Inequality and wellbeing

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Abstract

Income inequality has been growing in most developed nations since the late 1970s. The empirical evidence links the level of inequality with a range of health and social problems, although the exact causality is debated. This study explores the relationship between income inequality and social and economic factors in developed countries, using Australia as an example. Modelling is used to investigate mechanisms to reduce inequality over time through redistribution of income from high to lower level income groups. The simulations illustrate the potential economic implications and social benefits accruing from reduced inequality.

Introduction

Although Kuznets famously hypothesised that economic growth would lead firstly to rising then declining income inequality (Kuznets, 1955), it has increased in most developed countries since the 1980s. Indeed, Kuznets' U-curve has been flipped upside down. The recent focus on the subject can be attributed to Thomas Piketty and his book *Capital in the Twenty First Century* (Piketty, 2013). Piketty proposed that while *r* (the return on capital) is greater than *g* (the growth rate) growing income inequality is inevitable. While the facts of income inequality are clear, the reasons for it are more contested. According to the International Monetary Fund (IMF):

> *Some of key factors behind the increase in within-country income inequality noted in the literature include technological progress, globalization, commodity price cycles, and domestic economic policies such as redistributive fiscal policies, labor and product market policies.*

Even more contested is the impact of inequality. In their book *The Spirit Level*, Wilkinson and Pickett (2009) produce a comprehensive set of correlations between within-country income inequality and a suite of social indicators, reproduced here as Figure 1.
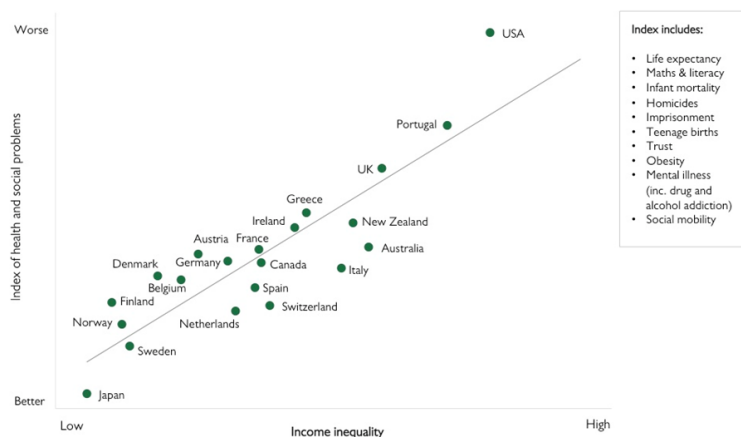
Figure 1 The Spirit Level Index of health and social problems

Similar data is presented for states with the United States. Of course, correlations, however strong do not equate to causation. As causal factors, the authors cite "*unhealthy self-esteem, better described as 'threatened egotism' or 'narcissism', deriving from increasing anxieties about how one is seen by others*". In subsequent work the authors identify the role of social dysfunction (R. G. Wilkinson & K. E. Pickett, 2009): "*… we conclude that these relationships are likely to reflect a sensitivity of health and social problems to the scale of social stratification and status competition, underpinned by societal differences in material inequality.*"

In *The Social Impact of Income Inequality*, Brian Nolan refers to a number of other sources offering such evidence, including "*reduced levels of social capital in terms of trust and norms of reciprocity*" (Kawachi & Subramanian, 2014), "*the impact on individuals of low social status producing negative emotions such as shame leading to stress*" (Marmot, 2005). Buttrick & Oishi (2017) conclude that: "*Living in highly unequal regimes is associated with both increased mistrust and increased anxiety about social status; these psychological mechanisms help explain some of the negative outcomes associated with income inequality, such as lower happiness, lower social cohesion, weaker morality, higher mortality, worse health, and weaker governance.*"

These ideas are strongly associated with the concept of relative deprivation, which (H. J. Smith & Huo, 2014) say:

"*… occurs when people compare themselves to those who are better off and conclude that their disadvantage is undeserved*".

Another study cited by Smith and Ho (Adler & Snibbe, 2003) found that survey respondents who placed themselves between a bottom and top rung of a ladder was a predictor of physical health irrespective of their material conditions. Clearly, most people are not analysing economic statistics to place themselves in the income hierarchy. However, the signs of their relative status are all around them in the form of urban conditions, amenities, schools, automobiles, retail outlets, restaurants, media and local crime and anti-social behaviour.

These psychological drivers are not reflected in most economists' conventional mental models of cause and effect. To the extent that they exist, they are obviously additional to the objective economic reality that the cost of living in a given city or region is set by average prices, and hence is relatively higher for lower income households.

Central to the findings of the Spirit Level is that everyone in a society is better off if inequality is lower, due to the background effects of better social cohesion and trust in the community, and the more direct benefits of lower incidences of crime and anti-social behaviour, and the societal tax burden of dealing with these factors. The International Association on Social Quality[1] (IASQ) is an international collaboration of researchers who have developed the concept of Social Quality (Van Der Maesen & Walker, 2011) which seeks to link individual wellbeing with the social environment:

"*…. the theory of social quality focuses on the eudaimonic tradition, and tries to understand processes, resulting into personal expressiveness in the context of societal wholes.*"

In her book *The Decent Society: planning for social quality*, Pamela Abbott (2016) describes the development of the concept and in earlier work (Abbott, 2012) used multiple regression analysis to test the relationship between self-reported (subjective) life satisfaction and a range of indicators reflective of social conditions in European countries, including those associated with the posited

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[1] https://socialquality.org/theory/

fundamental elements of Social Quality, i.e. Economic security; Social cohesion; Social inclusion and Social empowerment. The study found that:

"The model was …. found to explain a large amount of variance, which was consistent across time and space."

The objective of the work set out here is to explore the relationship between income inequality and social and economic factors in developed countries, using Australia as an example, and project the impact of changes over time through system dynamics modelling.

Methods

Data sources

Much of the data used in the study derives from the Australian Bureau of Statistics[2]:

5206.0 Australian National Accounts: National Income, Expenditure and Product
      Table 2. Expenditure on Gross Domestic Product (GDP), Chain volume measures
      Table 7. Income from Gross Domestic Product (GDP), Current prices
      Table 8. Household Final Consumption Expenditure (HFCE)
Household Income and Wealth, Australia: Summary of Results, 2019–20
      Key information from the Survey of Income and Housing 2019–20 including distribution of income and wealth by various household characteristics
Household Expenditure Survey, Australia: Summary of Results, 2015–16
      Key information about household spending, income and wealth based on various characteristics

Data on income inequality in the form of Gini coefficient in Australia was obtained from (Kennedy, Smyth, Valadkhani, & Chen, 2017). Data on health and welfare expenditure was obtained from the Australian Institute of Health and Welfare[3] who produce an annual report on Australia's welfare indicators.

Trust in government data for Australia was sourced from the OECD databank [4].

Social cohesion data was sourced from the Scanlon Foundation's Mapping Social Cohesion report (Markus, 2021).

Data analysis

Time series data from the sources above was analysed to identify the apparent relationship between each indicator and the Gini coefficient for Australia over recent decades. From this analysis a tentative causal relationship was postulated and used in the model to explore the likely implications of changes in income inequality over time.

Trends in inequality and social indicators in Australia

Australia's economy

Australia's Gross Domestic Product (GDP) has grown strongly in recent decades, in both aggregate and per capita terms (Figure 2).

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[2] https://www.abs.gov.au/
[3] https://www.aihw.gov.au/
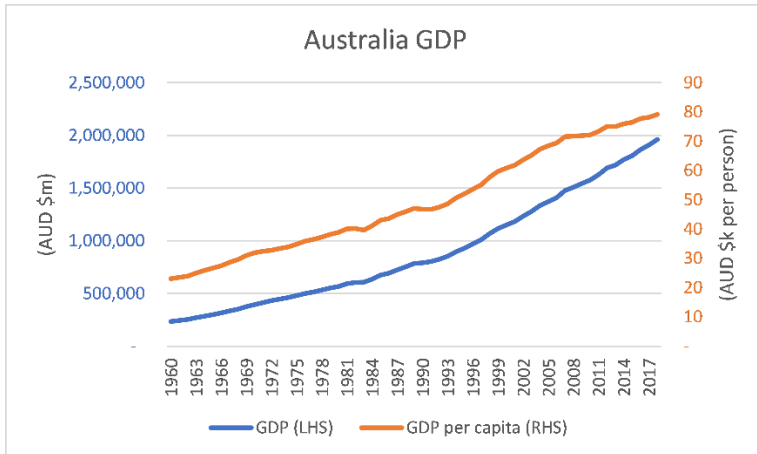[4] https://data.oecd.org/gga/trust-in-government.htm

