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Uninterrupted growth, redistribution and inequality: The Australian case 1991-2020

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Abstract

To what extent can a progressive tax and transfer system moderate the distributional impacts of uneven economic growth? We revisit this question in the unique Australian context of three decades of uninterrupted economic growth from 1991 to 2020. We analyse longitudinal tax records of millions of Australian taxpayers and examine the distributional impacts of uneven growth and the redistributive role of progressive income taxes and targeted transfers. Our results indicate that the uneven distribution of income growth, favoring higher income groups of taxpayers, contributes to a rising trend in income inequality. The increased progressivity of the tax and transfer system has been instrumental in moderating these uneven gains across different groups. While inter-cohort income inequality has risen over time, lifetime inequality within cohorts has remained relatively lower and more stable, revealing potentially biased conclusions drawn from cross-sectional analyses. Employing a dynamic general equilibrium lifecycle model, we highlight the trade-offs between efficiency and equity when implementing more progressive tax and transfer policies.

JEL Codes: E62, H24, H31

Keywords: Inequality, taxation, progressivity, redistribution, administrative data, dynamic general equilibrium

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1 Introduction

Over recent decades, advanced economies have witnessed a significant rise in income inequality occurring concurrently with a slowdown in economic growth. This is prominently evident in Anglo-Saxon nations like the United States (Piketty and Saez; Krueger et al. 2010; Guvenen et al. 2023; Saez and Zucman 2020; Heathcote, Storesletten and Violante 2020; Lippi and Perri 2023). The U.S. case engenders three possible explanations: (i) enduring growth patterns favoring higher-skill and income groups (Katz and Murphy 1992; Acemoglu and Autor 2011), (ii) lasting effects of cyclical fluctuations on lower-skill and income segments (Heathcote, Perri and Violante 2010; Glover et al. 2020), and (iii) decreasing progressivity in the U.S. tax system (Piketty and Saez 2007; Ferriere and Navarro 2022; Borella et al. 2023). In contrast, Europe (OECD 2011; Guvenen, Pistaferri and Violante 2022) and Australia (Productivity Commission 2018) have experienced comparatively milder rises in income inequality. This can be attributed partly to their more redistributive tax and transfer systems.

This paper aims to reevaluate the redistributive role of a progressive tax and transfer system in mitigating the distributional impacts of uneven economic growth. Our analysis is grounded in the unique case of Australia, marked by uninterrupted economic growth over a span of three decades, commencing in 1991 and persisting until the advent of the COVID-19 pandemic in early 2020.

Our investigation comprises two parts. We first document the ascending trajectory in market income, and how economic gains from three decades of uninterrupted economic growth have been distributed among Australians before and after considering taxes and public transfers. To accomplish this, we utilise confidentialised tax data retrieved from the Australian Tax Office's (ATO) Longitudinal Information Files (ALife) for the period spanning 1991 to 2020. This dataset covers approximately 10% of Australia's taxpaying population annually. We follow the approach in Heathcote, Perri and Violante (2010) and use the household budget constraint as a device to organise flows of incomes, transfers and taxes. Similar to Guvenen et al. (2023), we employ both point-in-time and lifetime methodologies to assess the dispersion of growth both pre- and post-tax and transfers. In the second part, we construct a structural dynamic general equilibrium model that aligns with empirical observations derived in the empirical part, and broader statistics from aggregate and household data. We use the structural model to investigate implications of various designs of the progressive tax and transfer system for income inequality and overall economic efficiency.

Our empirical analysis yields the following main findings. First, over the three decades, market income on average paralleled GDP growth. The 1990s marked a period of robust income growth, where both GDP per capita and mean market income grew on average around 2% per annum for the decade. This momentum decelerated in the 2000s. Coinciding with slower GDP growth, the rate of market income growth reduced to around 1% in the 2000s, and further receded to below 1% in the last decade.

Second, while the majority of Australian taxpayers benefited from uninterrupted growth, it has been uneven across the market income distribution. We also find significant variation in how growth was distributed over time. In the 1990s, those below the 20th percentile experienced higher growth on average compared to the rest of the income distribution barring the top 10%. Nevertheless, stagnant income tax policies during this period triggered bracket creep, leading to a higher proportion of income at the lower end being allocated towards taxes. Post-government income growth was thus considerably lower, averaging approximately 1% for the bottom segment. The next two decades saw little growth at the bottom. Consequently, over the span of 30 years, we find that post-government income for the bottom 20% had very modest gains. In contrast, market income at the top grew disproportionately, sharply and persistently in the 1990s and 2000s. Growth plateaued across the distribution, including the top from 2010-2020.

We relate these trends in the distribution of growth to trends in standard measures of income inequality. There was a steep increase in the Gini coefficient of market income inequality from 1991 to 2010, commensurate with the distribution of market income growth favouring those above median income. With the distribution of market income growth becoming more uniform in the 2010s, market income inequality also plateaued. The income gap between the rich and the poor is significantly reduced after accounting for taxes and transfers. Post-government income inequality generally paralleled market income inequality, albeit at a lower level, indicating the efficacy of the tax and transfer system in alleviating income inequality.

Third, we compare our point-in-time measures with measures of lifetime income growth and distribution for 10 cohorts, each over a period of 20 years. There was marked increase in lifetime income from one cohort to the next over the three decades, with all cohorts experiencing growth across the lifetime market income distribution. We observe a U-shaped distribution of growth in lifetime market and post-government incomes, with a significant growth of 10% for the bottom 10% of the lifetime market income distribution. This growth at the bottom, results in a flatter trend in lifetime income inequality compared to point-in-time income inequality.

Fourth, a salient trend we discern from both the point-in-time and lifetime approaches is that the tax system had become more redistributive over time while the transfer system had become less redistributive. This owes to the fact that inactive tax policy during the 1990s resulted in an increase in the size of the tax system (tax progressivity remaining fairly constant), while tax reforms of the 2000s led to a sharp rise in tax progressivity. Both these factors contributed to greater redistribution. In contrast, declining generosity of public transfers in real terms since 1991 negatively impacted its redistributive effect.

Having utilized the administrative tax data, we were able to encompass the entire span of uninterrupted economic growth in Australia from 1991 to 2020. Nevertheless, there are several caveats associated with the use of this dataset. First, our selected data sample is not a truly representative cross-section of the Australian population. Second, our analysis does not capture a full lifetime, as it does not account for periods of education and retirement. Third, the dataset we used lacks comprehensive information about the Australian transfer system and its extent. Fourth, our analysis falls short in providing a comprehensive assessment of labor supply, consumption patterns, and asset accumulation.

Our empirical results raise a question about the potential of more progressive tax and transfer system designs to further reduce inequality. To address this question, in the second part, we build a structural model and conduct experiments with counterfactual tax and transfer system. Specifically, we formulate a general equilibrium overlapping generations model, calibrated to align with the essential macro-fiscal and distributional characteristics of the Australian economy. We employ our model to scrutinize the effects of progressive income tax on long-term income inequality. This involves an assumption that the economy is on a balanced growth path, with a growth rate approximating the 2000-2004 levels. We then contemplate counterfactual steady-state economies with alternative income tax codes exhibiting varying degrees of progressivity.

