THE IMPACT OF SUPERANNUATION ON HOUSEHOLD SAVING

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Research Discussion Paper
2004-01

March 2004

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Reserve Bank of Australia

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Reserve Bank of Australia. We would like to thank Philip Gallagher, Luke Gower, John Piggott, Anthony Richards and seminar participants at the 11th Australian Colloquium of Superannuation Researchers and the Reserve Bank of Australia for helpful suggestions. The authors are solely responsible for any remaining errors.

Abstract

Over the last 20 years superannuation has grown to be the second largest component of household wealth in Australia after ownership of dwellings. This paper analyses the impact on household saving behaviour of the substantial rise in compulsory contributions to superannuation funds. Our analysis takes account of other macroeconomic developments that are likely to have had a strong influence on the household saving rate over this period, especially the financial deregulation of the 1980s and the unprecedented increase in the value of household wealth in the 1990s.

We first illustrate the effect of superannuation on household saving in a small theoretical model, also taking account of the effect financial deregulation and capital gains might have on saving. In an empirical model of saving motivated by our theoretical analysis, we find evidence that only part of compulsory superannuation contributions has been offset by reductions in other saving, suggesting that – other things being equal – compulsory superannuation has indeed resulted in higher household saving.

JEL Classification Numbers: E21, G11, G2
Keywords: superannuation, household saving, offset coefficient

Table of Contents

1. Introduction 1

2. The Superannuation System in Australia 2

3. Superannuation and Household Saving 4
   - 3.1 Household Saving: Measurement and Trends 5
   - 3.2 A Small Analytical Model of Household Saving 7
     - 3.2.1 Financial deregulation and borrowing 9
     - 3.2.2 Superannuation offset 10
     - 3.2.3 Consuming out of capital gains 14

4. The Empirical Model 15
   - 4.1 Previous Estimates of the Superannuation Offset 16
   - 4.2 Model Specification 17
   - 4.3 Estimation Results 19
   - 4.4 Counterfactual Saving Rate 22

5. Conclusions 24

Appendix A: Data Definitions and Sources 26

Appendix B: A Small Theoretical Model 31

Appendix C: Supplementary Results and Robustness 43

References 46

THE IMPACT OF SUPERANNUATION ON HOUSEHOLD SAVING

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1. Introduction

Over the last 17 years, Australian households have been encouraged to save more for their retirement through a range of pension schemes, including compulsory superannuation and tax incentives for voluntary superannuation. The wide-reaching nature of these policies is likely to have influenced households’ saving behaviour.

Despite the continuing decline of the household saving rate since its peak in the 1970s, superannuation is likely to have increased the level of household wealth through flows into households’ financial assets. This paper examines some of the causes of the decline in household saving, and attempts to measure the effect that superannuation growth has had in stemming the slide in the saving rate. Central to this exercise is the offset coefficient, which measures how much of the increase in saving through superannuation has been offset by a decrease in saving through other vehicles.

Most estimates of the compulsory superannuation offset in Australia to date have relied on judgment or extrapolation from the experiences of other countries. However, 17 years after the introduction of compulsory superannuation, we now have a sufficiently long time series available to estimate the offset coefficient econometrically. We find an offset coefficient of around 38 cents in the dollar, which lies within the range suggested by previous studies. This implies that less than half of the increased saving through superannuation has been offset by a reduction in voluntary saving, thus increasing households’ saving rate, other things being equal.

Section 2 gives a brief overview of the superannuation system in Australia. Section 3 starts with some stylised facts on the determinants of the saving rate of Australian households over the last 40 years and then analyses the impact of superannuation on household saving in a small theoretical model. In Section 4 a household saving equation motivated by our theoretical analysis is estimated, with specific focus on the effect of superannuation on saving. Section 5 concludes.

2. The Superannuation System in Australia

Superannuation has been used in Australia as a policy instrument to increase retirement incomes and reduce reliance on the age pension (which is provided by the government). Tax concessions have existed for superannuation since 1914.[1] Until the 1980s, interest and capital gains on superannuation funds were not taxed. However, the extent of tax concessions has since been reduced. In 1986 compulsory superannuation was introduced in Australia. The system initially applied to employees on Federal awards, with 3 per cent of their earnings saved in superannuation funds in lieu of wage rises.[2] The system was extended to apply to most employees in 1992 under the Superannuation Guarantee Charge (SGC), with the contribution rate gradually raised to its current level of 9 per cent of earnings and coverage increased to 90 per cent of employees.

Perhaps not surprisingly, households' superannuation assets as a proportion of GDP almost quadrupled in Australia over the last 20 years (Figure 1), and are now the second largest component of household wealth after non-financial assets, which comprise mostly housing.[3] However, the growth in superannuation funds (or their equivalent) was an experience shared by the US and the UK, which do not have compulsory superannuation schemes in place.

Valuation effects were an important factor behind the unprecedented growth in superannuation assets over the 1980s and 1990s, explaining around 70 per cent of the rise in current price terms in the UK and over 60 per cent in the US between 1988 and 2000. The importance of market movements is also evident in the reduction of the value of holdings of these assets since 2000 and the more volatile experience of the UK, where equities represented a much larger proportion of assets over the 1990s. However, valuation effects explain only one-third of the rise in Australian superannuation assets since 1988, with most of the growth due to increasing *flows* into these assets.

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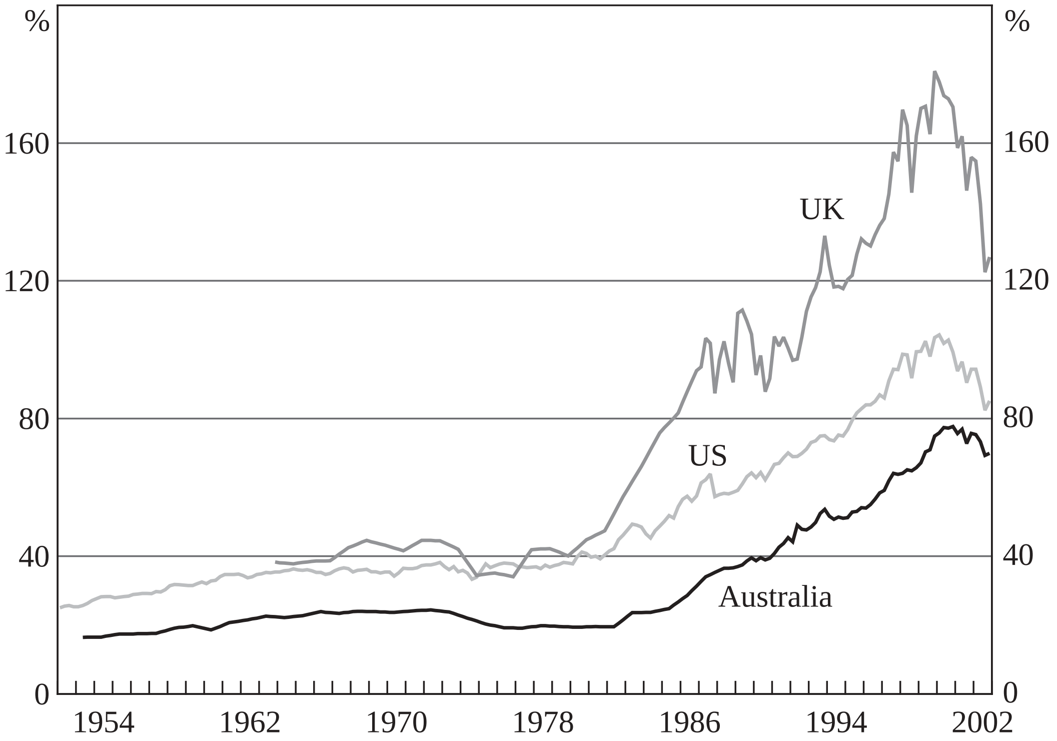
[1] See Bateman, Kingston and Piggott (2001, p 210). There is also a detailed description of the history of the Australian retirement income system in Commonwealth Treasury of Australia (2001).

[2] These are employees whose base wages and conditions were covered by national level arbitration.

[3] The term 'superannuation assets' used here includes both superannuation assets and life insurance. Assets in life insurance, part of which is not governed by the superannuation scheme, are reported as part of voluntary superannuation assets. See also Appendix A. For simplicity, we use in this paper the term 'superannuation' also for the pension schemes in the US (reserves in pension funds and life insurance) and the UK (life assurance and pension fund reserves).

Figure 1: Household Assets in Superannuation

Per cent of GDP



Sources: Australia – ABS, RBA; US – Bureau of Economic Analysis, Federal Reserve; UK – National Statistics

To abstract from valuation effects and overall growth in the economy, Table 1 shows households' flows into superannuation as a share of GDP. Due to data availability our analysis examines the period since 1989, broken into two equal samples.

Australian households' flows into superannuation have grown from an average of 2.8 per cent over 1989–95, to 4.6 per cent over 1996–2002. In contrast, over this period, US households' flows into superannuation fell, while in the UK, households' flows remained broadly flat.[4] This suggests that a factor that is specific to Australia, such as compulsory superannuation, may have contributed to the rise in flows into superannuation.

Table 1: Households' Superannuation Assets

Per cent of GDP

	Stock of superannuation		Average net flows into superannuation	
	Dec 1988	Dec 2002	1989–1995	1996–2002
Australia	36.6	69.9	2.8	4.6
US	58.6	85.1	4.0	2.8
UK	90.5	126.9	4.7	4.4

Notes: The difference between the change in the stock and the sum of the average net flows over the period reflect not only valuation effects, but also the change in GDP.

Sources: Australia – ABS, RBA; US – Bureau of Economic Analysis, Federal Reserve; UK – National Statistics

Superannuation has grown in importance as an investment vehicle for households and, over the last 10 years, appears to have driven an increase in household financial flows. Superannuation policies almost certainly have contributed to these developments. However, it is difficult to estimate the effect of superannuation policy on saving or wealth accumulation using net flows over such a short horizon. Moreover, net flows into financial assets measure only one aspect of households' saving behaviour. In the remainder of this paper, we take a broader perspective and analyse the effect of superannuation contributions on household saving.

3. Superannuation and Household Saving

One of the concerns behind the introduction of the compulsory superannuation scheme was the decline of the household saving rate in Australia following its peak in the mid 1970s (see Figure 2). This raises the issue of whether superannuation has been able to stem the slide in the household saving rate.[5] At first glance, this would not appear to be the case, since – although there has been strong growth in superannuation assets – household saving has continued to fall.

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[4] Part of the fall in flows into US superannuation may be due to the fact that Individual Retirement Accounts (IRAs) are not included. However, household flows into financial assets, which include IRAs, also fell over the period.

[5] In this paper we use the National Accounts measure of household (net) saving, that is, saving is defined as the difference between income and consumption. Alternatively, one could define saving as the change in wealth, thus including capital gains in saving.

However, the fall in household saving may have been exacerbated by measurement issues, which are discussed in Section 3.1. Since these do not explain all of the fall in household saving, we consider a number of changes that occurred in the economic environment over the last 20 years and that are likely to have affected the household saving rate, such as the financial deregulation of the 1980s and the increase in household wealth during the 1990s. In Section 3.2, we therefore develop a small theoretical model based on an overlapping-generations framework to illustrate the impact on household saving of superannuation, financial deregulation and an increase in capital gains on household assets.

