Intergenerational transfers and public policy.

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Abstract
This paper provides a selective overview of the enormous literature describing the ways public policy can alter intergenerational transfers. It has sections describing the way public policies alter the amount of the different types of intergenerational assets that can be accumulated in an economy, and the way the costs fall on different generations; the way public policies share risk across generations; and the ways the welfare consequences and sustainability of these policies can be evaluated. A focus of the paper is the way that the intergenerational consequences of “pay-as-you-go” and “save-as-you-go” funding for government programmes differs according to whether the average age of the recipients is greater than or less than the average age of taxpayers. An increase in the size of programmes that transfer resources to older New Zealanders ultimately result in high opportunity costs on future New Zealanders, and thus represent transfers from future generations to current generations.

The last section of the paper concerns retirement policies in New Zealand. It notes that increases 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, and uses the Treasury Living Standards framework to evaluate several different options that could be adopted in response to population ageing. In each case, it assumes the basic structure of New Zealand Superannuation remains as a cornerstone for future policy, but considers options to deal with the additional years of longevity. 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. However, various other options are possible including options that would enable an amount equivalent to New Zealand Superannuation to continue to be paid to people over 65 in the future.
1. Introduction

The appropriate size and nature of intergenerational transfers is central to many public policy issues. These issues include the amount a society should invest in education, in research, and in long-lived infrastructure; the size and structure of its public retirement income and health policies; the quantity of exhaustible natural resources it should use; the extent it should maintain or enhance the quality of the environment; and the way generations within a society should share risk. These issues are public policy issues because government programmes frequently result in a transfer of resources between cohorts or across periods. They are also public policy issues because many of these transfers are non-contractual. When one cohort makes a positive transfer to another cohort, it will often be unable to receive payment or reward, or be unable to enforce payment or reward. Conversely, when a cohort undertakes an action that harms another cohort, there is often no way for the latter to receive compensation or to offer payments to prevent the damage. Under these circumstances, there are incentives for selfish generations to provide fewer positive transfers and more negative transfers to other generations than would be the case if generations could form binding contracts. In addition, there is less risk sharing than optimal, as risk-sharing contracts with young or unborn cohorts can be difficult to make in advance, and contracts with older cohorts can be difficult to enforce.

Economists analysing intergenerational issues have typically tackled four classes of questions.

1. By how much do different policies alter the quantity or nature of intergenerational transfers?
2. What are the economic effects of these transfers?
3. Is there a well defined ethical framework or welfare metric that can be used to evaluate whether the amount of transfers that a generation makes to other generations is in some sense optimal?
4. Is there a way of designing policies and institutions that will achieve an optimal amount of intergeneration transfers?

This paper provides a selected overview of some of the ways these questions have been analysed and answered, with a focus on issues that have fiscal implications because the government uses expenditure programmes, taxes or debt finance to solve...
a policy issue. The schematic form of the paper is shown in figure 1. While there are several different types of intergenerational assets, in each case there are two main issues. First, government fiscal interventions tend to transfer resources between generations. These transfers impose costs and benefits that affect cohorts in very different ways, sometimes favouring particular cohorts and other times disadvantaging them. Secondly, government interventions tend to change a society’s total quantity of intergenerational assets and the way it shares risk. Since asset levels and the way risk is shared are unlikely to be optimal in the absence of government interventions, there are often circumstances where government interventions could improve the welfare of all members of a society, including future generations. In many cases, however, government interventions do not lead to universal welfare improvements, but result in transfers from one group to another.

As each class of intergenerational asset has its own particular issues, the paper focuses on one important policy question in depth rather than explore a broader set of issues less comprehensively. It concerns retirement income policies, particularly the extent that a government chooses a “pay-as-you-go” funded retirement income system rather than a “save-as-you-go” system. This topic has been the subject of fifty years intensive research, but it is still one of the biggest issues grappled by governments worldwide. It has urgency in the New Zealand context because New Zealand’s pay-as-you-go funded retirement income scheme automatically expands unless the age of entitlement increases at the same rate as longevity, leading to increasingly large transfers from future generations to current generations.

The paper begins by briefly outlining the types of intergenerational assets. The ways public policy can alter the levels and transfers of these assets are discussed in section 2, while section 3 discusses risk transfer and management issues. Section 4 explores intergenerational welfare metrics and discounting. In section 5, the various ways that government pension schemes affect the intergenerational transfer of resources are analysed, with particular reference to the effects of expanding a pay-as-you-go pension scheme. Lastly, a summary is offered.
Intergenerational assets

“Hard” capital
Roads, buildings, plant and equipment

“Soft” capital
Education, institutions

Natural resources
and the environment

Non-optimal provision in a laissez-faire economy without Government

Non-optimal provision in an economy with Government

Effects on the level of assets and output

Effects on risk sharing

Investment, tax, debt, and pensions

Optimal for whom? Intergenerational preferences

Example: Retirement Saving

PAYGO schemes
SAYGO schemes
Mandatory retirement accounts
Transition issues
2. Intergenerational assets and transfers: some basic issues

The living standards of any generation are determined by the quantity and quality of the intergenerational assets and resources they obtain from other generations. These assets include such things as investment goods and transport infrastructure, their education and training levels, their social institutions and the technologies they use, and the quality of the natural environment. They are factors that affect their productivity, wellbeing, and the quality of the natural, social and political environment they enjoy.

Intergenerational asset transfers between cohorts take many forms. They can occur as the result of a deliberate attempt to redistribute resources between generations, as the result of deliberate attempts to share risk, or as the inadvertent result of unexpected shocks. They occur at the level of the family, the private business, and the nation. Without transfers from earlier generations, each generation would be significantly poorer. But because asset transfers often cannot be directly reciprocated, there is no guarantee that the “right” amount of transfers takes place. A generation can impoverish itself by providing too much to future generations, or consume so much and leave so little that their descendents are worse off than themselves.

Intergenerational asset issues can be broadly categorized along two different dimensions. First, asset levels differ according to whether or not they exceed the “golden rule” level that maximizes consumption levels. It is possible for an economy to have too much capital, because it takes a lot of effort to produce and maintain capital goods that depreciate. In this case, pareto improving welfare improvements are possible by reducing capital levels, because members of the current generation could increase their own consumption without reducing the consumption of future generations. Conversely, if an economy has less than the golden rule level of capital,
Figure 2: Categories of intergenerational assets

<table>
<thead>
<tr>
<th>Private physical capital assets (few contractual issues)</th>
<th>Private Provision</th>
<th>Public Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no reason for capital to be at the golden rule level.</td>
<td>Taxes, debt, and a combination of government investment or consumption expenditure change the capital stock.</td>
<td></td>
</tr>
</tbody>
</table>

| Non-contractual intergenerational assets (public goods, knowledge education) | Externalities and the inability to contract mean there is too little private provision and asset levels are normally below the golden rule level. | Taxes and investment efficiently raise non-contractual IGA levels and reduce private capital levels. |

Changes in asset levels that increase the consumption levels of one generation can only occur at the expense of decreases in the consumption levels of other generations.

Secondly, assets differ according to the extent that their effects can be privately contracted. Many intergeneration actions involve ordinary capital assets that are non-rival and excludable, and for which contractual issues can typically be solved. The amounts of capital available to or accumulated by any generation need not be the amount that maximizes consumption levels even in this case, and government interventions typically alter total capital stocks despite offsetting changes in private saving levels. For other intergenerational assets such as public goods or education, contract issues are paramount. Policies changing the levels of these assets can be categorized according to whether they are non-contractual because agents cannot contract or because contracts cannot be enforced, and whether they are harmful or beneficial other generations. In each case a generation is likely to undertake too few beneficial activities and too many harmful activities relative to a hypothetical situation where parties could contract. For example, current agents may undertake too few investments in public roads, or generate too much pollution, because many of the costs and benefits of these activities accrue to currently unborn generations who cannot pay for them, but who, if alive, would be willing to pay to build the investments or stop the pollution.
Sometimes contractual difficulties are solved through voluntary intergenerational transfers. An agent could voluntarily reduce current consumption to pay for his or her child to get an education, to transfer resources to an older parent, or to clean up the environment. However, the quantity of voluntary actions is likely to be different than would be the case if the recipient could contract with the donor because a donor who trades off the costs and benefits of an activity is likely to value the benefits differently than the recipient. Agents can also undertake voluntary actions to offset government policies. In this respect, bequests are an important adjustment mechanism. An agent can adjust the size of a bequest, leaving a greater bequest if he or she believes that the government is under-providing intergenerational assets, or leaving a smaller bequest if governments raise taxes to provide intergenerational assets for subsequent cohorts. Nonetheless, there are few reasons to believe that adjustments to bequest levels largely offset the effects of government programmes, or, in the parlance of Barro (1974), that Ricardian equivalence holds.

The remainder of the section outlines the key intergenerational issues surrounding the average provision, accumulation, or use of different intergenerational assets. Economists typically distinguish three types of intergenerational assets:

i. physical or “hard” capital, such as machinery and buildings or public capital such as transport infrastructure;

ii. human and social capital (or “soft” capital) including the education, skills and talents acquired by people, the stock of knowledge, and a society’s habits, preferences, manners and customs; and

iii. durable natural assets, including the quantity of reproducible and non-reproducible natural resources, and the quality of the environment.

A list of the main types of intergenerational assets and the associated issues is provided in Figure 3. The focus of the paper concerns assets whose allocation is typically altered through fiscal policy initiatives, primarily private goods and goods with contracting difficulties, namely public capital goods, education and knowledge. Sections 2.1 (private capital goods) and 2.2 (public capital goods) flesh out the major issues concerning these two categories, while the remaining subsections provide a brief description of some of the other issues that arise with different classes of intergenerational assets.
<table>
<thead>
<tr>
<th>Physical Capital</th>
<th>Private provision without government</th>
<th>Effect of Government</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private goods</strong> (machinery, buildings)</td>
<td>-Local private provision likely to be suboptimal. -Foreign investment can rectify capital deficiency.</td>
<td>-Taxes, debt, and pensions reduce private capital quantities. -Tax-funded investment schemes can raise levels.</td>
</tr>
<tr>
<td><strong>Public goods</strong> (roads)</td>
<td>-Private investment is suboptimal as investors cannot capture externality benefits.</td>
<td>-Government investment can raise capital levels -Too few may be provided if current generations pay the cost but future generations obtain some of the benefits</td>
</tr>
<tr>
<td>Human and social capital, knowledge</td>
<td>Human capital (education, training)</td>
<td>-Too little education provided if parents are liquidity constrained or selfish or cannot capture the benefits of investments in children.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>-Private investment in research and knowledge development is suboptimal as investors cannot capture externality benefits.</td>
<td>Debt and tax-funded government subsidies or investments can increase research levels and reward current generations for effort that benefits the future. May affect growth levels.</td>
</tr>
<tr>
<td>Social institutions (habits, rules, laws)</td>
<td>-Inherited customs, habits and laws may be inefficient, but are costly to change by individual action.</td>
<td>-Government can oppose changes or coordinate mechanisms to enable change.</td>
</tr>
<tr>
<td>Durable natural resources</td>
<td>Natural and mineral resources</td>
<td>-There are incentives to over-use natural resources, particularly “commons” resources.</td>
</tr>
<tr>
<td>Environmental quality</td>
<td>-There are incentives to over-pollute or over-use the environment and to let future generations face clean-up/restoration costs.</td>
<td>-Government can regulate or internalise external pollution costs.</td>
</tr>
</tbody>
</table>
2.1 The accumulation of private physical capital assets and the golden rule

“Private good” capital is the type of capital where it is possible to exclude potential users so that the returns or benefits can be controlled by the owners through contractual means. For example, the owners of a cloth factory can contract with all of their workers and customers, so the factory’s productivity benefits are exclusively shared between the three parties. Within developed countries like New Zealand, the literature analysing the level of “private good” capital accumulation has two main themes.

1. Private saving decisions will not necessarily provide an economy with an efficient level of capital (the “golden rule”) in the absence of government.
2. Many government policies transfer resources between generations and change the aggregate level of the capital stock by altering the incentives and ability of private agents to accumulate capital.

The golden rule level of capital

It is possible for an economy to have too much capital, because it takes a lot of effort to produce and maintain capital goods that depreciate. In this case, the members of an economy would be better off producing fewer capital and more consumption goods. An economy that has too much capital is said to be dynamically inefficient, because members of the current generation could increase their own consumption without reducing the consumption of future generations. If there is no productivity growth, an economy will be dynamically inefficient when the marginal return to capital net of

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1 The accumulation of physical capital has been a central focus of economists and economic historians as it is a key part of the way economies develop and become wealthy. Most now agree with the “institutionalist” approach associated with North (1990) and Olson (1996) that a precondition for the accumulation of productive capital is a set of rules or institutions and enforcement mechanisms that provide people and firms with the incentives to accumulate and maintain capital. Capital is not worthwhile accumulating without these rules, due to the risk of annexation or destruction by other parties including the state. The institutionalist literature is used to explain the differences in the capital accumulation of developed and undeveloped societies, and to explain how differences in government policies cause differences in the quantity and type of capital accumulated in developed countries. As New Zealand is a developed economy, this paper largely ignores the way inadequate property rights or enforcement mechanisms are the cause of low capital stocks in underdeveloped countries.
2 The basic analysis of this issue was pioneered by Phelps (1961, 1965), Diamond (1965) and Cass (1972) in the context of a closed economy with no foreign investment (see de la Croix and Michel (2002) for a discussion.)
3 For example, if fishing boats take a long time to build and maintain, you might eat more fish by spending more time fishing and less time repairing boats.
4 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.
When there is productivity growth, an economy will be dynamically inefficient if the marginal return to capital \((r)\) is lower than the economic growth rate \((g)\), the sum of the population growth rate plus the productivity growth rate.

In contrast, an economy is dynamically efficient when capital goods are scarce and the marginal return to capital is greater than the economic growth rate. In this case, higher long term levels of per capita consumption can be achieved when the capital stock is increased, as the output gained from increasing the capital stock are greater than the increase in the amount capital itself. The economy is dynamically efficient because these increases in long term consumption can only be obtained at the expense of reductions in consumption in the short term. Conversely, in a dynamically efficient economy current generations can only increase their own consumption by reducing the consumption levels of future generations.

The level of the capital stock that maximizes the amount of production available for consumption is the “golden rule” level. It is one of the key benchmarks for interpreting intergenerational transfers. At this level, the marginal return to capital (net of depreciation) is equal to the growth rate of the economy. If the marginal return to capital is less than the growth rate of the economy then the economy has too much capital, and pareto welfare improvements can potentially be achieved by reducing the amount of capital in the economy\(^6\). If the rate of return to capital is greater than the growth rate, the economy has too little capital and increases in the consumption of one generation can only be achieved by reductions in the consumption of other generations.

The capital stock available to a particular generation is generally provided by older local residents, and non-residents. In a world without a government that comprises overlapping generations of people saving and accumulating capital for their retirements, there is no reason why local residents will provide the golden rule level of capital. When people save and accumulate capital goods, their decisions reflect a

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\(^5\) A growing population dilutes the amount of capital per person so addition capital has to be built merely to maintain per capita levels.

\(^6\) Pareto welfare improvements require no cohorts to be worse off and at least one cohort to be better off.
multiple of factors including their preferences for current and future consumption, the extent to which their incomes vary through their lifetimes, and their attitudes to risk. There is no necessary reason that the amount of capital they accumulate will match the level that maximizes consumption\(^7\). Whether the amount of capital accumulated by local residents is smaller than or larger than the golden rule level will depend on a number of factors including whether the amount of saving increases or decreases as the rate of return increases, which depends on individual preferences\(^8\).

An economy where agents are very risk averse or where saving rates are decreasing in the rate of return can have too much capital and be dynamically inefficient. An economy where local residents save little is likely to have less than the golden rule level of capital, and be dynamically efficient. If an economy has less than the golden rule level of capital, the shortfall could be provided by non-residents. However, international evidence suggests that countries with low domestic saving rates also tend to have low quantities of capital, even though large amounts of foreign capital do alleviate capital shortages in some countries. New Zealand is such a case: despite large capital inflows, New Zealand has a relatively low saving rate and low levels of capital by OECD standards (Saving Working Group, 2011).

\textit{Government interventions}\(^9\)

Government interventions can change the level of private saving and thus change domestic wealth and the level of the domestic capital stock. In principle, any level of private capital can be achieved by an appropriate mixture of spending and taxes. The extent to which government interventions alter the capital stock depends on the extent that taxes fund investment rather than consumption, and whether the transfers are from working age cohorts to cohorts that are younger or older. There are least four different cases.

(i) Taxes levied on working age people that are spent on consumption will reduce private capital without increasing other forms of capital\(^10\).

\(^7\) See de la Croix and Michel (2002) chapters 1 – 2 for a lengthy discussion.

\(^8\) If the rate of intertemporal substitution is greater than 1, the amount of saving increases as the rate of return rises; otherwise it falls, because people need to save less for any desired level of future consumption.

\(^9\) The classic paper analysing the role of government debt on different generations is Diamond (1965).

\(^10\) Consumption that is funded by the issuance of government debt will have little effect on capital accumulation at the time the debt is issued, but will reduce it when it is repaid.
(ii) Taxes levied on working age people to transfer resources to elderly people will also reduce private capital stocks without increasing other forms of capital. Pay-as-you-go funded medical and pension schemes are in this category, although warrant special consideration since these programmes also promise benefits to working age people when they are older.

(iii) Taxes levied on working age people that are invested by the government in private capital goods will raise capital stocks, as working age people reduce their saving by less than the government increases its investment.

(iv) Taxes levied on working age people that are spent on education for younger people, or that provide public goods available to future cohorts will reduce the accumulation of private capital, but will increase these forms of intergenerational assets.

