that since wage levels and capital incomes are similarly exposed to productivity risk, but people work for much longer than they are retired, "*working age individuals are more exposed to productivity risk than retirees.*" If only retirement income is considered, optimal risk sharing would suggest PAYGO-funded retirement income schemes should be used to reduce capital income risk. If income over the whole of life is

considered, optimal risk sharing suggests retirees should have more capital income risk, particularly diversified foreign capital income risk, to reduce their exposure to local productivity shocks (Acemoglu and Zilibotti 1997). For this reason, conclusions about the risk implications of different retirement income schemes depend on whether a narrow retirement income perspective or a broader whole of life perspective is considered.

2.3.3 Demographic risks

Government PAYGO–funded retirement income schemes that link retirement incomes to average contemporaneous wage levels are ideal for enabling cohorts to diversify aggregate demographic risks. Two of the largest demographic risks are the possibility that average life expectancy is larger than expected, and the possibility that the birth size of a generation is larger than or smaller than normal.

The first demographic risk concerns longevity. To "protect" against living too long – that is, for living longer than one has financial resources – an individual can purchase an annuity, if they are available. While private annuity markets are thin, they exist in many countries and in principle can be used to hedge the risk an entire cohort lives longer than expected. This risk is borne by the members of the subsequent generations that sell annuities. The public policy difficulty is that annuities may not always be available. To the extent they are available, they are typically sold many years in advance as part of a retirement saving scheme. Consequently, individuals or a cohort, wishing to purchase additional amounts of annuity income, may be unable to do so, at least at actuarially fair prices.[45]

Since the income from PAYGO-funded pension schemes is in the form of annuitized payments, these schemes are an obvious way to solve the longevity risk facing a cohort. If the cohort lives longer than expected, additional retirement income payments are made and subsequent cohorts are required to pay extra taxes. Longevity risk is thus shared across generations. Private SAYGO-funded retirement income schemes without annuities do not have this feature; rather, the cohort would have to change retirement incomes as information about longevity is revealed.

The ability to manage longevity risk is one of the biggest advantages of a PAYGO-funded retirement income scheme. Curiously, however, while these insurance benefits depend on the size of the payment $p(t)$, they do not depend on the average number of years a cohort expects to receive the payment ($\kappa(s)$). The longevity insurance obtained from an annuitized PAYGO pension scheme that provides an average of twenty years of retirement income beginning at age 65 is almost the same as one that provides an average of ten years of retirement income beginning at year 75. In both cases, a two-year increase in life expectancy results in a two-year increase in payments. The difference concerns the way in which income is provided from ages 65 to 75. An individual or cohort with a pension scheme with an age of entitlement of 75 could accumulate assets equal to ten years' payments and use a fixed term pension to fund the period between 65 and 75 and achieve a very similar risk profile to someone with a PAYGO-funded pension scheme with an age of entitlement of 65.

These considerations mean that even if a government wants to operate a retirement income policy for risk reasons, it has some scope over the degree to which it is funded on a SAYGO rather than a PAYGO basis. The additional annuity insurance provided by expanding the number of years of New Zealand Superannuation on a PAYGO basis is

---

45 See Benartzi, Previtero, and Thaler (2011) for a discussion. They argue that the availability of private annuities is an issue, but when provided by private retirement savings funds they are not badly priced.

essentially identical to that provided by expanding it on a SAYGO basis: zero. Moreover, the additional annuity insurance provided by increasing the size of New Zealand Superannuation payments is also the same on a PAYGO and SAYGO basis, although this benefit is positive as the private sector does not provide good substitutes for public sector annuities.

The second demographic risk concerns cohort size. A large generation may have different outcomes than one that is normal size. It may suffer from having fewer investments in education, or from lower per capita capital stocks. The abundance of labour and low capital/labour ratios may reduce wages (Welch 1979). Competition for scarce resources may cause it to pay high prices for land (Mankiw and Weil 1989). Finally, it may find it pays a premium for savings products when it is accumulating capital during its working age years, but sell capital for low prices when it is decumulating during retirement (Poterba 2001, Abel 2003). Conversely, a smaller than normal generation may benefit from high wages, low land prices, and high investment returns.

A cohort will find it difficult to diversify this risk by itself. Once the generation is born, and the size of the cohort is known, existing cohorts will be unwilling to insure it against the risk of being born "large," and subsequent cohorts cannot be contracted. Its main option is to adjust the size of the bequest it leaves to subsequent cohorts, reducing it if the generation is large.

In contrast, a government PAYGO-funded pension scheme linked to wages diversifies this risk. First, the per capita size of the contribution made to older cohorts is smaller for the members of a large cohort, both because there are many people to pay it and because any decline in its own wages is passed through as reduced pensions. Secondly, the per capita pension the cohort receives is a function of the wages of the succeeding generations, and unrelated to either its working age contributions or its investment returns. It is thus nearly a perfect hedge.

The main difficulties that arise from using a PAYGO-funded pension scheme to hedge cohort size are political. Suppose there is a large generation approaching retirement age. This will require young cohorts to make unusually large retirement income transfers to the older cohorts. For a generation to willingly provide a large cohort of its elders with additional resources, it will have to be convinced that the transfers really are a part of a "fair" retirement income insurance scheme, rather than an attempt by an older generation to rort them for resources. A young generation may be difficult to convince if the older generation undertakes activities to expand its entitlements or otherwise impose large intergenerational obligations on a younger generation. Moreover, members of a young generation can always move if the obligations to an older generation become onerous; this is a particularly attractive option if migration to a country with a SAYGO-funded retirement income system is easy, reducing the ability of a large older generation to use a PAYGO-funded pension scheme to smooth cohort size risk.[46]

[46] While there is an enormous literature examining the amount of local migration that takes place in response to the relative attractiveness of different combinations of local taxes and local amenities, there is very little literature about the extent differences in international tax rates or benefit systems influence migration flows. If relative taxes are important, the choice of PAYGO funding and SAYGO funding will alter relative international tax rates differently at different times. Compared to a SAYGO system, a PAYGO system will mean relatively low taxes for a short period of time, followed by relatively high taxes. Thus a SAYGO funding system may encourage outward migration for a short period of time, when tax rates are first raised, but discourage it in the long run.