3.1 Household Saving: Measurement and Trends

Two sources of measurement problems have been suggested in the literature on household saving: inflation bias, and the trend to incorporation (see Edey and Gower (2000); Commonwealth Treasury of Australia (1999)). The inflation bias explanation argues that measured household saving is biased upwards in times of high inflation due to the treatment of net interest receipts in the National Accounts.[6] To correct this problem, household net saving in Figure 2 has been adjusted to reflect the reduced value of households' net interest-bearing assets (for details, see Appendix A). The adjusted series is much more stable through the 1970s, and has converged towards the unadjusted series through the 1990s due to lower inflation and rising household debt.

Another potential source of mismeasurement is that the trend to incorporation may have resulted in a downward bias in household saving, as saving by unincorporated enterprises (which is classified as household saving) is gradually being reclassified as saving by corporations.[7] This would imply that there is a corresponding rise in the saving rate of non-financial corporations, but Figure 2 suggests that this rise is only small compared to the fall in household saving. In fact, the mildly inverse correlation between household and non-financial corporations saving over the last 40 years instead may be due to the inflation effect, since households were net holders of interest-bearing assets, while non-financial corporations were net debtors of these assets. When the inflation-adjusted series are compared since 1989, there is little evidence of an inverse relationship. This suggests that the trend to incorporation may not have been a major cause of the fall in household saving.

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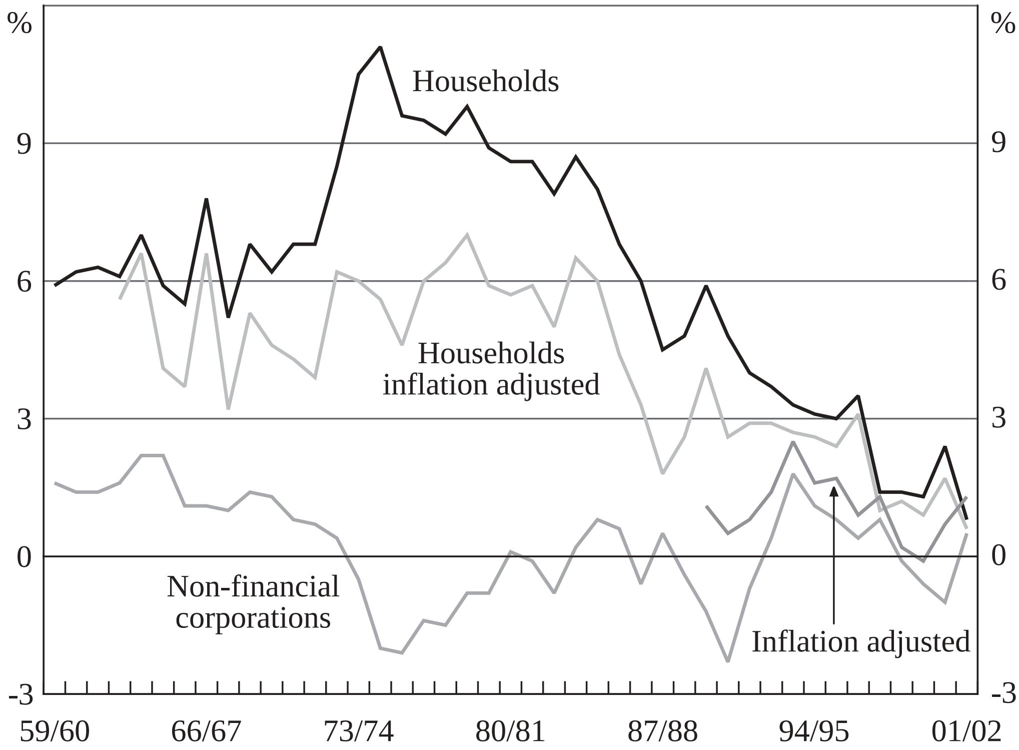
[6] During times of high inflation, creditors' real return on interest-bearing assets, which have a fixed nominal principal, is significantly lower than nominal interest rates would suggest. Since households were net holders of these assets, this leads to an upward bias in measured household saving during times of high inflation, such as the 1970s and 1980s.

[7] Other studies that investigate the effect of superannuation on saving, such as Edey and Gower (2000) and Commonwealth Treasury of Australia (1999), therefore have analysed private saving, rather than household saving. However, the ABS no longer produces private sector saving data.

Figure 2: Net Saving of Households and Non-financial Corporations

Per cent of GDP



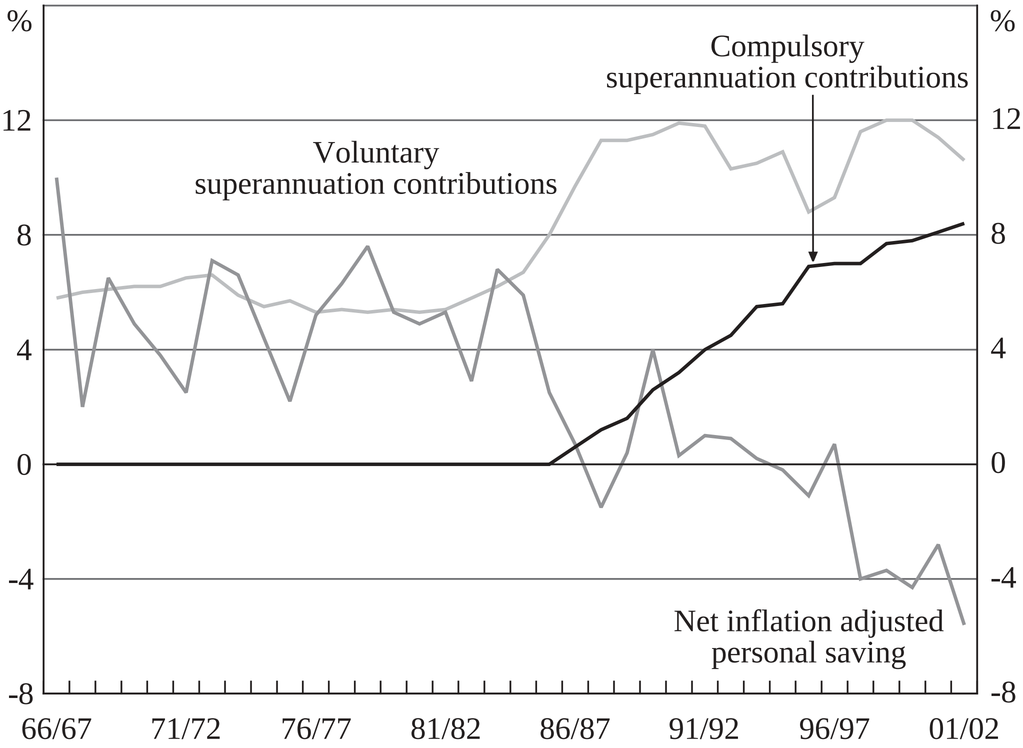
Sources: ABS; RBA

Another factor contributing to the fall in household saving is the reduction in reported government superannuation contributions. This is likely to be a result of the gradual phasing-out of unfunded government superannuation schemes, for which the ABS imputes contributions into household disposable income. We focus in this paper on personal saving decisions by households, and therefore remove the employer superannuation contributions from household saving.

After making the inflation adjustment and removing employer superannuation contributions, measured household saving still shows some downward trend (Figure 3). Part of this decline may be due to households offsetting their superannuation contributions, capital gains on household assets, or the effects of financial deregulation, as our model of household saving in Section 3.2 shows.

Figure 3: Superannuation and Saving Measures

Per cent of wages and salaries



Sources: ABS; ATO; RBA

3.2 A Small Analytical Model of Household Saving

This section illustrates the effect of financial deregulation, superannuation and (unexpected) capital gains on household saving using a small theoretical model. Our model is based on the overlapping generations framework introduced by Samuelson (1958), which has also been used by Miles (1992) and Bayoumi (1992) to analyse the effects of financial deregulation on consumption. We will briefly describe the set-up of the model and then informally discuss the results for the different scenarios. A more formal treatment of the model results, including some numerical examples, can be found in Appendix B.

We start with the basic overlapping-generations model of a small open economy. Consumers in our model live for three periods. Consumers are young in the first, middle-aged in the second period and old in the third period, and consume c_t^y,

c^m_{t+1} and c^o_{t+2}, respectively. They optimise the (log-) utility they get from life-time consumption, discounting future consumption at the rate β with $0 \leq \beta \leq 1$.

$$U(c^y_t, c^m_{t+1}, c^o_{t+2}) = ln(c^y_t) + \beta ln(c^m_{t+1}) + \beta^2 ln(c^o_{t+2}) \tag{1}$$

Consumers receive an endowment in each period, which could be thought of as labour income. When they are young they have a low income e^y_t, for instance because they are in education; at middle age, during their working life, they have a high income e^m_{t+1}; and they have a lower (labour) income e^o_{t+2} in old age.

Although the endowment is not storable, consumers can buy (or borrow) financial investments at the exogenous world interest rate r, which is assumed to be constant. In the basic case there are no restrictions on how much consumers can borrow. Thus they can go into debt or accumulate wealth in the first and second period. For simplicity, they are assumed to have no initial wealth beyond their endowment and they leave no bequests – that is, their wealth after the third period is zero. This implies the following intertemporal budget constraint:

$$e^o_{t+2} - c^o_{t+2} + (1+r)(e^m_{t+1} - c^m_{t+1}) + (1+r)^2(e^y_t - c^y_t) = 0 \tag{2}$$

Consumers choose their consumption to maximise their lifetime utility subject to the intertemporal budget constraint. They can use borrowing and lending to smooth consumption relative to their income stream. With our typical income profile, consumers will want to go into debt while they are young (and have a low income), pay off that debt and accumulate wealth while they are in high-income working age and finally consume that wealth when they are old.

At any point in time, there is a young, a middle-aged and an old generation, and aggregate consumption, net wealth and saving are the sum of the individual generations' consumption decisions. Note that, since consumers have access to an international capital market, the economy as a whole can run a current account surplus or deficit if borrowing by domestic households falls short (or exceeds) lending by domestic households, or, in other words, aggregate household saving does not need to be equal to zero.[8]

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[8] For simplicity, we assume that each generation has an equal number of consumers. In this case – in steady state – aggregate saving is zero. If the population grows or falls over time, aggregate consumption, saving and wealth will also grow or fall.

3.2.1 Financial deregulation and borrowing

Let us first consider the special case where financial markets in our economy are such that households face borrowing constraints, for instance because they do not have sufficient collateral.[9] In steady state, if households are unable to borrow without collateral (that is, households' net wealth cannot become negative), the young generation will be able to consume just their endowment in the first period. The middle-age generation will, however, accumulate wealth and save some of their income for retirement. Compared with the case when there are no borrowing constraints, consumers are forced to consume less when they are young and more when they are older. Since they do not pay interest on debt anymore, (undiscounted) life-time consumption is higher in the case with borrowing constraints, but the consumption path is less smooth. Since the young generation is not allowed to incur debt, the stock of aggregate net wealth is also higher compared with the first scenario (in fact, with borrowing constraints aggregate net wealth cannot be negative).