Figure 2 Australia GDP 1960-2018

Income inequality

As has been the case in most developed countries in recent decades, income inequality increases in Australia have occurred simultaneously with a reduction in the share of income for employees (Figure 3).
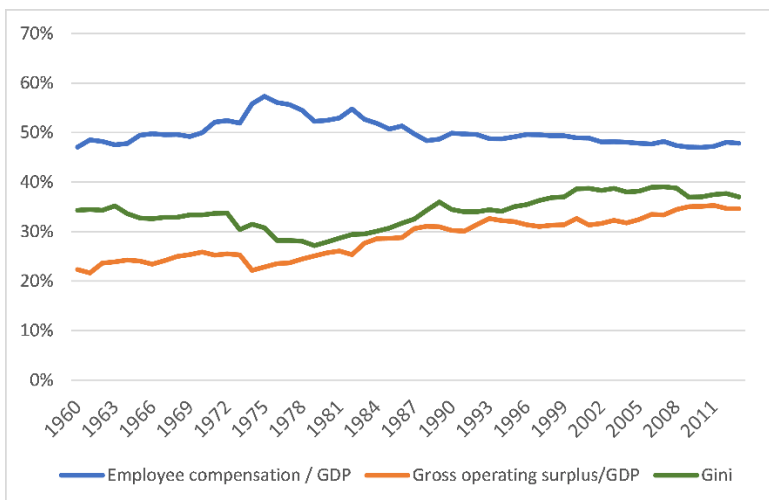

Figure 3 Employee and profit share of income and Gini coefficient 1960-2013

Income inequality grew from the late 1970's until around 2000 and has since reduced somewhat and stabilised since the Global Financial Crisis. The latest ABS data (Figure 4) depicts the relative share of income and the associated Gini coefficient.
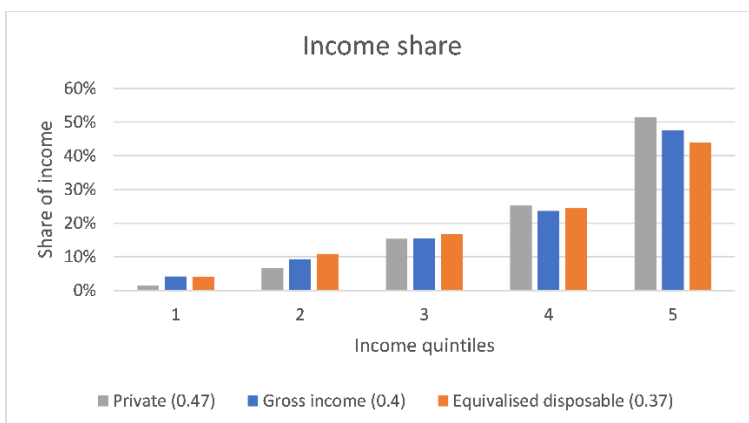
Figure 4 Income share 2019-20

Private income includes: Employee income, Own unincorporated business income, Investment income, Superannuation income and Other income. Gross income includes private income plus government pensions and allowances. Equivalised total household income is "*adjusted by the application of an equivalence scale to facilitate comparison of income levels between households of differing size and composition*".

Health expenditure

The per capita (real) costs of expenditure on health have risen significantly in total and in respect of Federal and State Government expenditure (Figure 5).
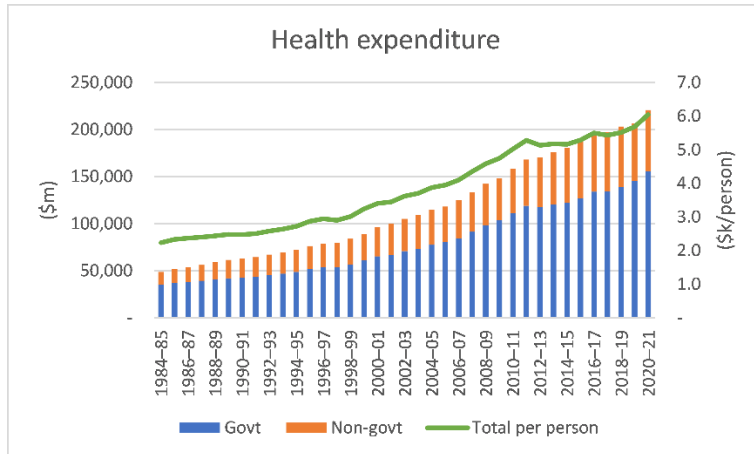
Figure 5 Health expenditure 1984-85 to 2020-21

This data represents all spending on health goods and services for recurrent and capital purposes. During this period the median age of the population increased marginally from 33 to 37 years.

Welfare expenditure

Welfare expenditure, particularly on services, by the Australian Government has also risen in real terms (Figure 6).
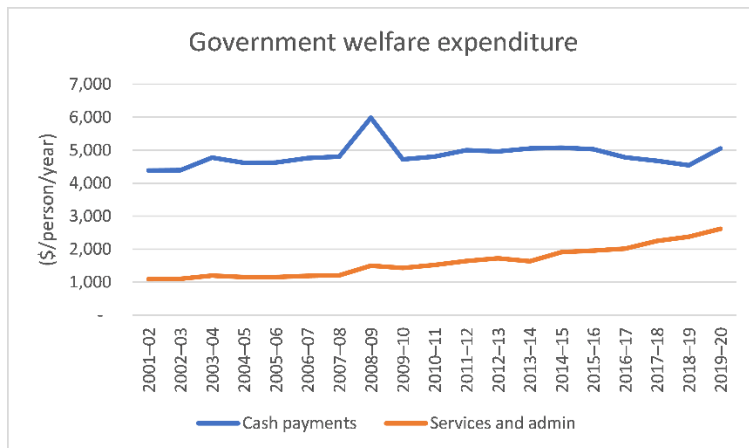

Figure 6 Welfare expenditure 2001-02 to 2019-20

This data represents cash payments, including the Age Pension, Family Tax Benefit, Disability Support Pension and Carer Allowance/Payment, Newstart Allowance and the JobSeeker Payment (unemployment benefits). Welfare services include those for family and children (e.g.youth support services; the aged (e.g. home and community care services); people with disability (e.g. personal assistance).

Social cohesion

The Scanlon Foundation[5] has conducted social cohesion surveys since 2007. The survey measures:

Sense of belonging	Indication of pride in the Australian way of life and culture
Sense of worth	Satisfaction with present financial situation and indication of happiness over the last year
Social inclusion and justice	Views on the adequacy of financial support for people on low incomes; the gap between high and low incomes; Australia as a land of economic opportunity; trust in the Australian government.
Participation (political):	Vote in an election; signing a petition; contact with a Member of Parliament; participation in a boycott; attendance at a protest.
Acceptance and rejection, legitimacy	Measurement of rejection, indicated by a negative view of immigration from many different countries; reported experience of discrimination in the last 12 months; disagreement with government support to ethnic minorities for maintenance of customs and traditions; feeling that life in three or four years will be worse.

The survey results are used to produce an index of social cohesion (Figure 7) with the first survey in 2007 set at 100. All measures save for Political participation have declined somewhat over that period.
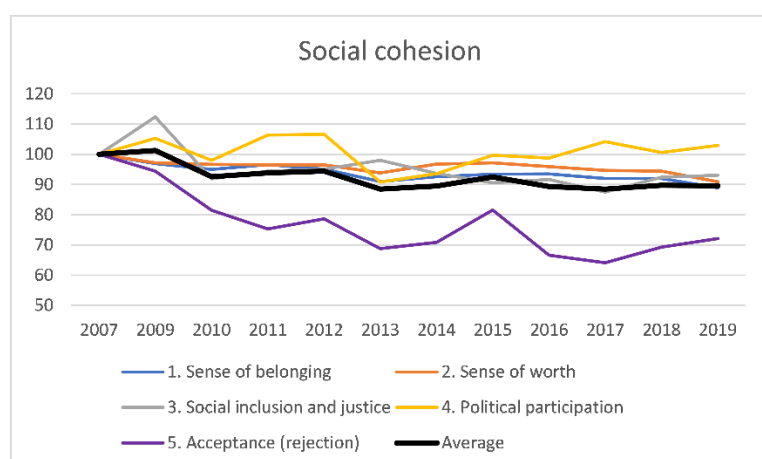

Figure 7 Social cohesion 2007-2019

Trust in government

The Organisation for Economic Cooperation and Development (OECD) conducts a survey of trust in government[6] and collects data as part of the "*How's Life? Well-Being*" series (OECD, 2020). The data refers to the share of people (percentage of all survey respondents) who report having confidence in the national government. answering "yes", "no", or "don't know") to the survey question: "*In this country, do you have confidence in… national government?*" The results for Australia are shown in Figure 8, which show a decline and then stabilisation at around 45-50% in the last decade.

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[5] https://scanlonfoundation.org.au/

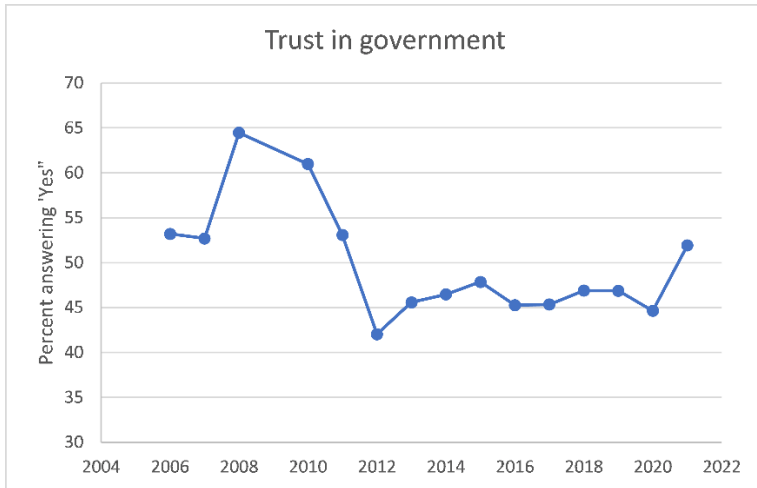[6] https://www.oecd.org/governance/trust-in-government/

Figure 8 Trust in government 2006-21

The model

There are challenges in creating a plausible macroeconomic scale model to explore the social and economic impact of inequality. This is because any changes to income have consequences for expenditure, savings and investment that could play out in a number of ways. In this study, economic and social indicators are combined to create a simple and tentative model that can illuminate the relevant dynamics.