2.3.4 Macroeconomic risks

SAYGO-funded retirement income schemes expose retirement incomes to three main macroeconomic risks: the possibility of a long period of low investment returns that reduces the sum investors accumulate up to the point of retirement; the possibility of low real interest rates at the time of retirement, which affects the size of the annual annuity purchased with a particular capital sum; and the possibility of high inflation during retirement. Defined benefit PAYGO schemes reduce these risks by providing retirement incomes that are independent of investment returns. While defined contribution SAYGO schemes offer high average returns in a dynamically efficient economy, the additional investment risk they entail reduces their attractiveness.

Three factors offset these concerns.

(a) Households should be concerned with capital income and labour income risk over the whole of their lives, not just their capital income risk in retirement.

(b) Although SAYGO-funded retirement incomes schemes increase exposure to capital income risk, they reduce it to labour income risk. Countries like New Zealand that have experienced long periods of low real wage growth suggest this risk can be considerable.

(c) The short term volatility of investment markets tends to exaggerate long-term risk, as much of this volatility reflects short-to-medium term fluctuations in asset prices caused by changing discount rates rather than the underlying earnings of the assets. Even though shocks to the underlying earnings of assets tend to be permanent, the fluctuations in asset prices caused by changing discount rates tend to be mean-reverting (Campbell and Shiller 1989; Campbell and Vuolteenaho, 2004; Cochrane 2008). Consequently the investment risks associated with SAYGO-funded retirement income schemes are much lower over the long horizons associated with retirement saving than is apparent from the short-term performance of investment markets.[47]

A key issue is the permanence of different types of shocks to an economy. The biggest risks to a cohort are the permanent income risks stemming from productivity and especially productivity *growth rate* shocks. These affect working-age earnings and retirement incomes, and it is likely that working age cohorts have excessive exposure to productivity risk and would benefit by shifting some of this risk to retirees and foreign investors by increasing the latter groups' exposure to capital income earning assets. Permanent productivity shocks are particularly bad for young cohorts as they lead to permanent loss of lifetime income that cannot be smoothed through temporary adjustments to consumption and saving.

Individuals can reduce their lifetime exposure to domestic productivity and labour market risk by increasing their holdings of capital market assets, particularly foreign assets (Acemoglu and Zilibotti 1997). If they do so, however, they increase their exposure to asset price risk, particularly during their retirement period. The extent that individuals undertake this diversification will depend on their attitude to the reward/risk ratio, and particularly their attitude towards asset price risk when they are old. Since old individuals have difficulty diversifying this risk, they hold relatively few assets and thus have a large exposure to labour market shocks.

---

[47] Several U.S.studies, of the riskiness of investment based retirement income schemes, suggest that there would be a very low probability that individuals using mandatory individual account schemes would retire with fewer resources than they would retire under U.S. Social security. See Feldstein, Ranguelova and Samwick (2001), Liebman (2002) and Feldstein and Liebman (2002a).

When asset price risk has temporary and permanent components, government intervention can potentially increase household welfare by increasing a household's exposure to high yielding asset markets while simultaneously reducing its risk.[48] For example, a government with a public SAYGO-funded retirement income scheme could use its balance sheet to absorb temporary asset price shocks without changing retirement incomes, or use its taxation powers to shift asset price shocks from one cohort to other generations. Such welfare improving interventions are possible because a long-lived government can operate with a different investment horizon than a short lived individual. Temporary asset price fluctuations that can cause acute problems to retirees who have limited life expectancy are not particularly problematic to long lived governments as these fluctuations can be shared across cohorts.

A SAYGO-funded government defined benefit retirement income scheme is only one way a government could use its long horizon and balance sheet to absorb temporary asset price fluctuations to make it easier for retired cohorts to increase their exposure to capital income earning assets. A government could be more creative with the different forms of financial contracts it issues to diversify intergenerational risks (Shiller 2003a) or it could offer minimum return guarantees to mandatory private saving accounts, using its ability to tax working age cohorts to fund the guarantees.[49]

Governments already use their balance sheets to share risks across generations. Governments use debt financing to smooth the cost of temporary economic shocks, perhaps to pay additional unemployment insurance payments during a recession. They use a mixture of prefunding and debt finance to spread the financial cost of natural disasters or wars across multiple cohorts or generations. Using a SAYGO-funded retirement income scheme, to reduce asset-pricing risk by sharing it across cohorts, fits within this framework. In doing so, it can alter the risk-return profile to provide households with greater exposure to high yielding assets without a commensurate increase in individual risk.

2.3.5 Risk consideration surrounding the New Zealand Superannuation Fund

Since by assumption the difference between PAYGO- and SAYGO- funded New Zealand Superannuation only concerns the funding, not the payment streams, there are relatively small differences in the way they transfer risk between cohorts. In particular, if New Zealand Superannuation were expanded on a SAYGO-funded basis through the New Zealand Superannuation Fund, unexpected shocks would not lead to changes in retirement incomes, but to changes in tax contribution rates.

There are two main risks. The first risk is that a period of relatively high or relatively low capital market returns that mean the balance sheet of the New Zealand Superannuation Fund is different than expected. If the changes are temporary, the balance sheet will be restored to expected levels over time and changes to tax rates will be unnecessary. If the changes were permanent, taxes would need to be altered, up or down, to ensure the balance sheet was gradually restored to target levels. While this risk is undeniably real,

---

48 In a similar fashion, 100 households may each lend nothing if they can only lend a large amount to a single borrower, because of the risk of default. However, if risks can be pooled so that each lender makes a small loan to each of a hundred borrowers, they may be happy lend a large amount in total. In this case a pooling mechanism will lead to an increase in the total number of loans and an increase in the aggregate risk, as nothing was lent previously; but welfare will be increased so long as the expected return from the loans compensates for the increase in risk.

49 For example, it could fund infrastructure projects using debt linked to average wage levels, selling the bonds to pension funds. This reduces the risk of low wages facing young cohorts, matches the tax and debt payment flows facing the government, and provides private SAYGO-funded pension funds with the ability to diversify their investment risks.

the most appropriate way to consider it is to calculate the probability that long run tax rates under a SAYGO-funded public system would be higher than long run tax rates under a PAYGO-funded public system. Given historic patterns of returns, this risk is very small.[50]

The second risk is political. As previously discussed, a future government could use the funds in the New Zealand Superannuation Fund for purposes other than the provision of retirement incomes, or they could borrow to finance other spending. While this risk can be potentially managed by suitable institutional safeguards, including appropriate accounting and reporting standards, international evidence suggests the assets held by the retirement income funds in many countries were offset by large government debts. In response to this type of institutional failure, some authors have argued a society desiring a SAYGO-funded retirement income scheme would be better served by adopting a system of mandatory individual accounts. Whether or not a mandatory account system would constrain governments from expropriating the retirement savings of older people is quite unclear, however. For example, a government could reduce superannuation payments to wealthier old people, impose tax surcharges upon them, or expropriate their resources through inflation. To date, there is little empirical evidence on whether a government is more likely to maintain fiscal discipline if there is a public managed SAYGO-funded retirement income system, or if there is a privately managed system retirement income system.