What happens now if the borrowing constraints are reduced or even eliminated? As discussed in the previous paragraph easier access to personal loans and home loans is likely to allow households to bring consumption forward, thus changing individual consumption and saving patterns. Households are now better off since they can smooth consumption relative to their income. For our endowment path, in steady state this results in lower aggregate consumption, since the average aggregate stock of net wealth is lower and therefore less interest income is earned (remember that net wealth can be positive or negative, since households have access to an international capital market).[10] A detailed numerical example is discussed in Appendix B, and we find that the differences in aggregate consumption between the two cases can be entirely explained by differences in interest income. Aggregate saving, which is defined as the difference between income and consumption, is therefore the same in either model. In fact, in our simple model, with no population growth and a constant endowment profile, in steady state aggregate saving is always zero – with or without borrowing constraints. Or in other words, in the long run, flows into wealth are matched by outflows, and therefore aggregate net wealth is constant (though at different levels).

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[9] There is an asymmetry in our model in that consumers never face lending 'constraints', that is, they always find a suitable investment opportunity. If no domestic household is able to borrow, households that accumulate wealth are assumed to lend to foreigners. It is beyond the scope of this paper to explicitly model the international capital market, but the investment opportunity could, for example, be provided by a market for government bonds, which are not collateralised.

[10] In our model, higher debt results in lower income for indebted households in the next period, since they face higher interest payments. However, the cost of servicing a loan of the same size has fallen in Australia as the cost of financial intermediation has decreased due to increased competition and innovation in the financial sector. In order to keep our model simple, we have not modelled this effect of financial deregulation.

While saving is unchanged in the long run, during the transition from one steady state to the other saving can change in order to allow for the adjustment in the long-run net wealth stock. As a result, in our model saving is lower for a transition period of two generations. This is because the middle-age and old generations, which were financially constrained in their youth, postponed consumption and therefore remain on their ‘original’ consumption path. On the other hand, the young generation is already consuming on the ‘new’ path, which allows them to bring consumption forward. While the population still comprises consumers that were financially constrained in their youth consumption will be higher (and saving will be lower) than in the steady state. The amount of net wealth, which includes the young generation’s debt, will gradually fall to the new level while consumption adjusts back to the new steady-state level.

Financial deregulation has often been cited as a major reason for the slide in household saving in Australia, with lower credit constraints allowing households to greatly expand their borrowing.[11] Our model shows that, after financial deregulation – for a transition period – saving can be expected to be lower while debt levels rise. Ultimately though, saving is expected to return to the pre-deregulation levels, but the transition period in our model comprises two generations.

3.2.2 Superannuation offset

We will now modify our model in order to illustrate the effects of the introduction of a compulsory superannuation scheme. We consider two broad channels through which superannuation can affect saving. The first is by forcing some consumers to save more since the superannuation scheme is compulsory. The second is by providing information to consumers about ‘appropriate’ levels of saving, thus reducing some uncertainty or myopia which consumers may face. We will discuss each channel in turn.

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[11] See, for instance, Edey and Gower (2000) and Ellis and Andrews (2001). For the UK, see Bayoumi (1993).

The effect of forced saving

We introduce superannuation in our model by assuming that a fixed percentage s of labour income (that is, the endowment) is not available for consumption in the first two periods but will be saved, and – together with the interest on the saving – is available for consumption when old.

The utility function remains the same, but the intertemporal budget constraint needs to be modified. Saving in each period can now be split into voluntary saving $((1-s)e_t - c_t)$ and compulsory saving se_t:

$$e_{t+2}^{o} - c_{t+2}^{o} + (1+r)\left((1-s)e_{t+1}^{m} - c_{t+1}^{m} + se_{t+1}^{m}\right) + (1+r)^2\left((1-s)e_t^{y} - c_t^{y} + se_t^{y}\right) = 0 \quad (3)$$

Note that the intertemporal budget constraint in Equation (3) is essentially unchanged from Equation (2), implying the same desired consumption path. We can distinguish three cases of actual consumption and saving based on the level of forced saving relative to desired saving, and also on the (in)ability to borrow.

If desired saving exceeds forced saving, the introduction of superannuation in our model does not affect the saving rate or the retirement income: the consumer will simply offset the compulsory superannuation by a reduction in other savings, leaving overall saving unchanged.

On the other hand, the consumer may wish to save less than the superannuation contributions as is the case for our typical endowment profile, where young consumers would like to borrow and thus their desired saving is negative. If the consumer faces no borrowing constraint, she can offset the superannuation contributions with debt, allowing her to keep consumption and net saving at the desired level.

The situation changes, however, when the consumer wishes to save less than the compulsory superannuation but cannot borrow to offset the saving in superannuation contributions. Then, consumption in the first two periods will be lower, and consumption in retirement will be higher. If borrowing is zero, wealth is at least as much as the sum of superannuation contributions for each generation, leading to a higher aggregate stock of wealth in every period.[12]

In this last scenario the introduction of superannuation increases saving of the young and middle-aged generations and – at least temporarily – also increases aggregate saving.[13] Ultimately, aggregate saving will return to the initial level, since contributions to superannuation wealth by the young and middle-age generation will be matched by outflows to the old generation, supporting their retirement consumption. However, in the transition period (which, in our model, is two generations) saving is higher since the contributions to superannuation wealth exceed the withdrawals during this period, and the net wealth stock gradually adjusts to the higher steady-state level. This also implies that when superannuation is introduced, the consumption of the old generation gradually increases to a higher steady-state level.

Stepping away from the simplicity of our model, in the real world the strength of this channel when compulsory superannuation is introduced will depend on how many consumers are liquidity-constrained or financially-constrained households, which consume all or most of their income. For instance, Debelle and Preston (1995) estimate that around 20–25 per cent of households were liquidity-constrained in the 1990s. These households would have had difficulty offsetting compulsory superannuation, unless they were able to borrow.

The effect of reducing uncertainty

We will now consider a different channel through which superannuation might change the consumption path chosen by consumers. In this case, rather than ‘constraining’, compulsory superannuation resolves some uncertainty around the adequate level of saving for retirement. This might be the case if some households are myopic and underestimate the need to finance consumption in old age, or they overestimate available income in retirement. Superannuation could then serve to indicate the ‘appropriate’ level of saving necessary for adequate retirement provision. In this case, we do not need a specific constraint (such as ‘no borrowing’) to affect consumption and saving, since the desired consumption path itself changes.

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[12] Formally, this implies a wealth constraint which is different from that in the simple case of ‘no borrowing’ where wealth must be non-negative.

[13] Superannuation can also have an effect on saving in the first two cases if it is not fully offset. This could be, for example, because the interest rate on voluntary saving is not equal to that on superannuation saving (for example due to different tax treatment) or if the interest rate on borrowing is different from that on lending.

In our model an overestimation of retirement incomes would imply an expected $\hat{e}^o_{t+2}$ which is too high, and myopia would imply a time preference parameter $\hat{\beta}$ that is too low (thus discounting future consumption needs by too much). In both cases, consumption is being brought forward through time.

If the superannuation scheme now provides a signal that actual retirement incomes might be lower (or that the time preference rate $\hat{\beta}$ should be increased) consumption is postponed in order to be able to finance a higher retirement consumption. While saving returns to its starting level in the long run, it increases during the transitional period, while the younger generation postpones consumption, and the older generation (which has consumed more in their youth) is still on the old consumption path with a low retirement consumption. As a result, aggregate net wealth increases gradually to a higher level where it stabilises (reflecting the lower debt of the young generation in steady state).[14]

The empirical relevance of this channel is supported by a number of surveys that have found that households have difficulties in estimating how much saving is needed for an adequate retirement provision. For instance, a recent *ANZ Survey of Adult Financial Literacy in Australia* (Roy Morgan Research 2003) found that only 37 per cent of respondents had worked out how much they needed to save for their retirement.[15]

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[14] Of course, the expectation adjustment could in principle also operate in the other direction. A superannuation contribution rate s might lie below the current saving rate of some consumers. If these consumers are uncertain how much saving is required for adequate retirement provision, they might reduce their saving. Of course, whether such a reduction is optimal will depend on the preferences and the income path of these consumers, that is, whether they saved ‘too much’ to start with.

[15] Also see the ABS Retirement and Retirement Intentions Cat No 6238.0, November 1997, which provides evidence that expected retirement incomes are often optimistic.

In summary, our analysis highlighted that compulsory superannuation can increase saving, particularly for two groups of households. One group is liquidity-constrained or financially-constrained households, which consume all or most of their income. A second group are myopic households who may underestimate how much long-term saving is necessary to accumulate sufficient funds for retirement. Indeed, some evidence of myopic and liquidity-constrained behaviour can be found in the reasons sighted by jobholders for not making voluntary superannuation contributions. Around a quarter of jobholders indicated that they were not interested in making voluntary contributions, while another quarter could not afford to make voluntary contributions.[16] Compulsory superannuation forces these households to save more, unless they are able (and willing) to offset it with either reduced short-term savings or increased borrowing.

So far we have assumed that the rate of return on superannuation is the same as the rate of return on other forms of saving. However, some forms of superannuation attract tax concessions. Voluntary superannuation, without the existence of tax concessions or regulations limiting access to funds, should be close to a perfect substitute for other forms of saving, with few implications for total saving. However, when tax concessions are introduced, voluntary superannuation can provide higher returns than other forms of saving. While tax incentives can encourage households to save more in superannuation, it is less clear whether they increase total saving. Households that would otherwise consume all their income might decide to save in tax-advantaged superannuation to take advantage of the higher returns and increase lifetime income. However, households that already save voluntarily may merely substitute into superannuation. They may even save less overall since they no longer have to save as much to achieve the same level of lifetime income.

3.2.3 Consuming out of capital gains

Our model can also be used to illustrate the effect of an unexpected, temporary increase in capital gains from investment, such as the rapid increases in the prices of some household assets over the past 20 years. We assume that the increase in wealth is unexpected, that is, *ex ante* consumption decisions do not take these capital gains into account. Note that the change in wealth due to the asset price increase is not counted as saving (at least in the definition used here), which is the excess of *income* over consumption and therefore does not include capital gains.

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[16] Survey of Employment Arrangements and Superannuation in March 2000, reported in ABS Cat No 6360. The proportion of respondents not making voluntary contributions to superannuation may have been affected by the existence of compulsory superannuation at the time of the survey.

We can model an increase in asset prices as an increase in the stock of wealth for those consumers who hold positive wealth (in our model this is typically the generation which moves from the middle-age to the old generation, since the young generation either has negative wealth or zero wealth at the end of the period). Not surprisingly, consumption of this generation increases, leading to a rise in aggregate consumption and a temporary fall in the saving rate. This result shows what is known in the literature as the 'wealth effect' on consumption: an increase in wealth allows higher consumption by those who own the asset. This will lead – at least temporarily – to a lower saving rate.[17]

4. The Empirical Model

In the previous section we analysed the effect of superannuation, financial deregulation and capital gains in a theoretical model. This provides the motivation for the econometric model in this section where we provide estimates of the impact of superannuation policy on household saving in Australia.

After 17 years of compulsory superannuation and 11 years of the SGC, it may now be possible to look back and analyse the evidence of how the scheme has affected household saving so far. Our main task is to estimate the extent to which compulsory superannuation has been offset by households reducing other forms of saving. We can also examine the offset for voluntary superannuation contributions. As illustrated in Section 3, an appropriate model of saving would also take account of the effect of financial deregulation in the 1980s and the increases in the value of household wealth in the 1990s.

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[17] Note that this wealth effect on saving stems partly from our definition of saving as the difference between income and consumption, where capital gains represent non-income returns to wealth.