The welfare effects of these changes will depend on whether the economy is dynamically efficient or dynamically inefficient, that is whether the capital stock is less than or greater than the golden rule level. When the capital stock is above the golden rule level, a reduction in capital stocks can make people better off. Since people will still wish to save for their retirements or to counter adverse shocks, replacement saving vehicles need to be found to enable them to save without accumulating capital. A mechanism to replace retirement saving involves people transferring resources to their elders when they are young, rather than accumulating capital, and obtaining a transfer in turn when they are old. Because it is difficult for old people to enforce private arrangements that require young people to provide them with unreciprocated transfers, traditionally such systems have involved intergenerational transfers within a family. However, a government can also develop transfer mechanisms, using its ability to impose taxes to force young people to make transfers to old people. This is the basis of a pay-as-you-go (PAYGO) pension system. A traditional PAYGO pension scheme imposes taxes on working age cohorts in return for providing them a pension when they are old. When the economy is dynamically inefficient, it raises welfare by enabling transfers from young to old to prevent the inefficient over-accumulation of capital.

When the capital stock is below the golden rule level, changes in the capital stock result in intergenerational welfare transfers. Suppose a government permanently
increased taxes and investment expenditures. This would that increase the overall capital stock and make all subsequent generations better off by increasing their consumption levels to those consistent with the golden rule level. (The increase in capital levels would increase their wages sufficiently to offset the effect of any higher taxes.) However, these increases in future levels of consumption would only be achieved at the expense of a decrease in the consumption of the first generation that experiences the higher taxes. Alternatively, suppose a government introduced a combination of taxes, debt, and expenditures that increased the consumption of the current generation. For example, a government could issue debt to increase current expenditure levels. Since the economy is dynamically efficient, the increase in the consumption of the first generation would come at the expense of lower consumption levels of some subsequent generations when taxes are raised to repay the debt. When issued, the debt will crowd out the capital stock if the economy is closed, or lower the domestic ownership of capital if the economy is open.

An economically important example is the introduction or expansion of a PAYGO pension scheme. This provides a consumption boost to the first cohort receiving the pension, at the expense of a reduction in the capital accumulation and consumption of younger cohorts (including future cohorts) who pay taxes but who are also promised a pension. Each cohort that pays taxes and subsequently receives a pension faces an implicit opportunity cost because they would receive a larger pension (on average) if the taxes they paid were invested. The opportunity cost is equal to the difference between the rate of return to capital and the growth rate of the economy multiplied by the size of the tax payment. The initial payment to the first generation is equal to the present value of the opportunity cost to all subsequent generations, when discounted at the rate of return to capital.

This result is addressed in detail in section 5, but it is sufficiently important that it warrants additional comment here. When there is an expansion in a pay-as-you-go funded government programme, all future cohorts face an increase in taxes. The taxes will normally cause a variety of deadweight losses, which represents part of the cost.

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

To be precise, the opportunity cost is \( \frac{(r-g)}{(1+r)}\)Taxes, where \( r \) and \( g \) are calculated as the n-year rates of return and n is the average period between when an individual pays the taxes and gets the benefits. See section 5 for further details.
of expanding the size of government programmes. In addition, there is an opportunity cost or gain. If the programme transfers resources from working age to older cohorts, as the case with a pension or medical insurance scheme, there is an opportunity cost borne by future cohorts associated with the loss of resources that comes from paying taxes rather than investing an equivalent amount of resources and earning the rate of return to capital. The opportunity cost is equal to the difference between the rate of return to capital and the growth rate of the economy multiplied by the size of the tax payment. If the programme represents a transfer from working age to younger cohorts, as is the case with education payments, future cohorts face lower payments than they would have if the government had funded the expansion of the education system with debt and taxed subsequent generations enough to repay the debt plus interest. In this case the value of the intergenerational transfer is also equal to the difference between the rate of return to capital and the growth rate of the economy multiplied by the size of the transfer, but it is a transfer to future generations at the expense of the payments made by the first generations.

New Zealand has a PAYGO pension scheme and thus government interventions have reduced the private capital stock from what it otherwise would be. The welfare effects of this scheme depend crucially on whether the economy is dynamically efficient or not. If the economy is dynamically inefficient, with the returns to capital lower than the growth rate of the economy, a PAYGO system will enhance welfare. If the economy is dynamically efficient, with returns to capital greater than the growth rate of the economy, a PAYGO scheme will redistribute resource between generations, benefiting those who were old when the scheme was introduced or expanded at the expense of subsequent generations. The welfare effects of government interventions that reduce the capital stock therefore depend crucially on the difference between the marginal return to capital and the growth rate of the economy.

Is the economy dynamically inefficient?

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. Nonetheless, international evidence
Figure 4: Private asset accumulation and the golden rule

<table>
<thead>
<tr>
<th>r &lt; g: Too much capital</th>
<th>r &gt; g: Too little capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>The economy is dynamically inefficient (one cohort’s consumption levels can be increased without reducing other cohorts’ consumption levels.)</td>
<td>The economy is dynamically efficient (one cohort’s consumption levels can be increased only by reducing other cohorts’ consumption levels.)</td>
</tr>
<tr>
<td>Reductions in capital stocks raise consumption and welfare.</td>
<td>Changes in capital accumulation transfer resources between generations.</td>
</tr>
<tr>
<td>A PAYGO pension system can raise the welfare of all generations by providing alternative saving instruments.</td>
<td>A PAYGO pension system raises the welfare of the first generation at the expense of subsequent generations.</td>
</tr>
</tbody>
</table>

suggest 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 investors will invest more in firms than firms make in profits in the long run 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 4.8 percent – 2.4 percentage points inflation, 1.2 percentage points productivity growth, and 1.2 percentage points population growth. 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.

2.2 The accumulation of public physical capital assets
Public goods are goods that are both non-rival and non-excludable, such as roads. As private firms cannot exclude users or make them pay for services, there is typically much less private investment in these types of assets than is socially optimal. For this reason, governments often are the main providers of this class of capital goods.

Governments can fund public capital investments through taxation or debt. If they impose taxes on current generations, these generations will reduce their private saving and capital accumulation. Public capital is thus a substitute for private capital, which is efficient so long as the return from public capital exceeds that from private capital. As is the case with private capital goods, any total level of public and private capital can be accumulated with an appropriate mixture of taxes and expenditure patterns. This is because uncompensated taxes imposed on one generation to build public infrastructure are likely to reduce private saving by less than the amount of tax.

If all of the benefits of a public investment are captured by the generation that builds them, the generation has an incentive to tax itself until the return from public investments is equal to the opportunity cost of the funds, namely the return from additional private good investment. However, many public goods are sufficiently durable that many of the benefits are captured by subsequent generations. In this case, agents have few reasons to invest in public capital goods until their returns are reduced to those obtained from private capital goods, and public capital levels are likely to be below the golden rule level. Subsequent generations would like to have been provided with more public goods, and would be willing to have paid earlier generations for them, if they could, but such contracting is difficult or impossible.
This situation can be rectified if the government issues debt to finance part of the public good investment, so that part of the cost as well as part of the benefit of the investment falls on subsequent generations. If the debt is purchased by foreign lenders, public capital stocks can be raised with little decrease in local private capital accumulation. If the debt is purchased by local residents, there will be a decrease in private capital accumulation, and the total capital stock, private plus public, will be smaller. In either case, debt funded public investment can be an efficient way to allocate capital between private and public investments, and to raise the welfare of the subsequent generations who repay the debt.

If permanent increases in long lived public infrastructure investment levels are funded by debt repaid from taxes, future cohorts face the true cost of the infrastructure and there is no intergenerational transfer. If they are funded directly from taxation on a PAYGO basis, the first generation pays a disproportionate share of the cost, and there is an implicit transfer to future cohorts. The gain to each subsequent cohort is the difference between the rate of return to capital and the growth rate of the economy, multiplied by the cost of the infrastructure programme. When the economy is dynamically efficient, the total present value of these gains discounted by the rate of return to capital is equal to the cost on the first generation.

Other “non-contractual” intergenerational assets that provide benefits to future cohorts face the same generic issues. In each case, the amount of investment in these assets is likely to be suboptimal without government, but government programmes can increase investment levels. Moreover, the extent to which the programme is debt or tax funded determines the extent to there is a transfer from the first generation to subsequent generations and private capital accumulation is crowded out.

2.3 Investments in human capital
Investments in human capital, particularly schooling, are another intergenerational activity that is difficult to contract, due to the young age of those being educated. Without government, children rely on their parents to fund their education, and thus their education levels may be too low if their parents lack funds to educate their children. Even if they have the funds, and even if the returns to education are very
Figure 5: Funding options for permanent increases in public investment

<table>
<thead>
<tr>
<th>Direct tax funding (PAYGO)</th>
<th>Debt funding (taxes raised subsequently to repay debt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each generation benefits from previous investment and provides investment to next generation</td>
<td>Each generation benefits from previous investment and provides investment to next generation</td>
</tr>
<tr>
<td>The first generation has a consumption loss</td>
<td>The first generation has little consumption loss</td>
</tr>
<tr>
<td>Public capital increases by more than wealth (private capital less debt) reduces.</td>
<td>Public capital increases by same amount as wealth (private capital less debt) reduces.</td>
</tr>
<tr>
<td>Efficiency requires equal rates of return from private and public capital.</td>
<td>Efficiency requires equal rates of return between private and public capital.</td>
</tr>
<tr>
<td></td>
<td>When debt is stable, subsequent generations have higher costs (debt repayment plus interest)</td>
</tr>
</tbody>
</table>

high, parents may choose to fund inadequate levels of education as it difficult for them to profit from the money they spend on their children’s education as it is not possible to write legal contracts obliging children to “repay” their parents for the resources they invest. Both of these reasons mean there may be less invested in education than is socially optimal. If this were the case, the marginal return to education investments would be higher than the marginal return to investments in private capital, and each generation would be better off if their parents had invested more in their education.

Government interventions can solve both problems. If the main issue were that parents were altruistic but lacked funds, a programme that provided loans would be sufficient to induce more investment in education. If the main problem is that parents are neither able to recoup their investments in their children’s education, nor sufficiently altruistic to invest on their children’s behalf, debt or tax-funded education subsidies are a means of raising education levels to socially efficient levels. Irrespective of the funding method, the subsidy raises education levels towards the point that returns are comparable to other investments. Since free or heavily subsidised
education addresses both issues, and redistributes to the poor, it is the solution of choice for primary and secondary education around the world.

The funding mechanism determines how much of the cost is paid for by the first generation of parents increasing the education levels of their children. If education programmes are always funded on a pay-as-you-go basis from tax revenues, the first generation is asked to reduce their consumption levels to pay for their children’s education, without receiving the benefit of greater investments in their own education. In this case, total investment levels (education and private capital investments) will increase. If education investments are debt funded, with each generation repaying the debt from taxes on their subsequent earnings, the first generation does not need to reduce consumption levels to raise the education levels of their children. In this case, total investment levels will increase by less, as the debt-funded education crowds out private asset accumulation.

From this perspective, there are many similarities between investments in public infrastructure and investments in education. In both cases, each generation has an incentive to invest less than a subsequent generation would like. In each case, tax or debt funded expenditure programmes can raise investment levels until marginal returns are equal to those earned from private asset accumulation. A debt funded programme repaid from taxes allows a substitution from one form of intergenerational asset (private capital) to another (education or public capital) with little change in total intergenerational asset accumulation. A pay-as-you-go funded programme enables this substitution but raises total asset levels in the economy by reducing the consumption of the first generation\textsuperscript{12}. Consequently pay-as-you-go funded education results in an intergenerational transfer of resources from the first to subsequent generations when the economy is dynamically efficient.

2.4 Knowledge and investments in research and development
Investments in research and development are likely to be too low because much of the output (knowledge) is non-rival and non-excludable and thus it is difficult for agents

\textsuperscript{12} Note that the state uses its taxation powers to provide education irrespective of whether the education expenditure was initially tax or debt funded, but there is a difference in the amount of ongoing tax payments that corresponds to the size of the necessary interest payments on any debt.
to capture all of the rewards from their investments. As knowledge does not depreciate (although it may become obsolescent), the generic issues surrounding the provision of intergenerational assets with contractual problems arise: the amount of investment in research and development is likely to be suboptimal without government, but government programmes to subsidise research can increase investment levels. In this case, however, an additional issue arises. When government interventions raise the stock of private or public assets, there is a change in the long run level of economic activity, but no change in the long run growth rate. However, there is a change in short run economic growth rates as the economy makes the transition from one level of intergenerational assets to another. This is not the case with investments in research and development. If the productivity of research activity depends on the stock of knowledge, increases in the stock of knowledge increase the speed at which knowledge about new productive techniques are adopted. In these circumstances government interventions that increase the stock of knowledge increase the long term growth rate of the economy as well as the level of economic output (Romer 1990).

If research and development investment rates affect growth rates as well economic levels, government interventions that are effective at increasing knowledge levels will have much larger long term consequences than investments in private or public capital assets. In particular, it is no longer always true that the sum of the future benefits discounted at the rate of return to capital is equal to the size of the initial investment made by the first generation, for when long term growth rates increase there is a potentially unbounded increase in output. The existence of potentially unbounded long term gains from research and development investment raises interesting ethical questions about the extent a cohort should sacrifice its own consumption to increase the consumption of other cohorts that are discussed in section 4. At a practical level,

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13 “Inventors are at once the rarest and most precious flower of the industrial world. Too often they are crushed by the obstacles of poverty, prejudice, or ridicule. While this is less so today than in the days of Roger Bacon or Galileo, it still requires far too much time for the Bells, Edisons, Fords, or De Forests to get their start. The decades in which these rare brains are doing their wonderful work are at most few, and it is worth many billions of dollars for their countrymen to set them to work early. As Huxley says, it should be the business of any educational system to seek out the genius and train him for the service of his fellows, for whether he will or not, the inventor cannot keep the benefits of his invention to himself. In fact, it is seldom that he can get even a small share of the benefits. The citizens of the world at large are the beneficiaries, and being themselves not sufficiently clever to invent, they should at least be sufficiently alive to their own interests to subsidize or employ the one man in a million who can.” Irving Fisher (1907) p 205
however, the type of interventions that are effective in raising knowledge stocks are not clear, because most knowledge is generated at the global rather than local level, and there are generally a large number of entrepreneurs willing to adopt or adapt global knowledge to local problems.

A particularly important research and development issue concerns the development of environmentally friendly technologies. When output is resource intensive, the use of “dirty” technologies can lead to excessive exploitation of non-renewable resources, or excessive pollution. In some circumstances, this can lead to an irreversible environmental collapse, such as the extinction of a species or the destruction of an ecosystem. In some circumstances these environmental collapses would be avoidable if cleaner technologies were developed in time. Acemoglu et al (2012) argue that in many cases a mixture of environmental taxes and temporary research and development subsidies is sufficient to provide the incentives to develop these technologies, and thus stave off collapses that have long term (intergenerational) effects. Permanent subsidies are not required when the profitability of research and development into clean technologies is increasing in the level of technological sophistication. If clean technologies are developed to a sufficiently advanced state that they dominate dirty technologies, the dirty technologies will be displaced and the subsidies will no longer be necessary\(^\text{14}\). In these circumstances the gains from one generation investing in knowledge development for subsequent generations can be enormous.

**2.5 Social Institutions**

The social institutions governing the ways a society operates are largely determined by its history, and the success of attempts to overthrow customary but inefficient rules and habits (North 1990). When these rules and customs are inefficient – for example, when women are restricted from participating in education or the paid workforce – there can be considerable gains to society from changing them. Typically the costs fall upon individuals within one generation, while the benefits are shared by subsequent generations. Consequently, there are reasons to expect less challenge to social institutions than is socially optimal.

\(^\text{14}\) The replacement of gas lamps by incandescent bulbs and then LED lights is such an example.
The intergenerational transfer of many social institutions raises different issues than the transfer of other forms of intergenerational capital as much of the transfer tends to be unconscious rather than deliberate. Moreover, many governments are conservative and avoid changes to institutions that result in significant costs to current voting groups. For these reasons, even though changes in social institutions often have fiscal implications, as was the case when women increased their participation in the paid workforce, fiscal policy is not the primary way that social institutions are changed. Since the forces determining how a society acquires social institutions are different to the forces determining the acquisition of other forms of intergeneration assets, these issues are not pursued in this paper in order to provide greater focus on fiscal issues.

2.6 Durable natural resources and environmental quality

The stocks of durable natural resources and the quality of the natural environment are the last major types of intergenerational assets. When a generation consumes non-renewable natural resources, it leaves fewer resources to subsequent generations. When a generation adds to the stock of pollution, it harms subsequent generations. Is there a well defined sense in which a generation consumes or pollutes too much? This question has been the subject of an extensive amount of ethical, ecological, and economic research that cannot be adequately summarized here. Nonetheless, some general public policy conclusions have been drawn.

First, it is possible to frame the question “Are we consuming too much?” in a way that generates falsifiable and testable hypotheses. In particular, it is possible to make rigorous definitions of the concepts of dynamic efficiency and sustainability (Stavins, Wagner, and Wagner (2003); Arrow et al (2004)). A resource usage path is dynamically efficient if it is non-wasteful in a pareto sense: that is, different usage patterns that would lead to non-decreasing utility changes for all generations do not exist. A resource usage path is sustainable if the present value of current and future welfare levels is potentially non-decreasing through time. These usage patterns incorporate the possibility that when one cohort uses natural resources it can create

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sufficient quantities of other intergenerational assets that the welfare of subsequent
generations are enhanced (Solow 1974b). It is possible that exhaustible resources are
sufficiently important in production processes and have so few substitutes that the
sustainability criterion is not met (Dasgupta and Heal 1974). However, the evidence
suggest that with the exception of some very poor underdeveloped countries, which
have difficulty generating intergenerational assets other than natural resources, most
countries are on sustainable paths. (Arrow et al 2004).

Secondly, a society (or the world as a whole) may be consuming too much of a
resource if its price is too low relative to its social cost. This can occur if a resource
has poor property rights, sometimes because it is non-excludable and suffers from the
“tragedy of the commons” 16, and sometimes because property rights are poorly
defined or enforced 17. It can occur if markets do not take into account negative
externalities associated with resource use. Or it can occur if the government
subsidises resource use, to achieve other aims. In each case, resource depletion will
take place too quickly and will be wasteful from an intergenerational perspective
when the price is too low.