The model has been created to reflect how changes to inequality might affect Australia over the coming 50 years. In the model, inequality as treated as a proxy for the underlying economic and social influences that (are argued to) give rise to adverse social outcomes. The trends set out above have been combined with inequality data in order to test and quantify their apparent relationship. The impacts of the causes reflected by changes in inequality, whatever they are, will obviously accumulate over time, and this has been taken into account in parameterising the model.

The model is highly simplified, with macroeconomic behaviour derived from household income and expenditure, an aggregated private sector and the health and welfare functions of all levels of government.

The model was created using Vensim Professional V9.3.5. Full documentation is set out in Appendix A.

The dynamic hypothesis

A simplified causal loop diagram of the model is set out in Figure 9. The dotted lines indicate potential causality that is not included in the model.
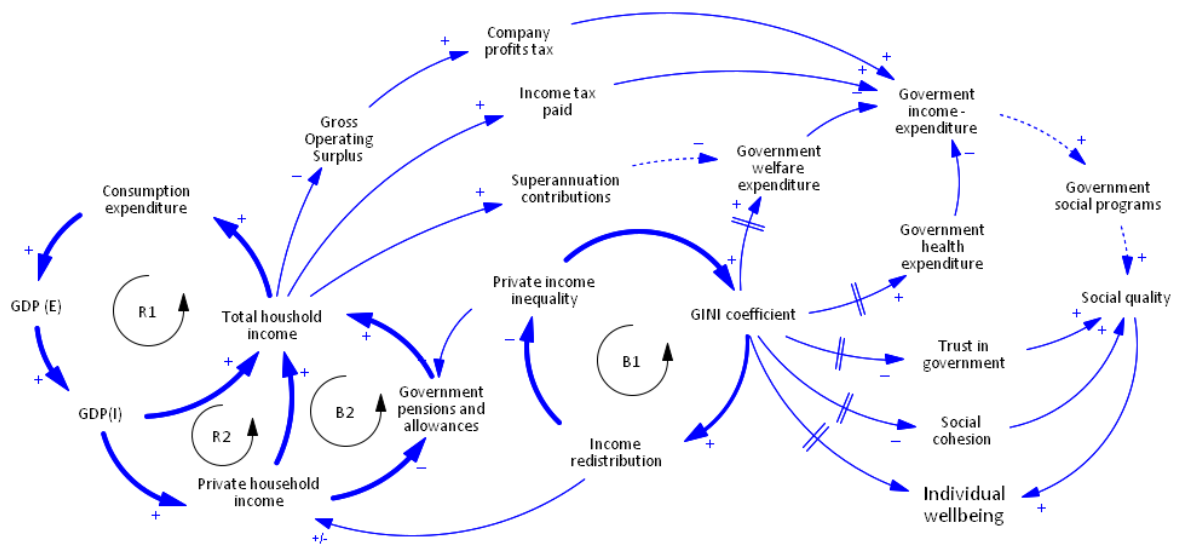
Figure 9 Causal loop diagram of model

The dynamics of the model are driven by the closure of the gap between the existing (see Figure 4) and desired Gini coefficient (assumed as 0.25).

Changes to the aggregate private income and associated Gini coefficient are converted to changes in the private income of each of five income groups (quintiles), thus re-distributing that total income. Government pensions and allowance are parameterised as a function of private income based on the existing relationship (Figure 11).
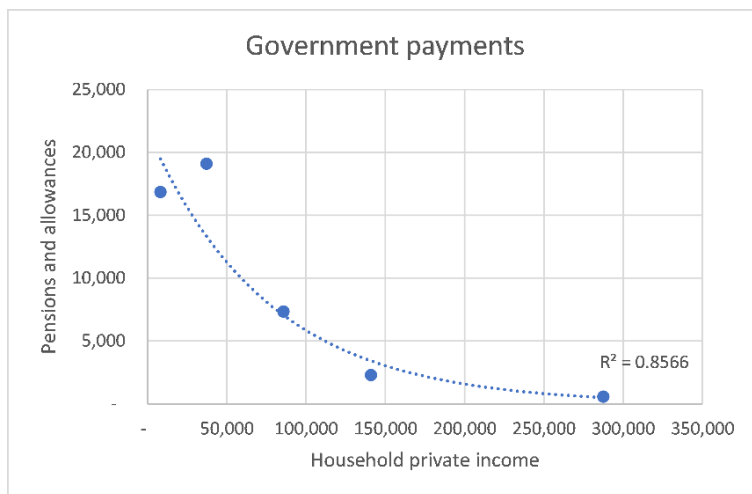
Figure 11 Government payments vs household private income

Changes to the income quintiles also affect income tax payments and contributions to superannuation which are parameterised as a percentage of expenditure, taken from the current ABS data (Figure 12).
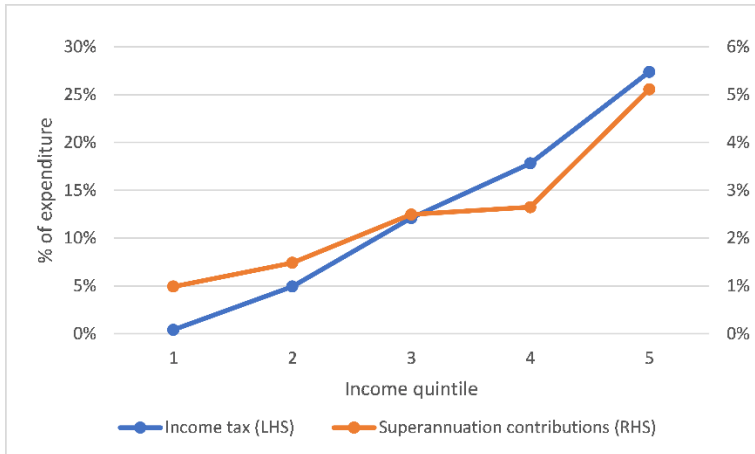
Figure 12 Income tax and superannuation contributions

Other expenditure categories (housing, consumption, investment) represent the balance of expenditure and are combined into a single category (other household expenditure).

Government health and welfare expenditure, social cohesion and trust in government are parameterised as a function of the Gini coefficient created using the Vensim 'Smooth' function with the time lags for each variable as set out below.

Inequality vs government health expenditure

A strong correlation exists between government health expenditure and the Gini coefficient from 10 years previously (Figure 13).
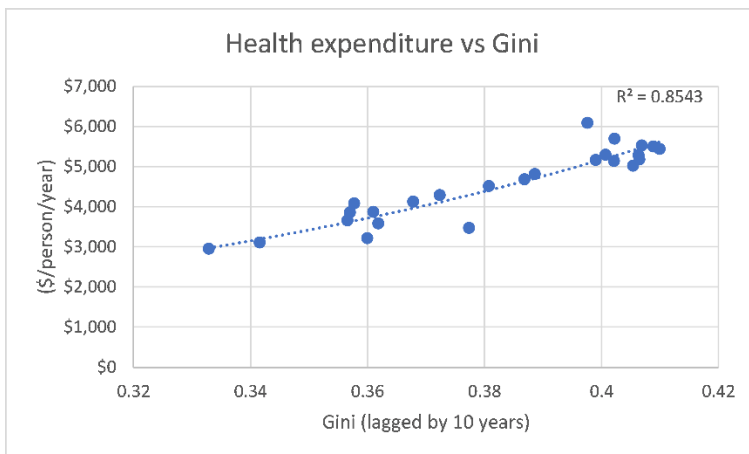
Figure 13 Government health expenditure per person vs Gini

Inequality vs government welfare expenditure on services

A similarly strong correlation (Figure 14) exists between government welfare expenditure (excluding payments to households) and the Gini coefficient from 15 years previously.
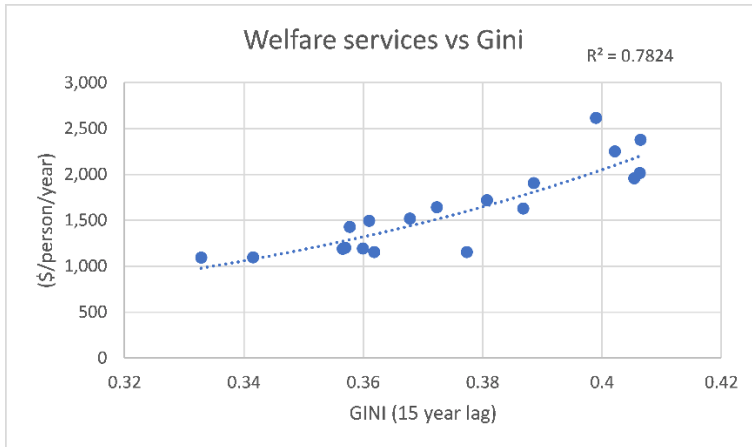
Figure 14 Government welfare expenditure per person (excluding payments) vs Gini