3 Discussion and conclusions

There seems little reason to doubt that age-specific death rates will continue to decrease and, consequently, that longevity will increase. An increase in longevity will automatically increase the size of New Zealand Superannuation unless changes are made to the age of entitlement or the average size of payments. If New Zealanders want to keep the existing payment structure of New Zealand Superannuation and maintain the age of entitlement at 65, there will be a steady and ultimately large increase in tax rates if the payments are primarily funded on a PAYGO basis. Expanding the programme on this basis will result in a transfer to current recipients, who can expect to have many more years of pension than they provided to their forbears. Conversely, the increase in taxes will impose additional opportunity cost on future generations, for an increasing large fraction of their income will be unavailable to save and invest to provide for their own retirements. For this reason, the default option of maintaining the age of eligibility and funding the scheme on a PAYGO basis is not intergenerationally neutral. Rather, it involves a transfer to current cohorts, and away from future cohorts.

There are various alternative responses to the increase in longevity that do not require such large intergenerational transfers. The size of the programme could be cut in the future, either by increasing the age of eligibility or by decreasing the average size of payments. However, other options exist. If New Zealanders wish to keep the current age of eligibility and benefit structure, they could fund the additional New Zealand Superannuation payments on a SAYGO basis. Funding the expansion of New Zealand Superannuation on a SAYGO basis is straightforward. All it requires is an increase in

[50] If government interest rates on debt exceed the rate of economic growth, which they have in New Zealand for much of the last two decades, the advantages of a SAYGO-funded system could be obtained with extremely little risk by having the New Zealand Superannuation Fund accumulate government debt liabilities. Similarly, when debt rates are higher than the economic growth rate, increasing taxes to retire debt is a form of SAYGO-funded retirement income scheme as it reduces claims on future output. Such a solution is not necessarily optimal when the average return to capital significantly exceeds government debt rates, however, as there may be additional benefits from investing in higher yielding assets, or investing in offshore assets.

taxes in advance of the larger Superannuation payments, with the funds accumulated in the New Zealand Superannuation Fund until the additional pension payments are made.

The difference between a PAYGO-funded and a SAYGO-funded expansion of New Zealand Superannuation all concern the size and timing of the tax payments used to fund the expansion, and the different risk profile facing the economy associated with the accumulation of assets in the New Zealand Superannuation Fund. When the economy is dynamically efficient, these differences have four main implications.

First, a SAYGO funded expansion of New Zealand Superannuation would require an earlier increase in tax rates, but long run taxes are likely to increase by significantly less – perhaps half as much - as they would if New Zealand Superannuation were expanded on a PAYGO-basis.

Secondly, a SAYGO funded expansion of New Zealand Superannuation is intergenerationally neutral, as each cohort pays for its additional entitlement. A PAYGO-funded expansion provides a transfer to the first generation of recipients at the expense of a large opportunity cost on future generations. Not only would many consider this unfair, but it raises the risk that future generations will suddenly reduce entitlements to New Zealand Superannuation, or that significant outward migration will occur.

Thirdly, a SAYGO-funded expansion of New Zealand Superannuation is likely to increase rather than decrease national wealth.

Fourthly, a SAYGO-funded expansion of New Zealand Superannuation will increase household exposure to capital income shocks. This may help diversify households' risk of low lifetime incomes that stems from a very high dependence on domestic productivity performance. However, it also raises governance risks for the New Zealand Superannuation Fund.

If the choice were only between SAYGO-and PAYGO-funded expansions of New Zealand Superannuation, a SAYGO-funded expansion of New Zealand Superannuation appears much better as it is likely to enhance economic performance and reduce intergenerational transfers. Indeed, there are really only three reasons to contemplate a PAYGO-funded expansion. First, the economy may not be dynamically efficient in the future, or investment returns may be lower than the growth rate of the economy for a long period of time. Past evidence suggests the economy will remain dynamically efficient, particularly as future population growth can be expected to be low. While this means returns to capital can be expected to be greater than the growth rate of the economy in the long run, it is possible that medium term investment returns could be poor. Nonetheless, while subsequent investment returns have been low when asset prices have been high in the past, it is extremely rare for low returns to persist over periods typically associated with a retirement planning horizon. Moreover, if the economy is dynamically efficient, long-term investment gains can be reaped for the benefit of future generations even if medium term investment returns are poor, by absorbing investment fluctuations through the balance sheet of the fund.

Secondly, there may be concern that an expanded New Zealand Superannuation Fund may not be appropriately managed, or that a future government may offset the assets in the Fund with higher debt. The governance of the structure suggests the first concern is misplaced. International evidence suggests the second concern is real. While raising taxes in advance of predictable expenditure increases may be intergenerationally neutral in some circumstances, it is in the interests of many individuals to delay such tax increases, even if this means higher taxes for subsequent generations. In these circumstances considerable discipline will be needed to ensure balances built up in a fund are not offset with high debt levels elsewhere in the government's balance sheet.

Thirdly, PAYGO-funding may be favoured as a deliberate attempt to transfer resources from future generations to current generations. This may have been justified in the past when people were much poorer than they are now and societies typically transferred resources to younger generations; but it seems hard to justify in 2013 when the incomes are high and at the margin intergenerational transfers appear to be from the future to the present.

The choice is not only between SAYGO-and PAYGO-funded expansions of New Zealand Superannuation, however. The government could simply raise the age of entitlement in line with increases in longevity to prevent significant increases in taxes, or reduce future entitlement amounts. Both options are broadly intergenerationally neutral. Those wanting to retire at age 65 could still do so, but only if they wished to save additional amounts to make up for the lower government support at age 65. In short such changes require cohorts to increase their own voluntary saving rather than to pay higher taxes that are held in a centralised government fund. Various other SAYGO-funded options that use increases in private saving rather than public saving are possible, such as a system of mandatory supplementary retirement income accounts. There are many advantages and disadvantages of these schemes, discussed elsewhere. In all cases they tend to lower long run tax rates for any level of retirement income, enhance capital accumulation, and alter the distribution of risk.