Our simulation results indicate that the disincentive effects on work and savings, which are induced by tax and transfer policies, significantly influence market income inequality. Notably, under the current transfer system, an increase in tax progressivity results in a small increase in market income inequality, as progressive tax tends to disincentivize saving and work at the lower end of the income distribution. In the extreme where the transfer system is eliminated, market income inequality diminishes as those at the bottom save more. Our most significant finding is that despite these effects on market income inequality, the tax and transfer system plays a substantial role in considerably reducing post-government income inequality, underscoring the impact of both progressive tax and transfers.

The paper proceeds as follows. Section 2 provides a description of the dataset and empirical methods. Section 3 presents empirical facts on trends in income growth, distribution and redistribution in Australia from 1991 - 2020 from the point-in-time and lifetime perspectives. Section 4 presents a structural model and calibration. Section 5 examines the redistributive role of a tax and transfer system and implications for macroeconomic aggregates and income inequality. Section 6 concludes. We provide additional results and information in our accompanying technical appendix.[1]

Related studies. Our paper contributes to different branches of the literature on income dynamics and inequality. Several papers studying the distributional impact of business cycles (e.g., see Hur 2018; Heathcote, Perri and Violante 2020; Glover et al. 2020) show that the welfare effects of a severe and long-lasting recession such as the Great Recession, are unevenly distributed. Differently, we focus on the distributional impact

[1] Our accompanying technical appendix is available online via our website.

of long-lasting economic growth. We show how the effects of long-run growth due to persistent aggregate shocks are unevenly distributed across households and generations over time.

We also contribute directly to the large literature on income inequality in advanced economies (e.g., see Piketty and Saez 2003; Krueger et al. 2010; Guvenen et al.; Saez and Zucman 2020; Heathcote, Storesletten and Violante 2020; Lippi and Perri 2023; Karahan, Ozkan and Song Forthcoming), and literature documenting income dynamics and inequality trends (e.g., see Guvenen et al. 2021; De Nardi et al. 2021; Guvenen et al. 2023; Heathcote et al. 2023). In particular, Guvenen et al. (2023) use panel data extracted from U.S. Social Security Administration's (SSA) Master Earnings File with individual labor income histories from 1957 to 2013 and document empirical facts about the distribution of lifetime income in the United States. We contribute new insights from Australia's unique experience of uninterrupted growth. We also expand beyond lifetime labour income, to consider lifetime market income, the role of tax and transfers over lifetime and ultimately, lifetime post-government income.

Using administrative tax data for Australia, we contribute to the literature on approximating progressive income tax codes using parametric tax functions (Benabou 2002; Heathcote, Storesletten and Violante 2017; Heathcote and Tsujiyama 2021) for the U.S. and other OECD countries (Heathcote, Storesletten and Violante 2020; Ferriere and Navarro 2022; Borella et al. 2023). Substantial evidence from this strand of literature suggests that tax progressivity in the US is declining. In contrast, we show that the Australian income tax code has become more progressive since 1991; effectively moderating uneven growth and mitigating the rise in income inequality in Australia.

There is a growing body of literature documenting inequality in Australia (e.g., see Leigh 2005; Wilkins 2015; Chatterjee, Singh and Stone 2016; Kaplan, Cava and Stone 2018; Productivity Commission 2018; Fisher-Post, Herault and Wilkins 2022). Our paper initiates first steps to account for lifetime income when analysing trends in inequality and the role of fiscal progressivity in Australia. Our paper is also related to a number of empirical studies on the redistributive and social insurance effects of the Australian tax and transfer system (Herault and Azpitarte 2015; Tran and Zakariyya 2021; Tin and Tran 2023). These previous studies rely mainly on household survey data. This paper complements those studies with administrative data, and an examination of equity-efficiency trade offs in dynamic general equilibrium.

2 Data

Our empirical analysis is based on data from the Australian Taxation Office Longitudinal Information Files: Individuals (ALife: Individuals) from 1991 to 2020. The data contains a 10% random sample of individuals drawn from ATO's client register, who are tracked longitudinally over time. Each year, the sample is topped up with 10% of new entrants on the client register (Abhayaratna, Carter and Johnson, 2022). ALife records annual data from individual tax returns, including information on demographics, market income, public transfers and tax liabilities for individuals. Tax returns cannot be filed jointly in Australia. Throughout the paper our unit of analysis is the individual rather than the household. We construct two data samples: (1) Cross-sectional (point-in-time) sample; and (2) Lifetime sample.

2.1 Point-in-time

Annual budget. The cross-sectional sample provides a snapshot of annual income, tax, and public transfer data between 1991 and 2020. We use the individual budget constraint to organise incomes, transfers and taxes as follows.

Consider an individual i aged j at time t, where $i \in \{1, ..., N\}$, $j \in \{j_1, ..., J\}$ and $t \in \{1991, ..., 2020\}$. Her budget constraint at a point-in-time is given by

$$c^i_{j,t} + a^i_{j+1,t} = \overbrace{\underbrace{\underbrace{w^i_{j,t}n^i_{j,t}}_{\text{labor inc.}} + \underbrace{r^i_{j,t}a^i_{j,t-1}}_{\text{capital inc.}}}_{y^{i,market}_{j,t}\text{: market income}} - \underbrace{t^i_{j,t}}_{\text{tax}} + \underbrace{tr^i_{j,t}}_{\text{gov. transfer}}}^{y^{i,post-gov.}_{j,t}\text{: post-government income}} + \underbrace{b^i_{j,t}}_{\text{pri. transfer}} + \underbrace{a^i_{j,t}}_{\text{asset}}, \tag{1}$$

where $c^i_{j,t}$ is consumption, $a^i_{j,t-1}$ and $a^i_{j+1,t}$are asset holdings (net wealth) at age j and $j+1$ respectively, $w^i_{j,t}$ is wage rate, $n^i_{j,t}$ is labour supply, $r^i_{j,t}$ is rate of investment return, and $t^i_{j,t}$ is tax payment. Three are four sources of income: labor income $w^i_{j,t}n^i_{j,t}$, capital income $r^i_{j,t}a^i_{j,t}$, public transfer income $tr^i_{j,t}$, and $b^i_{j,t}$ private transfer income including inheritances, inter-vivos transfers and private gifts.

Our market income concept includes labour and capital income, $y^{i,market}_{j,t} = w^i_{j,t}n^i_{j,t} + r^i_{j,t}a^i_{j,t-1}$. After-tax income is $y^{i,post-tax}_{j,t} = y^{i,market}_{j,t} - t^i_{j,t}$, while after-transfer income is $y^{i,post-transfer}_{j,t} = y^{i,market}_{j,t} + tr^i_{j,t}$. Finally, post-government income is given by $y^{i,post-gov.}_{j,t} = y^{i,market}_{j,t} - t^i_{j,t} + tr^i_{j,t}$.