Inequality vs social cohesion

A similar correlation, this time negative (Figure 15), exists between the Scanlon social cohesion index and the Gini coefficient from 10 years previously.
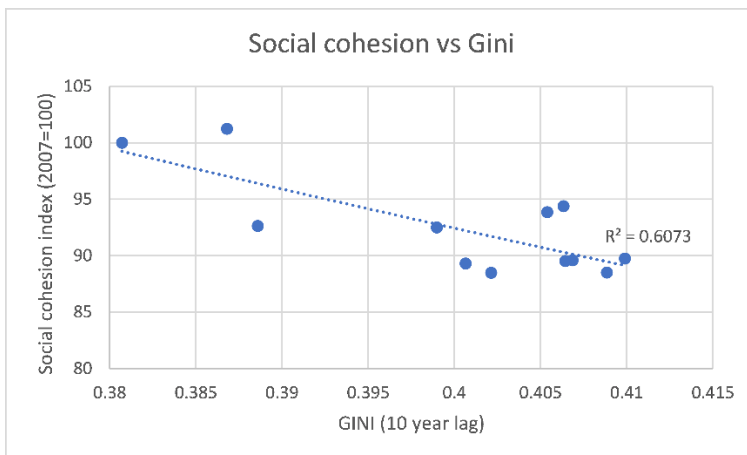

Figure 15 Social cohesion index vs Gini

Inequality vs Trust in government

A similar negative correlation (Figure 16), exists between the OECD Trust in Government index and the Gini coefficient from 10 years previously.
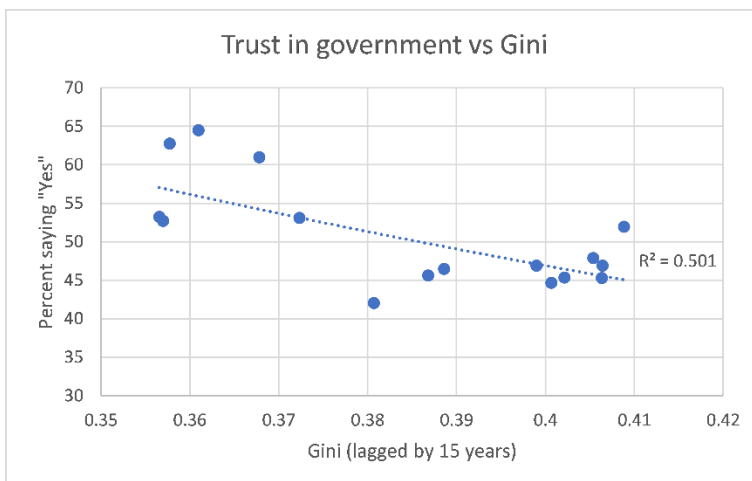

Figure 16 Trust in government vs Gini

Impact on economic growth

Changes in the proportion of income in each quintile also has an impact on consumption spending, as the savings ratio is greater for higher income groups (Figure 17).
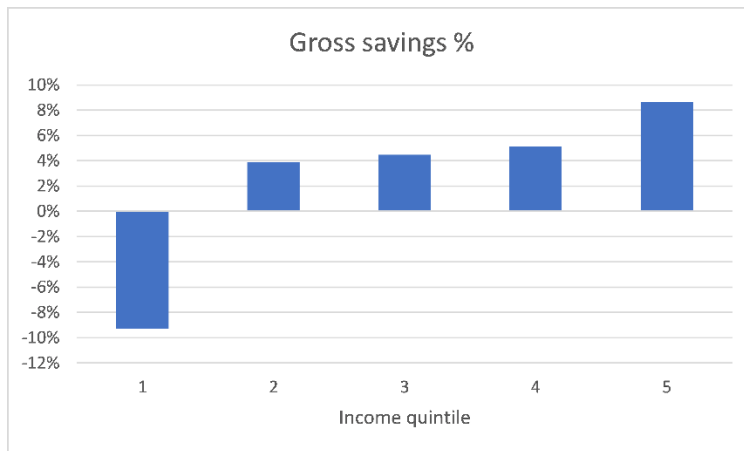

Figure 17 Savings by quintile

Although it has reduced, household consumption is presently around 55% of GDP by expenditure (Figure 18).
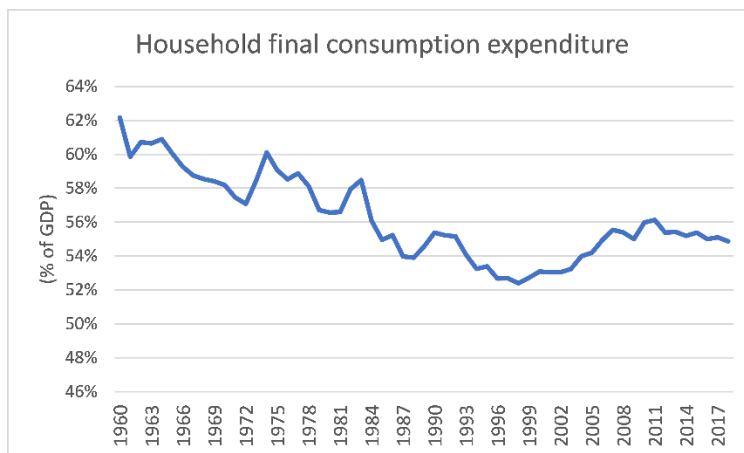

Figure 18 Household consumption expenditure as a proportion of GDP.

An increase or decrease in household expenditure (ceteris paribus) would be reflected in GDP. The model assumes that any changes are reflected by equivalent increases in private household income.

Results of simulations

The model was used to explore three scenarios:

1. Gross income to households remains constant (as a percentage of GDP) but is re-distributed from the highest quintile (Q5) to the lowest quintiles (Q1, Q2 and Q3) over time.
2. GDP by income remains constant (as a percentage) but Gross Operating Profits are reduced over time with the difference increasing the share to Employee compensation, with the increases to private income re-distributed from the highest quintile (Q5) to the lowest quintiles (Q1, Q2 and Q3).
3. Income taxation is increased to the highest quintile (Q5) and the revenue is used to increase the Gross income of the lowest quintiles (Q1, Q2 and Q3).

Scenario 1 Gross income redistribution

In this scenario the model redistributes a fraction of the total household gross income in each year from the highest quintile (Q5) to the others in the following ratio: Q1 receives 50%; Q2 receives 40% and Q3 receives 10%. In Year 1 the fraction redistributed is 0.5% and this decreases linearly as the Gini coefficient transitions to 0.25 from initial levels. The results of the simulation are illustrated in Figure 19.

Figure 19a illustrates the changes in private income (i.e. excluding government payments) which increases five fold for the lowest quintile (Q1) and by 70% for Q2 over the simulation period.

The impact of reducing income inequality in this manner has very little impact on aggregate household consumption expenditure (Figure 19b), increasing only by around 4% over fifty years, and therefore GDP is essentially unaffected (neglecting any other unmodelled consequences of the changes). Aggregate contributions to superannuation decline somewhat but increase for lower income households (Figure 19d) by 270% (Q1) and 200% (Q2) over the period.

The impact on the government sector is however significant. Rising income in the lowest quintiles both reduces government payments) and allowances (Figure 19e) and reduces necessary expenditure on health and welfare. Although taxation from income is also reduced as high income households pay less tax, the net impact reduces the overall tax burden arising from these demands (Figure 19f).

The non-economic impacts are also significant with social cohesion and trust in government also increasing, which according to the social quality research, would contribute to better overall life satisfaction outcomes for the whole community.

Scenario 2 Reducing the income share to the corporate sector

In this scenario the model reduces the corporate share of income from existing levels to 22.5% (the level in 1960) over time. The additional gross income is then distributed in the following ratio: Q1 receives 40%; Q2 receives 30%; Q3 receives 20%; Q4 10% and Q5 zero %. In Year 1 the fraction redistributed is 0.75% and this decreases linearly as the profit share transitions to 22.5% from initial levels. The results of the simulation are illustrated in Figure 20.

Figure 20a illustrates the changes in private income (i.e. excluding government payments) which increases nearly nine fold for the lowest quintile (Q1) doubles for Q2 and by 35 and 10% respectively for Q4 and Q5.

This scenario leads directly to an increase in aggregate household income and consumption which stimulates the economy and leads to around a 9% increase in GDP over the simulation period (assuming constant levels of Gross Fixed Capital Formation and Net Exports). Aggregate contributions to superannuation increase for all quintiles except Q5 (Figure 20d) with lower income households' contributions increasing by 560% (Q1) and 300% (Q2) over the period.

Rising income in the lowest quintiles both reduces government payments and allowances (Figure 20e) and reduces necessary expenditure on health and welfare. The reduction in tax receipts from corporations is more than offset by increasing income tax and the reduction in the overall tax burden is greater than Scenario 1 (Figure 20f).