If society were to adopt an intergenerationally neutral response to population ageing, are there are criteria to decide between, say, an increase in the age of eligibility or an immediate increase in taxation to fund the additional New Zealand Superannuation payments on a SAYGO basis? Various academics have developed frameworks isolating the advantages and disadvantages of the different approaches. For example, Cutler, Liebman, and Smyth (2007) present a model where the optimal age of eligibility represents a trade-off between the disadvantages of compulsion or higher taxes, and the problems of ill health and myopia. A lower age of eligibility is advantageous to those who have difficulty saving or investing, or when a large fraction of the population is likely to have poor late-life earnings opportunities, most commonly due to ill health. While an increase in the health status of the population, which may occur when age specific death rates decline, increases the optimal age of eligibility in this model, raising the age of eligibility imposes costs on those who have difficulty saving, or those who fall ill before the age of eligibility is increased. Consequently, a SAYGO-funded expansion in New Zealand Superannuation can be considered an intergenerationally neutral response to longevity that enables the structure of retirement benefits to be maintained without requiring large long term increases in tax rates, changes in the age of eligibility or cuts to average payment levels.

Perhaps the most intriguing issue concerns risk. The differences in the volatility of capital earnings and asset market returns pose a quandary for individual investors and governments. The high volatility of asset prices makes saving via the accumulation of financial assets less attractive than otherwise. Yet the high returns to capital available in a dynamically efficient economy makes capital accumulation a more attractive long-term retirement saving option than a PAYGO-funded transfer scheme that accumulates no capital. The puzzle is to find a way where the government can use its balance sheet and long horizon to reduce individual exposure to the mean-reverting component of asset price fluctuations while at the same time ensuring the economy utilizes individual saving behaviour to accumulate high returning real assets (Bohn 2005). In principle, there are several ways a government could use it s balance sheet in this manner. In the New Zealand context, the easiest way would be to fund any expansion of New Zealand Superannuation on a SAYGO-basis, using the New Zealand Superannuation Fund to invest additional funds. In this case almost all investment is risk is borne on the balance

sheet of the Government and ultimately shared across generations. Since the government has a much longer life than an individual, these risks can be borne collectively and shared in a manner not easily replicated by an individual. If done well, this suggests prefunding a fraction of future retirement income obligations has the potential to generate significant welfare gains for future generations.

References

Abel, Andrew B (2003) "The Effects of a Baby Boom on Stock Prices and Capital Accumulation in the Presence of Social Security," *Econometrica* 71(2) 551-578

Abel, Andrew B., N. Gregory Mankiw, Lawrence H. Summers and Richard J. Zeckhauser (1989) Assessing Dynamic Efficiency: Theory and Evidence," *Review of Economic Studies* 56(1) 1-19

Acemoglu, Daron and Fabrizio Zilibotti (1997) "Was Prometheus Unbound by Chance? Risk, Diversification, and Growth," *Journal of Political Economy* 105(4) 709-751

Arenas de Mesa, Alberto and Carmelo Mesa-Lago (2006) "The structural pension reform in Chile: effects, comparisons with other Latin American reform, and lessons," Oxford Review of Economic Policy 22(1) 149-167

Arnott, Robert D. and Peter L. Bernstein (2002) "What risk premium is normal?" *Financial Analysts Journal* 58(2) 66- 85

Arrow, K.J., W.R. Cline, K.-G. Maler, M. Munasinghe, R. Squitieri, and J.E. Stiglitz (1995) "Intertemporal Equity, Discounting, and Economic Efficiency," pp126 – 144 in Bruce, James P., Lee Hoesung, and Erik F. Haites (ed) *Climate Change 1995: Economic and Social Dimensions of Climate Change* (Cambridge: Cambridge University Press)

Auerbach, Alan and Laurence Kotlikoff (1987) *Dynamic Fiscal Policy* (Cambridge: Cambridge University Press)

Barr, Nicholas, and Peter Diamond (2006) "The economics of pensions," *Oxford Review of Economic Policy* 22(1) 15 – 39

Benartzi, Shlomo, Allesandro Previtero and Richard H. Thaler (2011) "Annuitization Puzzles" *Journal of Economic Perspectives* 25(4) 143-164.

Bohn, Henning (2005) "Who Bears What Risk? An Intergenerational Perspective" Paper prepared for presentation at the 2005 Pension Research Council Symposium April 25-26, 2005 The Evolution of Risk and Reward Sharing in Retirement

Bosworth, Barry, and Gary Burtless (2004) "Pension Reform and Saving," *National Tax Journal* 57 703-728

Campbell, John Y. and Robert J. Shiller (1989) "The dividend-price ratio and expectations of future dividends and discount factors," *Review of Financial Studies* 1(3) 195-228

Campbell, John Y. and Tuomo Vuolteenaho (2004) "Bad Beta, Good beta," *American Economic Review* 94(5) 1249-1275

Chichilnisky, Graciela (1996) "An axiomatic approach to sustainable development," *Social Choice and Welfare* 13 231-257

Christensen, Kaare, Gabriele Doblhammer, Roland Rau, and James W. Vaupel (2009) "Ageing Populations: the challenges ahead," *Lancet 34*(9696) 1196- 1208.

Cochrane, John H (2008) "Financial markets and the real economy," pp 237-325 in Rajnish Mehra, ed. *Handbook of the Equity Risk Premium* (Amsterdam: Elsevier).

Coleman, A M.G. (2012a) "Pension payments and receipts by New Zealand birth cohorts, 1916-1986," Motu Economic and Public Policy Research Working Paper 12-11.

Coleman, A M.G. (2012b) "Intergenerational transfers and public policy," Mimeo, New Zealand Treasury.

Cutler, David, Jeffrey B. Liebman and Seamus Smyth (2007) “How fast should the social security eligibility age rise?” *NBER Retirement Research Center Working Paper NB 04-05*

de La Croix, David and Phillipe Michel (2002) *A Theory of Economic Growth: Dynamics and Policy in Overlapping Generations* (Cambridge: Cambridge University Press)

Diamond, Peter (1965) “National Debt in a Neoclassical Growth Model,” *American Economic Review*, 55 (5) 1126-1150

Diamond, Peter A. (1996) “Proposals to restructure social security,” *Journal of Economic Perspectives* 10(3) 67-88

Diamond, Peter (1997) “Macroeconomic Aspects of Social Security Reform,” *Brookings Papers on Economic Activity 2*, 1–87.