All income and tax values are expressed in 2020 Australian dollars and adjusted for inflation with the Consumer Price Index.

Sample composition. Our cross-sectional sample for each year consists of those aged 20 years and above, with non-negative market and post-government incomes.[2] This sample consists of between 800 thousand individuals (in 1991) and 1.43 million individuals (in 2020). Annually, the sample consists of around 50-55% men and 40-55% women. It is also fairly balanced in terms of the age composition between men and women (Mean=44,

[2]In our online technical appendix, we conduct robustness checks where we compare our main results with those obtained from samples with alternative restrictions. Distributional and growth metrics from these alternative samples are almost identical to the sample used in the main paper.

SD=16 for both men and women). We report details of the sample composition by gender and age in our online technical appendix.

2.2 Lifetime

Lifetime income. Following Guvenen et al. (2023), we define lifetime income as the sum of real annual income for a given lifespan. Accordingly, the lifetime market income of an individual i is

$$LY_i^{market} = \sum_{j=j_1}^{J} w^i_{j,t+j-1} n^i_{j,t+j-1} + \sum_{j=j_1}^{J} r^i_{j,t+j-1} a^i_{j,t+j-1}, \tag{2}$$

where j_1 and J denote the initial and final age of the considered lifespan, respectively. All other lifetime counterparts of income concepts in the annual budget as per equation 1 are defined in this manner.

Sample composition. We track 10 cohorts, each over a period of 21 years, from the year they turned 30 ($j_1 = 30$) till the year they turned 50 ($J = 50$). As ALife data only covers period of 30 years, we are unable to observe complete lifetimes, and considering a longer age span comes at the cost of tracking fewer cohorts. As we show in Section 3, there was little growth in incomes for individuals below 30 years of age between 1991-2020. Further, 30-50 years covers a major portion of an individual's working life (i.e., prime working age).

In each cohort, we include individuals who filed a tax return in each consecutive year and earned non-negative lifetime market and post-government incomes. Table 1 lists the cohorts (labeled by year they turned 30), their birth years, the year they turned 50 ("last year"), frequency and the composition by gender. In each cohort, around 60% are male and 40% are female.

Table 1: **Sample composition by cohort and gender**

Cohort	Birth year	Last year	N	Females (%)	Males (%)
c1991	1961	2011	15,852	39	61
c1992	1962	2012	15,825	38	62
c1993	1963	2013	15,985	39	61
c1994	1964	2014	15,752	40	60
c1995	1965	2015	15,412	40	60
c1996	1966	2016	15,090	41	59
c1997	1967	2017	15,168	43	59
c1998	1968	2018	15,373	43	57
c1999	1969	2019	16,438	43	57
c2000	1970	2020	16,611	44	56

3 Empirical facts

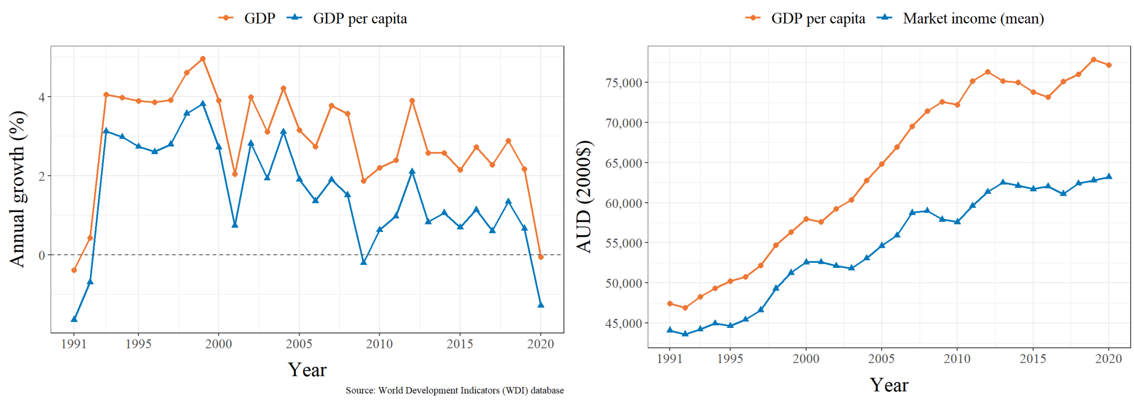
In this section, we present key empirical facts on market income growth, distribution and redistribution in Australia from 1991 to 2020. For the sake of conciseness, we focus on trends that are central to our analysis in this section. Further details are included in the online empirical appendix.

3.1 Economic growth and tax-transfer policy 1991-2020

We contextualise our empirical analysis around three salient facts.

Uninterrupted growth. First, since the 1990-91 recession until the onset of the COVID-19 pandemic in early 2020, Australia experienced 30 years of uninterrupted economic growth (Figure 1a). The trend in mean market income from our point-in-time sample from ALife echoes trends in GDP per capita (Figure 1b).

Australia experienced rapid economic growth from 1995 to 2007, with annual growth rates exceeding 3%. Market income increased from \$45,000 in 1995 to \$59,000 in 2007. Even though the Global Financial Crisis of 2007 did not cause a recession in Australia, it did negatively impact economic growth. There has not been a significant increase in average income in the years since then.



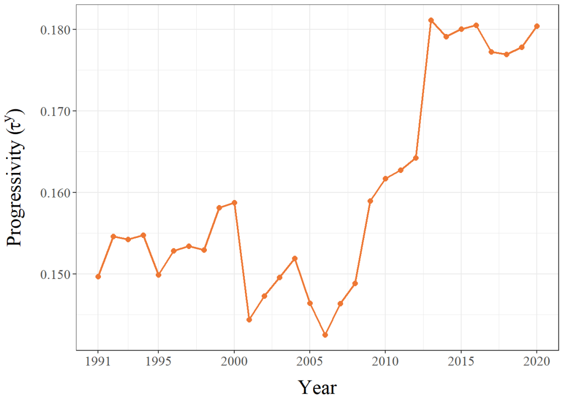
(a) Annual growth in GDP and GDP per capita. (b) Mean market income and GDP per capita

Figure 1: **Economic growth and mean market income.** Note: Panel (a) plots annual growth rates of GDP and GDP per capita (Source: World Development Indicators (WDI) database). Panel (b) compares GDP per capita with mean market income (Source: ALife data).