Scenario 3 Increasing income tax on the highest income quintile

In this scenario the model increases the taxation rate on the highest (Q5 quintile) and the additional government revenue is distributed to the other quintiles in the same ratio as for Scenario 2, i.e. Q1 receives 40%; Q2 receives 30%; Q3 receives 20%; Q4 10% and Q5 zero %. The model assumes that the amounts are received as private income, i.e. via paid employment (e.g. expanded social services) and not through government payments and allowances. The tax increase is introduced gradually over the simulation period, resulting in a similar trajectory for the Gini coefficient as the other scenarios.

Figure 21a illustrates the changes in private income (i.e. excluding government payments) which are similar as those for Scenario 2.

This scenario leads to a smaller increase in aggregate household income as the reduction in consumption expenditure from the Q5 quintile (Figure 21b) largely eliminates the increase in GDP over the simulation period (assuming constant levels of Gross Fixed Capital Formation and Net Exports). Aggregate contributions to superannuation are similar to Scenario 2 (Figure 21d).

The increased taxation of the Q5 quintile means that the aggregate reduction of tax burden is somewhat lower than for Scenario 2.
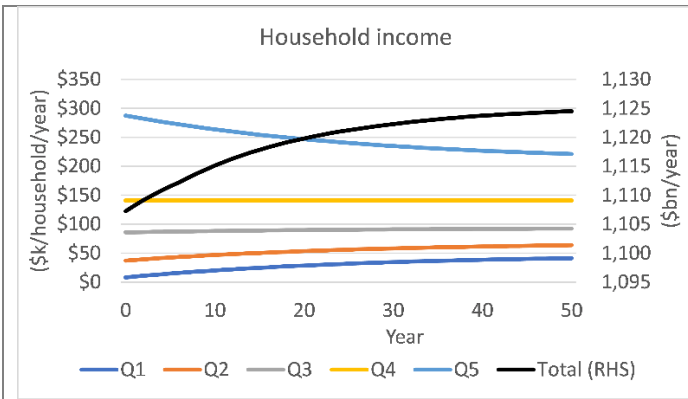
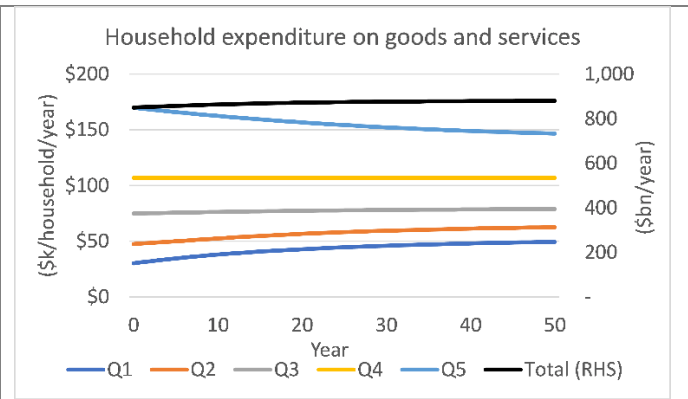Figure 19a Scenario 1 – Household private income

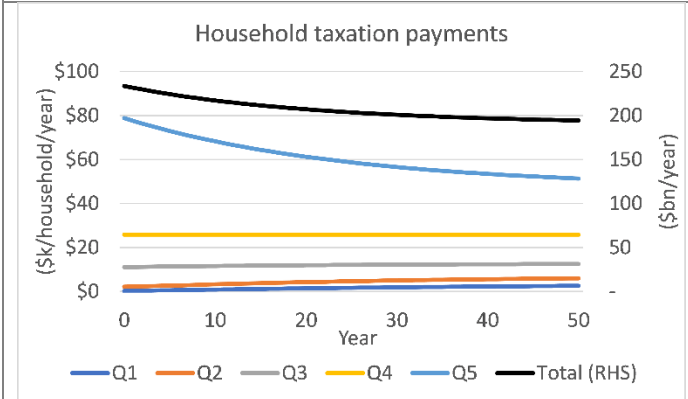Figure 19b Scenario 1 – Household consumption expenditure

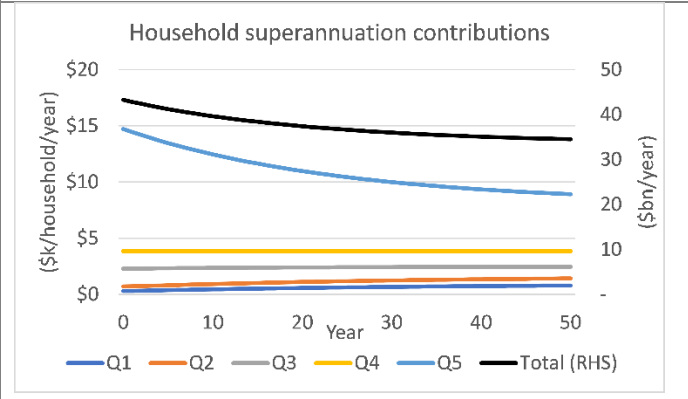Figure 19c Scenario 1 – Household taxation payments

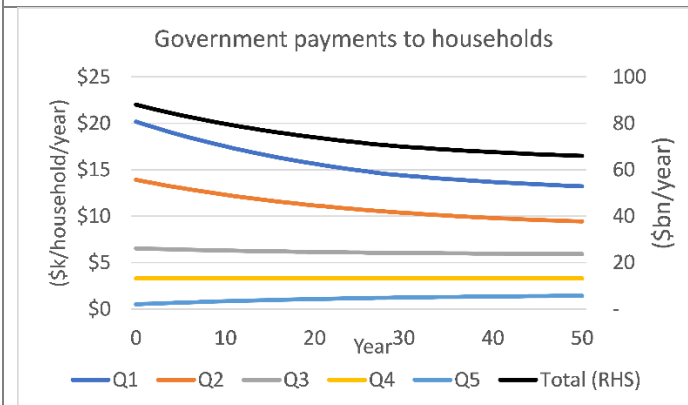Figure 19d Scenario 1 – Household superannuation contributions

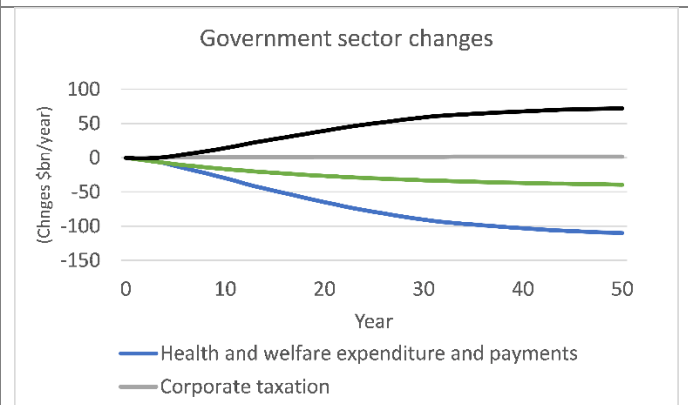Figure 19e Scenario 1 – Government payments to households

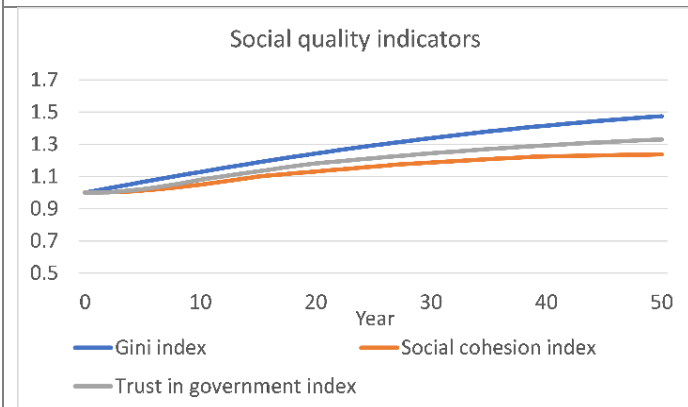Figure 19f Scenario 1 – Changes to Government sector income and expenditure

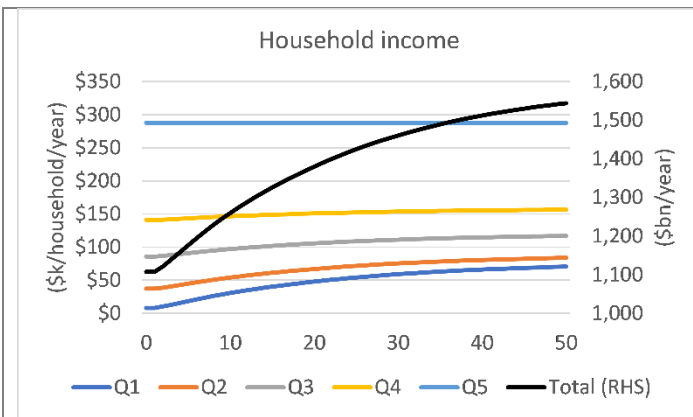Figure 19g Scenario 1 – Social quality indicators

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Figure 20a Scenario 2 – Household private income