4.1 Previous Estimates of the Superannuation Offset

The superannuation offset is the extent to which non-superannuation saving falls as a result of increased superannuation saving. Most estimates of the compulsory superannuation offset in Australia to date have relied on judgment or extrapolation from the experiences of other countries, with estimates between 30 and 50 cents per dollar (summarised in Table 2).[18]

Table 2: Previous Estimates of the Superannuation Offset in Australia Study

Study	Data and methodology	Offset
FitzGerald and Harper (1992) and FitzGerald (1993)	Examined micro data on number of liquidity-constrained households.	50 cents reduction in net private saving per dollar of compulsory superannuation.
Corcoran and Richardson (1995)	Proportion of employees making sufficient voluntary contributions in 1988 to fully offset compulsory contributions.	17 cents reduction in voluntary superannuation per dollar of compulsory superannuation.
Covick and Higgs (1995)	Estimated smoothing of private consumption in 1980s using aggregate consumption function.	37 cents reduction in net private saving per dollar of compulsory superannuation.
Morling and Subbaraman (1995)	Estimated aggregate relationship between net superannuation flows and other saving over 1960–94.	75 cents reduction in net household saving per dollar of superannuation net flows (120 cents if fund earnings are not included).
Gallagher (1997)	Assumption in RIMGROUP model based on a review of previous studies.	30–50 cents reduction in net private saving per dollar of compulsory superannuation.

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[18] Morling and Subbaraman (1995) find a much larger offset coefficient for *net* superannuation contributions. However, their results are not strictly comparable to the other studies for two reasons. Firstly, over the period estimated (1960–94) superannuation comprised mainly voluntary contributions and secondly, their coefficients summarise the behaviours of both the contributing and withdrawing cohorts.

In the United States, there has been considerable debate over the effectiveness of voluntary incentives aimed at increasing saving for retirement, with studies using survey data producing conflicting findings. Poterba, Venti and Wise (1996) found large and significant positive effects of tax-preferred savings programs on saving behaviour. By contrast, Engen, Gale and Scholz (1996) find little or no saving effects, while Hubbard and Skinner (1996) argue that the truth lies somewhere in between.

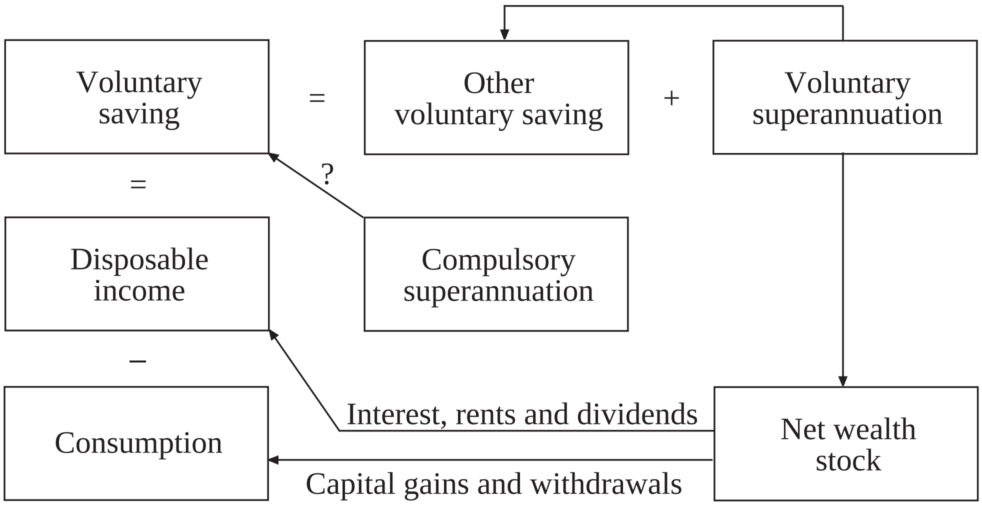
Our study is closest to the methodology chosen by Morling and Subbaraman (1995) in that we estimate the superannuation offset coefficient using annual aggregate data for Australia. However, we estimate both the compulsory and voluntary superannuation offset and we use a different model specification, described in Section 4.3.

4.2 Model Specification

Figure 4 summarises the influences on household saving as reflected in our estimated model. Voluntary saving is defined as the difference between disposable income and total consumption, where disposable income is the sum of labour and investment income excluding capital gains and employer superannuation. Households can choose to save in voluntary superannuation or in other voluntary saving depending on the relative returns. Voluntary saving and compulsory superannuation add to the stock of net wealth. Movements in net wealth, in turn, can reduce voluntary saving through the consumption of capital gains and other withdrawals, such as increased borrowing. The focus of our analysis is to determine what effect compulsory superannuation and voluntary superannuation have on voluntary saving.

In order to answer this question we formalise this model into a single equation. Given the close relationship between saving and consumption, we have designed our variables to maintain consistency with the work of Tan and Voss (2003) on consumption functions in Australia (see Appendix A for data construction). All variables are after tax, per capita and deflated using the household final consumption expenditure deflator.

Figure 4: Household Saving


Voluntary saving
=
Other voluntary saving
+
Voluntary superannuation
=
?
Disposable income
Compulsory superannuation
–
Consumption
Interest, rents and dividends
Net wealth stock
Capital gains and withdrawals

Our theoretical model in Section 3.2 suggests that, without a superannuation scheme, saving s_t is a function of labour income y_t, net wealth at the beginning of the period w_t, and a measure of the degree of financial deregulation dty_t:[19]

$$s_t = \beta_0 + \beta_1 y_t + \beta_3 w_t + \beta_4 dty_t + \varepsilon_t \tag{4}$$

We use dty_t, the ratio of household debt to income, as a proxy for the degree of financial deregulation. Following Bayoumi (1993), this ratio reflects the increased borrowing possibilities and may therefore be an appropriate measure of those aspects of financial deregulation that impact on household saving. Indeed, household debt to income has increased rapidly since the late 1980s, the same period over which the fall in household saving has been most pronounced.[20]

The introduction of compulsory superannuation $csup_t$ forces employers to pay into superannuation funds on top of households' labour income. As a result of the increased overall saving, households may reduce their voluntary saving s_t. A simple way of examining this proposition is to estimate the following equation and test the coefficient on compulsory saving β_2, the *offset coefficient*:

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[19] ε_t denotes a random disturbance with mean zero and β_0 denotes autonomous saving. Net wealth at the beginning of the period is used to avoid double counting superannuation contributions, which enter net wealth during the period. Net wealth, which is dominated by movements in asset prices, mainly captures the consumption effect of capital gains.

[20] Net wealth may capture financial deregulation only insufficiently, since net wealth is dominated by asset price growth. See Ellis and Andrews (2001) for a discussion of the relationship between deregulation, debt and dwelling prices.

$$s_t = \beta_0 + \beta_1 y_t + \beta_2 csup_t + \beta_3 w_t + \beta_4 dty_t + \varepsilon_t \tag{5}$$

If β_2 is equal to zero this implies no offset, with households unable or unwilling to lower their voluntary saving, and total saving has increased by the amount contributed to compulsory superannuation. If β_2 is equal to minus one, the compulsory superannuation is entirely offset by a reduction in non-superannuation saving, leaving overall saving unaffected.[21]

The effect of voluntary superannuation $vsup_t$ on other saving can be estimated in the same way, with other voluntary saving os_t as the regressand.

$$os_t = \beta_0 + \beta_1 y_t + \beta_2 csup_t + \beta_3 w_t + \beta_4 dty_t + \beta_5 vsup_t + \varepsilon_t \tag{6}$$

As above, if households consider voluntary superannuation and other voluntary saving as perfect substitutes, we would expect β_5 to be equal to minus one. If voluntary superannuation contributes to (reduces) total voluntary saving at the margin, we would expect β_5 to be larger (smaller) than minus one.

4.3 Estimation Results

The saving equations from the previous section are estimated using annual data from 1966/67 to 2001/02. As the data are non-stationary, we estimate the saving equations using Error Correction Models (ECMs), which allow us to estimate jointly the long-run coefficients and the dynamics if the variables are co-integrated.[22] We estimate two models based on Equation (5) and Equation (6). The results for the long-run coefficients are presented in Table 3, with more detailed results, including robustness checks, reported in Appendix C.

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[21] Note that in this case, even if overall saving is unaffected, the composition of saving is changed towards saving in long-term assets since compulsory superannuation is typically not accessible before an individual reaches retirement age.

[22] ADF tests suggest all the variables are I(1). The speed-of-adjustment coefficients in the ECMs are negative and significant, consistent with the presence of cointegration. Conventional ADF tests for cointegration on the residuals of the long-run relationship using the MacKinnon (1991) critical values all reject unit roots in the residuals at the 10 per cent level of significance.

Table 3: ECM Results for Saving Equations – Long-run Coefficients
Sample: 1966/67–2001/02

	Voluntary saving	Voluntary saving excluding super
Labour income	0.13**	0.13**
	(0.03)	(0.03)
Compulsory superannuation β_2	–0.38	–0.31
	(0.26)	(0.20)
Voluntary superannuation		–1.30**
		(0.18)
Net wealth	0.00	0.00
	(0.01)	(0.01)
Debt to income in per cent	–0.02**	–0.02*
	(0.01)	(0.01)
Speed-of-adjustment	–1.30**	–1.47**
	(0.20)	(0.24)
R^2	0.60	0.71
Chow breakpoint (1988/89)	{0.58}	{0.45}
Wald tests on β_2:		
No offset	{0.15}	{0.13}
Total offset	{0.02}	{0.00}

Notes: Numbers in parentheses are standard errors and **, * represent significance at 5 and 10 per cent levels. Standard errors on the long-run variables in the ECMs are calculated using a Bewley-Transformation and are Newey-West corrected for heteroskedasticity. Numbers in braces are p-values.
A negative and significant speed-of-adjustment coefficient is consistent with the presence of cointegration. The speed-of-adjustment terms of between –1 and –2 suggest that voluntary saving overshoots within one year in response to a shock. Overshooting of saving with respect to income, for instance, is consistent with a model where consumption does not adjust instantaneously to permanent shocks to income.

In the first regression, which is the equivalent to Equation (5), households' voluntary saving is modelled as a function of labour income, compulsory superannuation, net wealth and the debt-to-income ratio. The marginal propensity to save out of labour income is around 13 cents in the dollar. This estimate is somewhat lower than the marginal propensity to save which can be implied from the consumption function estimated by Tan and Voss (2003), but the latter estimate of around 30 cents in the dollar seems rather high. The difference may be due to Tan and Voss's estimation period, which starts only in the 1980s, or the treatment of consumer durables, which are excluded from Tan and Voss's measure of consumption, and from our measure of saving.[23]

The point estimate of the offset of compulsory superannuation is around 38 cents in the dollar. This estimate is within Gallagher's (1997) expected range of 30 cents to 50 cents. The Wald tests suggest that this offset is significantly below a full offset of minus one and, in fact, not significantly different from no offset at all. This coefficient is reasonably robust to the inclusion of other variables which could theoretically affect household saving. When the real interest rate, demographic variables and measures to capture labour market uncertainty are introduced, they are found to be insignificant. The point estimate of the compulsory superannuation offest remains within the range of 30 to 40 cents. These supplementary results are reported in Appendix C.