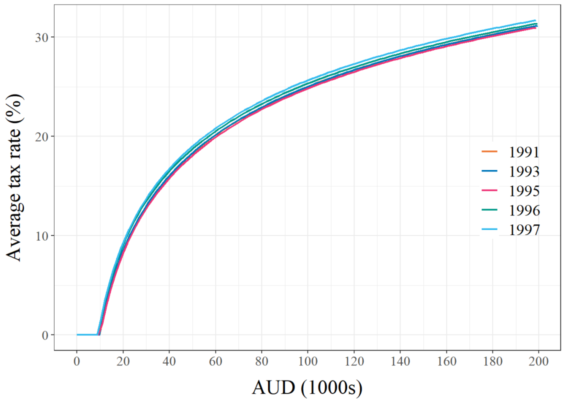
Bracket creep and an increasingly progressive income tax. Second salient fact is that throughout the three decades, Australia maintained a highly progressive income tax system. However, tax brackets/thresholds were not indexed to automatically rise with income growth. While the government periodically adjusts brackets through discretionary changes, for most of the accelerated growth years of the late 1990s, Australia's tax policy was relatively inactive.

It is beyond the purview of this paper to document all discretionary changes to the tax code. It is also a difficult task - the Australian income tax code being quite complex with numerous offsets, credits and levies. Yet, we can assess overall changes to the tax code by estimating its progressivity via a parametric tax function.

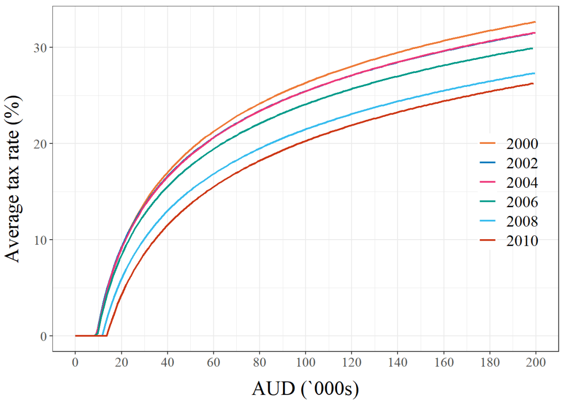
We employ a tax function commonly used in the public finance literature (e.g., see Jakobsson (1976), Persson (1983), Benabou (2002) and Heathcote, Storesletten and Violante (2017)). More specifically, the income tax function is given by $t(y) = y - \lambda y^{(1-\tau^y)}$, where $t(y)$ is total tax liability, y is taxable income , τ^y is progressivity parameter and $(1-\lambda)$ is average rate of taxation.[3]



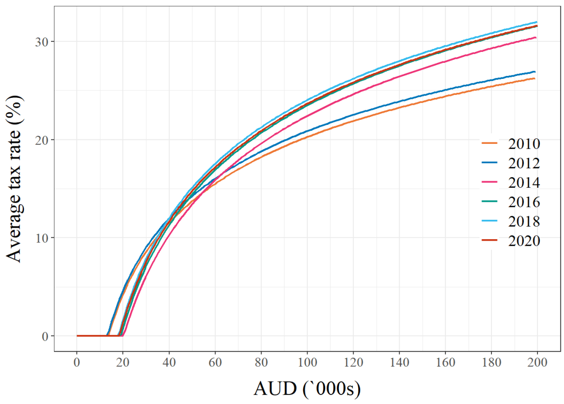
(a) Trends in income tax progressivity τ^y



(b) Average tax function 1990-2000



(c) Average tax function 2000-2010



(d) Average tax function 2010-2020

Figure 2: **Key changes to the tax code with parametric tax function estimates.**
Note: Panel (a) plots trends in the progressivity parameter τ^y. Panels (b)-(d) plots the estimated average tax rates across the real income scale for select years (Source: ALife data).

Figure 2a plots trends in tax progressivity. Throughout the 30 years, the income tax system has been very progressive. The value has ranged between 0.12 to 0.16, which is in the top range of progressivity estimates for OECD countries with highly progressive tax codes (see Holter, Krueger and Stepanchuk 2014).

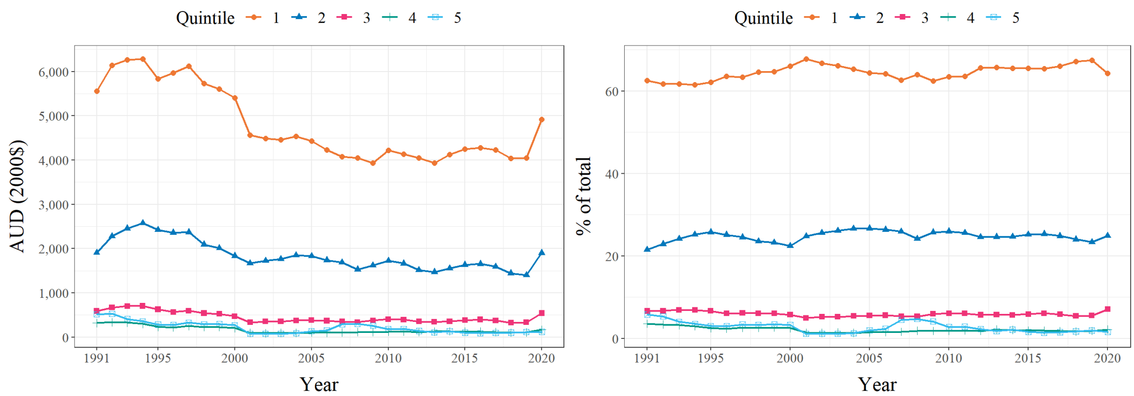
[3]We estimate the tax function using ALife data 1991-2020. We take the variable "ic_taxable_income_loss" as taxable income y and "tc_net_tax" as tax liability. Estimation results for select years are reported in Appendix A. More detailed information is available in our online technical appendix.

During the period of accelerated market income growth in the 1990s, tax policy was stagnant. As evident from Figure 2b, the tax code remained relatively unchanged during this period, and tax progressivity was constant around 0.12 - 0.13. Growth in nominal taxable income due to productivity growth and inflation moved more and more Australians into tax brackets with higher tax rates. This phenomenon arising from the lack of indexation is known as "fiscal drag" or "bracket creep".

The 2000s were a period of tax cuts across the board, and especially for low incomes since 2006 (Figure 2c). It was also a period when the government regularly adjusted income tax brackets, namely an "active" tax policy owing to a series of changes after the introduction of a New Tax System (Goods and Services Tax) Act 1999. In line with this on Figure 2a, we observe a rise in progressivity since 2006.

In the most recent decade, we saw significant changes to the tax code (Figure 2d), with tax rates at the top initially rising, contributing to a sharp increase in progressivity. In the late 2010s, although this trend has reversed to a slight extent, the level of tax progressivity was at its highest since 1991.

Declining generosity of progressive public transfers. Thirdly, over the 30 year period, while Australia maintained a highly progressive public transfer system targeted towards low incomes via means-tests, transfer generosity has steadily declined. This is evident in Figure 3a where we plot the trend in mean public transfer by market income quintile. Since the 1990s, public transfers received by the bottom 20% had sharply declined from over \$6,000 to under \$4,000 by 2020. The progressivity of the transfer system has remained fairly constant with the bottom 20% receiving a little over 60% of total public transfers through out the 3 decades (Figure 3b).