Figure 20b Scenario 2 – Household consumption expenditure

Figure 20c Scenario 2 – Household taxation payments

Figure 20d Scenario 2 – Household superannuation contributions

Figure 20e Scenario 2 – Government payments to households

Figure 20f Scenario 2 – Changes to Government sector income and expenditure

Figure 20g Scenario 2 – Social quality indicators
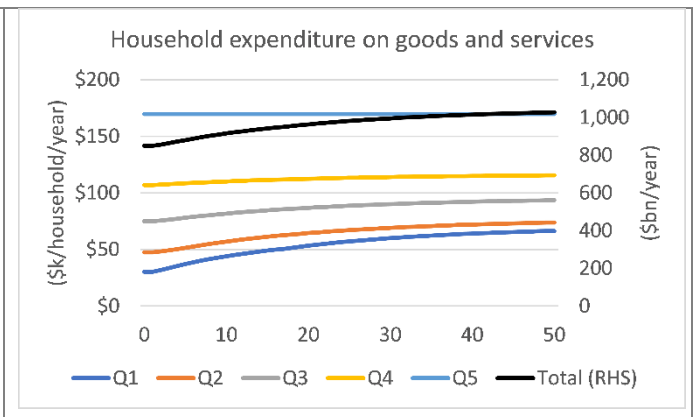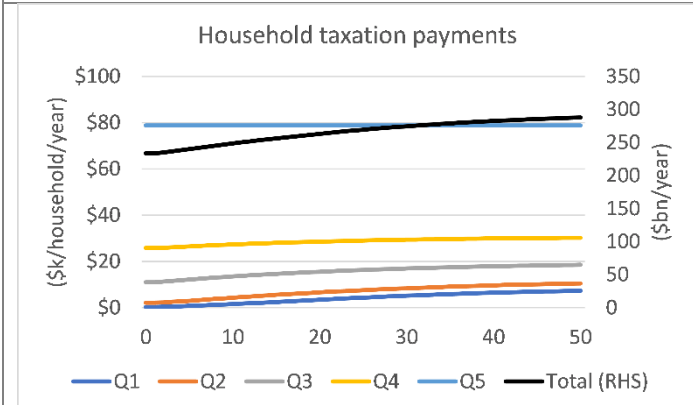
Figure 21a Scenario 3 – Household private income

Figure 21b Scenario 3 – Household consumption expenditure
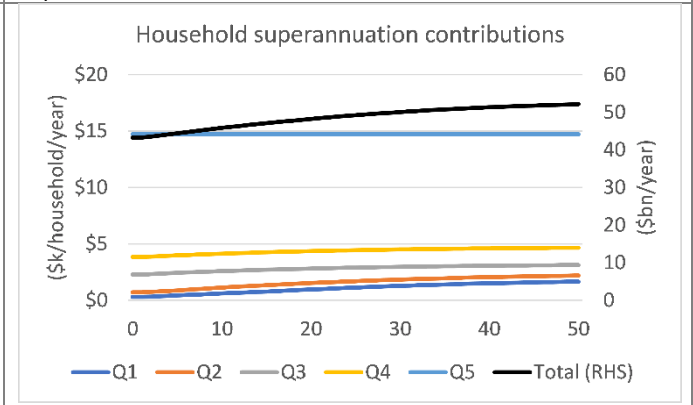

Figure 21c Scenario 3 – Household taxation payments

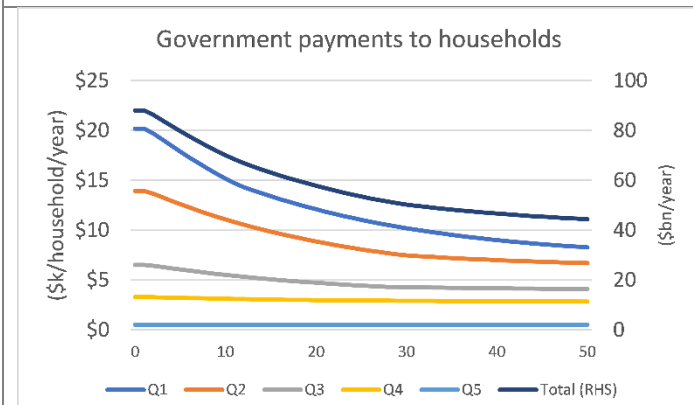Figure 21d Scenario 3 – Household superannuation contributions

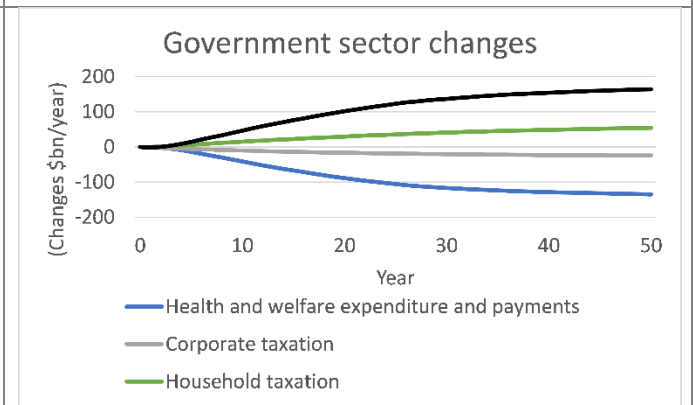Figure 21e Scenario 3 – Government payments to households

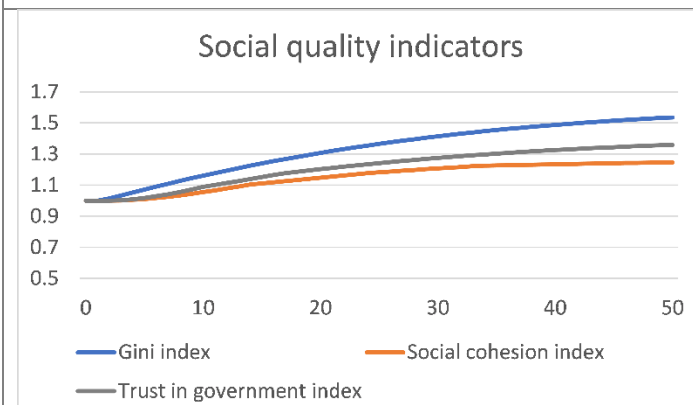Figure 21f Scenario 3 – Changes to Government sector income and expenditure