The second regression is the equivalent to Equation (6), which explains other voluntary saving (that is, exclusive of voluntary superannuation) with the same variables as in the first regression, plus voluntary superannuation. The offset coefficient on voluntary superannuation is quite large at 130 cents, but close to the 120 cents estimated by Morling and Subbaraman (1995). Since Wald tests are unable to reject that this coefficient is equal to minus one, these estimates suggest that contributions to voluntary superannuation have roughly been offset by decreases in other voluntary saving. However, these results are likely to be affected by the quality of the data, with some double-counting of voluntary superannuation contributions through rollovers likely to bias the size of the voluntary superannuation offset upwards (more details are provided in Appendix A). We should also note that our measure of voluntary superannuation includes life insurance and has been subject to a number of changes in the tax regime over the sample period.

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[23] The coefficient on net wealth in the first regression is also smaller than the implied coefficient in Tan and Voss (2003). However, the two coefficients are not, strictly speaking, comparable. In their consumption framework, net wealth increases consumption through both capital gains and interest income, while in our saving measure, net wealth would be expected to have a negative effect on measured saving through capital gains, but a positive effect through higher interest and dividends.

The other parameter estimates do not appear to be significantly affected by the introduction of voluntary superannuation as a regressor. The coefficient on compulsory superannuation in the second regression is slightly lower than the corresponding coefficient in the first regression. The lower coefficient may suggest that households reduce their voluntary superannuation contributions to offset compulsory superannuation, but we should note that the wide standard errors make this only a tentative conclusion. However, some supporting evidence that compulsory superannuation may have an offsetting effect on voluntary superannuation can be gleaned from the Household Expenditure Survey. Although the total value of voluntary contributions has grown since the 1980s, this has been driven by high-income earners, while lower to middle-income earners reduced their contributions. Households who may have otherwise chosen to save in voluntary super may be increasingly relying on their compulsory contributions.

4.4 Counterfactual Saving Rate

In this section we construct a counterfactual to gauge the net effect compulsory superannuation has had on the saving rate. Of course, such a scenario analysis can always be only illustrative as we have to hold all other factors constant.

In our first scenario we simulate what the household saving rate would have been if no employers' superannuation contributions had been paid. Based on the estimated equation for total voluntary saving, for each dollar less in compulsory superannuation saving overall saving would decrease by 62 cents (since households reduce their voluntary saving by an estimated 38 cents in response to a compulsory superannuation contribution of one dollar). If we assume that this marginal effect is also the average effect, we can construct a rough counterfactual saving rate. In this scenario (depicted in Figure 5 as 'superannuation not paid as income') the saving rate would have been lower by around 2 per cent of GDP by 2001/02.

One might also assume that the introduction of superannuation contributions that need to be paid by the employer may have had some effect on subsequent wage increases. At the other extreme, in our second scenario we therefore assume that employers' superannuation contributions were made in lieu of wage rises.[24] In this case, we have to consider that households would have received every dollar of superannuation as additional income, out of which they would have saved an estimated 13 cents voluntarily. The net effect on saving of each dollar less in compulsory superannuation is therefore estimated to be a reduction of 49 cents (a decrease of 62 cents plus an increase of 13 cents in saving out of the additional income).[25] Based on this assumption (depicted in Figure 5 as 'superannuation paid as income') the counterfactual saving rate would have been lower by around 1.5 per cent of GDP by 2001/02.

Taking the wide standard errors on our estimates of the offset coefficient into account, the counterfactual saving rates from both scenarios are not significantly different from each other. In fact, both numbers are roughly in line with the model calibrations by the RIM Task Force, which estimated that the effect of compulsory superannuation on the private saving rate would be an increase of 2 per cent by 2002 (see Gallagher (1997)).

However, one caveat should be mentioned which applies to all the analysis in this paper. Consistent with the previous literature (Gallagher 1997; FitzGerald and Harper 1992), withdrawals from superannuation are only included in our analysis through their effect on consumption (and thus on our measure on saving) rather than explicitly in a net superannuation inflow measure. To date, we do not have sufficient data available to include superannuation withdrawals in an econometric

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[24] It is possible that some compulsory superannuation contributions have increased total labour costs rather than being in lieu of wage rises. Gallagher (1997) assumes that real wages would have only increased by half the amount of the superannuation guarantee contributions if there had been no superannuation guarantee. This would shift the burden of forced saving from households to corporations, potentially having a similar overall effect on national saving.

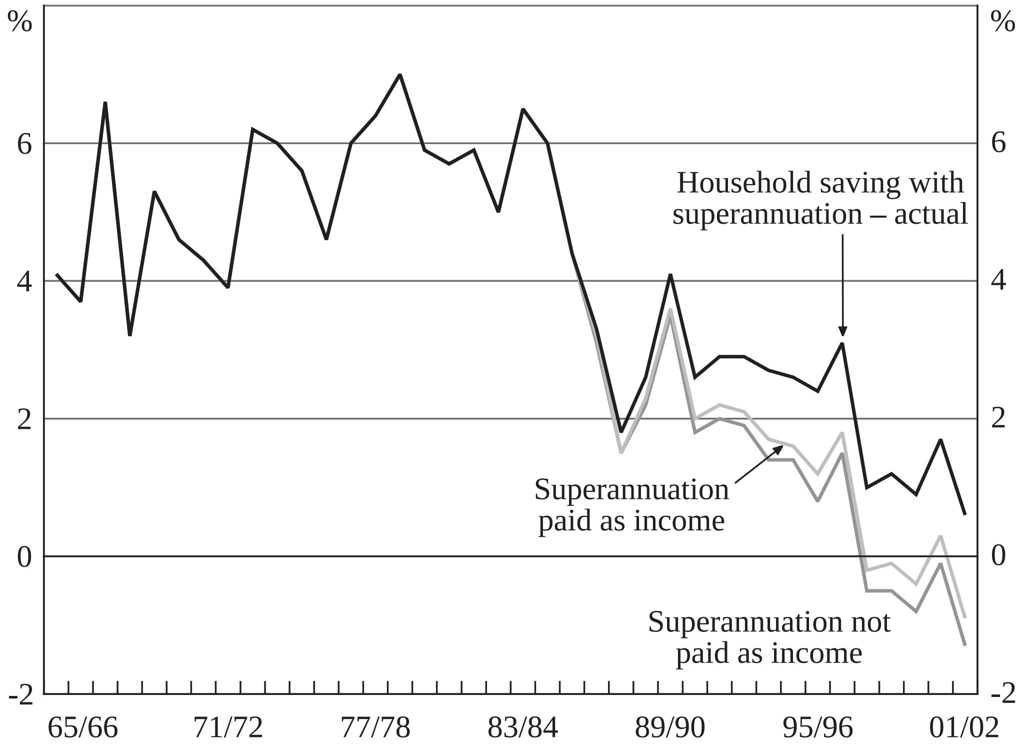
[25] Formally, for this scenario reconsider Equation (4). With the introduction of compulsory superannuation, total income becomes $y+csup$, and total saving becomes $s+csup$. After re-arranging $csup$ this gives:

$$s=\beta_0+\beta_1 y+(\beta_1-1)csup+\beta_3 w+\beta_4 dty$$

Compare this with Equation (5): if β_2 (the offset coefficient) equals β_1-1, households adjust their voluntary saving in response to compulsory superannuation so that overall, they save β_1 of their total income. The *net effect* of the introduction of compulsory superannuation on saving is then the difference between the actual saving rate on compulsory superannuation $1-\beta_2$ and the household saving rate on income β_1.

Figure 5: Effect of Compulsory Superannuation on Household Saving – Scenario Analysis

Per cent of GDP



Sources: ABS; RBA

analysis. However, as current contributors begin to withdraw their superannuation over the next 30 years, the impact of superannuation on saving flows is likely to be more muted. In fact, our theoretical model suggests that the effect on household saving *flows* is entirely reversed once withdrawals from superannuation are equal to the inflows. On the other hand, our stylised model shows also that retirement incomes and the *stock* of wealth stabilise at a higher level after the introduction of compulsory superannuation.

5. Conclusions

This paper has attempted to analyse the impact on household saving behaviour arising from the changes to superannuation policies in Australia over the last 17 years. Our analysis takes account of other macroeconomic developments that are likely to have had a strong influence on the household saving rate over this period, especially the financial deregulation of the 1980s and the unprecedented increase in the value of household wealth in the 1990s.

In the first part of this paper we developed a stylised theoretical model in order to gauge the effect financial deregulation, unexpected capital gains on household assets and compulsory superannuation might be expected to have on the saving rate, household wealth and retirement consumption. The model suggests that compulsory superannuation is expected to increase the saving rate if there are households that are not able or not willing to offset the superannuation contributions through reduction in other saving or increased borrowing. This effect is expected to dissipate over time, as contributing cohorts become withdrawing cohorts – although the effect can last for several generations. In contrast, the positive effects on net household wealth and retirement incomes are permanent.

We then estimated a saving equation for Australia to gauge how much of the compulsory superannuation has – on average – been offset by reductions in other saving. We estimate that around 38 cents of each dollar in superannuation contributions are offset, or in other words, 62 cents in each dollar are saved additionally. We use these estimates to construct a counterfactual saving rate, which suggests that compulsory superannuation may have increased the household saving rate by up to 2 per cent in recent years. Overall, our results suggest that government policies encouraging superannuation have added to both household saving and wealth.

Appendix A: Data Definitions and Sources

Household assets in superannuation *(Figure 1)*

Sources: For Australia, the data are households’ net equity in reserves of superannuation funds and life insurance corporations from the Australian Bureau of Statistics (ABS) Financial Accounts and Foster (1996) prior to 1988. The ABS Financial Accounts began in December 1988, with some classification changes in June 1992. For the US, reserves in pension funds and life insurance from the Federal Reserve Flow of Funds. For the UK, net equity of households in life assurance and pension funds reserves from the UK National Statistics Financial Statistics and net assets of life insurance and pension funds prior to 1987.

Net inflation-adjusted household voluntary saving

Construction: Household net saving is obtained from the National Accounts and is the difference between disposable household income and consumption. The inflation adjustment is made using Reserve Bank of Australia (RBA) household debt estimates from 1976/77 to 2001/02, Foster (1996) from 1965/65 to 1975/76, interest-bearing asset estimates from the Financial Accounts from 1988/89 to 2001/02 and Foster (1996) from 1965/66 to 1987/88, and the household final consumption expenditure deflator from the National Accounts. Employer superannuation is removed from saving using unpublished National Accounts data back to 1983, and prior to 1983 by replacing compensation of employees in disposable income with wages and salaries (from various ABS Cat No 5204.0 prior to 1994/95) and contributions to workers compensation.

Sources: ABS Cat No 5204.0 (2001/02); ABS Cat No 5232.0; Foster (1996); Reserve Bank of Australia *Bulletin*.

After-tax labour income

Construction: This series is constructed consistent with the measure used in Tan and Voss (2003). After-tax labour income is defined as

$$YD = Wages + Transfers - \gamma \cdot Tax$$

Transfers are calculated as *Total Secondary Income – Social Contributions for Workers Compensation*. γ is the share of labour income in total household income. It is calculated as *Wages/Total Primary Income*. *Tax* is calculated as the sum of *Income Tax Payable* and *Other Current Taxes on Income, Wealth etc*. *Wages* is a quarterly wage bill measure constructed from Average Weekly Earnings and measures of employment as follows:

$$Wages = (\omega \cdot AWE \cdot WSE) \cdot Scale$$

where *AWE* is average weekly earnings, *WSE* is the total number of wage and salary earners from the National Accounts and *Scale* converts the wage bill for wage and salary earners to one for all employed individuals. ω is the number of weeks in a quarter, calculated as $\frac{1}{7}\frac{365}{4}$. *Scale* is the ratio of aggregate hours worked by all individuals in the quarter, including those not identified as wage and salary earners by the ABS, to aggregate hours worked in the quarter by wage and salary earners. These are unpublished ABS data.