Thirdly, a society may produce too much pollution. This has negative consequences
on future generations, either because it is harmful or because these generations have
to undertake costly actions to clean up the pollutants or reduce their own pollution
levels.

If a society depletes its natural resources too quickly, or pollutes too much, there is an
implicit intergenerational transfer. Neither transfer is necessarily a fiscal issue,
although pollution clean-up costs may be funded by governments. However,
governments could engage in fiscal policies to offset the costs imposed on future
generations, repaying debt or building addition infrastructure for example. In addition,

16 Of course the tragedy of the commons is not inevitable for common-good resources that are rival but non-excludable. See Ostrom (1990) for the classic exposition of this issue.
17 When property rights are well defined, the owner of the resource will take into account the future sales value of the resource when calculating how much to use. There are many reasons why this might not occur: for example, the owner may have obtained the resource as a result of political favours that are not expected to last permanently; or there may be principle/agent issues that mean the manager of the resource and the owner have different objectives.
some of the incidence of any future taxes levied to pay for the costs incurred cleaning up pollution may fall on current generations if land prices capitalize tax rates.

2.7 Discussion

The above discussion suggests that there are various ways that public policies can alter the levels of intergenerational assets produced or purchased by the private sector. Many of these interventions will reduce the level of private capital goods. Some of these interventions will increase intergenerational assets levels to those nearer to the golden rule level than would occur otherwise, and thus will lead to long term increases in output levels and welfare. The ways that expenditure programmes are funded also have intergenerational effects. These are summarized in Table 6. When a new, permanent expenditure policy is funded on a pay-as-you-go basis, there is a cost imposed on all future generations if the expenditure recipients are older than average, and a gain to all future generations if the expenditure recipients are younger than average. Thus PAYGO funded pension policies result in transfers from future generations to the present, whereas PAYGO funded education and infrastructure programmes result in transfer from current working age generations to future generations.

Government debt levels also affect the level of intergenerational transfers. When new education or long-lived infrastructure programmes are funded by debt repaid from future taxes, the increase in asset levels is offset by increases in future tax payments and the programme is intergenerationally neutral. When debt is issued to fund government consumption expenditure or pension payments, the increase in future tax payments results in transfers from future generations to current generations and lower wealth levels.
Table 6: The effect of PAYGO funded policies

<table>
<thead>
<tr>
<th>PAYGO Programme</th>
<th>Effect on first old cohort</th>
<th>Effect on first working age cohort</th>
<th>Effect on future cohorts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>None</td>
<td>Reduce consumption</td>
<td>Increase education levels and welfare</td>
</tr>
<tr>
<td>Public infrastructure</td>
<td>Increase infrastructure levels</td>
<td>Increase infrastructure levels and reduce consumption</td>
<td>Increase infrastructure levels and welfare</td>
</tr>
<tr>
<td>Pension – expansion of current old aged entitlements</td>
<td>Increase consumption and welfare</td>
<td>Reduce consumption and welfare when r&gt;g</td>
<td>Reduce consumption and welfare when r&gt;g</td>
</tr>
<tr>
<td>Pension – future expansion of current working age entitlements</td>
<td>None</td>
<td>Increase consumption and welfare</td>
<td>Reduce consumption and welfare when r&gt;g</td>
</tr>
</tbody>
</table>

3. Intergenerational transfers and risk management

People in an economy face risks. Many of these risks are idiosyncratic, but some affect whole cohorts or generations. When a person is young they face a series of idiosyncratic risks concerning their later life including:

1. they don’t know how long they or their partner will live;
2. they don’t know who their partner will be;
3. they don’t know their and their partner’s health status and labour market outcomes during prime working years, and thus how much they can save for their retirements;
4. they don’t know their and their partner’s health status late in life;
5. they don’t know their and their partner’s labour market opportunities late in life, and the wages they could earn if they work;
6. they don’t know how their and their partner’s investments will work out, or whether they will be subject to fraud and crime.

In principle, some or many of these risks can be shared within a cohort. Financial markets provide an accessible way to share idiosyncratic investment risks. Families
and insurance markets provide a way of sharing health risks. A pension scheme delivering annuity income provides insurance against having few resources if you live much longer than average. A pension scheme also provides a way of sharing the risk of poor late-life work opportunities as those with low incomes can take the pension rather than work.

However, many of the most important risks cannot be shared within a cohort. For example:

1. the average life expectancy of a cohort may be different than expected;
2. average working-age incomes may be different than expected because of random aggregate productivity outcomes linked to the rate of technological growth;
3. average capital returns may be different than expected;
4. average health expenditure may be different than expected; and
5. the government may expropriate the cohort’s resources.

These risks are potentially large. If a cohort expects to live 20 years after the standard retirement age and it lives 25 years, average annual retirement resources are reduced by 20 percent. If real investment returns were one percent lower than average, the average annuity income earned by members of a cohort would fall by over 25 percent. Since most New Zealanders over 65 have total income less than a third more than the poverty level, such risks have the potential to sharply increase poverty unless risks are shared and mitigated.

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. As Merton (1983) observed, however, such contracting is inherently difficult.

Consider a cohort aged 30 at time \( t \) that is worried about the resources available to it at time \( t+50 \) when aged 80. Some of the younger generations who could provide it with resources at age 80 will not be born at time \( t \), and therefore cannot be voluntarily contracted. Some of the risks affecting income at \( t+50 \) will be realized before \( t+50 \), reducing the opportunities to share risk as younger cohorts will not wish to enter
contracts that require certain transfers to older generations. Moreover, contracts that require a younger cohort to make large transfers to an older cohort may be difficult to enforce, particularly if the younger cohorts are in control of the normal enforcement institutions, or can choose to migrate.

Merton 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 a mixture of foreign and local goods and services, and the prices of many local services will be correlated with local incomes. Assets providing a return linked to local labour incomes typically do not exist, however, because of the difficulty of enforcing such contracts. 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.

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. Two government programmes in common use concern pensions and education. A government can provide a pension to old people funded by taxes on younger workers that is that is proportional to wage incomes. If the pension is structured so its payment streams are independent of investment outcomes and shocks to life expectancy, these pensions would share risk in a manner not otherwise possible, and thus have the potential to raise the welfare of all generations. A government could also provide free education to youth and impose progressive income taxes to recover the average cost of education. These taxes redistribute the tax burden when wage growth is different than expected, providing insurance to retired cohorts.

3.1 Government pension policies as risk sharing devices: macroeconomic risk.
The structure of government pension policies has a large effect on the way risk is shared in an economy. The extent pensions are funded on a pay-as-you-go rather than
a save-as-you go basis, the extent pension benefits are defined in terms of set of exogenous criteria such as wage levels rather than linked to contributions and investment returns, and the extent pensions entitlements can be changed by the political process have major ramifications for the ways different types of aggregate and idiosyncratic shocks are absorbed.

Following Bohn (2005), Table 7 lists several of the major macroeconomic risks affecting retirement. In each case the focus is on aggregate rather than idiosyncratic risk. The first column shows the effect of a shock on a SAYGO-funded retirement plan in which benefits are linked to contributions and 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 pension linked to average contemporaneous wages. The first three risks concern macroeconomic shocks affecting wage and investment returns, while the last two are demographic shocks.

Much of the literature on this topic concerns investment risk, for the volatility of investment returns makes many people wary of being too reliant on capital incomes during their retirement. Obviously defined contribution SAYGO schemes expose holders to much more investment risk than defined benefit PAYGO schemes, reducing their attractiveness. Three downside risks feature in the literature: a long period of low investment returns that reduces the sum investors accumulate up to the point of retirement; 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 risk of high inflation during retirement. Each of these shocks reduces the resources available to people in their retirement. In each case a defined benefit PAYGO scheme reduces this risk by providing a retirement income independent of investment returns. These considerations suggest that a PAYGO retirement income scheme linked to wages should be part of an optimal retirement package, one which balances the average returns from each type of asset against its risks. Some analysts go further and argue that governments should only using pay-as-you-go funding for a defined benefit pension scheme such as New Zealand Superannuation (Littlewood 2010.)
Table 7: Effect of different macroeconomic risks on pension schemes

<table>
<thead>
<tr>
<th>Risk</th>
<th>Effect on SAYGO pension</th>
<th>Effect on PAYGO pension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low capital investment returns, but normal wage growth</td>
<td>Low pensions due to low capital returns and low consumption in old age.</td>
<td>Normal pension payments in old age as pension linked to contemporaneous wages.</td>
</tr>
<tr>
<td></td>
<td>Low wages reduce retirement saving when working age</td>
<td>Low wages offset by reduced contributions when working age</td>
</tr>
<tr>
<td></td>
<td>Low pensions in old age due to low saving.</td>
<td>Low pension payments in old age as pension linked to contemporaneous wages.</td>
</tr>
<tr>
<td>Normal capital investment returns, but low wage growth</td>
<td>Low wages reduce retirement saving when working age</td>
<td>Low wages offset by reduced contributions when working age</td>
</tr>
<tr>
<td></td>
<td>Low pensions in old age due to low capital returns and low savings.</td>
<td>Low pensions in old age as pension linked to contemporaneous wages.</td>
</tr>
<tr>
<td>Low productivity growth reduces capital returns and wage incomes</td>
<td>Low wages reduce retirement saving when working age</td>
<td>Low wages offset by reduced contributions when working age</td>
</tr>
<tr>
<td></td>
<td>Low pensions in old age due to low capital returns and low savings.</td>
<td>Low pensions in old age as pension linked to contemporaneous wages.</td>
</tr>
<tr>
<td>Large contemporaneous cohort causes low wages when working age</td>
<td>Low wages reduce retirement saving when working age</td>
<td>Low wages offset by small per capita pension contributions when working (due to large cohort).</td>
</tr>
<tr>
<td></td>
<td>Low pensions in old age due to low saving.</td>
<td>Normal pension payments in old age as linked to contemporaneous wages.</td>
</tr>
<tr>
<td></td>
<td>If the large cohort increases the capital stock and reduces investment returns, low pension in old age (Baby-boom, baby bust).</td>
<td></td>
</tr>
<tr>
<td>Higher than expected longevity.</td>
<td>Cohort may run out of capital resources if it has high longevity and annuities are not available.</td>
<td>Higher pension contributions if preceding generation has high longevity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Length of pension payments automatically extended if contemporaneous cohort lives longer than expected.</td>
</tr>
</tbody>
</table>

While it is clearly true that SAYGO-funded retirement income schemes expose retirement incomes to greater capital income risk than PAYGO-funded schemes, three factors offset these concerns.

1. 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. While the 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; 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 markets19.

2. 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.

3. The real issue is not so much capital income risk versus labour income risk, but the fundamental causes of these risks. One of the major macroeconomic risks facing an economy is long term productivity risk. If a country experiences poor productivity, both labour incomes and local capital incomes will be poor. This will lead to poor retirement incomes in both SAYGO- and PAYGO-funded retirement income schemes, in part because saving levels while working will be affected by low incomes, and in part because retirement incomes will be low either because of poor investment returns or because they are linked to the low wages of contemporaneous workers. It will also lead to low lifetime incomes. Bohn (2005 p13) argues that since wage levels are as exposed to productivity risk as capital incomes, 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 take on more capital income risk, particularly diversified foreign capital income risk, to reduce their exposure to local productivity shocks (Acemoglu and Zilibotti 1997.)

As these considerations suggest, 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

19 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, Rangelova and Samwick (2001) and Feldstein and Liebman (2002).
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 life-time income cannot be and smoothed through temporary adjustments to consumption and saving.

If households hold additional capital assets in retirement as part of a strategy to reduce lifetime exposure to wage and productivity risk, they increase their exposure to asset price risk. Asset price risk associated with permanent changes in earnings is difficult to diversify and for this reason this risk commands a high price (Campbell and Vuolteenaho, 2004). However, many fluctuations in asset prices are temporary and reflect changes in the rate at which earnings are discounted. Temporary asset price risk can cause acute problems to retirees, due to their limited life expectancy. Because these risks are temporary, however, they have the potential to be shared across cohorts. In particular, a government offering a public SAYGO funded retirement income scheme can use its balance sheet and taxation powers to shift the temporary asset price shocks hitting any particular cohort to other cohorts. For example, if a cohort experiences a sudden increase in potential annuity income when it reaches retirement age, either because of temporarily high interest rates or asset prices, the surplus can be kept by the government fund for subsequent cohorts that experience low outcomes, or passed on as reduced tax rates.

This analysis suggests there is considerable opportunity for governments to manage the risks caused by temporary asset price fluctuations that cohorts face when they retire. If these problems can be solved, it becomes easier for retired cohorts to have greater exposure to capital income earning assets. A save-as-you-go (prefunded) government defined benefit pension scheme is one way to manage these risks. However, other alternatives are possible. For example, a government could offer minimum return guarantees to mandatory private saving accounts, using its ability to tax working age cohorts to fund the guarantees. Modern finance theory suggests myriad other alternatives are possible.
Ultimately, the extent that a government adopts a pay-as-you-go funded retirement income programme as a means of sharing investment and macroeconomic risk should depend on its risk and return characteristics relative to save-as-you-go schemes. Most of the best know writers on the topic argue it is desirable to have both (eg Diamond 1996, 1997; Shiller 2003b; Feldstein 2005). Given that the additional return from save-as-you-go schemes are considerable when the rate of return to capital exceeds the growth rate of the economy, it is important to accurately categorize the risks of both types of schemes. In addition to wage risk and investment risk, government schemes suffer from a sizeable risk of political interventions that change the size of retirement benefits (Diamond 1997; Shoven and Slavov 2006). As McHale (2001) documented, most G7 countries made very large reductions in their PAYGO funded pension schemes between 1980 and 1995, and many have subsequently cut them further in response to budget pressure.

It should also be noted that there are other ways that governments could intervene to enhance an economy’s ability to share intergenerational risk rather than providing PAYGO-funded defined benefit pension schemes. Shiller (1993, 2003a) argues that a Government could use its taxation powers to create risk-sharing financial contracts. For example, if cohorts saving for retirement wish to purchase securities linked to wage growth, the government could fund infrastructure investments using long term bonds indexed to domestic wages and sell these funds to pension schemes. Since the bonds would be repaid from tax revenues that themselves are linked to wages, the government would reduce its own risk exposure while at the same time enabling cohorts to have additional exposure to domestic wage growth. These risks need to be taken into account when considering the extent that PAYGO and SAYGO-funded schemes are used to provide retirement incomes.

3.2 Government pension polices as risk sharing devices: demographic risk.
Government PAYGO–funded defined benefit pension schemes linked to average contemporaneous wages also enable cohorts to diversify aggregate demographic risks. Two of the largest demographic risks are the possibility that the birth size of a generation is larger than or smaller than normal, and the possibility that average life expectancy is larger than expected.
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 PAYGOS-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 with using a PAYGO-funded pension scheme as a hedge against cohort size are political. Suppose there is a large generation approaching retirement age. As the size of this generation and the subsequent generations are known, the younger cohorts will have to be compelled to make unusually large retirement income contributions to the older cohorts. For them to do this willingly, they will have to accept that the pension scheme provides insurance cover as if from behind a Rawlsian veil – that is, as if the outcomes were not known at the time the cohorts were born. 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.

A second 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 as they are subject to adverse selection issues. 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 maybe unable to do so, at least at actuarially fair prices.\(^20\)

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 longevity of a cohort is greater than expected, additional retirement income payments are made and subsequent cohorts are required to pay extra taxes. Since longevity shocks are typically persistent, these cohorts will typically receive longer pensions in turn, meaning the lifetime cost they face is the opportunity cost of the additional payments, the difference between the return to capital and the growth rate of the economy multiplied by the size of the additional payments. A SAYGO-funded public pension scheme without annuitization does not have this feature; rather adjustment in this case would take place through reduced pension payments as information about longevity is revealed.

If the provision of risk-sharing annuitized income is one of the benefits of a PAYGO-funded pension scheme, the scheme should be designed to enhance these advantages.

\(^{20}\) 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.
One of the issues facing individuals reaching retirement age is the inability to purchase an annuity greater than that provided by the government (Bernheim 1991). A government could solve this issue by allowing individuals to delay the time they first obtain a pension in exchange for obtaining a larger pension. By using non-annuitized assets to fund the first years of their retirement, an individual could use the “delay” mechanism to purchase additional annuity income from the government and thus minimize the risks they face of outliving their financial resources.

3.3 Discussion

Risk considerations suggest that PAYGO-funded government retirement schemes have some role in the overall package of a country’s retirement income policy. These schemes have a different risk profile than SAYGO-funded schemes, and can hedge different risks. In particular they can use the government’s ability to tax subsequent generations to hedge productivity risk, capital income risk, asset price risk, cohort size risk, and longevity risk in ways that cannot be easily replicated using either public or private SAYGO schemes. If schemes can be designed that hedge the income risks facing different cohorts, there is scope for pareto improving welfare gains even in a dynamically efficient economy.

The appropriate amount of a PAYGO scheme will depend on the balance of risk and return. The opportunity cost of a PAYGO scheme offering a return linked to productivity growth is the difference between the rate of return to capital and the economic growth rate multiplied by the annual size of the scheme, a sum that can be considerable. Because the intergenerational risk sharing opportunities of PAYGO schemes result in transfers between cohorts, these schemes also introduce new types of political risk that can undermine the sustainability of the schemes if they become too large. For this reason, over-reliance on PAYGO-funded transfer schemes can be problematic.

Some forms of risk can be shared with relatively small schemes. For example, the longevity insurance provided by 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 is 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 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. It follows 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 SAYGO rather than PAYGO funded.

These considerations suggest a government could be more creative with the different forms of financial contracts it issues to diversify intergenerational risks (Shiller 2003a). 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 SAYGO-funded pension funds with the ability to diversify their investment risks. Such instruments would appear to be a useful supplement to other methods of managing intergenerational risk and provides a largely unexploited avenue for public policy interventions.