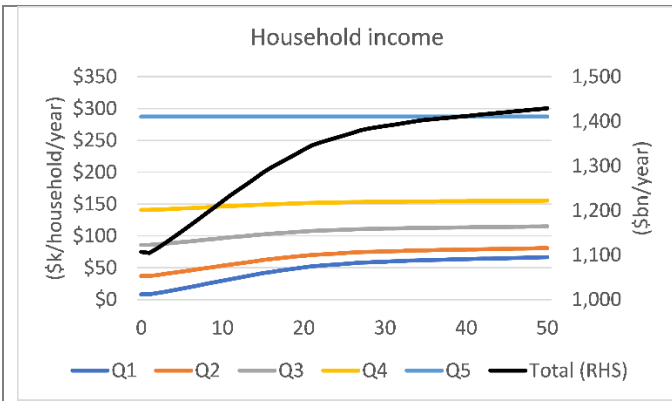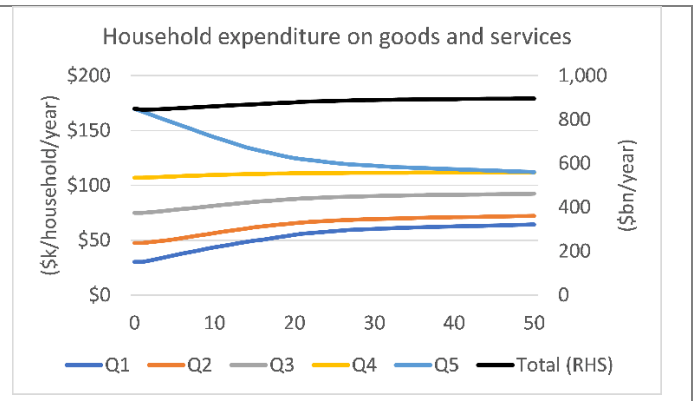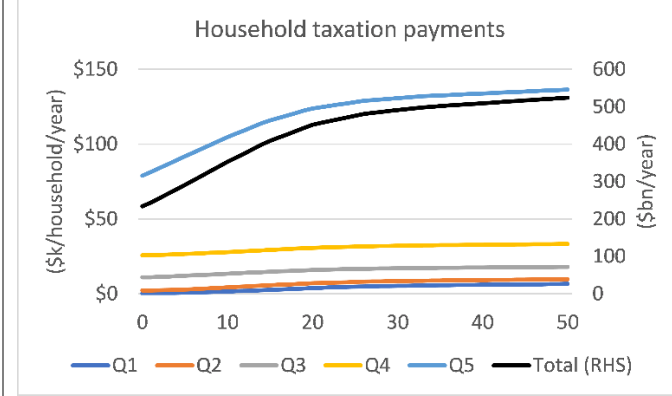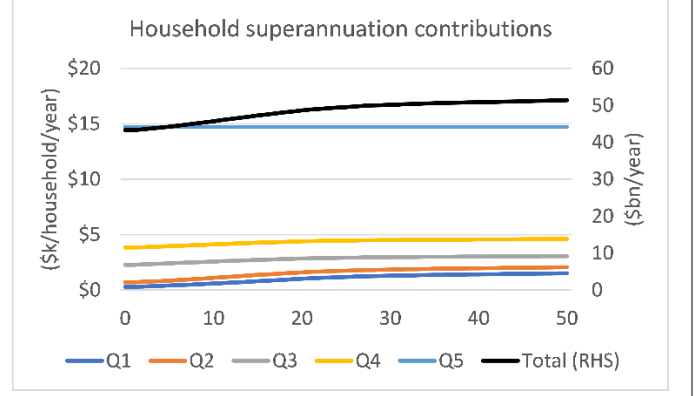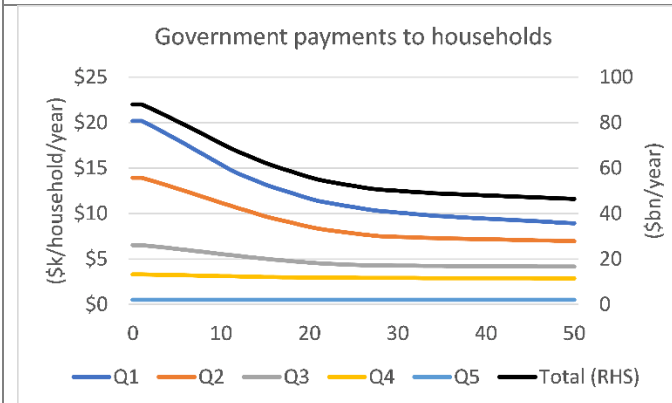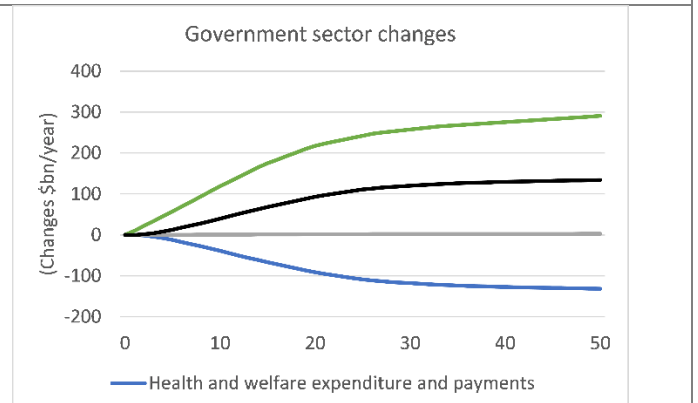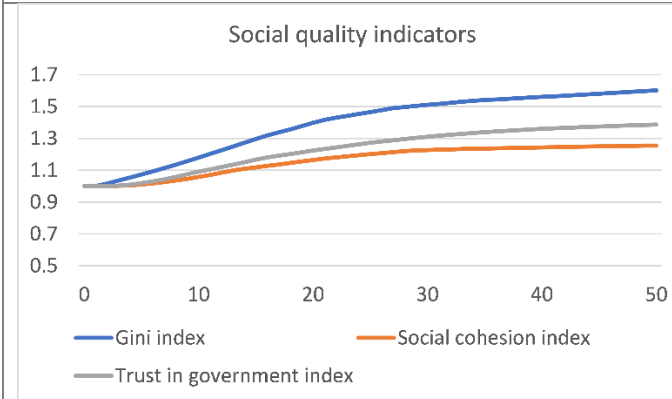Figure 21g Scenario 3 – Social quality indicators

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Discussion

This article sets out three different mechanisms to address income inequality: a re-distribution of total private income from high to low income households; a distribution of increased total private income arising from a reduction in corporate profits; and taxation of high income households to pay for increased income from employment for lower income households. Although the model does not address all the possible economic consequences of / feedback from these approaches, it is appropriate to consider what they may be.

The first of the scenarios assumes no initial change to total expenditure in the economy, but would lead to changes in the pattern of expenditure, including fewer high cost purchases and more purchases of basic household goods and services. As there are likely higher margins in the high cost purchases, there is probably an impact on profit margins (and corporate tax) that is not reflected in this scenario. The re-distribution would also lead to lower saving within the Q5 quintile and in aggregate. Although less net government revenue is received from income taxation, this is significantly outweighed by the reduction in government expenditure on government payments and allowances, health and welfare.

The second scenario assumes the income redistribution costs are met from reduced corporate profits. The rise of income inequality in developed countries including Australia over recent decades has occurred contemporaneously with an increased share of income to profit (Figure 3). Thus, as the profit share has grown so has the return to high income households. The conventional wisdom is that the maintenance of high profits is necessary for capital accumulation required for investment (Mankiw, Romer, & Weil, 1992). This however assumes that capital accumulation only occurs in companies and high worth individuals. While this may have been the case in Solow's day (Solow, 1956), the steady rise in average incomes in developed countries has led to significant savings in middle income groups. In Australia the introduction of compulsory retirement savings (superannuation) in the 1990s has led to a dramatic increase in funds under management. The balance of aggregate funds under management is now many times greater than the annual investment of the private sector in Gross fixed capital formation (Figure 22).
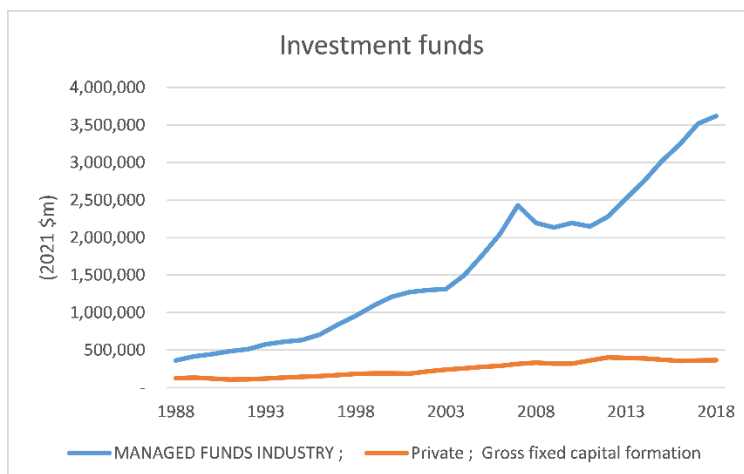

Figure 22 Funds under management and private sector investment[7]

[7] Source: Derived by author from ABS 5655.0 Managed Funds, Australia

It is therefore questionable whether lower profits would result in lower levels of investment in a modern global economy awash with funds.

The third scenario assumes the income redistribution costs are met from higher levels of taxation on high income households. Notably, progressivity of income tax in Australia has been declining since the 1950s (J. P. Smith, 2001). As is the case for corporate profits, it is posited that the maintenance of low taxes on corporations and high income earners is necessary to promote economic growth (Macek, 2015) by ensuring sufficient funds are accumulated for investment. As noted above, this is questionable.

The other argument put forward is that taxation reduces the motivation for high-achieving individuals and hence has adverse impacts on productivity. However, Rick et all (2018) found that this may be simplistic, finding that for people with positive attitudes to redistribution and government intervention, motivation and productivity may actually be enhanced by being taxed, while for others "taxes did not reliably influence productivity".

Rather than increasing income taxes on higher income earners, the Australian Government is proposing to reduce it. From 2024, the highest income brackets will obtain substantial tax cuts. Recent research identifies that tax cuts for the rich in OECD countries in Europe have had no bearing on economic growth or employment (Hope & Limberg, 2022). The treatment here is limited to the impact of income redistribution on household income and consumption expenditure arising from higher taxes on Q5 households, but supports the thesis that its impact on GDP would be minimal.

All the scenarios lead to reduced government expenditure on income support, health and welfare, and accordingly relieve the tax burden on these items (Figure 23) by between 25-50% over the fifty year period of the simulation. The quantity of this benefit is certainly challengeable, as the model attributes all recent increases in spending to rising inequality. In fact in recent decades there have been many additions to the suite of health and welfare services provided by government. However, even if the influence of inequality represents half of the attribution here, the impact remains very significant.

Figure 23 Tax burden   Figure 24 Gini coefficient
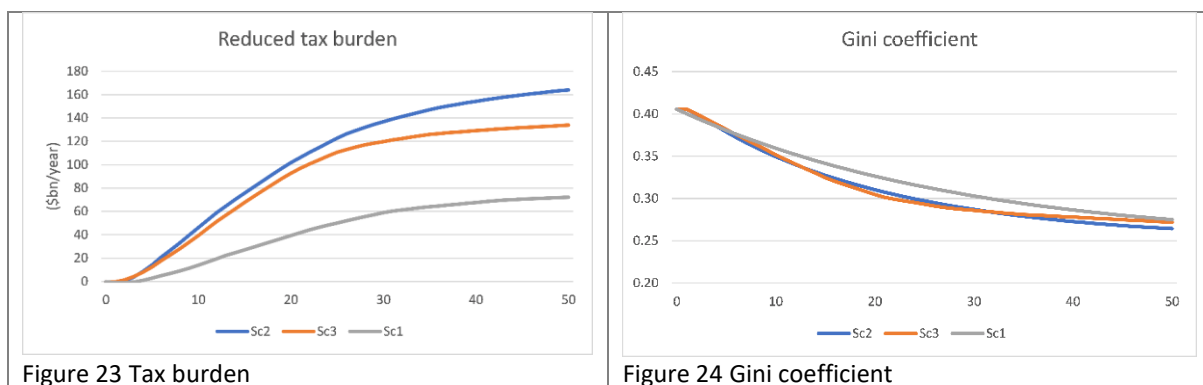
The impact on income inequality as measured by the Gini coefficient is similar by design in these simulations (Figure 24), reducing gradually over half a century to levels of the 1970s. This translates to concomitant improvements in the other key indicators of social quality (Figures 19-21g). Feedback from these improvements in social outcomes is not parameterised in the model but would likely lead to significant benefits in productivity in the economy. More important than economic statistics is the potential improvement in the lives, not only of the lowest income households, but the whole community.