Sources: ABS Cat No 5204.0 (2001/02); Foster (1996).

After-tax compulsory superannuation

Construction: An annual series for employer contributions to superannuation funds is available from the ATO from 1988/89 to 1999/2000. For 2000/01 and 2001/02, National Accounts unpublished funded employer superannuation contributions are spliced on. It is possible that some non-compulsory employer contributions also appear in this series, but the impurity appears to be small when the series, as a share of wages and salaries, is compared with the SGC rate.

Compulsory superannuation contributions are zero in 1985/86 and interpolated for 1986/87 and 1987/88. This provides a plausible measure of Award superannuation from 1986/87 to 1991/92 which is consistent with movements in employee coverage over the period. Taxation is removed from the series by applying the 15 per cent contribution tax from 1988/89, and by removing the receipts of the superannuation surcharge, introduced in 1996/97.

Sources: ABS unpublished estimates; ATO Taxation Statistics 1999–2000.

After-tax voluntary superannuation

Construction: Contributions to superannuation and life insurance companies are obtained from the National Accounts. Funded employer contributions to superannuation are removed using: the after-tax compulsory superannuation series above from 1990, private sector employer superannuation contributions from the ABS Major Labour Costs survey from 1985 to 1990, and the ABS employer superannuation contributions series in ABS Cat No 5204.0 (various) back to 1966, using the private sector share of total employer superannuation contributions in 1985.

In line with the standard ABS classification, assets in life insurance, part of which is not governed by the superannuation scheme, are reported as part of voluntary superannuation assets. Unfortunately, separate data for life insurance are not available over the entire estimation period. However, they account only for between 30 per cent (in the earlier part of our sample) and 10 per cent (in the later part of the sample) of voluntary contributions, and they account for about 5 per cent of the total superannuation contributions in the later part of the sample, having steadily fallen from around 15 per cent in the earlier part. Taxation of voluntary contributions (mainly the self employed) is removed using ATO tax data.

Note that voluntary contributions here do not include voluntary employer contributions, which in any case are only a small share of total employer contributions.

It is possible that the data are contaminated with some double counting of 'rollover' funds, which were introduced in 1983. This double counting has probably fallen since 1992, when 'rollover' operations were allowed to be carried out within the same fund (see Edey and Simon (1998)). APRA have found evidence that double counting is less of a problem recently, indicating that in 1999 less than 10 per cent of voluntary contributions were reinvested superannuation withdrawals (Australian Prudential Regulation Authority 1999).

Sources: ABS Cat No 5204.0 (2001/02); ABS Cat No 6348.0

Household wealth

Construction: Household wealth is the sum of financial and non-financial wealth, consistent with Tan and Voss (2003). Household financial wealth includes household holdings of currency, bank deposits, building society deposits, credit co-op deposits, cash management trusts, public unit trusts, public common funds, friendly society holdings, government bonds, life office and superannuation fund assets and direct holdings of equities, but excludes unfunded superannuation and prepayment of premiums. Household non-financial wealth consists of dwellings and durable goods. The measure for the value of dwellings is taken from the product of the estimated number of dwellings and the dwelling price index. The estimated number of dwellings is calculated using ABS data on completions and the census number of dwellings. The dwelling price index is constructed by using a weighted average of metropolitan and regional dwelling prices in each state, as reported by the CBA/HIA Housing report. The methodology for calculating the value of the dwelling stock is outlined in Callen (1991).

Sources: ABS Cat No 5232.0 for data 1988/89 onwards. Data prior to 1988/89 are from Foster (1996). ABS Cat No 2015; ABS Cat No 8752 and CBA/HIA Housing Report.

Household debt

Construction: This measure consists of all financial institutional lending of personal credit, housing credit and securitised mortgaged lending. Prior to 1977, data from Foster (1996) are used to back-cast household debt, assuming that household borrowings from other non-bank deposit taking institutions grew in line with borrowings from building societies prior to 1977. This assumption is valid over the late 1970s, when data for non-bank deposit taking institutions become available. This debt series is also used in the debt-to-income ratio.

Source: Reserve Bank of Australia *Bulletin*.

Total consumption deflator

Construction: Implicit price deflator for total household final consumption expenditure.

Sources: ABS Cat No 5204.0 (2001/02).

Population

Construction: Estimated resident population of Australia.

Sources: ABS Cat No 3101.0; Foster (1996).

Appendix B: A Small Theoretical Model

This appendix presents a simple model of saving based on the overlapping generations framework introduced by Samuelson (1958). Within this highly stylised framework we can analyse the effects on saving from financial deregulation, the introduction of superannuation, and (unexpected) increases in wealth. These effects are illustrated with numerical simulations.

A simple overlapping-generations model with three generations

Our model is based on a standard overlapping-generations model of a small open economy in which consumers live for three periods. Consumers are young in the first period, middle-aged in the second period and old in the third period. They optimise the (log-) utility they get from life-time consumption, discounting future consumption at the rate β with $0 \leq \beta \leq 1$.

$$U(c_t^y, c_{t+1}^m, c_{t+2}^o) = ln(c_t^y) + \beta ln(c_{t+1}^m) + \beta^2 ln(c_{t+2}^o) \tag{B1}$$

Consumers receive an endowment in each period, which could be thought of as labour income. When they are young they are assumed to have a low income e_t^y, for instance, because they are in education; at middle age, during their working life, they have a high income e_{t+1}^m; and they have a lower (labour) income e_{t+2}^o in old age. Although the endowment is not storable, consumers can buy (or borrow) financial investments at the (exogenous) world interest rate r_t. Thus they can go into debt or accumulate wealth in the first and second period. For simplicity, they are assumed to leave no bequests at the end of the third period, that is, their wealth at the end is zero and they have no initial wealth beyond their endowment.

In the first basic case, consumers are allowed to borrow at any point in time as long as they have no debt at the end of their life. The budget constraints for each period (that is, wealth measured at the end of each period) are then defined as:

$$\begin{aligned} w_t^y &= e_t^y - c_t^y \\ w_{t+1}^m &= e_{t+1}^m - c_{t+1}^m + (1+r_t)w_t^y \\ w_{t+2}^o &= e_{t+2}^o - c_{t+2}^o + (1+r_{t+1})w_{t+1}^m = 0 \end{aligned} \tag{B2}$$

The change in the asset position is equal to the consumers' saving, that is, an increase means that she has saved and a decrease means that she has borrowed. If the asset position is unchanged, consumption in each period equals the endowment (labour income) plus interest income. The constraints in Equation (B2) can be collapsed to an intertemporal budget constraint by recursive substitution of w_{t+1}^{m} and w_t^y:

$$e_{t+2}^{o} - c_{t+2}^{o} + (1+r_{t+1})(e_{t+1}^{m} - c_{t+1}^{m}) + (1+r_{t+1})(1+r_t)(e_t^y - c_t^y) = 0 \tag{B3}$$

The first-order conditions, together with the intertemporal budget constraint, yield the optimal consumption path for a consumer:

$$\begin{aligned} c_t^y &= \frac{1}{(1+r_t)(1+r_{t+1})}\frac{(e_{t+2}^{o} + (1+r_{t+1})e_{t+1}^{m} + (1+r_t)(1+r_{t+1})e_t^y)}{(\beta^2+\beta+1)} \\ c_{t+1}^{m} &= \frac{\beta}{(1+r_{t+1})}\frac{(e_{t+2}^{o} + (1+r_{t+1})e_{t+1}^{m} + (1+r_t)(1+r_{t+1})e_t^y)}{(\beta^2+\beta+1)} \\ c_{t+2}^{o} &= \beta^2\frac{(e_{t+2}^{o} + (1+r_{t+1})e_{t+1}^{m} + (1+r_t)(1+r_{t+1})e_t^y)}{(\beta^2+\beta+1)} \end{aligned} \tag{B4}$$

The savings profile and the consumption profile are of course a function of the endowment path, the time preference and the interest rate. Typically, we assume an endowment profile that is low when young and old, and high in middle age. This means, if there are no restrictions on the amount that can be borrowed, consumers will typically go into debt while they are young, pay off that debt and accumulate wealth while they are in working age and finally consume that wealth when they are retired (together with the endowment during that period).

At any point in time, there is a young, a middle-aged and an old generation, and aggregate consumption, net wealth and saving are the sum of the individual consumption decisions. For simplicity, we assume that each generation has an equal number of consumers, normalised to one (if the population grows or falls over time, aggregate consumption, saving and wealth will also grow or fall).

$$\begin{aligned} C_t =& c_t^y + c_t^m + c_t^o \\ W_t =& w_t^y + w_t^m = (e_t^y - c_t^y) + (e_t^m - c_t^m) + (1+r_{t-1})((e_{t-1}^y - c_{t-1}^y)) \\ S_t =& W_t - W_{t-1} = e_t^y - c_t^y + e_t^m - c_t^m + r_{t-1}(e_{t-1}^y - c_{t-1}^y) - \\ & (e_{t-1}^m - c_{t-1}^m) - ((1+r_{t-2})(e_{t-2}^y - c_{t-2}^y)) \end{aligned} \tag{B5}$$

Table B1 illustrates the results of the basic model when we set the time discount rate β to one, the interest rate to 0.05, and the initial endowment for each generation to (1, 4, 1). The first panel shows the results of the basic model if consumers are allowed to borrow. Unrestricted borrowing in the first period allows the young generation to bring consumption forward, and – with a zero interest rate – would yield the optimal consumption path of (2, 2, 2). Since we have assumed a positive interest rate, it pays off to postpone some of the consumption and increase life-time consumption somewhat.

Table B1: Basic OLG Model With and Without Borrowing

Consumption with borrowing

Generation	Time period									
	1	2	3	4	5	6	7	8	9	10
…					…					
4				1.91	2.00	2.10				
5					1.91	2.00	2.10			
6						1.91	2.00	2.10		
…					…					
Aggregate consumption	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01
Aggregate saving	0	0	0	0	0	0	0	0	0	0
Aggregate net wealth	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14

Consumption without borrowing

Generation	Time period									
	1	2	3	4	5	6	7	8	9	10
…					…					
4				1	2.47	2.60				
5					1	2.47	2.60			
6						1	2.47	2.60		
…					…					
Aggregate consumption	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07
Aggregate saving	0	0	0	0	0	0	0	0	0	0
Aggregate net wealth	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52

Note: The endowment path is (1, 4, 1), the interest rate is set to 0.05, and the time discount rate is set to one.

Now let us consider the case where households are not allowed to borrow. If we do not allow households to borrow we introduce the additional assumption that household wealth cannot become negative:[26]

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[26] Since households can still lend (that is, they hold positive wealth) they are assumed to lend to foreigners (for instance, they could buy government bonds).

$$\begin{aligned} w_t^y &\geq 0 \\ w_{t+1}^m &\geq 0 \end{aligned} \tag{B6}$$

For our endowment path this means that the young generation will be able to consume just their endowment in the first period (see the second panel in Table B1). The middle-age generation will, however, accumulate wealth and save some of their income for retirement. Undiscounted life-time consumption is higher in this case, but the consumers consume less when they are young and more when they are older.[27] Of course, consumers may prefer to consume more when they are young, even if it means sacrificing some of the life-time consumption. The stock of aggregate wealth is also higher compared with the first scenario, since the young generation is not allowed to incur debt.