Diamond, Peter (2011) “Economic Theory and Tax on Pension Policies,” *The Economic Record* 87 (Special Issue) 2-22.

Dimson, Elroy, Paul Marsh, Mike Staunton (2003) “Global evidence on the equity premium,” *Journal of Applied Corporate Finance* 15(4) 27-38

Dimson, Elroy, Paul Marsh, Mike Staunton and Andrew Garthwaite (2013) *Credit Suisse Global Investment Returns 2013* (Zurich: Credit Suisse)

Dynan, Karen E., Jonathon Skinner, and Stephen P. Zeldes (2004) “Do the rich save more?” Journal of Political Economy 112 (2) 397-444.

Engelhardt, Gary V. and Jonathon Gruber (2006) “Social security and evolution of elderly poverty,” in

Auerbach, Alan, David Card and John Quigley (ed) *Public Policy and Income Distribution* (New York: Russell Sage Foundation)

Engen, Eric M. William Gale, and John Karl Scholtz (1996) “The illusory effects of saving incentives on saving,” Journal of Economic Perspectives, 10(4) 113-138

Feldstein, Martin (1974) “Social Security, induced retirement, and aggregate capital accumulation,” Journal of Political Economy 82: 905- 926.

Feldstein, Martin (2005) “Rethinking Social Security,” *American Economic Review* 95(1) 1 – 24

Feldstein, Martin and Jeffrey B. Liebman (2002a) “Social Security”, pp 2245-2345 in

Alan J. Auerbach and Martin Feldstein (ed.) *Handbook of Public Economics Volume 4*, (Chicago: University of Chicago Press)

Feldstein, Martin and Jeffrey B. Liebman (2002b) “The Distributional effects of an investment based Social Security system”, pp 263-326 in

Feldstein, M., and Jeffrey B. Liebman, ed, (2002) *The Distributional aspects of Social Security and Social Security Reform* (Chicago: University of Chicago Press)

Feldstein, Martin, Elena Ranguelova, and Andrew Samwick (2001) “The Transition to Investment-Based Social Security When Portfolio Returns and Capital Profitability Are Uncertain,” pp 41-90 in John Y. Campbell and Martin Feldstein (ed.) *Risk Aspects of Investment-based Social Security Reform*, (Chicago: University of Chicago Press, 2001)

Gilchrist, Simon and John C. Williams (2000) “Putty-clay and investment: a business cycle analysis,” *Journal of Political Economy* 108(5) 928-960

Gilchrist, Simon and John C. Williams (2004) “Transition dynamics in vintage capital models: explaining the postwar catch-up of Germany and Japan,” NBER Working Paper 10732

Gokhale, Jagadeesh, Laurence J. Kotlikoff, and John Sabelhaus (1996) “Understanding the Postwar Decline in U.S. Saving: A Cohort Analysis” *NBER Working Paper 5571*

Goetzmann, William N. and Roger G. Ibbotson (2008) “History and Equity Risk Premium” pp 515-529 in Rajnish Mehra, ed. *Handbook of the Equity Risk Premium* (Amsterdam: Elsevier).

Gordon, Robert J (1990) *The measurement of durable goods prices.* (Chicago: University Chicago Press)

Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell (1997) “Long-run implications of investment specific technological change,” *American Economic Review* 87(3) 342-362

Harberger, Arnold C. (1998) “A vision of the growth process,” *American Economic Review* 88(1) 1-32

Holzmann, Robert and Joseph E. Stiglitz, ed, (2001) *New Ideas About Old Age Security: Toward Sustainable Pension Systems in the 21st Century* (Washington D.C.: The World Bank)

Holzmann, Robert and Richard Hinz (ed) (2005) *Old-Age Income Support in the Twenty-first Century: An International Perspective on Pension Systems and Reform* (Washington D.C.: The World Bank)

Lee, Ronald (2007) “Demographic change, welfare, and intergenerational transfers: a global overview,” pp17-43 in

Véron, Jacques; Sophie Pennee, and Jacques Légaré (2007) *Ages, generations, and the social contract* (Springer)

Lees, Kirdan (2013) “Should I pay or should I go,” mimeo, New Zealand Institute of Economic Research.

Liebman, Jeffrey B. (2002) “Redistribution in the current U.S. Social Security System,” pp 11-48 in Feldstein, M., and Jeffrey B. Liebman, ed, (2002) *The Distributional aspects of Social Security and Social Security Reform* (Chicago: University of Chicago Press)

Lindbeck, Assar and Mats Persson. 2003. “The Gains from Pension Reform,” *Journal of Economic Literature*, 41:1, pp. 74–112.

Littlewood, Michael. 2010. “Prefunding a Government’s Financial Obligations: The New Zealand Superannuation Case Study,” *New Zealand Economic Papers* 44(1), 99–111.

McHale, John (2001) “ The risk of Social Security Benefit Rule changes: some international evidence,” pp 247-290 in John Y. Campbell and Martin Feldstein (ed.) *Risk Aspects of Investment-based Social Security Reform*, (Chicago: University of Chicago Press, 2001)

McCulloch, Brian, and Jane Frances (2004) “ Governance of Public Pension Funds: New Zealand Superannuation Fund,” in A. R. Musalem and R.J. Palacios (eds) Public pension Fund management: Governance, Accountability and Investment Policies (Washington: World Bank, 2004)

Mankiw, N. Gregory and David Weil (1989) “The baby boom, the baby bust, and the housing market,” *Regional Science and Urban Economics* 19 235-258.

Mason, Andrew, Ronald Lee, An-Chi Tung, Mun-Sim Lai, and Tim Miller (2009) "Population aging and intergenerational transfers: introducing age into national accounts," pp 89-122 in David A Wise ed (2009) *Developments in the economics of aging* (Chicago: University of Chicago Press)

Merton, Robert C. (1983) On the role of social security as a means for efficient risk sharing in an economy where human capital is not tradable," pp 325-358 in

Bodie, Zvi and John B. Shoven, eds, (1983) *Financial aspects of the United States Pension System* (Chicago: University of Chicago Press)

New Zealand Treasury. 2013. Affording our Future: Statement of New Zealand's Long-term Fiscal Position. (Wellington: New Zealand Treasury).

http://www.treasury.govt.nz/government/longterm/fiscalmodel

Phelps, Edmund (1961) "The golden rule of accumulation: a fable for growthmen," *American Economic Review* 51(4) 638 – 643