(a) Mean public transfer by market income quintile

(b) Share of public transfer by market income quintile

Figure 3: **Declining generosity of the public transfer system.** Note: Panel (a) plots mean public transfer by quintiles of market income. Panel (b) plots share of total public transfer by quintiles of market income (Source: ALife data).

3.2 Point-in-time measures

Keeping these contextual facts in mind, we now turn towards a deeper examination of income growth, distribution and redistribution from the point-in-time perspective. We begin by analysing how market and post-government income has evolved over time, and then turn towards differences across age-groups, genders and income groups. We finally focus on how the gains from the three decades of uninterrupted growth have been shared among the population.

Growth in average incomes over time. It is evident from Figure 1b that income growth was not stable over the 30 years. To facilitate comparison across years, we first examine growth in average incomes by decade. Table 2 presents annualized percentage changes in mean incomes along with annualized GDP growth rates for the entire 30 years and for each decade.

Table 2: **Annualised growth in income in comparison with GDP growth**

Year	GDP	GDP per capita	Market income	Income tax	Public transfer	Post-govt income
1991-2020	2.92	1.53	1.23	1.68	-0.25	1.05
1991-2000	3.32	2.20	1.80	3.40	-0.66	1.27
2000-2010	3.14	1.67	1.08	-0.27	-2.20	1.33
2010-2020	2.35	0.80	0.81	2.25	2.12	0.48

Note: Except for column 1, all other columns list annualized growth rates (expressed in percentages) for each respective period and income component.

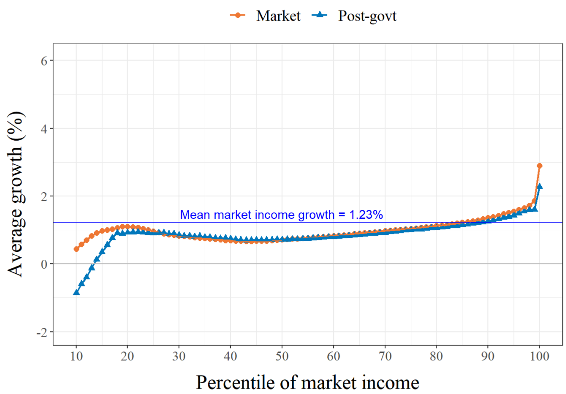
Overall, market income growth tracks growth in GDP per capita. However, growth in post-government income during the 1990s tended to be lower than market income growth. This largely owes to the 3.4% growth in mean income tax arising from bracket creep during the decade.

From 2000 to 2010, post-government income grew by 1.33% on average compared to 1.08% growth in market income. As explained in the previous section, this period saw significant tax cuts (see Figure 2c) resulting in a decline in average income tax by -0.27%.

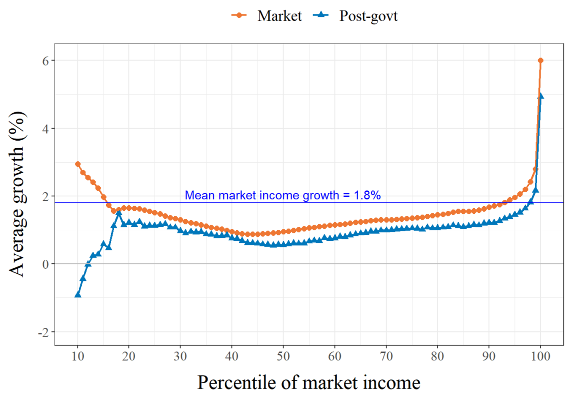
The last decade saw little increase in mean market income (0.87%) and a significant rise in income tax (2.25%), resulting in an increase in mean post-government income by less than half a percent.

How equal or unequal was economic growth? Just as growth rates varied over time, they also varied across individuals. To explore this, we examine how market income and post-government income growth is distributed across the market income distribution. We calculate the annualized growth rate in incomes by quantiles of the market income distribution (i.e., distributional incidence of growth).

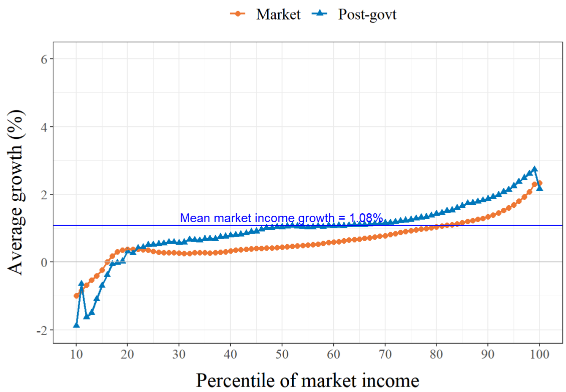
Figures 4a-4d plot growth incidence curves by various sub-periods. The orange curve plots the growth incidence for market income while the blue curve plots that for post-government income. We complement these annualized growth incidence curves with



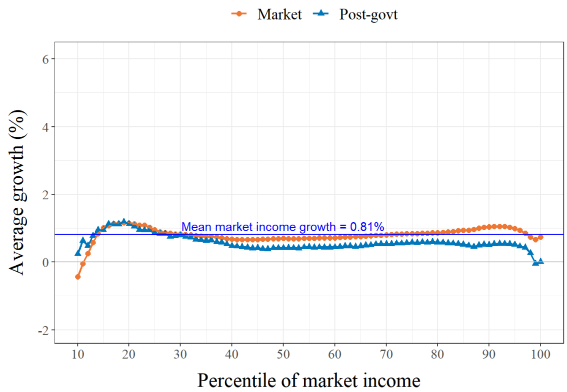
(a) 1991-2020



(b) 1991-2000



(c) 2000-2010



(d) 2010-2020

Figure 4: **Annualised growth incidence curves for market income and post-government income.** Note: Growth rates are calculated by taking the average for each percentile of market income and taking the average of year-on-year growth within that percentile for that period.

Figure 5 that shows cumulative growth rates for key quantiles of the market income distribution.

If we take the entire 30 years (Figure 4a), we observe that from p20 to p80, growth rates for both market and post-government incomes are fairly similar across the distribution. Since 2000 (Figures 4c and 4d), the distribution of growth rates have become more equal, with annualized income growth at the top getting ever closer to the mean. In the last decade, we observe relatively flat curves with more even growth.

Market income growth at the top (particularly above p90) is disproportionately higher than the rest. For the entire 3 decades, the annualized growth rate at the top 1% is at 3%. This is mostly driven by high growth rates of around 6% (compared to the average growth of 1.8%) in the 1990s (Figure 4b). Panels (d) - (f) in Figure 5 shows this steep increase in cumulative growth rates at the top.