We will now modify this model in order to illustrate the effects of financial deregulation, the introduction of a compulsory superannuation scheme, and an (unexpected) increase in the value of assets held by households.

Financial deregulation and saving

We first analyse the impact of financial deregulation on saving in our model. This analysis borrows from Bayoumi (1993), who modelled the effect of financial deregulation on saving and the current account for the UK.

In a world of financial regulation, consumers face borrowing constraints. The extreme assumption of a ‘no borrowing’ constraint underlies the model described in the second scenario in Table B1. In this scenario, young consumers need to postpone consumption to middle and old age.

After financial deregulation, consumers face no borrowing constraints (at least in our stylised model world), described in first scenario in Table B1. Saving in both scenarios is the same, but the aggregate stock of wealth in the world with financial constraints is higher, mainly since the young generation does not contribute negative wealth, or debt. It should be noted that for the parameters chosen in our model simulations, in aggregate consumers would prefer to hold less net wealth, or more debt, which would allow them to smooth consumption more evenly through time.[28]

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[27] In our model, the lower debt levels increase disposable income since less interest needs to be paid to service the debt. However, life-time consumption of some households could also fall permanently if geared investments earn higher returns on their asset portfolio, thus increasing lifetime income when households are allowed to borrow (see Deaton (1992) and Attanasio (1998)).

Table B2: Financial Deregulation in an OLG Model

Consumption

Generation	Time period									
	No borrowing				Free borrowing					
	1	2	3	4	5	6	7	8	9	10
...					...					
2		1.00	2.47	2.60						
3			1	2.47	2.60					
4				1	2.47	2.60				
5					1.91	2.00	2.10			
6					1.91		2.00	2.10		
7							1.91	2.00	2.10	
...					...					
Aggregate consumption	6.07	6.07	6.07	6.07	6.98	6.51	6.01	6.01	6.01	6.01
Aggregate saving	0	0	0	0	–0.90	–0.48	0	0	0	0
Aggregate net wealth	1.52	1.52	1.52	1.52	0.62	0.14	0.14	0.14	0.14	0.14

Note: The endowment path is (1, 4, 1), the interest rate is set to 0.05, and the time discount rate is set to one.

Table B2 illustrates how our model changes when financial constraints get abolished in period 5, thus illustrating the effects of deregulation. While saving is unchanged in the long run, for a transition period (which takes two generations) saving is lower. This is because the middle and old generations, which were financially constrained in their youth, have postponed consumption and therefore remain on their ‘original’ consumption path. On the other hand, the young generation is already consuming on the ‘new’ path, which allows them to bring consumption forward. While the population still comprises consumers which were financially constrained in their youth, consumption will be higher (and saving will be lower) than in steady state. The amount of net wealth (which includes the young generation’s debt) will gradually fall to the new level while consumption adjusts back to the new level.

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[28] This is partly because wealth serves mainly the purpose of allowing to choose the timing of consumption. Of course, the introduction of other ‘utility’ of wealth, such as allowing bequests, would alter our model results.

This exercise illustrates that after financial deregulation – for a transition period – saving can be expected to be lower while debt levels rise. Ultimately though, saving is expected to return to the pre-deregulation levels, but the transition period in our stylised model comprises two generations.

A model with superannuation

We now turn to an analysis of the effects of a compulsory superannuation scheme in our model. We consider two channels through which a superannuation scheme can affect our model outcome. First, compulsory superannuation can force households to save. Second, consumers may be uncertain about the value of some future variables, such as retirement income. Superannuation schemes may then provide a signal about the value of this future variable, leading possibly to revisions of the saving and consumption path. We model each channel in turn.

Superannuation and forced saving

We introduce compulsory superannuation in our model by assuming that a fixed percentage s of labour income (that is, the endowment) is not available for consumption in the first two periods but will be saved, and – together with the interest on the saving – is available for consumption in retirement. We also assume for simplicity that income of the 'old' generation is not subject to superannuation contributions (since this generation has to consume all its wealth in the same period). Note that the corresponding saving is the sum of superannuation contributions plus the part of disposable income that is not consumed.

$$\begin{aligned} w_t^y &= se_t^y + (1-s)e_t^y - c_t^y \\ w_{t+1}^m &= se_{t+1}^m + (1-s)e_{t+1}^m - c_{t+1}^m + (1+r_t)w_t^y \\ w_{t+2}^o &= e_{t+2}^o - c_{t+2}^o + (1+r_{t+1})w_{t+1}^m = 0 \end{aligned} \tag{B7}$$

Reducing Equation (B7) to the intertemporal budget constraint in Equation (B8), we can see that this is the same as Equation (B3). The desired consumption path with and without superannuation is therefore identical.

$$\begin{gathered} e_{t+2}^o - c_{t+2}^o + (1+r_{t+1})((1-s)e_{t+1}^m - c_{t+1}^m + se_{t+1}^m) + \\ (1+r_{t+1})(1+r_t)((1-s)e_t^y - c_t^y + se_t^y) = 0 \end{gathered} \tag{B8}$$

We can now distinguish three cases depending on whether forced saving is more (or less) than desired saving, and depending on whether the consumer can borrow.

If the superannuation contributions are less than what the consumer wants to save anyway, she will simply offset the compulsory superannuation by a reduction in other savings – assuming the rate of return on both types of saving are identical. Total saving will then remain unchanged.

If, on the other hand, the consumer wishes to save less than the superannuation contributions, she can offset the superannuation contributions through borrowing. This is the case in our model simulations, where consumers would like to borrow when they are young and bring consumption forward. Of course, borrowing will entirely offset the superannuation saving only if the interest rate on borrowing and on saving is the same, as assumed in our model. Table B3 shows the model simulations when a superannuation contribution rate of 10 per cent is introduced in period 5. Not surprisingly, in the case of unconstrained borrowing, the results are identical to those in Table B1.

The situation changes, however, when a consumer wishes to save less than the superannuation contributions but she cannot borrow (enough) to offset the saving in superannuation contributions. Our 'constrained' scenario in Table B3 assumes that borrowing is zero, which implies that wealth is now at least as much as the sum of superannuation contributions for each generation. The wealth constraints are now:

$$\begin{aligned} w_t^y &\geq se_t^y \\ w_{t+1}^m &\geq se_{t+1}^m + (1+r_t)se_t^y \end{aligned} \tag{B9}$$

In our 'constrained' example, consumption in the first two periods will be lower, and consumption in retirement will be higher, leading to a higher aggregate stock of wealth in every period. Ultimately, aggregate saving is zero, since the old generation dissaves every period the amount of superannuation paid in by the young and middle-age generation. However, in the 'changeover' period (which, in our model, is two generations) saving is higher since the old generation, who did not pay superannuation contributions when they were young and/or middle-age, have a lower (individual) wealth and therefore do not withdraw as much superannuation as if they had accumulated superannuation over their entire lifetime.

Table B3: Superannuation in an OLG Model With and Without Borrowing

Consumption with borrowing

Generation	Time period									
	Superannuation rate $s = 0$				Superannuation rate $s = 0.1$					
	1	2	3	4	5	6	7	8	9	10
…					…					
4				1.91	2.00	2.10				
5					1.91	2.00	2.10			
6						1.91	2.00	2.10		
…					…					
Aggregate consumption	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01
Aggregate saving	0	0	0	0	0	0	0	0	0	0
Aggregate net wealth	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Of which: super	0	0	0	0	0.5	0.61	0.61	0.61	0.61	0.61

Consumption without borrowing

Generation	Time period									
	Superannuation rate $s = 0$				Superannuation rate $s = 0.1$					
	1	2	3	4	5	6	7	8	9	10
…					…					
2		1.00	2.47	2.60						
3			1	2.47	2.60					
4				1	2.47	2.60				
5					0.9	2.53	2.65			
6						0.9	2.53	2.65		
7							0.9	2.53	2.65	
…					…					
Aggregate consumption	6.07	6.07	6.07	6.07	5.97	6.03	6.08	6.08	6.08	6.08
Aggregate saving	0	0	0	0	0.1	0.05	0	0	0	0
Aggregate net wealth	1.52	1.52	1.52	1.52	1.62	1.68	1.68	1.68	1.68	1.68
Of which: super	0	0	0	0	0.5	0.61	0.61	0.61	0.61	0.61

Note: The endowment path is (1, 4, 1), the interest rate is set to 0.05, and the time discount rate is set to one.

Superannuation and uncertainty about model parameters

We will now consider a different scenario where superannuation might change the consumption path chosen by consumers. In this case rather than ‘constraining’, superannuation resolves some uncertainty around the adequate level of saving for retirement. This might happen if some households are myopic and underestimate the need to finance consumption in old age, or they overestimate available income in retirement. Superannuation could then serve to indicate the ‘appropriate’ level of saving necessary for adequate retirement provision. In this model, we do not need borrowing constraints to affect saving, as the desired consumption path changes.

In our model, the assumption of an overestimation of retirement incomes would imply an expected $\hat{e}^{o}_{t+2}$ which is higher than the actual e^{o}_{t+2}, and myopia would imply a time preference parameter $\hat{\beta}$ that is too low (thus discounting future consumption needs by more). In both cases, as we can see from Equation (B4) consumption is being brought forward through time.[29]

Table B4 shows our model simulation if the introduction of superannuation signals that the time preference parameter should be increased from 0.9 to 1 (we have only included the results for the model without borrowing). Similar to the introduction of superannuation which cannot be offset, consumption is postponed when the time preference increases. This leads to an increase in aggregate wealth (as the young generation needs to borrow less to finance the lower consumption). While saving returns to its starting level in the long run, it increases during the transitional period, while the younger generation postpones consumption, and the older generation (which has consumed more in their youth) also consumes less.

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[29] Formally, this can be shown by examining the derivatives of the optimal consumption choices with respect to e^{0} and β:
Since $\frac{\partial c^{y}}{\partial e^{0}} = \frac{1}{(1+r_{t})(1+r_{t+1})}A > 0$ and $\frac{\partial c^{m}}{\partial e^{0}} = \frac{\beta}{(1+r_{t+1})}A > 0$, where A is an expression that is positive, the consumer will increase consumption in the first two periods if the expected income in the last period is higher. However, in the third period, he will realise that the expectation was wrong and he will be forced to reduce consumption. With the benefit of hindsight, he would prefer to have consumed slightly less in the first two periods in order to be able to consume more when old.
Since $\frac{\partial c^{y}}{\partial \beta} = \frac{-(2\beta+1)}{(1+r_{t})(1+r_{t+1})}B < 0$, $\frac{\partial c^{m}}{\partial \beta} = \frac{1-\beta^{2}}{(1+r_{t+1})}B > 0$ and $\frac{\partial c^{o}}{\partial \beta} = (\beta^{2} + 2\beta)B > 0$, where B is a positive term, a lower β (which discounts future consumption by more) implies that consumption when young increases, while consumption in the next two periods decreases.