Phelps, Edmund (1965) "Second essay on the golden rule of accumulation," *American Economic Review* 55(4) 793-814

Poterba, James M. (2001) "Demographic Structure and Asset Returns," *The Review of Economics and Statistics* 83(4) 565-584

Poterba, James, Steven Venti and David Wise (1998) "Personal retirement saving and asset accumulation: reconciling the evidence," pp 23-124 in

David Wise (ed) Frontiers in the Economics of Aging (Chicago: University of Chicago Press)

Poterba, James, Steven Venti and David Wise (2011) "The composition and drawdown of wealth in retirement," Journal of Economic Perspectives 25(4) 95-118

Rangel, Antonio (2003) "Forward and Backward Intergenerational Goods: why is Social Security good for the Environment," American Economic Review 93(3) 813-834

Ramsey, F.P. (1928) "A mathematical theory of saving," *The Economic Journal* 38 (152) 543-559

Samuelson, P.A. (1958) "An exact consumption-load model of interest with or without the social contrivance of money," *Journal of Political Economy* 66 467-482

Samwick, Andrew A. (2000) "Is pension reform conducive to higher saving?" *Review of Economics and Statistics* 82(2) 264-272

Schmidt-Hebbel, Klaus (1998) "Does pension reform really spur productivity, saving, and growth?" *Banco Central de Chile* Working Paper 33

Seigel, Jeremy J. (1999) "The shrinking equity premium: historical facts and future forecasts," *The Journal of Portfolio Management Fall* 1999 10 -17

Shiller, R.J. (1981) "Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review* 71 (3) 421-436

Shiller, Robert (2003a). "Social Security and individual accounts as elements of overall risk sharing," *American Economic Review* 97(2) 343-347

Shiller, Robert (2003b). *The New Financial Order: Risk in the 21st Century* (Princeton, N.J.: Princeton University Press).

Shoven, John B. and Sita N Slavov (2006) "Political risk versus market risk in Social Security," NBER Working Paper 12135

Sinn, Hans Werner (2000) "Why a funded pension is needed and why it is not needed" *International Tax and Public Finance* 7 (4-5) 389-410

Sonnega, Amanda (2006) “The future of human life expectancy: have we reached the ceiling or is the sky the limit.” *Research Highlights in the Demography and Economics of Aging* 8 (March 2006).

Welch, Finis (1979) “Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust,” *Journal of Political Economy* 87(5, Part 2) S65-S97

Wilmoth, J.R. (2000) “Demography of longevity: past, present and future trends,” *Experimental Gerontology* 35 1111-1129

Appendix 1: Pension schemes – a mathematical overview

A The opportunity cost of a pension scheme

When a PAYGO-funded expenditure scheme transfers resources between generations, the value of the transfer to or from the first generation (those paying without having received services, or those receiving without having to pay earlier cohorts) is exactly equal to the discounted sum of the opportunity costs or benefits on all subsequent generations, when the discount rate is the return to capital. The result is elegantly presented in Sinn (2000) in the context of an overlapping generations model in which there are two generations, each of which lives two periods.

Suppose a cohort with N_t people makes a transfer a_t to the older generation and is promised a pension z_{t+1} in the subsequent period. Let S_t be the amount of saving at time t needed to create a pension size z_{t+1} at $t+1$and let $(1+ r_{t+1})$ be the return to capital from period t to $t+1$. It follows:

$$S_t = \frac{z_{t+1}}{1+r_{t+1}} \qquad \text{A1}$$

Let $(1+i_{t+1})$ be the internal rate of return of the pension scheme, which is equal to the ratio of the total payments received by a generation in $t+1$ compared to the payments it made at time t. If n_t = growth rate of population = $N_{t+1}/N_t - 1$

$$1+i_{t+1} = \frac{a_{t+1}N_{t+1}}{a_t N_t} \qquad \text{A2}$$

If the productivity growth rate is ρ, and the contribution is a constant fraction of wages (as is the case in most countries), i is equal to the growth rate of the economy, $(1+i_{t+1}) = (1+n_{t+1})(1+\rho_{t+1})$

Let $T_t = a_t - S_t$ be the per capita implicit tax or opportunity cost of the PAYGO scheme. This is the additional amount that needs to be paid by agents since they are forced to contribute to a PAYGO scheme rather than save themselves.

The initial value of the transfer to the first generation receiving it is an amount $P_t = N_t a_t = N_t(T_t + S_t)$

Now $N_t S_t = \frac{N_t z_{t+1}}{1+r_{t+1}} = \frac{N_{t+1}a_{t+1}}{1+r_{t+1}} = \frac{N_{t+1}(T_{t+1}+S_{t+1})}{1+r_{t+1}}$

Hence

$$\begin{aligned} P_t &= N_t T_t + N_t S_t \\ &= N_t T_t + \frac{N_{t+1}T_{t+1}}{(1+r_{t+1})} + \frac{N_{t+1}S_{t+1}}{(1+r_{t+1})} \\ &= N_t T_t + \frac{N_{t+1}T_{t+1}}{(1+r_{t+1})} + \frac{N_{t+2}T_{t+2}}{(1+r_{t+1})(1+r_{t+2})} + \frac{N_{t+2}S_{t+2}}{(1+r_{t+1})(1+r_{t+2})} \\ &\ldots \\ &= \sum_{j=0}^{\infty} \frac{N_{t+j}T_{t+j}}{\prod_{k=1}^{j}(1+r_{t+k})} \end{aligned}$$

In other words, the initial payment to the first generation is equal to the present value of the "tax" opportunity cost to all subsequent generations, when discounted at the rate of return to capital.

B The effect of a PAYGO pension scheme on aggregate utility

A similar proof can be used to derive the conditions under which the adoption of a PAYGO-financed retirement income scheme raises aggregate welfare as measured by the discounted value of marginal utility. Again, the result is most easily shown in the standard 2 generation overlapping generations model. In each period there are two generations, one old and one young. The result is derived under the following assumptions.

(i) The population of the young cohort is $N_t = N_0(1+n)^t$. In any period the young cohort is n% bigger than the old cohort.

(ii) Per capita incomes increase at rate θ.

(iii) Consumption in the first period of a person born in period t life is c_t, while consumption in the second period is $d_{t+1.}$ First and second period consumption increase at rate θ.

(iv) There is a transfer size a_t paid to each old generation. It is financed on a pay-as-you go basis, so at time *t* the young generation pays taxes $\tau_t = a_t/(1+n)$.