While this discussion has been fairly narrowly focused on aggregate retirement income risk, other risks can be shared across generations. For example, governments can and do use debt financing to smooth the cost of temporary economic shocks, perhaps to pay additional unemployment insurance payments during a recession. Governments use a mixture of prefunding and debt finance to spread the financial cost of natural disasters or wars across multiple cohorts or generations. And governments can use progressive income taxes to shift the risk of productivity shocks that affect different cohorts differently across cohorts, as those cohorts doing relatively well will pay a higher fraction of the tax burden. The extent that a government accumulates assets in advance of a negative shock rather than repays debts after the shock is realized will depends on its attitudes towards risk, and its willingness to transfer resources to or from current generations to future generations. In turn, this will depend on the ways it evaluates intergenerational welfare.
4. Assessing intergenerational welfare

What is the appropriate quantity of intergeneration assets that one generation should provide to its successors? This is a deeply contentious question that many if not most economists have decided is fundamentally a question of ethics. At least three major positions have been identified.

1. A generation may choose to leave intergenerational assets to its successors, particularly those to which it has an emotional link (such as its children), or it may choose to make transfers to contemporaneous older people, but it has no ethical obligation to do so. There is no greater obligation to give resources to unborn people several hundred years in the future than there is an obligation to give to currently poor people (Schelling 1995). Since there isn’t a firm ethical obligation to give to the contemporaneous poor, there shouldn’t be a firm ethical requirement to give to distant future generations. If people choose to adjust the quantity of assets they bequeath to other generations because of ethical considerations, it should be on a similar basis to the way they help the contemporaneously poor.

2. A generation should act so the total utility of all generations, discounted at an appropriate rate, is maximized.

3. A generation should aim to bequeath a stock of intergenerational assets to its successors as least as large as it was bequeathed. To ensure the society is on a sustainable development path, a generation should not intentionally undertake actions that reduce the stock of assets available to subsequent generations that will adversely affect its wellbeing.

This section provides an overview of the key issues surrounding the utility maximization and sustainability metrics that are used to evaluate policies that transfer resources between generations. For a fuller discussion of many of these issues, particularly those concerning discounting, see Arrow et al (1995).

4.1 Utility maximization and discounting

When governments make decisions that have effects in different periods, they usually evaluate the total value of the policy by discounting the costs and benefits that occur at different times to bring them onto an equivalent basis. The literature on discounting approaches the issue in two different ways, one based on cost benefit analysis and the
other on time preferences. The approach based around time preferences is most relevant to this paper. This approach is predicated on the observation that most people value the pleasure or utility that stems from future consumption less than they value current consumption simply because it occurs in the future and has to be waited for.\textsuperscript{21}

For this reason, economists find that when they analyse human choices, it is realistically done by assuming there is a rate of time preference that can be used to discount the utility value of future consumption. For many decisions, it is useful to model people as making choices that maximize the discounted sum of the utility they derive from consumption in different periods. If \(\{C_t, C_{t+1}, C_{t+2}, \ldots C_T\}\) are the levels of consumption anticipated in a finite number of different periods, the current value of this consumption stream is frequently represented as\textsuperscript{22}:

\[
U(t) = \sum_{i=0}^{T} \rho(t+i)u(C_{t+i})
\]

where \(u(C)\) is a measure of the utility or pleasure obtained from a particular level of consumption and \(\rho(t+i)\) is a measure of the time preference used to discount this utility. Until recently most economists have assumed the discount schedule is exponential:

\[
\rho(t+i) = (1 + \rho)^{-i}
\]

where \(\rho\) is known as the pure rate of time preference. This is still the standard approach in most macroeconomic models because only exponential discounting provides an individual with a time-consistent decision path (Strotz 1955)\textsuperscript{23}. This rate of preference is not directly observed, although there are reasons to believe that in equilibrium market returns will reflect the distribution of rates of time preference across agents.

\textsuperscript{21} Naturally, it is recognized that some things are best anticipated, at least for short periods of time, but this doesn’t change the general nature of the observation.

\textsuperscript{22} Equation 3 is written as if utility is intertemporally separable: that is the enjoyment a person gets from consumption in one period does not depend on their levels of consumption in other periods. This is quite a stringent restriction that does not need to be made; for the purposes of this paper it simplifies the exposition.

\textsuperscript{23} Economists increasingly recognize that time preferences are better represented by a hyperbolic discount function which involves a large discount for the first period consumption is delayed, and a much smaller discount thereafter:

\[
\rho(t) = \frac{1}{a + pt}
\]

This formulation is an example of Herrnstein’s matching law (Ainslie 1991). An approximation popularised by Laibson (1997) is hyperbolic discounting, \(\rho(t) = \phi \varphi^t, t > 0\), where \(\phi\) is a factor that reflects the penalty of waiting for any time at all. See Loewenstein and Prelec (1992) for a discussion of many of the problems with the discounted utility model for individuals.
The theory that individual time preferences can be modeled using equation (1) is often used to motivate the use of a similar equation to provide a metric for valuing consumption across different generations:

\[ U(t) = \sum_{i=0}^{\infty} \frac{(1 + \rho)^{-i}}{\rho} u(C_{t+i}) \]  

(3)

For example, this equation could be used to consider the pattern of expenditure that a utilitarian social planner - or a government - might choose to maximize the welfare of all current and future agents in an economy. Such equations are ubiquitous in modern macroeconomic theory, having been pioneered by Ramsey (1928) and Samuelson (1937).

The similarity of equations (1) and (3) hides the assumption in equation (3) that it is appropriate for a social planner to use the same discount rate to value the utility of different people born in different periods as it to use to discount a single individual over the course of their life. For non-zero discount rates, this means

(i) the utility of people living in the present and the near distant future is considered much more important than the utility of people in the medium-to-far distant future, whose discounted utilities are near zero;

(ii) the utility of people separated by time in the medium distant future (eg people alive in 300 years’ time rather than 350 years’ time) are valued quite differently.

Many economists (and others) have found these two implications unsettling, for they do not match well with their own views of the relative importance of people living in different periods. Arrow (1999), for example, provides a list of damning comments by many famous economists who find it strange that we think a social planner should value the utility of people differently simply because of the date of their birth; and Schelling (1995 p396) focuses on the second implication, noting

“Introspectively I can find no impatience about an increment of consumption that may accrue to people whom I shall never know and who do not now exist, in the year 2150, compared with an increment closer in time, accruing to people whom I shall never know, and who do not now exist, who might enjoy it instead in the year 2100.”
Indeed, it would appear there is no *logical* reason why a utilitarian social planner may maximize the sum of utilities discounted by exponentially by the rate of individual time preference.

Nonetheless, if a utilitarian social planner were to maximize the discounted sum of utilities, equation (3) has a second implication. In a world where incomes are steadily increasing, say at rate $g$, the marginal benefit (utility) of additional consumption can be expected to be steadily decreasing. In this case, an intergenerational action that transfers *resources* (not utilities) from the current time to a time $T$ periods in the future needs to be discounted not only by the rate of time preference but a factor that reflects the different utility of those resources because the generation is wealthier. The combination of these terms is the social discount rate, $\delta$; when there is steady growth, this is equal to

$$\delta = \rho + g \theta$$  \hspace{1cm} (4)

where

- $\rho =$ individual rate of time preference
- $g =$ growth rate of consumption
- $\theta =$ elasticity of marginal utility with respect to consumption.

The last term $\theta g$ can be considered a wealth effect.\(^{24}\)

This logic suggests that if a utilitarian social planner were to choose policies that affect intergenerational assets in order to maximize discounted utility, he or she should discount using the social discount rate, not the rate of individual time preference. The social discount rate is not observable, but following Ramsey (1928) economic logic suggests that in the absence of taxes or other distortions it should be equal to the return to capital when an economy is in equilibrium. This provides a rationale for using the return to capital to discount future consumption flows that is quite separate from strict cost-benefit analysis. Note, however, that to discount in this manner is to make a large number of questionable assumptions, assumptions that have

\(^{24}\) See the discussion by Groom et al (2005)
been found wanting my many including the economists who pioneered this technique.\footnote{Ramsey (1928 p543), for example, decried the practice of discounting “later enjoyments in comparison with earlier ones” as “ethically indefensible and arises merely from the weakness of the imagination.”}

Since most economists and government agencies use discounting methodology, the most relevant issue is the appropriate discount rates. Even if the pure rate of time preference $\rho$ is set at zero, there is enough uncertainty about the expected growth rate $(g)$ and the elasticity of utility with respect to consumption $(\theta)$ to have a wide range of discount rates.\footnote{Weitzman’s (1998) point applies here as well: that if there is a range of discount rates, in the long term the minimum of the range should be used.} Unfortunately, small differences in discount rates can lead to significantly different rankings of policies with long time frames. There is not much guidance, except a growing consensus that discount rates should decline with horizon (Weitzman 1998; Groom et al 2005).

### 4.2 Economic Sustainability.

A different approach to intergenerational equity is the principle of economic sustainability. In broad terms, this means each generation should be left sufficient quantities of intergenerational assets that it can have a standard of living at least comparable to the current generation. Advances in technology mean that consumption standards are likely to keep increasing, even if the stocks of some assets decline. (For a comprehensive analysis of this conjecture, see Dasgupta and Heal (1974).) For this reason, much of the literature on sustainability concerns long term environmental outcomes, out of concern that reductions in the stock of environmental assets may have long term adverse effects on future generations. Nonetheless, the same logic applies to economic policies that concern long term tax rates. For instance, as discussed at length in sections 2 and 5, if a society adopts a pay-as-you-go funded superannuation scheme, all generations except the first will have higher tax rates than they would have if the society adopted a save-as-you-go superannuation scheme. In both cases, the policies that lead to an increase in consumption for the first generation are not sustainable, because they cannot be implemented without an increase in taxes on subsequent generations.
A social planner attempting to achieve economic sustainability has a goal quite different from an utilitarian social planner attempting to maximize the discounted sum of utilities. If the discount rate is positive and does not decrease asymptotically to zero, the welfare of distant generations is completely negligible in the latter case. Clearly discounting is not consistent with the goal of economic sustainability in which a social planner attempts to choose policies that allow all future generations to have welfare in excess of a certain minimum level. Rather, the sustainability objective is met by choosing policies that ensure a long term average standard of living is achieved, or a minimum level of an intergeneration asset stock is maintained.

Mathematically, a “sustainability” social planner can with preferences over a policy $X$ that delivers a stream of utilities to people living in different periods $\{U_0, U_1, U_2, \ldots\}$ can be represented by a preference function calculated over the long term average value of utility:

$$U\_{\text{sustain}}(X) = \bar{U} = \lim_{N \to \infty} \frac{U_0 + U_1 + \ldots + U_N}{N}$$

The utility in each period can depend on a variety of factors that affect living standards such as consumption levels, the quality of the environment, and so on. Note that the average is dominated by the infinite number of terms in the distant future, so that this formulation depends on the limit value of $U_t$. It is equivalent to using a zero discount rate. This metric means that policies that deliver low long term outcomes to the distant future, perhaps by imposing high taxes on future generations or by delivering them an irrevocably polluted environment, are valued poorly.

While this ethical framework has some attractions as it treats the welfare of all people symmetrically and does not discriminate against them merely because of the date of their birth, it is at odds with another strongly held moral principle: that it is not incumbent for an individual to sacrifice him or herself for the betterment of others. Arrow (1999) argues that an implication of using a zero discount rate is that the present generation should save most of its income and invest it for others, for even though this may dramatically reduce current utility, this loss will be offset by a small increase in utility for an infinitely large number of future souls. He rejects this argument as being inconsistent with normal moral precepts.
Chichilnisky (1996) provides an elegant synthesis. She argues that a utilitarian social planning framework such as equation 3 implies the “dictatorship of the present over the future”, in the sense that long term outcomes do not matter when choosing policy options. In contrast, a sustainable social planning framework such as equation 5 implies the “dictatorship of the future over the present,” as short term outcomes do not matter when choosing policy. She analyses welfare frameworks in which there is neither the dictatorship of the future over the present, nor the dictatorship of the present over the future and shows they must comprise a weighted average of two terms

1. a term that involves the dictatorship of the future by the present, because far distant terms are discounted to zero; and
2. a term that involves the dictatorship of the present by the future, because the long term limit value matters.

Thus the only acceptable welfare functions must have the form

\[ W = \alpha \sum_{g=0}^{\infty} \lambda^g u_g + (1-\alpha) \lim_{g \to \infty} u_g \]  

(6)

where \( \alpha = \) a non-zero weight
\( \lambda = \) a discount factor over utilities
\( u_t = \) utility in period \( t \)

Welfare frameworks not meeting this criteria can be criticized for neglecting the interests of one group or other – although, as noted at the start, it remains a coherent position to asset that the present generation does not have an ethical obligation to consider the welfare of future generations.

**Resilience and irreversibility.**

Any welfare metric that does not involve the dictatorship of the future by the present has to be concerned about actions that cause irreversible losses to intergenerational asset stocks. Most of these issues concern irreversible damage to the environment, such as species extinction, but it is possible to consider other long term issues such as the introduction of a debilitating medical condition, or the possibility of long term economic or social catastrophes. If irreversibility is an issue, different policies can lead to very different long term outcomes. In this case, policy makers will want to be
particularly concerned about policies that may tip a society from a path that has good long term outcomes to one that has poor long term outcomes.

As Perring (1998) makes clear, the key issue is resilience, which he describes as a function of the probabilities of making a transition from one state to another. Economic and social policies may differ along two different dimensions. First, they may differ in terms of the size of the possible outcomes they achieve. Secondly, they can differ in terms of the probabilities with which they experience these outcomes. For example, one policy may have a 10 percent chance of a recession (or an outbreak of a deadly epidemic) each year while another may only have a 5 percent chance. While long term average outcomes depend on the transition probabilities as well as the size of the outcomes, the sustainability of any policy depends largely on the transition probabilities and the likelihood of an irreversible or near irreversible event.

An economy is resilient if it has a low probability of making the transition to an irreversible state or set of states. Using this framework Acemoglu and Zilibotti (1997) consider the process of economic growth where investment possibilities are risky, but where low income countries are limited in the range of investments they can undertake. They show that up to a certain income level the economy will not be resilient, as bad shocks can provide debilitating setbacks. Once this income level is reached it is possible to diversify sufficiently that shocks no longer cause permanent losses. In these circumstances, short term saving sacrifices by one generation to push the economy past this income level can induce very large long term rewards. Examples such as these raise difficult issues about the appropriate levels of investment in intergeneration assets that a generation should make for its successors, if underinvestment can significantly increase the chances of future collapse.

5: Example: the economics of expanding a PAYGO pension scheme

This section uses the Treasury Living Standards framework to examine the economic consequences of one New Zealand’s main policies that transfers resources between generations: New Zealand Superannuation, the primary government retirement

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27 Technically, the first case, where a particular outcome is no longer possible is a subset of the second case where all transition probabilities to the “extinct” outcome are zero. As they are qualitatively different, it is useful to treat them as different cases.
income scheme. In particular, it considers the implications of a PAYGO-funded expansion of New Zealand Superannuation due to increasing longevity. The consequences are contrasted with the effects of a SAYGO-funded expansion of New Zealand Superannuation or a supplementary mandatory private retirement saving scheme.

The Treasury Living Standards framework assesses policies according to five criteria:

1. economic growth or performance;
2. sustainability for the future;
3. increasing equity;
4. social infrastructure;
5. reducing risks.

The framework is used to consistently evaluate policies along a number of different dimensions. Once the effects on these various dimensions are identified, decision makers or the public can weight them to come to a conclusion about the overall merits of a proposal.

5.1 New Zealand Superannuation

New Zealand Superannuation is a largely pay-as-you-go funded tier 1 pension scheme funded out of general taxation (see Appendix 1 for a brief description of these terms and of different pension schemes). All people over 65 meeting a residency criteria get the same pension, which is set at 65 percent of average wages for a couple, and slightly more per person for singles.

When life expectancy conditional on turning 65 increases by a year for cohorts born after year \( s \), but the age of entitlement is maintained at 65, there is an effective increase in the size of the pension scheme. The first cohorts born after year \( s \) will get a pension for a year more than the preceding cohorts, and thus will get additional pension payments. This expansion could be funded on a pay-as-you-go basis or on a save-as-you-go basis. Funding it on a save-as-you-go basis would require a cohort born in year \( s \) to pay sufficient additional taxes when working age to cover the expected increase in pension payments, with the taxes accumulated in a fund similar to the New Zealand Superannuation Fund. Funding it on a pay-as-you-go basis would require younger cohorts to pay additional taxes when the cohort born in year \( s \) turned
65. Funding the expansion of New Zealand Superannuation on a pay-as-you-go basis therefore involves a transfer to the first generation of recipients, as those cohorts obtain more years of pension benefits than they provided to earlier cohorts. While subsequent generations also get pension payments for longer, these payments are offset by the higher tax payments made to the previous generation of recipients.

A key insight of the literature discussed in section 2 is that an additional transfer to the first generation of recipients comes at the expense of reduced consumption for all subsequent generations even if these generations also get the pension for an expanded period of time. 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. If the rate of return to capital \((r)\) exceeds the growth rate of the economy \((g)\), 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 to get a retirement income from a government pension rather than by saving.

Three observations can be made about this opportunity cost. First, the opportunity cost is rising. The Long Term Fiscal Plan (New Zealand Treasury 2009) estimates that the size of the tax payments needed to fund the current form of New Zealand Superannuation steadily increases from approximately 3.7% of GDP to 7.3% of GDP by 2060. In addition, changes in demography mean the growth rate of the population is likely to reduce over time, suggesting the opportunity cost \((r-g)\) will 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. This is shown schematically in figure 8.