Table B4: Change in Time Preference in an OLG Model with Borrowing

Consumption with borrowing

Generation	Time period									
	Superannuation rate $s = 0$				Superannuation rate $s = 0.1$					
	Time preference $\beta = 0.9$				Time preference $\beta = 1.0$					
	1	2	3	4	5	6	7	8	9	10
...					...					
3			2.11	1.99	2.88					
4				2.11	1.89	1.99				
5					1.91	2.00	2.10			
6						1.91	2.00	2.10		
...					...					
Aggregate consumption	5.98	5.98	5.98	5.98	5.68	5.90	6.01	6.01	6.01	6.01
Aggregate saving	0	0	0	0	0.31	0.1	0	0	0	0
Aggregate net wealth	–0.27	–0.27	–0.27	–0.27	0.04	0.14	0.14	0.14	0.14	0.14
Of which: super	0	0	0	0	0.5	0.61	0.61	0.61	0.61	0.61

Note: The endowment path is (1, 4, 1), the interest rate is set to 0.05, and the time discount rate is set to one.

Of course, expectation adjustment could in principle also happen in the other direction, that is, consumers save more since they are uncertain how much saving is required for adequate retirement provision. A superannuation contribution rate of *s* might indicate the 'right' level, and consumers would reduce their retirement provisions (and consequently saving and wealth implications are reverse to those illustrated in Table B4).

To summarise, our simple model has highlighted that the introduction of superannuation is likely to have most effect on aggregate wealth and saving if consumers cannot offset the additional saving by either reducing other saving or increased borrowing, or if they do not wish to offset it, since superannuation provides a signal by which model parameters (such as expected retirement income, or time preference parameters) get affected. Of course, more realistic assumptions, such as different rates of return on superannuation saving and other saving (e.g., because of different tax treatment) or costs of borrowing that are higher than the return on savings, will affect our conclusions in that fully offsetting the superannuation – even if feasible – will be costly and thus might be undesirable. If superannuation saving is not offset, during an adjustment period (which in our model is two generations) aggregate saving will also be higher, but ultimately, when outflows from superannuation funds match the inflows, saving will return to the initial level.

Unexpected capital gains

Finally, we will use our model to illustrate the effect of an unexpected, temporary increase in capital gains from investment. This extension aims at providing some insights into the effect on saving, consumption and wealth of unexpected wealth effects, such as the rapid increases in the prices of some assets over the 1990s. Again, of course, our model is highly stylised, and thus can only provide insights into the basic mechanism at work with respect to saving rather than give a detailed account of all the effects such a boom has on the macroeconomy.

In our stylised scenario, we can model an increase in asset prices as an increase in the stock of wealth for those consumers who hold positive wealth by w_s per cent. We assume that the increase is unexpected, that is, *ex ante* consumption decisions are made on the basis of the original model parameters for endowment and interest. Note that the change in wealth due to the asset price increase is not counted as saving (at least in the definition used here), which is the excess of income over consumption and therefore does not include capital gains.

Formally, the consumption path (assuming the wealth shock happens in time $t = T$) is given by the following solution:

$$\begin{array}{rll} c_T^m = & \dfrac{e_{T+1}^o + (1+r_T)e_T^m + (1+r_T)(1+r_{T-1})w_{T-1}^y(1+w_s)}{(1+r_T)(1+\beta)} & \text{if } w_{T-1}^y > 0 \\ c_{T+1}^o = & \beta\dfrac{e_{T+1}^o + (1+r_T)e_T^m + (1+r_T)(1+r_{T-1})w_{T-1}^y(1+w_s)}{1+\beta} & \text{if } w_{T-1}^y > 0 \\ c_T^o = & e_T^o + (1+r_{T-1})w_{T-1}^m(1+w_s) & \text{if } w_{T-1}^y > 0 \\ c_t^y = & c_t^{y,B}, c_t^m = c_t^{m,B}, c_t^o = c_t^{o,B} & \text{in all other cases} \end{array} \tag{B10}$$

where $c_t^{y,B}, c_t^{m,B}, c_t^{o,B}$ are the consumption choices of the basic model in Equation (B4).

None of the consumption decisions before $t = T$ are affected, since the wealth shock is not anticipated. The consumption path of the generation that is young in $t = T$ remains unchanged, since the young generation does not profit from the wealth shock (initial wealth is assumed to be zero). The consumption of the generation that is working age in $t = T$ is not affected if they are in debt after the first period (our ‘typical’ scenario). However, if the working-age consumer has positive net assets in time T, she will increase consumption in the current period and in the next period, when he is old. Similarly, the consumer that is old in $t = T$ will increase consumption if she has positive net assets (as is the case in our ‘typical’ scenario) and has an unchanged consumption otherwise. The wealth shock therefore can increase aggregate consumption in T and $T + 1$.

Table B5 shows the model simulations of such a temporary increase when wealth (excluding debt) is increased by 20 per cent between period 4 and period 5, but only for those who have positive wealth at this point (for our model parameters this is the generation which moves from middle-age to old). Not surprisingly consumption of this generation increases, leading to a rise in aggregate consumption and a temporary fall in the saving rate. We show here only the results for the model with borrowing, since the general conclusions are not affected by this assumption (remember that in our simulation the young generation either has negative wealth or zero wealth at the end of the first period).

Table B5: Unexpected Capital Gains in an OLG Model With Borrowing

Consumption with borrowing

Generation	Time period									
	One-off capital gains on net wealth at the end of period 4									
	1	2	3	4	5	6	7	8	9	10
…					…					
3			1.91	2.00	2.32					
4				1.91	2.00	2.10				
5					1.91	2.00	2.10			
6						1.91	2.00	2.10		
…					…					
Aggregate consumption	6.01	6.01	6.01	6.01	7.11	6.01	6.01	6.01	6.01	6.01
Aggregate saving	0	0	0	0	–0.21	0	0	0	0	0
Aggregate net wealth	0.14	0.14	0.14	0.35	0.14	0.14	0.14	0.14	0.14	0.14

Note: The endowment path is (1, 4, 1), the interest rate is set to 0.05, and the time discount rate is set to one.

Our stylised model shows, not surprisingly, what is known in the literature as the ‘wealth effect’ on consumption: an increase in wealth allows higher consumption by those who own the asset. This will lead – at least temporarily – to a lower saving rate.

Appendix C: Supplementary Results and Robustness

Table C1: ECM Results for Saving Equations

Sample: 1966/67–2001/02

	Voluntary saving	Voluntary saving excluding super
Labour income$_{t-1}$	0.13**	0.13**
	(0.03)	(0.03)
Compulsory superannuation$_{t-1}$	–0.38	–0.31
	(0.26)	(0.20)
Voluntary superannuation$_{t-1}$		–1.30**
		(0.18)
Net wealth$_{t-1}$	0.00	0.00
	(0.01)	(0.01)
Debt to income$_{t-1}$	–0.02**	–0.02**
	(0.01)	(0.01)
$\triangle$(Voluntary saving)$_{t-1}$	0.10	0.19*
	(0.14)	(0.12)
$\triangle$(Labour income)$_t$	0.53***	0.39***
	(0.11)	(0.11)
$\triangle$(Compulsory super)$_t$	–1.78**	–0.93
	(0.70)	(0.86)
$\triangle$(Voluntary super)$_t$		–1.47**
		(0.38)
$\triangle$(Net wealth)$_t$	–0.03**	–0.01
	(0.01)	(0.01)
$\triangle$(Debt to income)$_t$	0.03*	0.01
	(0.01)	(0.01)
Constant	–0.68	–0.53
	(0.48)	(0.49)
Speed-of-adjustment	–1.30**	–1.47**
	(0.20)	(0.24)
$\bar{R}^2$	0.60	0.71

Notes: Numbers in parentheses are standard errors. **, * represent significance at 5 and 10 per cent levels. Standard errors on the long-run variables in the ECMs are calculated using a Bewley Transformation. Standard errors are Newey-West corrected for heteroskedasticity. A negative and significant speed-of-adjustment coefficient is consistent with the presence of cointegration.

Hausman tests for regressor endogeneity in the dynamics do not suggest that there are endogeneity problems that could be corrected using the instruments that we selected. Potentially endogenous variables include the change in labour income and the change in voluntary superannuation. Our instruments include lags of these variables and lagged voluntary super, US output, lagged consumption, lagged government expenditure and the other variables in the ECMs.

We also test for parameter instability using Chow breakpoint tests and recursive regressions, which do not suggest that parameter instability is a serious problem. Note that a possible problem might be posed by the compulsory superannuation variable, which is zero in the first half of the sample. However, the coefficient on this variable does not change if we shorten the time period, as also suggested by the Chow test. The other coefficients, however, can be estimated more efficiently over the longer time period.

Several other variables were introduced into the model to check the robustness of the results to potential omitted variables bias (Table C2). The short-term real interest rate was not significant in regression (c). This is not surprising given that the income and substitution effects of interest rate movements on saving are of opposite signs, potentially producing an ambiguous outcome: Deaton (1992) and Edey and Britten-Jones (1990). A demographic variable (ratio of persons aged 45 to 59 relative to persons aged 15 to 59), was insignificant in regression (d). This result is also not surprising, since Edey and Britten-Jones (1990) could not find evidence that consumption smoothing behaviour is important over individuals' lifetimes. A measure to capture uncertainty, the unemployment rate, was also insignificant in regression (e). This may be because uncertainty is being captured in movements in labour income and wealth.

We have only dealt with the effect of compulsory superannuation and voluntary superannuation on voluntary saving, without explicitly considering the role of other employer superannuation contributions and superannuation fund earnings. A large proportion of other employer superannuation was provided through unfunded schemes, which are in the process of being phased out. In our model, we would not expect households to offset the portion of compulsory superannuation that merely superseded these unfunded schemes. Past funded employer contributions and superannuation fund earnings can influence current saving through the net wealth variable.[30]

Deaton (1992) argues that it is difficult to use macroeconomic data to test micro theories of consumption and saving due to the aggregation of individuals with heterogenous information and different life spans. Nevertheless, in the absence of appropriate micro data on saving over the period of interest, we believe that the analysis of macro data is an appropriate methodology for measuring the effect of superannuation on aggregate household saving.

Table C2: Supplementary ECM Results for Voluntary Saving Equations

Long-run coefficients only, sample: 1966/67–2001/02

	(c)	(d)	(e)
Labour income	0.15**	0.11**	0.14*
	(0.05)	(0.04)	(0.08)
Compulsory super	–0.33	–0.40	–0.34
	(0.42)	(0.31)	(0.32)
Net wealth	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)
Debt to income	–0.02*	–0.02**	–0.02*
	(0.01)	(0.01)	(0.01)
Ratio of persons aged 45–59	0.02		
to persons aged 15–59	(0.03)		
Short-term interest rate		0.01	
		(0.01)	
Unemployment rate			–0.01
			(0.03)
Speed-of-adjustment	–1.34**	–1.15**	–1.28**
	(0.22)	(0.22)	(0.25)
$\bar{R}^2$	0.57	0.61	0.57

Notes: Numbers in parentheses are standard errors. **, * represent significance at 5 and 10 per cent levels. Standard errors on the long run variables in the ECMs are calculated using a Bewley Transformation. Standard errors are Newey-West corrected for heteroskedasticity. A negative and significant speed-of-adjustment coefficient is consistent with the presence of cointegration.

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[30] Unfunded schemes are not included due to data limitations. Since these schemes did not provide employees with vested superannuation accounts, they are less likely to be influencing households' saving behaviour, reducing the potential for omitted variables bias.

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