(v) The value of the pension increases through time at rate ω (possibly different to the growth rate of productivity)

(vi) The return to capital is r_t.

(vii) Agents have a utility function $U(c,d) = u(c) + \frac{1}{1+\rho}u(d)$ where $u(c) = c^{1+\varepsilon}/(1+\varepsilon)$ and ρ is the rate of time preference. Marginal utility is $u'(c) = c^{\varepsilon}$ and the elasticity of marginal utility with respect to consumption is ε.

(viii) The social planner discounts the utility of cohorts born at different times using the same rate that individuals use to discount their own utility, ρ.

At time t the retirement income policy is introduced. The first generation born at *t-1* obtains additional consumption a_t. Subsequent generations born at *t+i* , i = 0, 1, 2 pay taxes τ_t and get a transfer a_{t+1}.

The value of the utility change is equal to the dollar value of the size of the consumption change multiplied by the marginal value of the consumption change:

$\Delta U = \frac{dU}{dC}\Delta C$ Hence the value of utility change is $\Delta u = c^{\varepsilon}\Delta c$

(i) The total value of the marginal utility gain to the first generation at time t is

$$\Delta u_{t-1} = \frac{N_t}{(1+n)} a_t (d_t)^{\varepsilon}$$

(ii)The opportunity cost on the generation born *t+i* in terms of the loss of consumption of their second period is

$$\frac{a_t(1+\omega)^i}{(1+n)}(1+r) - a_t(1+\omega) = a_t(1+\omega)^i \frac{(1+r)-(1+n)(1+\omega)}{1+n}$$

The utility loss in terms of *t+i* utility is therefore $\dfrac{a_t(1+\omega)^i \dfrac{(1+r)-(1+n)(1+\omega)}{1+n}\left(d_t(1+\theta)^i\right)^{\varepsilon}}{1+\rho}$

The total utility loss affecting the generation, is therefore

$$\Delta u_{t+i} = N_t(1+n)^i \frac{a_t(1+\omega)^i\left((1+r)-(1+n)(1+\omega)\right)\left(d_t(1+\theta)^i\right)^{\varepsilon}}{(1+n)(1+\rho)}$$

The discounted sum of all subsequent generations, discounted back to time t is

$$\sum_{i=0}^{\infty} N_t(1+n)^i \frac{\dfrac{a_t(1+\omega)^i\left((1+r)-(1+n)(1+\omega)\right)\left(d_t(1+\theta)^i\right)^{\varepsilon}}{(1+n)(1+\rho)}}{(1+\rho)^{i+1}}$$

$$= \frac{N_t}{1+n} a_t (d_t)^{\varepsilon} \frac{(1+r)-(1+n)(1+\omega)}{1+\rho} \sum_{i=0}^{\infty}\left[\frac{(1+\omega)(1+n)(1+\theta)^{\varepsilon}}{1+\rho}\right]^i$$

$$= \frac{N_t}{1+n} a_t (d_t)^{\varepsilon} \frac{(1+r)-(1+n)(1+\omega)}{1+\rho}\left[\frac{1+\rho}{1+\rho-(1+\omega)(1+n)(1+\theta)^{\varepsilon}}\right]$$

The gain by the current generation is equal to the loss of subsequent generations when

$$\frac{N_t}{1+n} a_t (d_t)^{\varepsilon} = \frac{N_t}{1+n} a_t (d_t)^{\varepsilon} \frac{(1+r)-(1+n)(1+\omega)}{1+\rho}\left[\frac{1+\rho}{1+\rho-(1+\omega)(1+n)(1+\theta)^{\varepsilon}}\right]$$

$$1+\rho-(1+\omega)(1+n)(1+\theta)^{\varepsilon} = (1+r)-(1+n)(1+\omega)$$

$$\Rightarrow \rho-\omega-n-\theta\varepsilon \cong r-n-\omega$$

$$\Rightarrow r \cong \rho-\theta\varepsilon$$

As Ramsey (1928) observed, in a world without distortions, the real return to capital should equal $p+|\theta\varepsilon|$, or else agents have an incentive to borrow or invest to adjust their consumption through time. In this case, the discounted consumption value of the losses is exactly equal to the gain by the first generation of recipients. If the return to capital exceeds this value, the losses of future generations exceed the value of the transfer to the first generation. If individuals borrow and lend until the after tax rate of return is equal to $p+|\theta\varepsilon|$, the pre tax rate of return will exceed $p+|\theta\varepsilon|$ and thus the adoption of a PAYGO funded retirement income system will reduce aggregate welfare. In this case, the gain to the first generation will be smaller than the losses imposed on subsequent generations, even taking into account their lower marginal utility from a transfer because of their greater income.

This argument does not mean there are no welfare grounds for adopting a pay-as-you-go funded welfare retirement income system. If it is adopted at a time when circumstances for the first generation are particularly dire, the gain in their welfare will be unusually large and can conceivably exceed the losses imposed on subsequent generations. However, the argument that there are normally welfare gains from the adoption or expansion of a pay-as-you-go retirement income scheme because subsequent generations are likely to be richer is not correct in general.

C Tax rates and accumulation in a simple PAYGO and SAYGO retirement income scheme

This subsection makes an estimate of the approximate size of the opportunity cost of New Zealand Superannuation in its current form by calculating the long term equilibrium level of contributions that would be needed to fund New Zealand Superannuation on a PAYGO- or SAYGO- basis. The calculations are based on a simple model of the economy in which a cohort works for N years and lives for an additional T years in retirement. The average income of the cohort increases at rate g^W and the retirement income increases at rate g^R. The model calculates the constant tax rate that needs to be applied each year to provide a pension that is a fraction θ of average incomes, assuming (i) all labour income in the economy is taxed and (ii) capital income earned in the SAYGO-funded system is not taxed but accumulates in the fund. The average income is the income earned by working age cohorts in a particular year, and the number of people in each cohort increases at rate n.

To simply the model, it is assumed that all working age people in a particular year earn the same amount. This means the life-time income of successive cohorts increases at rate g^W. This assumption is counterfactual when there is a lifecycle earnings profile and people earn less in early life than in middle age. For this reason the model will understate the contribution rate needed to achieve a particular retirement income level in a SAYGO system, as the amount saved at the start of life, which is compounded for the longest amount of time, is overstated. In practice, however, the difference is small, under 8 percent when the real rate of return is 4% and even smaller when the real rate of return is 3 percent.[51]

In addition to the sum accumulated by each cohort to provide resources for its own retirement, the total funds accumulated at a particular year, equal to the funds accumulated by all the different aged cohorts, is calculated. This provides an indication of the total sum accumulated in equilibrium under a SAYGO system.