Secondly, 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 – the taxes needed to fund New Zealand Superannuation payments on a pay-as-you-go basis are over twice as large as the taxes needed to fund it on a save-as-you-go basis\(^{28}\). If the return to capital is only 1.25 percentage points higher than the growth rate the taxes needed to fund New Zealand Superannuation payments on a pay-as-you-go basis are

\(^{28}\) See the calculations in Appendix 1.
still fifty percent higher than the taxes needed to fund it on a save-as-you-go basis. If the age of eligibility were to remain the same and the size of New Zealand superannuation payments were to increase from 3.7 percent of GDP to 7.3 percent of GDP over the next fifty years, the annual opportunity cost on future generations would increase by approximately 2 percent of GDP, or $4 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 4 percent of GDP. This will be approximately twice as high as the cost they would face in Australia, which is adopting a partially SAYGO-funded retirement income scheme.

Thirdly, 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. A simple proof of this result is shown in Appendix 1. 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.
Even if the net present value of a PAYGO scheme is zero when discounted at the rate of return to capital, this does not mean the programme is welfare neutral. First, it involves a redistribution from one set of cohorts to others, which has welfare implications. Secondly, a society wishing to adopt policies that maximise the discounted sum of current and future utility would not normally use the real rate of return to capital to make this calculation. Rather, it would use its preferred social discount rate. As Ramsey (1928) pointed out, there are reasons why the return to capital will tend towards the social discount rate in the long term, for individuals have an incentive to save and invest whenever the return to capital exceeds their rate of time preference adjusted for consumption growth. However, it may not be equal in the short run. If the social discount rate is higher than the return to capital, the discounted sum of the transfers associated with an expanded PAYGO pension scheme will be positive: in essence, society will want to transfer resources from the future to the present because they discount the welfare of future generations at such a high rate. If the social discount rate is lower than the return to capital, the discounted sum of the transfers associated with an expanded PAYGO pension scheme will be negative. One reason why this might occur is because of the way capital income is taxed, for when capital incomes are subject to income tax the private return is less than the social return. If individuals invest until the after tax return to capital is equal to their rate of time preference (adjusted for consumption growth), capital stocks will be sufficiently low that the pre-tax return will exceed the social discount rate\(^{29}\). If this were the case, lowering the level of private capital further by expanding a PAYGO pension system would reduce welfare overall, even though it increases the welfare of the first generation receiving the transfer.

It can also be noted that even if one uses a discount rate equal to the rate of return of capital, the expansion of a PAYGO funded pension scheme will result in a redistribution that reduces intergenerational welfare measured by any of the class of Chicilnisky’s axiomatic welfare functions that require neither the dictatorship of the future by the present nor the dictatorship of the present by the future. These functions calculate an average of the discounted sum of utility and the change in the long run

\(^{29}\) See the discussion in Linbeck and Persson (2003) or Feldstein and Liebman (2002)
utility of future generations. If the former is zero and the latter is negative when a PAYGO-funded pension system is expanded, aggregate welfare must decline.

5.2 Assessing a PAYGO-funded expansion of New Zealand Superannuation using the Treasury Living Standards framework

When each birth cohort experiences an increase in average longevity but the age of eligibility for New Zealand Superannuation is not changed, there is an expansion in the size of New Zealand Superannuation because each cohort receives pension benefits for more years than it was required to fund them. Consider a cohort born in year $s$ that on average gets $E(s)$ years of pensions beginning year $s + 65$. When $E(s)$ is rising through time, the taxes required to pay pensions will rise through time, as will the opportunity cost of those additional tax payments on subsequent generations. Recent evidence suggests longevity may be increasing by between 2 and 3 years per decade (Christensen et al 2009), suggesting a substantial expansion of the length of time a person may expect a pension if the age of entitlement is not changed.

The effect of the increasing pension payments and taxes can be assessed using the five dimensions of the Treasury Living Standards framework. This increase can be compared to the benchmark case where every cohort is provided with an average of $\bar{E}$ years of pension entitlement because the age of entitlement is increased in line with longevity. In this benchmark case people would have to use a mixture of voluntary saving or additional workforce participation to provide income for the $k$ years between 65 and the higher age of entitlement. This default option is chosen to emphasise that not changing the age of entitlement represents an expansion of the average length of time cohorts get a pension payment and thus a transfer to those cohorts that first benefited from the increased longevity.

5.2.1 Economic Growth

(a) A PAYGO-funded expansion of New Zealand Superannuation will require increased taxes. This will decrease the allocative efficiency of the economy, by reducing the incentive to participate in the workforce and by increasing the incentive to invest in tax sheltered assets. The deadweight costs associated with higher taxes could be substantial, although will depend on the type of the tax that is increased. It is plausible that
increasing expenditure taxes or introducing a land tax would have lower deadweight costs than increasing income taxes.

(b) The increase in taxes will affect the incentive to save, although saving could increase or decrease depending on the rate of intertemporal substitution. It will also reduce retained earnings available for reinvestment in businesses. If firms are liquidity constrained, or they are reluctant to increase their borrowing to fund investment, investment will decline.

(c) A PAYGO-funded expansion of New Zealand Superannuation will reduce wealth accumulation in the economy. A cohort born in year $s$ gets a transfer by being given more years of pension than it funded, and thus increases its consumption; as subsequent cohorts face an increase in taxes but receive a promise of increased pension benefits themselves, their consumption is likely to fall by little so their saving should reduce. The result is a net decrease in wealth accumulation.

(d) The decrease in wealth will lead to a decrease in local capital unless there is a completely offsetting increase in foreign investment; if this substitution does not occur, the decrease in capital/labour ratios can be expected to decrease wage levels.

Overall, a PAYGO-funded expansion of New Zealand Superannuation would reduce the long-run level of economic activity, and reduce growth rates in the transition to this new long run level. Long run growth rates may also fall due to the reduction in allocative efficiency.

### 5.2.2 Sustainability for the future

(a) A PAYGO-funded expansion of New Zealand Superannuation will increase opportunity costs on future generations by an amount \((r-g)/(1+r)\) multiplied by the increase in taxes. This is likely to reduce the political sustainability of the scheme as it becomes more apparent to younger generations that they are being asked to make a much larger sacrifice than older generations.

(b) The increase in the taxes needed to fund an expanded New Zealand Superannuation scheme is likely to reduce its political sustainability due to
the higher deadweight costs of these taxes, and the reluctance of many people in a society to pay high taxes.

(c) A PAYGO-funded expansion of New Zealand Superannuation will increase the likelihood of outward migration to Australia, as Australia has adopted a mandatory save-as-you-go personal saving scheme to supplement their PAYGO-funded pension scheme. Not only is their scheme particularly attractive to medium and high income earners, but as a SAYGO-funded scheme the contributions have a much lower opportunity cost.

Overall a PAYGO-funded expansion of New Zealand Superannuation is likely to reduce its political sustainability, by making it more likely that future cohorts will revolt against it or leave the country.

McHale (2001) analysed how PAYGO-funded pension schemes were changed in several OECD countries in the 1980s and 1990s. He showed that most were retrenched, normally by cutting the future entitlements of contemporaneous middle aged workers rather than by cutting the entitlements of contemporaneous retired people. He further argued that middle aged agents have an incentive to cut their own future entitlements if they are likely to become onerous on future working age people, as this prevents even harsher cuts. This is because it is politically costly to cut the pensions of the currently retired, and thus only worth doing if really large cuts are made. Following this logic, a PAYGO-funded expansion of New Zealand Superannuation would raise the likelihood of a sudden retrenchment of the scheme by younger future cohorts, by increasing the gains to these cohorts from taking large and decisive actions.

5.2.3 Increasing Equity

(a) A PAYGO-funded expansion of New Zealand Superannuation will increase future within-cohort transfers from high income to low income households, as receipts are not tied to earlier tax payments. This will reduce income inequality by giving income to low income people or people with low late-life income opportunities for k additional years. Over time, the extent of the redistribution will be limited by the positive correlation between income and longevity, as many low income households will pay higher taxes when they
are working, but not live long enough to enjoy the increased pension benefits (Liebman 2002).

(b) This reduction in within-generation income inequality comes at the expense of additional intergenerational transfers, potentially increasing inequality. A PAYGO-funded expansion of New Zealand Superannuation increases the opportunity costs on future generations who already have high opportunity costs, and reduces them on the generations gaining from the expansion, who have much lower opportunity costs. As future generations are likely to have higher incomes than current generations, the effect on equity depends on how society evaluates these transfers. If it is mainly concerned about the fraction of income each cohort is required to transfer to other cohorts, this would significantly reduce equity by asking the cohorts experiencing the highest percentage opportunity cost to have an even higher cost. If it is mainly concerned about income levels, this would increase equality by making greater and greater transfers from future cohorts to current cohorts

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(c) A PAYGO funded expansion of New Zealand Superannuation will increase the fraction of retirement income paid out as annuity income. This is bad for people who have low life expectancy and good for people with average or high life expectancy. It may increase intergenerational wealth inequality by reducing the bequests of young low lifetime-income households who typically die younger than high-lifetime income households (Feldstein and Ranguela 2001; Gokhale et al 2001). Given that private annuity markets in New Zealand are practically non-existent, in general an increase in the availability of annuities has the potential to increase welfare. However, a simple expansion in the length of time people can obtain a fixed amount of annuity income is not particularly useful, as people could manage an additional $k$ years of average life expectancy by decumulating wealth for the first $k$ years after they turn 65. It would be much more useful to allow people to buy larger amount of annuity income if they desire.

(d) The increase in taxes associated with larger New Zealand Superannuation payments is likely to tighten borrowing constraints on younger cohorts, and

30 Many people note there is an asymmetry in the way people consider transfers from poor to rich. While it is widely considered that there is no need for the poor to transfer to the rich, this does not justify taking from them.
reduce their consumption. This is likely to reduce home-ownership rates and reduce lifetime welfare, even for those who pay less in taxes than the additional value of their retirement income (Coleman 2010.)

The key issue is the trade-off between intergenerational transfers and intragenerational transfers. Depending on the way taxes are levied, the expansion of New Zealand Superannuation involves a transfer from high lifetime income households to low lifetime income households. This transfer can be expected to reduce consumption inequality, although it still may reduce welfare of most households if the higher taxes tighten liquidity constraints on households when they are young. This intragenerational welfare gain or loss is offset by an intergenerational transfer from the future generations to present generations. This maybe seen as negative if one considers the transfer equivalent to unconsented intergenerational theft, or positive if one believes that transfers from future generations are warranted simply because they are likely to be wealthier than us.

5.2.4 Social Infrastructure

(a) The effect on social infrastructure depends on whether young and working age households consider the expansion of the PAYGO-funded pension scheme to be a naked grab for resources by a generation content to get more years of pension than they provided to their elders – the intergenerational conflict – or whether they consider it as a positive contribution to an older generation that provides them with a better sense of community. It could be interpreted either way.

(b) A pension scheme provides an insurance scheme against low late-life employment opportunities, perhaps because of ill health, perhaps because of technological redundancy (Diamond 2011). In principle, an expansion of the scheme improves social infrastructure by introducing an insurance system that is not offered by the private sector. In practice, people with low late-life income opportunities due to ill health already obtain other government benefits, so the improvement is likely to be modest.

Rangel (2003) makes the political economy argument that the willingness of a generation to make payments to older cohorts will depend on its view of the
generosity of those cohorts to other cohorts, both older and younger. An older cohort that provided large quantities of intergenerational assets to other cohorts will be supported; one that did not will be viewed as selfish and punished by cuts in the transfers its receives when old. Rangel argues that when there is an implicit linkage between the resources a generation provided to other generations and the resources it gets from younger generations when it is old, a working age generation has an incentive to provide an efficient amount of intergenerational assets to other generations. If a cohort wishes to expand the benefits it gets relative to the benefits it provided, it may undermine the social contract by which it is provided with transfers when it is old.

5.2.5 Reducing Risk

(a) A PAYGO-funded expansion of New Zealand Superannuation increases the link between retirement incomes and average New Zealand wages, as New Zealand superannuation provides a wage-linked pension, and reduces the link to capital market returns. It increases the chance that pensioners will have low retirement incomes because economic growth in NZ is low or because an economic disaster strikes, although increases the chance of high incomes if New Zealand productivity growth improves and wage levels catch up with those in the rest of the OECD. As it reduces exposure to capital market returns, there is less risk of low outcomes when capital incomes or asset prices are low.

(b) An increase in the length of the period that households get government pensions also significantly reduces the risk of low consumption in retirement because of poor investment strategies or fraud.

(c) An expanded PAYGO-pension scheme lowers capital accumulation and national wealth and thus increases macroeconomic risks.

(d) An expanded PAYGO-pension scheme also increase the risk of politically-inspired changes in the scheme, typically leading to lower pensions and consumption (McHale 2001)

5.2.6 Discussion

Figure 9 represents the likely effects of a PAYGO-funded expansion of New Zealand Superannuation on a pentagon diagram. The arrows summarise the effect of the policy
change compared to the default option in which the age of entitlement is increased with longevity, and people save voluntarily or work to provide for the additional $k$ years between 65 and the higher age of entitlement. Under this option each cohort receives a pension entitlement for the same number of years. An arrow pointed inwards suggests a likely worsening effect along a particular dimension, whereas an arrow pointed outwards represents an improvement.

The diagram indicates that the expansion would reduce economic growth and performance, due to the need to increase taxes, would reduce sustainability and worsen social infrastructure, and have mixed effects on risk and equity. There is a small increase in intra-generational equity, offset by a decrease in intergenerational equity because of the increasing opportunity cost falling upon future generations; and there is a change in risk exposure, with more exposure to wage and productivity risk, offset by reduced exposure to capital income risk and reduced exposure to idiosyncratic fraud and poor investment strategy. With little upside and considerable downside, expanding the scope of the PAYGO system would appear poor policy. Indeed, one could use this analysis to make the case for a reduction in the extent of the PAYGO system.
5.3 Assessing a SAYGO-funded expansion of New Zealand Superannuation using the Treasury Living Standards framework

If New Zealanders wanted to keep the existing payment structure of New Zealand Superannuation but expand the average duration of pension payments by maintaining the age of entitlement at 65 as longevity increases, they could fund the additional payments on a SAYGO rather than a PAYGO basis. In practice this could be done by raising taxes in advance of the increased Superannuation payments, and by placing the funds in the New Zealand Superannuation Fund until the additional pension payments were made. This scheme would mean that increases in the average length of entitlement to New Zealand Superannuation were prefunded by those cohorts benefiting from the expansion in pension payments. Since by assumption the payments would be exactly the same whether the expansion of New Zealand Superannuation were funded on a SAYGO or PAYGO basis, the differences 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.
The following comparison uses the living standards framework to evaluate a SAYGO-funded expansion of New Zealand Superannuation. The benchmark case is again one where the age of entitlement is raised in line with increasing longevity, and where people use voluntary savings or additional workforce participation to provide income for the \( k \) years between 65 and the higher age of entitlement.

5.3.1 Economic Growth

(a) The SAYGO-funded expansion of New Zealand Superannuation will require increased taxes. These will decrease the allocative efficiency of the economy, by reducing the incentive to participate in the workforce and by increasing the incentive to invest in tax sheltered assets. Compared to a PAYGO-funded increase, there would be a smaller increase in taxes, but one that was introduced earlier. As discussed above, if the difference between the rate of return to capital and the economic growth rate is 2.5%, the long term increase in taxes would be approximately half as much under SAYGO funding than PAYGO funding. Thus the average deadweight costs associated with SAYGO funding will be smaller than the deadweight costs associated with PAYGO funding, but will be higher in the short term. The other issues associated with higher taxes, such as the reduction in retained earnings, will also be smaller in the long term but larger in the short term.

(b) Unlike the PAYGO-funded expansion of New Zealand Superannuation, there would be little reduction in wealth accumulation or local capital accumulation in the economy. Capital accumulation may even increase as not everyone will reduce saving by the amount of the tax increase.

Overall, a SAYGO funded expansion of New Zealand Superannuation would have a smaller adverse effect on the level of economic activity in the long run, with fewer deadweight taxation costs and less reduction in capital. In the medium term there would be a larger adverse effect as taxes would be increased earlier under SAYGO-funding than PAYGO-funding.
5.3.2 Sustainability for the future

(a) A SAYGO-funded expansion in New Zealand Superannuation will require higher taxes than the alternative policy of increasing the age of eligibility, but any tax increases are likely to have only modest adverse effects on sustainability as they don’t increase the opportunity costs of the New Zealand Superannuation scheme. The tax increase is smaller in the long term than the increase under a PAYGO-expanded expansion of New Zealand Superannuation, and will have fewer adverse effects on sustainability.

(b) The increase in taxes in the medium term may increase the likelihood of outward migration to Australia in the short term and medium terms, even though the increase in taxes is offset by the promise of a pension at an earlier age. Longer term there will be reduced incentive to move to Australia, as taxes will not have to increase by so much, and the opportunity cost of staying in New Zealand compared to moving to Australia to partake in their mandatory save-as-you-go personal saving scheme will be lower.

Overall a SAYGO-funded expansion of New Zealand Superannuation is likely to reduce its long term political sustainability, but by significantly less than a PAYGO-funded expansion. A more rapid increase in tax rates in the short term may increase the attractiveness of outward migration.

5.3.3 Increasing Equity

(a) A SAYGO-funded expansion of New Zealand Superannuation will have a smaller effect on within-household transfers from high income to low income households as a PAYGO-funded expansion, for even though low income households get the same transfers, high income households will have to pay lower tax rates. Thus in the long term a SAYGO-funded expansion represents a pareto-improving increase in income inequality compared to a PAYGO-funded expansion.

(b) The smaller reduction in within-generation income inequality associated with lower taxes on high income people is associated with smaller intergenerational transfers. The SAYGO-funded expansion of New Zealand Superannuation does not change the opportunity costs on future generations. The effect on equity depends on how these transfers are valued by society,
given future generations are likely to have higher incomes than current
generations. If the welfare function has a high weight on sustainability,
SAYGO-funding would increase welfare relative to PAYGO-funding, and
have no change compared to the status quo of increasing the age of
entitlement in line with longevity. If the welfare function has a high weight on
discounted utility, SAYGO-funding reduces equality relative to PAYGO
funding as it transfers fewer resources from richer future cohorts to poor
current cohorts.