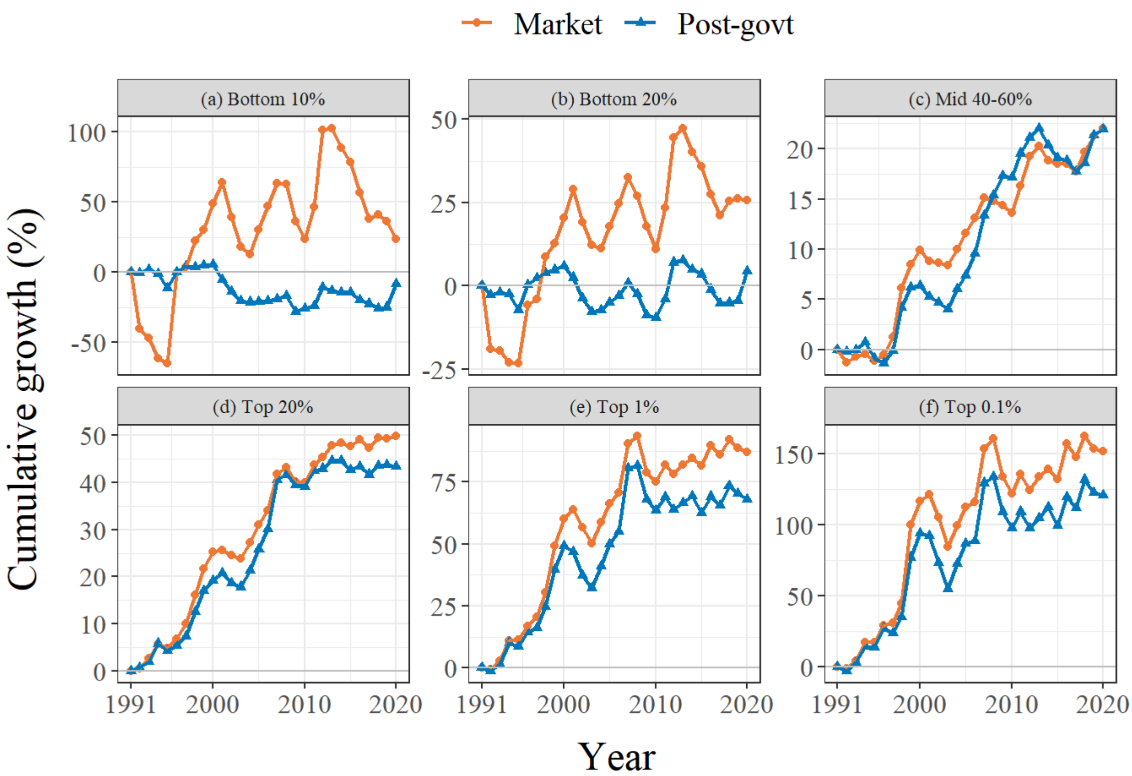


Figure 5: **Cumulative growth in market and post-government income**

The bottom 20% generally experienced lower growth than the rest. Although market incomes at the bottom grew at a rate higher than average in the 1990s (Figure 4b), the bottom experienced little growth after 2000 (Figures 4c and 4d).

The role played by tax policy is quite clear in all panels of Figures 4 and 5. Inactive tax policy in the 1990s leading to bracket creep resulted in post-government income growth being lower than market income growth across the distribution on Figure 4b. Bracket creep impacted lower incomes more severely. At p10, despite an annualized market income growth rate of 3%, post-government income growth is at -1%.

The effect of bracket creep in the 1990s and the declining generosity of public transfers over the past 30 years is clear in Figure 5. Panels (a) and (b) shows that despite considerable gains in market income, there is virtually no income gain for the bottom over the past 30 years. In contrast, the middle experienced around 22% growth (c), the top quintile gained 45% (d), the top 1% gained 60% (e) and the top 0.1% gained a disproportionate 125% in post-government income. The disproportionate gains at higher incomes warrants a closer examination of the very top earners. We present a closer examination of the top 1% and top 0.1% in Appendix.

The impact of unequal growth on inequality. The variation in income growth across the income distribution directly affects trends in income inequality. That is, if income growth is even across the distribution, trends in inequality would be constant. If growth at the top is higher relative to the rest of the distribution, inequality would rise. Similarly, if growth at the bottom was higher, inequality would fall.

Figure 6 presents two inequality measures that provide an overall picture on how uneven growth affected income inequality. Panel (a) plots trends in the Gini coefficient, while panel (b) plots the p90/50 ratio which measures mean income at the 90th percentile relative to the 50th percentile. The latter is useful, given that our growth incidence curves in Figure 4 show that the major portion of the distribution below p90 experienced similar rates of growth.

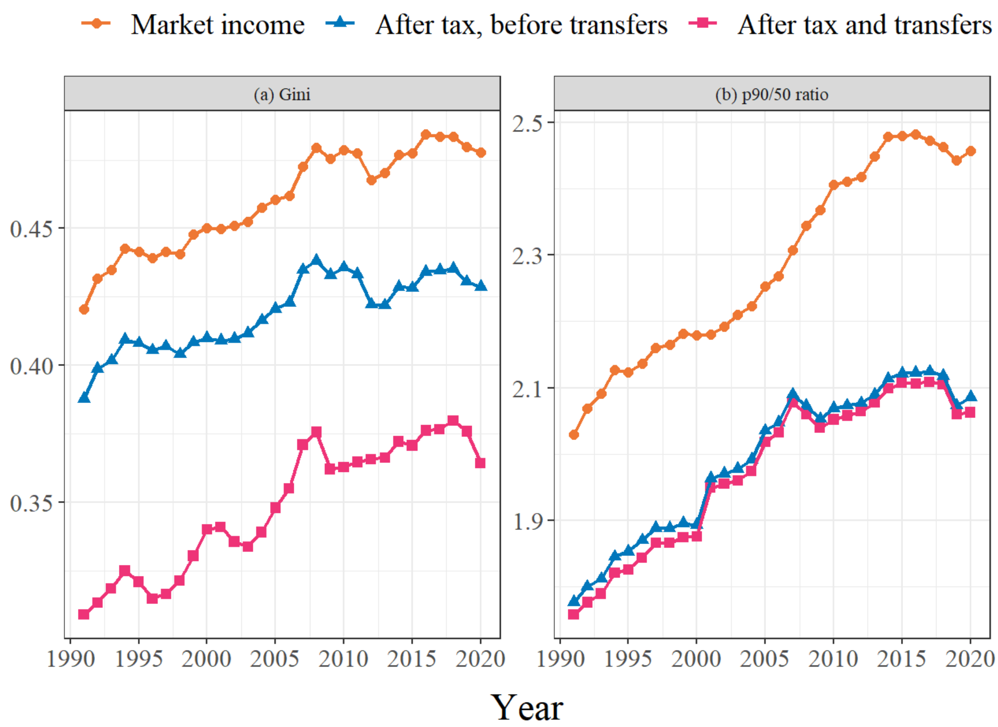


Figure 6: **Trends in income inequality**

Although small in terms of magnitude, we can observe an upward trend in the Gini coefficient of market income inequality. This is especially true for the 1990s and 2000 when top income growth was high relative to the rest. This is captured even more clearly in panel (b) which shows a sharp rise in the p90/p50 ratio from 1991-2010. As evident in the fairly flat incidence curves in Figure 4d, growth was relatively even from 2010 to 2020. Consequently trends in income inequality stabilised during that decade as seen in the relatively constant Gini coefficient and p90/p50 ratio for market income in Figure 6a and b.