Of course, the question arises about how such outcomes could be achieved. Only one of the three scenarios is government controlled, and if proposed in isolation would likely be met by a severe backlash from those adversely affected. In reality the only politically feasible way any (or some combination) of the scenarios could be achieved is with widespread support from the community, including shareholders, to drive whole-of-society changes that reverse the multi-decadal trend of excessive profits and executive pay at the top, and low wages at the bottom. This would require inequality to become a much more important and newsworthy social, and hence, political issue. It would also require inequality to be added to the Environmental, Social, and Governance (ESG) agenda of the private sector and become a priority for investors, overturning Friedmann's famous doctrine that "*The social responsibility of business is to increase its profits*".

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Appendix A Documentation

"10 years"=
    10
   Units: year

Additional HH Q5 taxation[Income groups]=
   IF THEN ELSE(Switch=2, GF Q5 Taxation(HH income[Income groups])/100*HH income
[Income groups]*GF Q5 tax introduction(Time
)*Q5 taxation multiplier,0)
Units: $/year

Annual change in employee income=
   (Additional employee income per quintile-Employee income delayed)/"1 year"
Units: $/(year*year)

Annual change in HH income tax=
   (Addtional HH income tax per quintile-Addtl HH tax delayed)/"1 year"
Units: $/(year*year)

Annual HH income=
   Households per quintile*Total HH income
Units: $/year

B private=
   ("Q1~"+"Q2~Q1"+"Q3~Q2"+"Q4~Q3"+"Q5~Q4")*0.2
Units: 1

B total=
   ("Q1~T"+"Q2~Q1T"+"Q3~Q2T"+"Q4~Q3T"+"Q5~Q4T")*0.2
Units: 1

Chgs to HH Private income[Income groups]=
   IF THEN ELSE(Switch=0, Income adjustment amount*Sw 0 redistribution[Income groups
],Income adjustment amount*Sw 1 redistribution[Income groups])
Units: $/(year*year)

"GDP(E) index"=
   "GDP(E)"/"Initial GDP(E)"
Units: 1

GF Expenditure(
   [(0,0)-(10,10)],(25000,1.1),(56250,0.961),(93132,0.955),(143156,0.948),(288028
,0.914))
Units: Dmnl

GF Gini income adj(
   [(0,0)-(10,10)],(0.25,0),(0.407,0.005))
Units: 1/year

GF Govt payments(
   [(0,0)-(10,10)],(0,22000),(33450.4,14545.5),(75000,7500),(110142,4318.18),
(150000,3000),(210198,1590.91),(288000,517),(350000,0))
Units: $/year

GF Q5 tax introduction(

[(0,0)-(10,10)],(0,0),(9.77337,0.439394),(14.3059,0.621212),(19.6884,0.776515
),(26.0623,0.871212),(33.1445,0.924242),(50,1))
Units: Dmnl

GF Q5 Taxation(
   [(0,0)-(10,10)],(25012,0),(56212,0),(93132,0),(143156,0),(288028,1))
Units: Dmnl

GF Super(
   [(0,0)-(10,10)],(25012,0.0099),(56212,0.0148),(93132,0.0249),(143156,0.0265
),(288028,0.0511))
Units: Dmnl

GF Taxation(
   [(0,0)-(10,10)],(25012,0.4),(56212,4.93),(93132,12.1),(143156,17.81),(214264
,22.9545),(288028,27.37))
Units: Dmnl

Gini private=
   (0.5-B private)/0.5
Units: Dmnl

Gini total=
   (0.5-B total)/0.5
Units: Dmnl

Government salary costs=
   182940*1e+06*1.1
Units: $/year

Government share of HH income=
   Government salary costs/Annual HH income
Units: 1

HH Expenditure[Income groups]=
   GF Expenditure(HH income[Income groups])*HH income[Income groups]
Units: $/year

HH government payments[Income groups]=
   GF Govt payments(HH Private income[Income groups]) {21678*exp(-1.3e-05*HH Private income[Income
groups])}
Units: $/(year)

HH income[Income groups]=
   HH government payments[Income groups]+HH Private income[Income groups]
Units: $/(year)

HH other expenditure[Income groups]=
   HH Expenditure[Income groups]-(HH Superannuation contributions[Income groups
]+HH Taxation
   [Income groups])
Units: $/year

HH Private income[Income groups]= INTEG (
   Chgs to HH Private income[Income groups],
      Initial HH private income[Income groups])
Units: $/year

HH Superannuation contributions[Income groups]=
    GF Super(HH income[Income groups])*HH income[Income groups]
Units: $/year

HH Taxation[Income groups]=
    GF Taxation(HH income[Income groups])/100*HH income[Income groups]+Additional HH Q5 taxation
[Income groups]
Units: $/year

Households per quintile=
    Population/Persons per household
Units: Dmnl

Income adjustment amount=
    IF THEN ELSE(Switch=1,Annual change in employee income, IF THEN ELSE(Switch
=0, Ttl HH Private Income*Income adjustment fraction,Annual change in HH income tax
))
Units: $/(year*year)

Income adjustment fraction=
    GF Gini income adj(Gini total)
Units: 1/year

Index of HSP=
    Gini total*1.173
Units: Dmnl

Initial Gini=
    INITIAL(Gini total)
Units: Dmnl

Initial HH private income[Income groups]=
    8154,37100,85775,140866,287452
Units: $/year

Q1 fraction=
    HH Private income[Q1]/Ttl HH Private Income
Units: 1

Q1 fractionT=
    HH income[Q1]/Total HH income
Units: 1

"Q1&2 HH income"=
    HH Private income[Q1]+HH Private income[Q2]
Units: $/year

"Q1~"=
    Q1 fraction/2
Units: Dmnl

"Q1~T"=
    Q1 fractionT/2
Units: Dmnl

Q2 fraction=

HH Private income[Q2]/Ttl HH Private Income+Q1 fraction
Units: 1

Q2 fractionT=
    HH income[Q2]/Total HH income+Q1 fractionT
Units: 1

"Q2~Q1"=
    (Q1 fraction+Q2 fraction)/2
Units: 1

"Q2~Q1T"=
    (Q1 fractionT+Q2 fractionT)/2
Units: 1

Q3 fraction=
    HH Private income[Q3]/Ttl HH Private Income+Q2 fraction
Units: 1

Q3 fractionT=
    HH income[Q3]/Total HH income+Q2 fractionT
Units: 1

"Q3~Q2"=
    (Q2 fraction+Q3 fraction)/2
Units: 1

"Q3~Q2T"=
    (Q2 fractionT+Q3 fractionT)/2
Units: 1

Q4 fraction=
    HH Private income[Q4]/Ttl HH Private Income+Q3 fraction
Units: 1

Q4 fractionT=
    HH income[Q4]/Total HH income+Q3 fractionT
Units: 1

"Q4~Q3"=
    (Q3 fraction+Q4 fraction)/2
Units: 1

"Q4~Q3T"=
    (Q3 fractionT+Q4 fractionT)/2
Units: 1

Q5 fraction=
    HH Private income[Q5]/Ttl HH Private Income+Q4 fraction
Units: 1

Q5 fractionT=
    HH income[Q5]/Total HH income+Q4 fractionT
Units: 1

Q5 income=
    HH Private income[Q5]

Units: $/year

Q5 taxation multiplier=
    20
Units: Dmnl

"Q5~Q4"=
    (Q4 fraction+Q5 fraction)/2
Units: 1

"Q5~Q4T"=
    (Q4 fractionT+Q5 fractionT)/2
Units: 1

Sw 0 redistribution[Income groups]=
    0.5,0.4,0.1,0,-1
Units: Dmnl

Sw 1 redistribution[Income groups]=
    0.4,0.3,0.2,0.1,0
Units: Dmnl

Switch=
    2
Units: Dmnl

Total additional HH Q5 taxation=
    SUM(Additional HH Q5 taxation[Income groups!])
Units: $/year

Total HH Expenditure=
    SUM(HH Expenditure[Income groups!])
Units: $/year

Total HH government payments=
    SUM(HH government payments[Income groups!])
Units: $/year

Total HH income=
    SUM(HH income[Income groups!])
Units: $/year

Total HH other exp=
    SUM(HH other expenditure[Income groups!])
Units: $/year

Total HH Super contr=
    SUM(HH Superannuation contributions[Income groups!])
Units: $/year

Total HH Taxation=
    SUM(HH Taxation[Income groups!])+Total additional HH Q5 taxation
Units: $/year

Ttl HH Private Income=
    SUM(HH Private income[Income groups!])*"GDP(E) index"
Units: $/year