(c) The increase in taxes associated with additional SAYGO-funded New
Zealand Superannuation will still tighten borrowing constraints on younger
cohorts, and reduce their consumption, but by less in the long term than a
PAYGO-funded expansion. Coleman (2010) analysed this case theoretically
and found that a SAYGO-funded expansion involving proportional increases
in tax rates will reduce home-ownership rates and lower lifetime welfare for
rational savers in almost all positions of the income distribution.

Compared to the status quo of not increasing New Zealand Superannuation, a
SAYGO-funded expansion in New Zealand Superannuation reduced income
inequality. The effect on lifetime welfare is ambiguous, even for low income people,
because of the way the increase in taxes may tighten credit constraints on people
when they are young.

Compared to a PAYGO-funded expansion of New Zealand Superannuation, a
SAYGO-funded expansion involves a much smaller intergenerational transfer, and a
much smaller intra-generational transfer. Interestingly, the long run effect of the
smaller taxes required under a SAYGO-funded scheme is to induce a pareto welfare
improving increase in income inequality compared to the PAYGO-funded scheme, as
benefits are the same but taxes are lower.

5.3.4 Social Infrastructure

(a) A SAYGO funded expansion in New Zealand Superannuation is
intergenerationally neutral and thus unlikely to affect intergenerational
conflict.
(b) Any low late-life employment insurance benefits that stem from the expansion of New Zealand Superannuation will be the same under SAYGO-funding and PAYGO-funding, but greater than the alternative of simply raising the age of entitlement.

A SAYGO-funded expansion of New Zealand Superannuation has a smaller adverse effect on social institutions than a PAYGO-funded expansion of New Zealand Superannuation. It may be positive on balance because of the expansion of insurance benefits, but the improvement is likely to be modest.

5.3.5 Reducing Risk
(a) A SAYGO-funded expansion of a wage-linked pension increases the link between retirement incomes and average New Zealand wages, and reduces the link between retirement incomes and capital market returns. Its effects are thus similar to a PAYGO-funded expansion. It increases the chance that pensioners will have low retirement incomes because economic growth in New Zealand is low or because an economic disaster strikes, although it increases the chance of high incomes if New Zealand productivity growth improves and wage levels catch up with those in the rest of the OECD. As it reduces exposure to capital market returns, there is less risk of low outcomes when returns are low.
(b) An increase in the length of the period that households get government pensions reduces the risk of low consumption in retirement because of poor investment strategies or fraud.
(c) An expanded SAYGO-pension scheme may increase capital accumulation and national wealth and thus reduces macroeconomic risks.
(d) A SAYGO-funded expansion of New Zealand Superannuation transfers risk between generations as New Zealand Superannuation benefits are tied to wages. Higher than expected capital market returns will lead to lower than expected future taxes whereas lower than expected returns will lead to higher taxes.
(e) The expansion of the New Zealand Superannuation Fund brings with it the risk of political interference that may reduce returns. There is also risk that a future government may try to use the funds for a different purpose, either
directly by raiding the fund or indirectly by increasing debt levels in response to the increase in the assets held in the New Zealand Superannuation Fund.

Compared to the status quo of an automatic increase of the age of entitlement with longevity, a SAYGO-funded expansion in New Zealand Superannuation will reduce idiosyncratic and aggregate investment risk, the latter by transferring it between generations. It will also raise governance risks for the New Zealand Superannuation Fund. If there is additional offshore investment, it will reduce risk stemming from poor domestic productivity performance.

5.3.6 Discussion

Figure 10 represents the likely effects of a SAYGO-funded expansion of the average entitlement length of New Zealand Superannuation on a pentagon diagram compared to a policy of simply increasing the age of entitlement in line with longevity. The diagram suggests that the need to increase taxes would reduce economic growth and performance, and reduce sustainability. The long run effect is plausibly only half as large as that associated with a PAYGO-funded expansion, but there is a greater detrimental effect in the short run. The expansion may improve social infrastructure, and have mixed effects on risk and equity. There is greater potential for an improvement in intra-generational equity than under a PAYGO-funded system as long run taxes are not so high. There are also fewer intergenerational transfers, although this can be interpreted negatively or positively. Economic risks are likely to be reduced by the SAYGO-funded expansion relative to simply raising the age of eligibility, as cohorts will face lower asset price risk (which is transferred between cohorts) and may face less productivity risk if the New Zealand Superannuation Fund is invested disproportionately offshore.

The mixture of positive and negative effects of a SAYGO-funded expansion of New Zealand Superannuation means different people are likely to come to different conclusions as to whether such an expansion is warranted compared to the policy of simply increasing the age of entitlement in line with longevity. Ultimately the decision will reflect choices over the extent that a society believes people can manage resources to provide for themselves after age 65, and the extent that society believes
governments should assist them in this endeavour (see Coleman 2011). There are costs and benefits of such a strategy, largely concerning a trade-off between the economic efficiency costs associated with higher taxes and the possible welfare gains associated with enhanced risk sharing and redistribution.

On balance, a SAYGO-funded expansion of New Zealand Superannuation appears better than a PAYGOS-funded expansion. There are three reasons to contemplate a PAYGOS-funded expansion. First, the return to capital might be less than the economic growth rate. Past evidence suggests this is unlikely 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 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. Indeed, unless such a transfer is the main reason to use PAYGO-funding, not only is it reasonable to argue that any expansion of New Zealand Superannuation should be funded on a SAYGO basis, but there may be a case for reducing the current level of PAYGO funding for New Zealand Superannuation in favour of additional SAYGO funding.
5.4 Assessing a SAYGO-funded mandatory private retirement accounts scheme as a supplement to New Zealand Superannuation using the Treasury Living Standards framework

As an alternative strategy to keeping the age of entitlement to New Zealand Superannuation fixed as longevity increases, the government could raise the age of entitlement and introduce a “structured” saving scheme to help people fund the period between the new entitlement age and 65. This could be voluntary, like the current Kiwisaver scheme, or mandatory like the “Australian Guarantee” system of supplementary private retirement accounts. As it is funded on a SAYGO basis, a structured saving scheme would have some similarities to a SAYGO-funded expansion of New Zealand Superannuation. However, it is likely to reduce the deadweight costs of taxation by creating a tight link between contributions and benefits, would have less redistribution from high income to low income people, and would have different governance issues (Disney 2004.)

There are large number of ways that a Government could introduce a structured saving scheme. There is now a wealth of international experience with mandatory private account or notional account schemes, following their use in several European countries, and their introduction in many Latin American and Eastern European countries since the early 1980s. Rather than discuss these options in general, this paper considers two possibilities. The first is a mandatory saving scheme similar to the voluntary scheme proposed by the Financial Services Council (2012)32. The second is similar to the Australian scheme involving mandatory accounts and a means-tested public pension33.

In 2012 the Financial Services Council published a proposal suggesting that the age of entitlement be raised in line with longevity, and that people make payments into personal retirement accounts to provide income in retirement for the \( k \) years between 65 and the higher age of entitlement. New Zealand Superannuation would continue to

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31 In 1981 Chile became the first Latin American country to transform its public retirement scheme into a mandatory private account scheme. See Arenas de Mesa and Mesa-Lago (2006) for a discussion of the Chilean and Latin American experience, or Holzmann and Stiglitz (2001) or Holzmann and Hinz (2005) for lengthy evaluations of the international experience.

32 The author was part of the team that wrote the FSC proposal and thus cannot be considered a disinterested party.

33 Of course, one would want to introduce it in a manner that learns from the Australian experience.
be funded on a PAYGO basis, and not mean tested, so in this respect the proposal has
the same role for New Zealand Superannuation as the baseline scenario. The
difference is that instead of relying on voluntary saving to supplement New Zealand
Superannuation, people would be required to place 10 – 12 percent of their incomes
into a personal retirement saving account when they were aged less than 65. This
money, along with accumulated earnings, would be available for use when a person
was over 65.

The scheme can be summarised in terms of five main features. While a Government
may not wish to adopt all of them, they provide a basis for the evaluation using the
Living Standards framework. Suppose a $k$ year increase in longevity means there are $k$
years between age 65 and the age of entitlement for New Zealand Superannuation.

(a) A person would be required to place 10 – 12 percent of income earned prior to
age 65 into their personal retirement account\textsuperscript{34}.

(b) Upon turning 65, a person would be required to purchase a fixed term pension
for the $k$ year gap that provided retirement income as least as large as a New
Zealand Superannuation payment.

(c) Any funds above this amount could be withdrawn at the person’s discretion.

(d) All funds remaining in the account would be part of the person’s estate upon
death.

(e) If a person had insufficient funds in their account at age 65 to purchase a $k$
year fixed term pension, the government would top up the account.

Four important features of this scheme should be emphasised. First, it is explicitly
designed to supplement New Zealand Superannuation and thus is directly comparable
to the expansion of New Zealand Superannuation that would occur if the age of
entitlement is not increased when longevity increases. Rather than paying additional
taxes and getting an extra $k$ years’ Superannuation, people would make contributions
into an account and accumulate funds for the additional $k$ years of their own
retirement, with any surplus funds being available as a lump sum.

\textsuperscript{34} In an alternative scenario, half of the income could be placed in a person’s own account and half
would be placed in their partner’s account. This does three things. First, it formalises a within-household transfer for those in a legal partnership. Secondly, it prevents legal complications in the event the partnership dissolves. Thirdly, if, as discussed in point (e) below, the government tops up accounts that have insufficient funds, this arrangement would protect the government from having to top up someone’s account if they but not their spouse was a low income earner, for their account would contain half of their spouses’ contributions.
Secondly, because it is a supplementary measure designed to provide income for the $k$ years between 65 and the age of entitlement, it avoids the need to use annuities to decumulate retirement funds. People still obtain exactly the same annuity income from the Government, and have no need to purchase annuity income from private providers.

Thirdly, in addition to being intergenerationally neutral, as each cohort gets the same number of years of New Zealand Superannuation payments on average, it is largely intra-generationally neutral as an individual’s additional retirement resources are proportional to contributions. The exception is that there would need to be some additional taxes to top-up the accounts of those whose accounts were insufficient to purchase a $k$ year fixed-term pension. When taxes are progressive and top-up payments are to people with low-lifetime income, the package as a whole is slightly progressive.

Fourthly, even though it is distributionally neutral, it can reduce welfare by changing the timing of saving and consumption behaviour, and by restricting the type of investments a person can make. These problems arise because most people are liquidity constrained to some extent when they are young and thus cannot borrow for consumption or investment purposes to undo the effects of the required saving contributions. The same issues arise when people are required to pay taxes for a future pension, but they do not occur when people save voluntarily. Welfare is not necessarily reduced as mandatory saving schemes reduce the chance that people save

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35 There is still an annuity problem, however, as people cannot obtain a larger annuity using any accumulated balance of their funds. As discussed previously, the most promising solution would be to allow people to delay obtaining New Zealand Superannuation in return for a larger annual payment. In this way they could convert any additional balances into annuity income by using them to provide “income” in the period when they delay obtaining New Zealand Superannuation.

36 Note that a proposal to top up small accounts to 100 percent of the amount needed to purchase a $k$-year pension is logically equivalent to placing $k$ years’ pension in each account and then imposing a means test at a 100 percent tax rate up to a maximum of a $k$-year pension. If the $k$-year pension is low compared to the accumulated amount, most people will have a zero marginal tax rate on the contributions, so the means test will have little distortionary effect. The Financial Council Services modelling suggests that the average person in all income quintiles (male and female) will have sufficient income to not need a top up.
too little for retirement, reduce the likelihood people make poor investments, and reduce the chance of fraud or theft\textsuperscript{37}.

The next sub-sections outline the likely effects of this policy along the five dimensions of the living standards framework. In each case a comparison is made with a scheme that increases the age of eligibility in line with longevity, and relies on voluntary saving.

5.4.1 Economic Growth

(a) A supplementary mandatory scheme with a top-up arrangement will require only a small increase in taxes, and thus will introduce few tax-related distortions into the economy that decrease its allocative efficiency. Tax rates may even fall due to the tax collected on the earnings on the additional accumulated capital. The mandatory saving contributions in conjunction with the top-up arrangement may reduce the incentive to participate in the workforce, as the rewards from work are not immediately available. Even though the mandatory contributions in the Financial Services Council style scheme are higher than the taxes needed under a SAYGO expansion of New Zealand Superannuation, the distortionary effects are likely to be much smaller because the contributions are kept by the contributor or his or her estate (Disney 2004.) There is likely to be some distortion in investment patterns as liquidity constrained small businesses divert savings from their businesses to other forms of saving; this will not have large adverse effects if the returns to investments in small businesses are lower than the returns to investments in large businesses.

(b) Capital accumulation is likely to increase as some people will save more than they otherwise would have saved\textsuperscript{38}. The extent of this accumulation, and the overall benefits to the economy will depend on the extent that the returns to capital are high and are captured by the investor. Overseas evidence suggests that the transactions costs associated with retail mandatory investment

\textsuperscript{37} See Coleman (2011) and the references therein for a longer discussion of the costs and benefits of mandatory saving schemes.

\textsuperscript{38} This lowers welfare if people are saving more than they otherwise would have saved because they are liquidity constrained, but raises welfare if people were saving sub-optimally small amounts because they find it difficult to discipline themselves.
accounts can be very high, and can chew up a large fraction (say 25 percent) of the overall economic benefits of the capital investment. (Diamond 1996; Barr and Diamond 2006.) The evidence also suggests that transactions costs can be minimised, and that government has a crucial role in designing the regulatory regime to ensure that accumulated funds are invested appropriately, and that the returns are largely captured by investors.

(c) If the government taxes the returns to the private accounts, and a large amount of new capital is accumulated, the government’s tax revenue will increase. This could allow reductions in other tax rates, although it depends on the design of the scheme. Overall, this supplementary mandatory retirement scheme would have little adverse effect on economic performance. There is likely to be an increase in wealth, but investment patterns will be altered away from small, liquidity constrained businesses. There will be modest adverse labour market disincentives compared to a voluntary saving regime.

5.4.2 Sustainability for the future

(a) New Zealand Superannuation with a topped-up supplementary mandatory retirement scheme is likely to increase the sustainability of New Zealand’s retirement arrangements. It provides a structured retirement saving scheme that has lower taxes than either a PAYGO-or SAYGO funded expansion of New Zealand superannuation, and offers most people a way of retiring at 65 if they wish. Its sustainability is enhanced because it is intergenerationally neutral, and the top up arrangement provides insurance against a period of very poor investment returns.

(b) The main difficulty occurs because the mandatory contributions are likely to be higher than the tax rates needed to expand New Zealand Superannuation. This intensifies the liquidity constraints on many young people and families: they have less money available for immediate consumption or for the purchase of a house. This could lead to opposition amongst lower income people – although this has not been a major issue in Australia. It can be partly

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39 Many countries have an EET “Exempt Exempt Tax” treatment for some voluntary retirement savings, as these schemes are much less distortionary than income tax. An EET scheme would initially reduce tax revenues and was not advocated by the FSC.
ameliorated by design features that, for example, allow people to use some or all of their contributions to purchase a house when they are below a certain age\(^\text{40}\).

(c) As the proposal is similar in contributions (but not in payments) to the Australian Guarantee scheme, it is unlikely to increase migration to Australia in the short, medium, or long term.

Overall, this supplementary mandatory retirement scheme is likely to have higher sustainability than an expanded New Zealand Superannuation scheme. It involves lower taxes, and as it is intergenerationally neutral it imposes a smaller opportunity cost on future generations. The Australian experience suggests it could be broadly popular.

5.4.3 Increasing Equity

(a) A topped-up supplementary mandatory retirement scheme is progressive compared to the alternative of relying on voluntary saving, as each person keeps their own contributions but there is a transfer to people with low lifetime incomes funded from a tax system that is progressive. It is, however, likely to be less progressive than an expanded New Zealand Superannuation system, as, depending on the way taxes are levied, a mandatory private account scheme is likely to require higher contributions from low income people than the additional taxes they would pay to fund New Zealand Superannuation. Compared to an expanded New Zealand Superannuation scheme, low lifetime-income people including, on average, women are likely to be worse off as they would not get such large transfers.

(b) The scheme is intergenerationally neutral. Again, the effect on equity depends on whether or not society believes that future generations should be asked to provide additional resources to current generations because they are likely to have higher incomes. If the welfare function has a high weight on discounted utility rather than sustainability, the scheme will be less attractive than a PAYGO-funded expansion of New Zealand Superannuation as it transfers fewer resources from richer future cohorts to poor current cohorts.

\(^{40}\) The voluntary KiwiSaver scheme already has this feature, and it is included in the FSC proposal.
(c) The mandatory contributions will tighten borrowing constraints on younger cohorts, and reduce their consumption. This is likely to produce the greatest welfare impact of the scheme, particularly for low income people with families. If some of the contributions can be used to fund the purchase of a house, the adverse effects of the mandatory contributions will be reduced. The Government could also consider additional measures to make the tax system more progressive to make the mandatory payments more affordable.\(^{41}\)

The adverse welfare effects could be larger or smaller than under an expanded New Zealand Superannuation scheme. If the mandatory contributions could be used to purchase housing, the adverse effects are possibly smaller, as the liquidity constraints imposed by a SAYGO funded expansion of New Zealand Superannuation have the potential to significantly reduce welfare (Coleman 2010.) A PAYGOFunded expansion of New Zealand Superannuation would ultimately be even worse as it ultimately requires much higher increase in taxes.

(d) The returns from a mandatory contribution scheme will differ according to investment performance. Since the skill of selecting and evaluating appropriate investments is not evenly distributed across the population, there is potential for risk averse, low skilled and low income investors to do worse than high income investors.\(^{42}\) Diamond (1997, 2011) argues there is a large benefit from tightly regulating retirement income providers to minimize fees and raise returns for all investors, particularly those with limited investment experience.

(e) U.S. studies indicate that there is a positive correlation between lifetime income and life expectancy that means low income people are more likely to receive zero or low retirement income than high-lifetime income recipients because they die young. Since the money contributed into private accounts, but not the taxes paid to fund New Zealand Superannuation, would be kept by the estate, a mandatory account scheme may reduce wealth inequality over

\(^{41}\) This principle is adopted in overseas countries. For example, in the United States social security payments are mandatory on the first dollar of earned income, but low income people with families have high exemptions thresholds before they start paying income tax.