Redistributive role of tax and transfers. With inequality measures for after tax and transfer incomes significantly lower than that for market income, Figure 6 reveals that the tax and transfer system reduces inequality to a large extent in Australia. However, if income tax and public transfers perfectly mitigated rising inequality, these trend lines would be completely flat.

We examine the redistributive effect of tax and transfers by measuring the Reynolds-Smolensky index, which measures the difference between the Gini coefficient of market (pre-government) income and that of income after tax and transfers. The redistributive effect can further be decomposed into the average size of the tax/transfer system, and its progressivity.[4] An increase in progressivity and/or size makes tax more redistributive.

Figure 7 plots trends in the redistributive effect of income tax (panel a), its progressivity as measured by the Kakwani index (panel b) and its average size.[5]

In the 1990s, there was fairly little change to the progressivity of the tax system. At the same time, there was significant growth in incomes at the bottom of the income distribution. This pushed more individuals into higher tax brackets, leading to a sharp increase in the size of the tax system from 1996 to 2000 in Figure 7b. As a result, despite the flat trend in tax progressivity, the tax system became more redistributive during the 1990s due to bracket creep.

Major changes to the tax system in the 2000s led to a sharp increase in tax progressivity (especially from 2005 to 2010) as seen in Figure 7c, resulting in a sharp increase in redistributive effect from 2005 to 2010.

One interesting point to note from Figure 7 is that while tax progressivity declined since 2013, the redistributive effect has trended upwards. This can be contextualised in reference to market income growth during that period (Figure 4). Panels 2011-2015 and 2016-2020 show a decline in market income growth at the bottom and a small increase at the top. Given that the tax system is still highly progressive compared to the 1990s despite the recent downward trend, the rise in incomes at the top resulted in an increase in tax size and in redistribution.

[4] We provide a more formal exposition of distributional measures and their decompositions in Appendix B.

[5] Note that the Kakwani index is one of 2 key distributional indices of progressivity. The other measure is the Suits index (see Appendix C), We present the former here as it is used in the decomposition of the Reynolds-Smolensky index of redistributive effect. Distributional indices are different from the progressivity of the income tax code as measured by the parameter τ^y. However, as evident from Figure 2a, they yield similar trends.

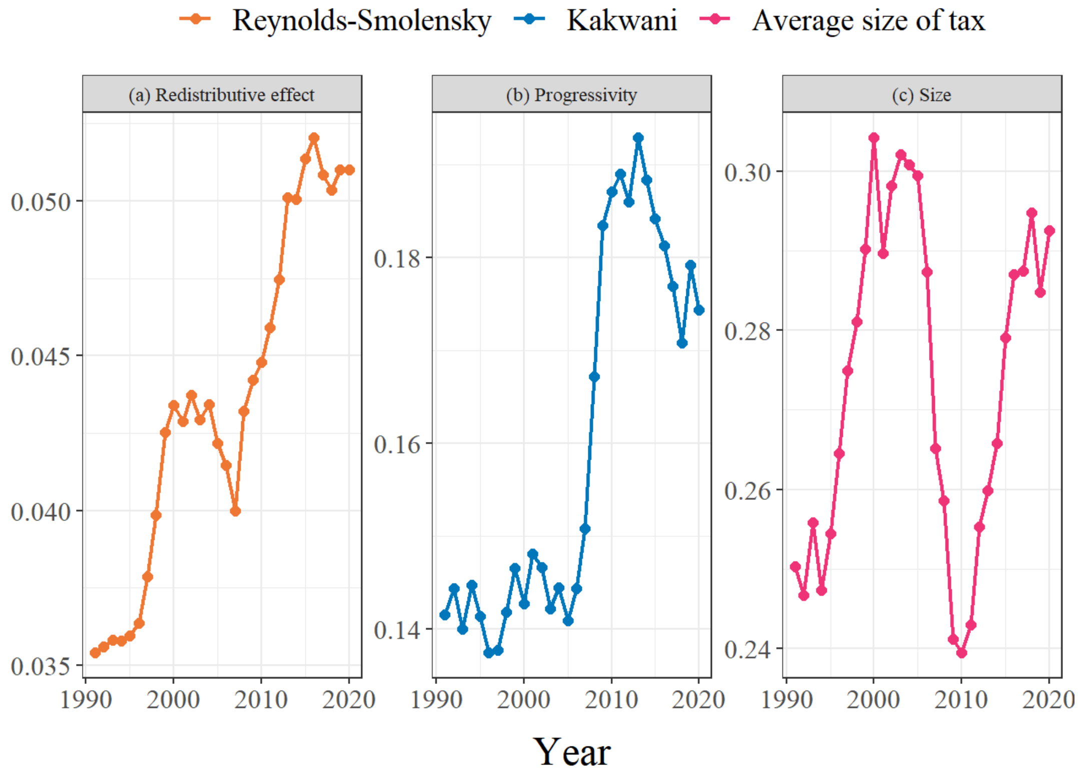


Figure 7: **Redistributive role of the tax system.** Note: The redistributive effect is decomposed into the progressivity and size of the income tax system.

Figure 8 plots the redistributive effect, progressivity and average size of the public transfer system. Despite the transfer system becoming more progressive over the 30 years, its redistributive effect declined. This owes to a decline in the average size of transfers. As shown in Figure 3a, public transfers received by the bottom 20% had fallen by a large extent from 1991 to 2020.[6]

3.3 Growth and redistribution by age, sex and cohort

A limitation of the point-in-time approach lies in its failure to account for disparities in income growth and distribution among different age groups. By treating all individuals across various life stages equally, this approach neglects the potential variations in economic opportunities and challenges that distinct age cohorts at different stages in their lives might face.

Income growth by age and sex. Income growth by age and sex forms a good starting point towards expanding beyond the point-in-time approach. Figure 9a plots trends in mean market income and Figure 9b plots that for post-government income by age groups between 20 and 59 years. We examine the trend in mean incomes for men and women

[6] Tran and Zakariyya (2021) also reports a decline in the redistributive effect of public transfers in Australia, using household survey data HILDA 2001-2016.