The formula depends on:

- n the growth rate of the population
- g^W the growth rate of the incomes
- g^R the growth rate of retirement incomes, if these are not indexed to wages
- r the return to capital
- N the average working life
- T the average length of retirement

There are different formulae depending on whether any of the variables are zero or whether $g^R = g^W$. The results are presented in Table 3 and 4 for the various cases.

---

[51] In 2006, average male incomes by five year bands starting at 20-24 and ending at 60-64 were: $19600, $31500, $39900, $43800, $44900, $45100, $44000, $42100, $35200. The average of these numbers is $38400. If contributions were collected at the actual rates and compounded at 4%, the total would be 8% higher than if it were assumed contributions at different ages were equal. The same calculations for women gives a 4% difference. If the rate of return were 3 percent, the respective differences would be 6% and 3% respectively.

Table 3: **Contribution rates for PAYGO and SAYGO pension schemes**

$g^R = g^W$	n=0	n≠0
PAYGO	*T/N θ*	$\frac{\left(1-1/(1+n)^T\right)}{\left((1+n)^N-1\right)}\theta$
SAYGO	$\frac{g^W-r}{r-g^R}\left(1-\left(\frac{(1+g^R)}{(1+r)}\right)^T\right)\Big/\left(1-\left(\frac{1+r}{1+g^W}\right)^N\right)\theta$	
$g^R \neq g^W$	**n=0**	**n≠0**
PAYGO	$\frac{\theta}{N}\frac{(1+g^W)}{g^W-g^R}\left(1-\left((1+g^R)/(1+g^W)\right)^T\right)$	$\theta\frac{1+g}{g-g^R}\frac{n}{1+n}\left(1-\left((1+g^R)/(1+g)\right)^T\right)\Big/\left((1+n)^N-1\right)$
SAYGO	$\frac{g^W-r}{r-g^R}\left(1-\left(\frac{(1+g^R)}{(1+r)}\right)^T\right)\Big/\left(1-\left(\frac{1+r}{1+g^W}\right)^N\right)\theta$	

Table 4: **Sums accumulated under a SAYGO pension scheme**

$g^R = g^W$	
Accumulation at 65/pension amount	$\frac{S_{t+65}}{P_{t+65}}=\frac{1}{r-g^R}\left(1-\left(\frac{(1+g^R)}{(1+r)}\right)^T\right)$
Total accumulated in economy	$\frac{1}{r-g^R}\left[(T-1)-\frac{(1+g^R)}{(r-g^R)}\left(1-(1+g^R)^{T-1}/(1+r)^{T-1}\right)\right]*P_{t+65}*cohort\ size$
$g^R \neq g^W$	
Accumulation at 65/pension amount	$\frac{S_{t+65}}{P_{t+65}}=\frac{1}{r-g^R}\left(1-\left(\frac{(1+g^R)}{(1+r)}\right)^T\right)$
Total accumulated in economy	$\frac{1}{r-g^R}\left[\begin{array}{l}\frac{(1+g^R)}{(g^W-g^R)}\left(1-(1+g^R)^{T-1}/(1+g^W)^{T-1}\right)\\ -\left((1+g^R)/(1+r)\right)^T\frac{(1+r)}{(g^W-r)}\left(1-(1+r)^{T-1}/(1+g^W)^{T-1}\right)\end{array}\right]*P_{t+65}*cohort\ size$

Table 5 uses these formulae to calculate the relative size of PAYGO and SAYGO contribution rates. The first two sections of the table are calculated for 3 and 4 percent real rates of return, 1.5% productivity growth rates, and population growth rates varying from 0 – 1%. As the productivity growth rate is higher than the 1.2% per annum achieved in New Zealand between 1989 and 2011, and the real rate of return is lower (approximately 4.5- 5.5%), these sections of the table underestimate the opportunity cost. The last section calculates the contribution rates with 1.2% growth and 5% real rates of return.

Table 5: **Long term equilibrium taxes needed to pay for New Zealand Superannuation**

N Working life	T Life expectancy after 65	r	g^W	g^R	N	SAYGO taxes	PAYGO Taxes	ratio
45	19	3.0%	1.5%	1.5%	0.0%	8.1%	13.1%	1.62
45	19	3.0%	1.5%	1.5%	0.25%	8.1%	12.1%	1.50
45	19	3.0%	1.5%	1.5%	0.50%	8.1%	11.1%	1.38
45	19	3.0%	1.5%	1.5%	1.00%	8.1%	9.5%	1.17
45	19	4.0%	1.5%	1.5%	0.0%	5.8%	13.1%	2.27
45	19	4.0%	1.5%	1.5%	0.25%	5.8%	12.1%	2.09
45	19	4.0%	1.5%	1.5%	0.50%	5.8%	11.1%	1.93
45	19	4.0%	1.5%	1.5%	1.00%	5.8%	9.5%	1.64
45	19	5.0%	1.2%	1.2%	0.00%	3.7%	13.1%	3.57
45	19	5.0%	1.2%	1.2%	0.25%	3.7%	12.1%	3.29
45	19	5.0%	1.2%	1.2%	0.50%	3.7%	11.1%	3.03
45	19	5.0%	1.2%	1.2%	1.00%	3.7%	9.5%	2.58

The table indicates that the opportunity cost is quite sensitive to the population growth rate, as well as real returns. The opportunity cost of the PAYGO system varies from 17 percent of the SAYGO contribution rate (if real returns are 3%, productivity growth is 1.5%, and population growth is 1.0%) to 257% of the SAYGO rate (if real returns are 5%, productivity growth rates are 1.2%, and population growth is 0 percent.)

Ultimately, the growth rate of the workforce is determined by the birth-rate, adjusted for net migration. According to Statistics New Zealand data and projections, the number of births fell from 65,000 in the early 1960s to 50,000 in the early 1980s before increasing back to 65,000 in 2010. They are only expected to increase by 0.04% per annum over the next 50 years. The growth rate of the 25-29 year old population has similar trends, although is projected to increase at the slightly faster rate of 0.2% over the next 50 years.

When the population growth rate is 0.25%, the pension contributions (taxes) required using PAYGO funding are from 50 percent to 229% higher than the contributions required using SAYGO funding, depending on the relative size of real capital returns and productivity growth. These are large numbers, at least 4 percent of GDP per year.