\(^{42}\) The experience of Chile confirms this – but even so, while low income investors performed worse than high income investors in Chile, 1981 – 2004, they still earned real returns in excess of 6 percent on average (Arenas de Mesa and Mesa-Lago 2006).
time by increasing the bequests to low wealth families who experience the early death of a family member (Gokhale et al 2001).

Overall, this supplementary mandatory retirement scheme is likely to have mixed effects on equity. It is likely to improve equity relative to a system of voluntary saving, due to the top-up of low income accounts. It is likely to reduce income inequality among *old* people relative to voluntary savings, or an expanded New Zealand Superannuation scheme, as it provides at least as many resources to most low income as these alternatives. It is likely to reduce long run wealth inequality by raising the bequests of people who die relatively young, predominantly low income people. It improves equity relative to a PAYGO-funded expansion of New Zealand Superannuation as it is intergenerationally neutral. However in lifetime income terms it is likely to be less redistributive than a SAYGO-funded expansion of New Zealand Superannuation, as low income people will contribute more to their retirement accounts than they would pay in taxes. The comparison with a PAYGO-funded expansion of New Zealand Superannuation is less clear, as in the long run contributions could be smaller than the additional taxes needed under a PAYGO system due to the higher rate of return earned on SAYGO-funded.

The most difficult issue concerns the welfare effects of high contributions on young people. The high contributions are likely to reduce consumption when people are young because of liquidity constraints, and this has the potential to reduce welfare compare to the other alternatives. Whether or not it does will depend on design issues including, crucially, the extent families can use some of the funds they accumulate at a young age to purchase housing.

5.4.4 Social Infrastructure

(a) A topped-up supplementary mandatory private account retirement scheme is intergenerationally neutral and thus unlikely to affect intergenerational conflict.

(b) It may reduce wealth inequality over time, as low income households will hold more of their wealth in non-annuity forms.

(c) If the funds can be used to purchase housing at a young age, it may improve owner-occupied home-ownership rates among younger
 households, particularly in comparison to an expanded New Zealand Superannuation scheme.

(d) It is likely to worsen the effects of low income among young people as it requires them to save more at times that may be inconvenient to save.

Overall, a topped-up supplementary mandatory retirement scheme has mixed effects on social infrastructure as it causes young people some inconvenience by forcing them to save, but in the process increases their wealth.

5.4.5 Reducing Risk

(a) A topped up supplementary mandatory private account retirement scheme has mixed effects on risk. Compared to a system of voluntary saving, it reduces some of the idiosyncratic risk associated with investing and provides insurance against very poor outcomes. Compared to a SAYGO- or PAYGO-funded pension linked to contemporaneous wages, it increases individual exposure to capital market returns, and reduces exposure to local productivity and wage risk. It thus alters the risk profile.

(b) The risk characteristics of a topped-up supplementary mandatory private account retirement scheme depend in part on the characteristics of the top up. The Financial Services Council proposal removes all the risk of accumulating less than the equivalent of $k$ year’s pension, essentially by transferring this risk to future generations of taxpayers. Should a cohort experience high capital returns, it keeps the upside returns. Thus the Financial Services Council scheme has features similar to those of a strategy of selling and buying options on capital market returns (Bohn 2005). This means future generations both have the risk of higher tax payments should the private accounts of their elders be low, and insurance against their own returns being low. Such a risk-sharing strategy is likely to increase welfare on an ex-ante basis. It is also somewhat similar to the risk sharing under a SAYGO-funded expansion of the New Zealand Superannuation. This would not be the case without the top up arrangement.

(c) Two different types of U.S. studies have analysed the riskiness of individual account retirement schemes. The first has simulated investment returns over long periods of time and calculated the probability of hypothetical “typical” individuals doing worse with private accounts than U.S. Social Security (for
example Feldstein, Rangelova and Samwick 2001; also see the review in Feldstein and Liebman 2002). These studies suggest the probability of doing worse than U.S. Social Security is very small, in large part because in the period under consideration the return to capital had been much greater than the growth rate of the economy. The second used the actual tax and marriage records of a sample of U.S. tax payers born in the 1920s and studied the outcomes of various alternative retirement schemes tax given actual and simulated capital returns until 1995 (Feldstein and Leibman 2002b). The advantage of this study is that it takes into account the actual household income of a sample of people, and thus realistically includes the effects of income volatility as well as the effect of family formation and dissolution. This study also showed that a mixed system with both individual investment accounts and Social Security outperformed a system solely based on U.S. Social security, even when the mixed system had substantially smaller total contributions and even when capital returns were artificially reduced below those occurring historically. As the authors write “Our principal finding is that in the long run virtually all of the demographic groups we examine would receive higher average benefits under a mixed system with an investment-based component than they would receive under current social security rules with a substantially higher tax cost. There would also be a smaller share of individuals with benefits below the poverty line than under a pure PAYGO system that maintained current law benefits.” (Feldstein and Leibman 2002b p265)

(d) Inference from one particular historic group is always problematic. Nonetheless, this evidence suggest it is very easy to overstate the risks associated with individual accounts. Historically, investment based retirement income schemes (such those operated in Denmark or Chile) have had high returns, and most policy simulations based on historical data suggest there is a very low risk of doing badly in well structured retirement accounts. Accounts with minimum guarantees would appear to have even smaller risks

(e) One of the biggest investment risks for many people is annuity price risk at the time someone retires. While asset price fluctuations over the course of a forty year accumulation phase can be expected to even out, if people have to purchase an annuity on a single date, they are exposed to enormous interest
rate risk on that date. The Financial Services Council scheme reduces this risk by getting people to purchase a fixed price pension rather than a whole of life annuity, but even so this risk could be considerable.

(f) Barr and Diamond (2006) and Diamond (2011) argue convincingly that the idiosyncratic risk aspects of a supplementary retirement account scheme can be minimized by reducing the investment choices available to people. These idiosyncratic risks include the problems of making insufficiently diversified investments, and the problems of theft and fraud (particularly for retired people).

(g) Individual retirement accounts reduce but do not eliminate the ability of governments to confiscate savings by introducing special taxes, by inflating, or by introducing targeted means tests. In general, the more the accounts look like other private accounts, the less the chance of government expropriation. Paradoxically, the government top up guarantee may increase the likelihood of expropriation by making the accounts “special.”

It is difficult to summarise the effects of a mandatory retirement account on risk. A scheme that offers a minimum guarantee or a Government top-up has some similarities with a SAYGO-funded public scheme, and thus its macroeconomic risk profile will also be similar: that is to say, it alters risk, increasing exposure to capital market risk and reducing it to wage risk. Compared to a public scheme there is more idiosyncratic risk. Since this idiosyncratic risk can be managed, any mandatory scheme should be designed so that simple methods to manage this risk are commonplace. There is also a concentration of exposure to annuity price risk at the time someone retires, although this can also be appropriately managed.

Overall, US modelling and international experience suggests that with appropriate structure and regulations, idiosyncratic risk from individual retirement accounts can be appropriately managed. There remains, however, macroeconomic risks and the risk of Government intervention.

An appropriately diversified portfolio could easily become the default option, so that people would have to explicitly choose high risk options if they wanted them.
5.4.6 Discussion

Figure 11 represents the effects of a supplementary, topped-up mandatory retirement income account scheme of the type proposed by the Financial Services Council on a pentagon diagram. It is compared with the baseline option of increasing the age of eligibility and using voluntary saving and workforce participation to provide income for the $k$ years between age 65 and the higher age of entitlement. The diagram suggests there would be little change in economic performance, sustainability, or social infrastructure. There would be a significant reduction in risk, both because of the top up process and because of the reduction of idiosyncratic risk inherent in a structured saving programme. The effect on equity is mixed. The top up means there would be a transfer to low lifetime income households, which improved equity, although the transfer can be expected to be less than that from an expanded New Zealand Superannuation scheme funded using progressive taxation. On the other hand, forcing people to save at times that could be very inconvenient for them reduces equity. The extent that this causes a worsening of equity depends on whether funds accumulated at a young age can be used to help purchase housing.
On balance, this scheme appears to be an attractive way to tackle increasing longevity, and one that deserves further consideration. Given most of the downsides are associated with the problems associated with the way mandatory contributions tighten liquidity constraints on young households, it would appear worth considering variations in which contributions increase with age (as is done in Switzerland) or in which contributions are voluntary, but perhaps encouraged with subsidies (the current KiwiSaver approach). While a voluntary scheme reduces the costs of a mandatory scheme, it also reduces the transfer to low lifetime income households and thus will have a different effect on equity and income distribution.

5.4.7 A means-tested alternative mandatory private account retirement income scheme.

A mandatory private account retirement scheme could also be structured to have many of the features of the Australian Guarantee scheme. In this case people pay a fraction of their income into private retirement accounts when they are working, currently 9 percent rising to 12 percent. Upon reaching the age of entitlement, they get the state PAYGO-funded pension, but the amount they receive is means tested, decreasing according to the size of their accumulated funds. Those with large amounts receive no state pension. Unlike the Financial Services Council proposal, which is explicitly designed to fund the additional $k$ years of retirement between age 65 and the new, higher age of entitlement, and which provides the same state pension to all people once the age of entitlement is reached, the means test applies for the life of the person.

This scheme is different to either the PAYGO- or SAYGO-funded expansion of New Zealand Superannuation, or the Financial Services Council proposal discussed above, as it is not a simple marginal change to the current arrangements. Rather, people with large retirement accounts would potentially be worse off from the introduction of this scheme as they can lose some or all of their entitlement to New Zealand Superannuation for the entire period, not just the additional $k$ years associated with the increase in longevity. Compared to the baseline scenario where the age of entitlement is raised by $k$ years, this proposal can be represented as follows:

1. individuals place 10 – 12 percent of their income into private retirement accounts;
2. the government extends New Zealand Superannuation on a PAYGO-funded basis by $k$ years to maintain the age of eligibility at 65;
3. the state imposes a tax surcharge on the retirement income accounts with a maximum amount payable equal to the standard New Zealand Superannuation amount multiplied by the total number of years of entitlement.

In these terms, the scheme can be seen to be similar to the Financial Services Council Scheme, except with different tax surcharge arrangements. The top up provision of the Financial Services Council Scheme can be represented as a 100 percent tax surcharge on the first $D$ dollars in the retirement account, where $D$ is equal to $k$ times the amount of New Zealand Superannuation. The Australian Guarantee scheme can be seen as an $x$ percent tax surcharge on the first $D^*$ dollars in the account, where the product $x.D^*$ is much greater than $D$, potentially three or four times as large. The major economic differences between the two schemes thus concern the different economic effects of these different marginal tax surcharge rates and thresholds.

The Financial Services Council modelling suggests that most people will have more in their accounts than the amount $D$, so that the marginal tax surcharge rate for their scheme is zero: that is most people do not get a government top up, but keep all marginal deposits in their own accounts. This is not the case with the Australian Guarantee style scheme. Treasury modelling suggests $D^*$ is sufficiently high that fewer than a third of people would have enough in their accounts to exceed it, and thus a majority of people would be facing the tax surcharge. Thus an Australian Guarantee scheme would represent either an effective increase in the marginal tax rate on low to moderate income people or a very large tax surcharge on high lifetime income people. The increase in marginal taxes is equal to $x$ percent multiplied by the 10-12 percent contribution rate, plus or minus any change in marginal income taxes that might occur as a result of the difference between the increased tax on high income people and the cost of extending New Zealand Superannuation by $k$ years.

In terms of the Living Standards framework, the effects of an Australian Guarantee style scheme will have many similarities to the Financial Services Scheme discussed above. The main differences concern the different tax surcharge. Compared to the
Financial Services Council scheme, an Australian Guarantee style scheme is likely to worsen economic performance, because of the increase in marginal tax rates affecting most people, and alter equity. High lifetime income people will pay considerably more than either the FSC proposal or the baseline proposal in which the age of eligibility is increased $k$ years, while low lifetime income people will pay less. In both cases the problems caused by the tightening of liquidity constraints on young people will be similar.

5.5 Discussion

This section has considered the intergenerational issues surrounding the provision of retirement in more depth. The main insight is that the expansion of a PAYGO-funded retirement income policy involves a transfer to the first generation receiving additional retirement income, at the cost of lower expected incomes from all successive generations. The net value of these transfers, when discounted at the return to capital is zero. However under most plausible welfare functions, including all those that obey the Chilchinisky axioms, the expansion will lower intergenerational welfare. There are circumstances where this will be not true, when the social discount rate is higher than the rate of return to capital, which may be the case during a war or a prolonged depression. It seems unlikely to be generically true in a modern developed country experiencing its highest income levels ever. If an expansion of retirement incomes is desirable because of redistribution concerns, or to enhance risk sharing, it is probable that many of the gains can be obtained using a SAYGO-funded expansion, designed to enhance intergenerational risk sharing opportunities.

The design of New Zealand Superannuation means that it will expand unless the age of entitlement is increased in line with longevity, for it will provide pension benefits to successive cohorts for longer periods than they had to fund earlier cohorts. A comparison of PAYGO-funded and SAYGO-funded expansions favours SAYGO-funding, as this requires significantly lower increases in long term taxes, albeit at the expense of earlier increases in taxes. The expansion is likely to be more sustainable given it does not require large transfers from young and future cohorts to middle age cohorts, transfers which seem hard to justify on any grounds other than vae victus.
It remains to be answered whether a SAYGO-funded expansion of New Zealand Superannuation is better than other alternatives, including a mandatory retirement income account alternative and the alternative of simply raising the age of entitlement and relying on a combination of voluntary private saving and additional workforce participation. Each of these alternatives has different costs and benefits. In terms of intergenerational equity, they are broadly neutral, requiring each cohort to save for their own higher life expectancy. In this sense, all three of the options considered in this section (an increased age of entitlement with voluntary saving, a SAYGO-funded expansion of New Zealand Superannuation, and a supplementary mandatory saving scheme) are fundamentally different than a PAYGO-funded expansion of New Zealand Superannuation.

Lastly, the public and private schemes differ in the extent they allow people to accumulate bequeathable wealth rather than wealth in the form of annuitized income. If New Zealand Superannuation is expanded, either on a PAYGO-funded or SAYGO-funded basis, people will hold a greater fraction of their retirement wealth in a non-bequeathable form. While one cannot be certain of the effect of this change, the most rigorous analysis suggests that long term wealth inequality increases the more retirement wealth is annuitized, since most low income people hold most of their retirement wealth in annuitized form and thus have little to bequeath. Thus expanding New Zealand Superannuation as longevity increases may reduce the extent people can use bequests to reduce wealth inequality over time.

6. Discussion and conclusions
This paper has provided a selective overview of the enormous literature describing the ways public policy can alter intergenerational transfers. The focus has been the way public policies alter the amount and ownership patterns of the different types of capital that can be accumulated in an economy. While both backward and forward intergenerational links are considered, most attention is paid to retirement income schemes due to the salience of the issue to New Zealand and other OECD countries given their ageing population structures.
As the literature is now several decades old, many of the findings are broadly uncontroversial. In particular, it is now generally accepted that in OECD countries the return to capital is higher than the growth rate of the economy, and thus that these economies are dynamically efficient. There is no evidence that suggests that the New Zealand economy is dynamically inefficient; and if it were, given how small the capital stock is in New Zealand, it would suggest economic problems of considerably greater magnitude than could be solved by altering the structure its public retirement income scheme. It is also generally accepted that the expansion or contraction of a government programme in which the average age of the taxpayers is different than the average age of the recipients involves intergenerational transfers. These transfers result in reduced consumption for some cohorts and increased consumption for others, and alter the quantity and type of capital owned by the residents of the country.

I would like to summarise by focussing on five issues.

(i) Using opportunity cost to measure the size of intergenerational transfers.
When there is a difference in the average age of taxpayers and the average age of the recipients of a permanent government programme that is funded on a PAYGO basis, there is an implicit intergenerational transfer. The size of this transfer can be measured as the opportunity cost of making the tax payment rather than the funding the transfer through saving or debt. When the average age of the recipients is n years older than the average age of the taxpayers, the opportunity cost falls on future generations of taxpayers and is equal to \((r-g)/(1+r)\)\*tax, where the return to capital \((r)\) and the growth rate \((g)\) are measured as n-year rates of return. This metric is natural as it measures the additional resources would have had if they had been able to put the tax money aside and invest it for their own use. When the average age of the recipients is n years younger than the average age of the taxpayers, the opportunity “cost” is also \((r-g)/(1+r)\)\*tax, and is a transfer to future generations of recipients as it measures the extent they are better off from paying for a subsequent generation of recipients rather than themselves.

44 If the New Zealand economy were dynamically inefficient, it would mean the capital stock is too high and should be reduced. Given that per capita capital levels are significantly lower than average OECD levels, if the New Zealand economy were dynamically inefficient it would indicate capital cannot be productively used in the country.
In traditional societies and less developed societies, the average age of the recipients of transfers is lower than the average age of payers, so these transfers represent a transfer to future generations. The rapid expansion of public health and retirement schemes in most modern industrial countries means the average age of recipients 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).

The size of these opportunity costs is large. A SAYGO-funded pension scheme can be plausibly funded with half the contributions of a PAYGO funded pension scheme. The way they fall on current and future cohorts is also uneven. Past decisions to expand health and pension programmes resulted in net transfers to the first cohorts of recipients, but the implicit cost is likely to fall more heavily on future generations of taxpayers than current generations of taxpayers, in part because of falling population growth rates.

The way a society chooses to distribute these costs and benefits is fundamentally a political question. Improving a society’s measurement and understanding of them is not. As public programmes funded on a PAYGO-basis result in intergenerational transfers that are different from, but related to the size of tax payments, it seems reasonable that estimates of their size are used as one indicator of the impact of fiscal policy. Internationally, new methodologies are being developed to do this on a consistent basis (Mason et al 2009). It is to be hoped these can be applied to New Zealand to provide a better understanding of the intergeneration effects of current and future policies.

(ii) Bygone history and new developments: analysing marginal changes to government programmes.

When an economy is dynamically efficient, a government decision to debt fund a temporary expenditure or introduce a new permanent programme results in intergenerational transfers that can be measured in terms of the opportunity cost or benefit facing future generations. Many of these decisions occurred a long time ago and may appear as reasonable now as they did then — such as the decision to borrow
to pay for a war, for example, or the decision to introduce a PAYGO- funded retirement income scheme. While current generations of taxpayers may be suffering an opportunity cost as a result of these decisions, they cannot alter it without shifting costs or benefits onto other generations. On the whole, decisions from the past cannot be costlessly undone.

The decision to primarily fund New Zealand Superannuation on a PAYGO basis was one of these decisions. If New Zealand Superannuation had been funded on a SAYGO basis, it is plausible that the taxes required to fund the current and future levels of payments would be half as large as they currently are - $5 billion rather than $10 billion. However, making the transition to a SAYGO-funded version of New Zealand Superannuation to reduce long term tax rates on future New Zealanders would require a long transition involving a double payment by current and some future taxpayers, as they would be required to pay for their parent’s pensions as well as contribute to their own. This transition may or may not be particularly onerous, depending on the relative size of capital returns and the growth rate of the economy (Feldstein, Ranguela, and Samwick 2001), and it may or may not be considered fair given that current cohorts face a smaller opportunity cost than future cohorts (Coleman 2012). Nonetheless, there maybe some reluctance on the part of current taxpayers to increase their own payments in order to lower those of future generations.

Even if the decision is made to let past decisions stand, modifications to existing programmes also result in intergenerational transfers and should be analysed on a marginal basis. New Zealand Superannuation is a case in point. If the age of entitlement does not increase with longevity, there is an implicit increase in the scope of the New Zealand Superannuation scheme. If the scheme continues to be funded on a PAYGO-basis, this results in a transfer from future generations to the first cohorts benefiting from the increased size of the scheme. In essence, a cohort that may have funded previous generations for an average of, say, 18 years will receive 25 years payments. As there is no logical reason why the additional seven years needs to be funded on the same basis as the previous 18 years, the funding decision can and should be considered on a separate, marginal, basis.
The same calculus can be applied to other areas of government expenditure. If funded on a PAYGO-basis out of contemporaneous taxation, an expansion of the university system represents a transfer from current taxpayers to future generations. Alternatively, it could be funded on an intergenerationally neutral basis by issuing debt, possibly as student loans, or as government debt to be repaid by taxes on future cohorts. Similar logic applies to the way an expansion in public infrastructure is funded. In each case, however, the important principle is that marginal spending decisions do not need to funded in the same way as historic funding decisions, and, if intergenerational neutrality is an important consideration, should not be.

*(iii) Risk management and the government: capital returns and asset market risk.*

The key criteria for whether or not an economy is dynamically efficient is whether or not the return to capital exceeds the economic growth rate. At the macroeconomic level, this condition fundamentally concerns how the marginal returns from new capital investments, measured in terms of additional output, compares to the economic growth rate. The available evidence suggests this condition has held comfortably in most developed economies (Abel et al. 1989). This, however, is not the same as the criteria used by individual investors when deciding to purchase shares or make loans. The returns to different financial assets not only depend on the fundamental earnings made by the firms but the prices paid and received when the assets are purchased and sold. As the modern macro-finance literature makes clear, asset price volatility reflects both the volatility of the fundamental earnings of the underlying assets and the volatility of the discount rates used to value these earnings, so it tends to be greater than the volatility of the underlying earnings. Moreover, since changes in discount rates tend to be temporary, asset prices have much greater mean reverting tendencies than fundamental capital earnings.

The differences in the volatility of capital earnings and asset market returns poses a quandary for individual investors and governments. The high volatility of asset prices makes the use of financial assets as a saving vehicle for retirement 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 solution 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).

There are many ways this can be done. 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 by the Government and ultimately shared across generations. Alternatively, the government could adopt a supplementary mandatory retirement income scheme and offer a minimum return guarantee. This removes some of the deterrent effect of low returns, again by spreading the risk across generations. Other possibilities exist.

The Government also has indirect opportunities to reduce the asset price risk facing individuals as they attempt to smooth consumption over their lifecycles, and thus make it easier for society as a whole to use capital-based rather than transfer-based retirement saving schemes. These include the issuance of inflation or wage indexed securities to fill in “missing markets” in the range of available private sector securities. These securities fundamentally reduce the risk of inflation, as well as facilitate international risk sharing. It can also ensure as far as possible that the tax system is neutral to different types of asset income, to encourage appropriate risk diversification.

.(iv) The evaluation of government interventions: utilitarian welfare metrics and sustainability.

When societies make choices over policies that distribute resources between people, they implicitly make judgements about the relative value of the resources to those who gain and those who lose from the transfers. When these transfers involve people who may not yet exist, the nature of the welfare judgements gets trickier as these “potential people” have no direct say in the decisions. When transfers are mainly from older people to younger people – as they still are in contemporary developing countries – the welfare calculus is easier as few societies have moral qualms about giving to others even if the recipients are better off than the givers. Now that public transfers on average involve implicit transfers from the future to the present, the
calculus is a little more difficult, as there is an asymmetry as to how most societies view giving and taking.

Recent thinking about economic sustainability has helped clarify many issues involving intergenerational transfers, including the extent that policies ultimately affect the interests of current generations or the interests of future generations. Chichilnisky’s axiomatic classification of policies that involve the dictatorship of the future over the present or the dictatorship of the present over the future in accordance with their long term sustainability is a particularly useful approach. Again, it is not the role of government bureaucrats to make judgement calls over these decisions. But there are ways the consequences of different policies on different generations can be reported that may allow better judgements over their desirability. Reporting on the implicit opportunity cost of policies on different generations may be a good start.

(v) New Zealand retirement income policy: options for marginal change.

As noted above, increases 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 the programme continues to be funded on a PAYGO-basis, an increase in the size of the programme involves an additional opportunity cost on future generations, and thus can be considered a transfer from the future to the present. For this reason, the default option of “no change” is not intergenerationally neutral; it involves a transfer to current cohorts, who can expect to have many more years of pension than they provided to their forbears.

Intergenerational neutrality is not necessarily a goal of society, and even if it is it is not the only goal. Nonetheless, it is possible to consider that are intergenerationally neutral as a basis for comparison. Broadly speaking, these are:

- a SAYGO funded expansion of the current New Zealand Superannuation scheme, holding the entitlement age for New Zealand Superannuation constant;
- a reduction in the average size of benefits, possibly through means-testing, so that the total value of payments remains constant per retiree;
• an increase in the age of entitlement in line with increases in longevity with a reliance on increased workforce participation, or increased voluntary saving, to provide people with resources between the age of 65 and the higher age of entitlement;

• an increase in the age of entitlement in line with increases in longevity, and the introduction of a supplementary mandatory retirement scheme to provide people with resources between the age of 65 and the higher age of entitlement.

Voluntary saving could include structured or subsidised saving schemes such as Kiwisaver.

The advantages and disadvantages of many of these alternatives were discussed in section 5, and that discussion will not be repeated here. The main point to note is that in most countries retirement schemes have many components, and it is by no means obvious that the automatic expansion of the existing components provides the best or the most sustainable mix. New Zealand is currently notable for the large size of its tier-1 transfer system, the absence of a tier-2 system linking retirement contributions to benefits, and its reliance on largely unsubsidised voluntary saving— in short, on a system comprising extreme positions on most dimensions. The mandatory component of these schemes (New Zealand Superannuation) is largely funded on a SAYGO-basis, even though the evidence suggest New Zealand has low rates of capital accumulation. These features of its current system reflect a series of past decisions that may or may not have been optimal for the circumstances then prevailing. It should not be assumed that the continued expansion of the current mix is optimal to the New Zealand of the next generations.
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Appendix 1: Pension schemes – an overview.

Different countries around the world have adopted a wide range of strategies to transfer resource to elderly people, particularly the non-working elderly. In broad terms, these strategies can be categorized two ways: the extent to which they are arranged by the government rather than privately arranged; and the extent to which they are funded on a pay-as-you-go (PAYGO) basis rather than a save-as-you-go (SAYGO) basis. In a SAYGO scheme, people accumulate assets while they are working, and sell or exchange these assets for resources when they are old. This can be done voluntarily, it can be done through government-mandated retirement saving accounts, or it can be done through a government scheme in which tax-revenues are accumulated into a large fund that is used to pay pensions. In a PAYGO scheme, resources are directly transferred from working age people to older people. This can be done privately through families, or it can be done through a government tax-funded pension scheme. No capital is directly accumulated in such schemes, as the transfers passed from the young to old are largely consumed.

Government schemes can be further classified by the way they are funded, and the extent they link an individuals pension benefits to the contributions they made. New Zealand has a tier 1 scheme funded out of general taxation. All people over 65 meeting a residency criteria get the same pension, which is set at 65 percent of average wages for a couple, and slightly more per person for singles. Globally, this is highly unusual as most countries supplement their tier 1 schemes with tier 2 schemes, and most countries have dedicated social security taxes or mandated private account contribution arrangements. New Zealand’s scheme is thus considerably more redistributive than most schemes.

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
Table A1: Categories of retirement schemes.

<table>
<thead>
<tr>
<th>PAYGO</th>
<th>SAYGO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Privately Arranged</strong></td>
<td>Adults voluntarily provide resources to older parents, and are given resources by their children in turn when they are old</td>
</tr>
<tr>
<td></td>
<td>Sometimes the resource transfers are linked through the education adults provide to their children.</td>
</tr>
<tr>
<td><strong>Government Arranged</strong></td>
<td>Government raises taxes that are transferred to older people as pensions.</td>
</tr>
<tr>
<td></td>
<td>Taxpayers receive a pension from younger taxpayers when they are old.</td>
</tr>
<tr>
<td></td>
<td>Government raises taxes that are accumulated into a Government retirement fund. The contributions are sold, normally to young contributors, to pay pensions</td>
</tr>
<tr>
<td></td>
<td>The government mandates people have to buy assets accumulated in private accounts. These assets are sold to fund pensions.</td>
</tr>
</tbody>
</table>

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:

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

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 $n_t = \text{growth rate of population} = \frac{N_{t+1}}{N_t} - 1$

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

If the productivity growth rate is $\rho$, 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,

$$(1 + i_{t+1}) = (1 + n_t)(1 + \rho_{t+1})$$
Table A2: Categories of Government retirement schemes.

<table>
<thead>
<tr>
<th></th>
<th>Tier 1</th>
<th>Tier 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pension benefits</strong></td>
<td>All eligible adults get a pension independent of earnings but possibly linked to length of time in the country.</td>
<td>Adults get a pension linked to their lifetime contributions.</td>
</tr>
<tr>
<td></td>
<td>Considerable within-cohort redistribution.</td>
<td>Less lifetime redistribution, although other benefits may be reduced to high income earners.</td>
</tr>
<tr>
<td></td>
<td>Pension normally linked to wages</td>
<td>Retirement incomes typically linked to investment returns (defined contribution scheme) but may be independent of investment returns (defined benefit scheme)</td>
</tr>
<tr>
<td><strong>Taxes</strong></td>
<td>Revenue can be raised from general taxes or a specific social security tax on working age labour incomes.</td>
<td>Revenue typically raised from specific social security taxes on working age labour incomes.</td>
</tr>
<tr>
<td></td>
<td>There is no link between taxes paid and pensions received.</td>
<td>Benefits are linked to taxes or mandated contributions.</td>
</tr>
</tbody>
</table>

Let \( T_i = a_i - S_i \) 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

\[
P_i = N_i a_i = N_i (T_i + S_i)
\]

Now

\[
N_i S_i = \frac{N_i z_{i+1}}{1+r_{i+1}} = \frac{N_i z_{i+1} a_{i+1}}{1+r_{i+1}} = \frac{N_i (T_{i+1} + S_{i+1})}{1+r_{i+1}}
\]

Hence

\[
P_i = N_i T_i + N_i S_i
\]

\[
= N_i T_i + \frac{N_{i+1} T_{i+1}}{(1+r_{i+1})} + \frac{N_{i+1} S_{i+1}}{(1+r_{i+1})}
\]

\[
= N_i T_i + \frac{N_{i+1} T_{i+1}}{(1+r_{i+1})} + \frac{N_{i+2} T_{i+2}}{(1+r_{i+1})(1+r_{i+2})} + \frac{N_{i+2} S_{i+2}}{(1+r_{i+1})(1+r_{i+2})}
\]

\[
= \sum_{j=0}^{\infty} \frac{N_{i+j} T_{i+j}}{\prod_{k=1}^{j} (1+r_{i+k})}
\]
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.

The size of the opportunity cost terms through time has not been directly estimated. The Long Term Fiscal Plan (2009) estimated the size of the tax payments if the current form of New Zealand Superannuation is not changed, and shows it steadily increases, from approximately 3.7% of GDP to 7.3% of GDP. In addition, changes in demography mean the growth rate of the population is likely to reduce over time, suggesting the opportunity cost (r-g) will increase. Thus a back of the envelope calculation suggests it is reasonable to expect the opportunity cost of the current system to be approximately twice as large for future generations as it is for current cohorts.

It is possible to make a more accurate estimate of the approximate size of the opportunity cost of New Zealand Superannuation in its current form by calculating the level of contributions that would be needed in a government-operated save-as-you-go scheme that provided the same level of pensions as New Zealand Superannuation. The following calculations calculate the taxes that need to paid each year to provide a pension that is a fraction \( \theta \) of incomes, assuming all income in the economy is taxed. The formula depends on:

\[
\begin{align*}
n & \quad \text{the growth rate of the population} \\
g^W & \quad \text{the growth rate of the incomes} \\
g^R & \quad \text{the growth rate of retirement incomes, if these are not indexed to wages} \\
r & \quad \text{the return to capital} \\
N & \quad \text{the average working life} \\
T & \quad \text{the average length of retirement}
\end{align*}
\]

The formulae depend on whether any of the variables are zero or whether \( g^R = g^W \). They are presented in Table A3 for the various cases.
Table A3: Formulae for calculating contribution rates for PAYGO and SAYGO pension schemes

<table>
<thead>
<tr>
<th></th>
<th>N=0</th>
<th>n≠0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PAYGO</strong></td>
<td>$g^R = g^W$ $T/N \theta$</td>
<td>$\frac{1-1/(1+n)^T}{\theta}$</td>
</tr>
<tr>
<td><strong>SAYGO</strong></td>
<td>$\frac{g^W - r}{r - g^R} \left{ 1 - \left[ \frac{(1 + g^R)}{(1 + r)} \right]^T \right}/\left[ 1 - \left[ \frac{1 + r}{1 + g^W} \right]^N \right] \theta$</td>
<td>$\frac{1 + \frac{g}{g^R}}{g - g^R} \left[ \frac{\frac{n}{1+n} \left[ \left( 1 + g^R \right)/(1 + g) \right]^T}{\left( (1+n)^N - 1 \right) \theta}$</td>
</tr>
<tr>
<td><strong>PAYGO</strong></td>
<td>$\frac{1 + \frac{g}{g^R}}{g - g^R} \left[ \frac{\frac{n}{1+n} \left[ \left( 1 + g^R \right)/(1 + g) \right]^T}{\left( (1+n)^N - 1 \right) \theta}$</td>
<td></td>
</tr>
<tr>
<td><strong>SAYGO</strong></td>
<td>$\frac{g^W - r}{r - g^R} \left{ 1 - \left[ \frac{(1 + g^R)}{(1 + r)} \right]^T \right}/\left[ 1 - \left[ \frac{1 + r}{1 + g^W} \right]^N \right] \theta$</td>
<td></td>
</tr>
</tbody>
</table>

Table A4 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.

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.)
Table A4: Long term equilibrium taxes needed to pay for New Zealand Superannuation

<table>
<thead>
<tr>
<th>N Working life</th>
<th>T Life expectancy after 65</th>
<th>r</th>
<th>g_Y</th>
<th>g_R</th>
<th>N</th>
<th>SAYGO taxes</th>
<th>PAYGO Taxes</th>
<th>ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>19</td>
<td>3.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.0%</td>
<td>8.1%</td>
<td>13.1%</td>
<td>1.62</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>3.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.25%</td>
<td>8.1%</td>
<td>12.1%</td>
<td>1.50</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>3.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.50%</td>
<td>8.1%</td>
<td>11.1%</td>
<td>1.38</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>3.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>1.00%</td>
<td>8.1%</td>
<td>9.5%</td>
<td>1.17</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>4.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.0%</td>
<td>5.8%</td>
<td>13.1%</td>
<td>2.27</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>4.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.25%</td>
<td>5.8%</td>
<td>12.1%</td>
<td>2.09</td>
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<tr>
<td>45</td>
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<td>4.0%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.50%</td>
<td>5.8%</td>
<td>11.1%</td>
<td>1.93</td>
</tr>
<tr>
<td>45</td>
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<td>1.5%</td>
<td>1.5%</td>
<td>1.00%</td>
<td>5.8%</td>
<td>9.5%</td>
<td>1.64</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>5.0%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>0.00%</td>
<td>3.7%</td>
<td>13.1%</td>
<td>3.57</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>5.0%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>0.25%</td>
<td>3.7%</td>
<td>12.1%</td>
<td>3.29</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>5.0%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>0.50%</td>
<td>3.7%</td>
<td>11.1%</td>
<td>3.03</td>
</tr>
<tr>
<td>45</td>
<td>19</td>
<td>5.0%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.00%</td>
<td>3.7%</td>
<td>9.5%</td>
<td>2.58</td>
</tr>
</tbody>
</table>

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 65000 in the early 1960s to 1962 to 50000 in the early 1980s before increasing back to 65000 in 2010. They are only expected to increase by 0.04% per annum over the next fifty 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 fifty years.

When the population growth rate is 0.25%, the pension contributions (taxes) required using a 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.