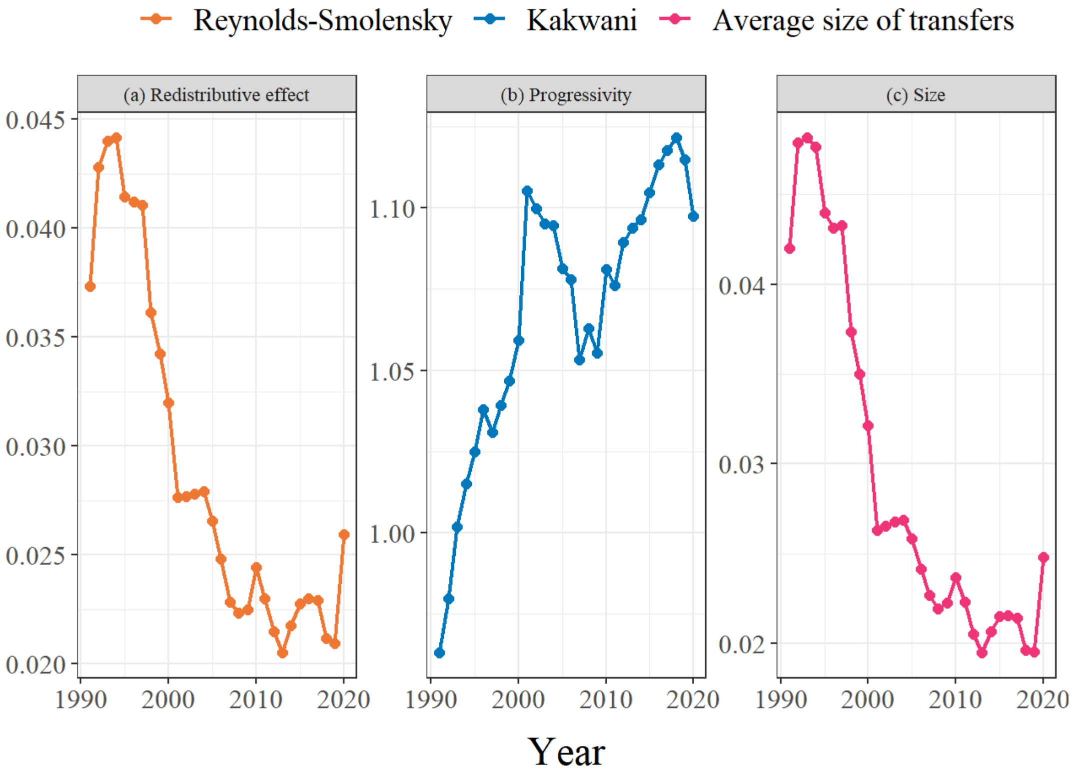


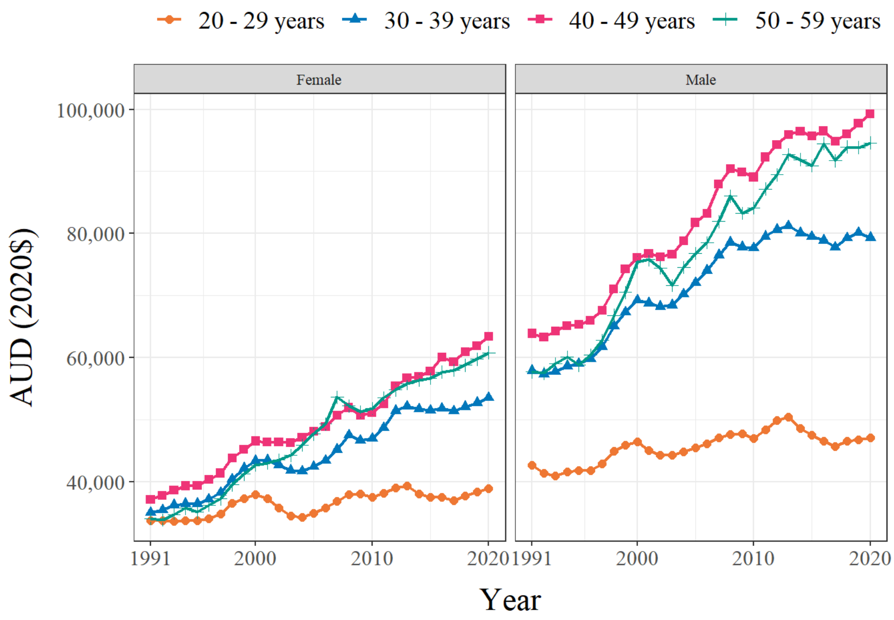
Figure 8: **Redistributive role of the public transfer system.** Note: The redistributive effect is decomposed into the progressivity and size of the public transfer system.

separately. Table 3 provides further details to the figures by examining the cumulative growth in incomes by 5 year age groups.

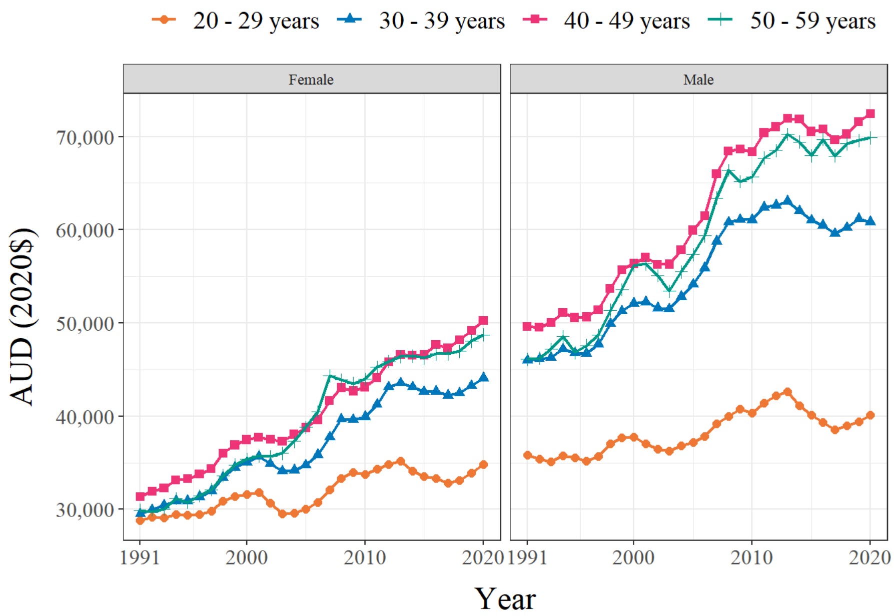
Table 3: **Cumulative growth rates by age group and sex 1991-2020**

	Market		Post-govt	
Age group	Female	Male	Female	Male
20 - 24 years	1.11	1.49	9.23	5.59
25 - 29 years	22.00	14.31	25.35	14.54
30 - 34 years	41.03	27.73	39.90	25.14
35 - 39 years	45.83	35.96	42.12	31.69
40 - 44 years	52.47	44.74	46.63	38.56
45 - 49 years	56.09	45.00	49.06	38.76
50 - 54 years	59.39	49.76	51.18	42.18
55 - 59 years	60.63	53.82	49.48	44.74
60 - 64 years	62.53	52.14	40.22	40.71
65 - 69 years	47.19	55.41	22.36	33.28
70+ years	28.77	33.38	8.88	16.72

Note: Except for column 1, all other columns list the cumulative growth rate (expressed in percentages) from 1991 to 2020.



(a) Market income



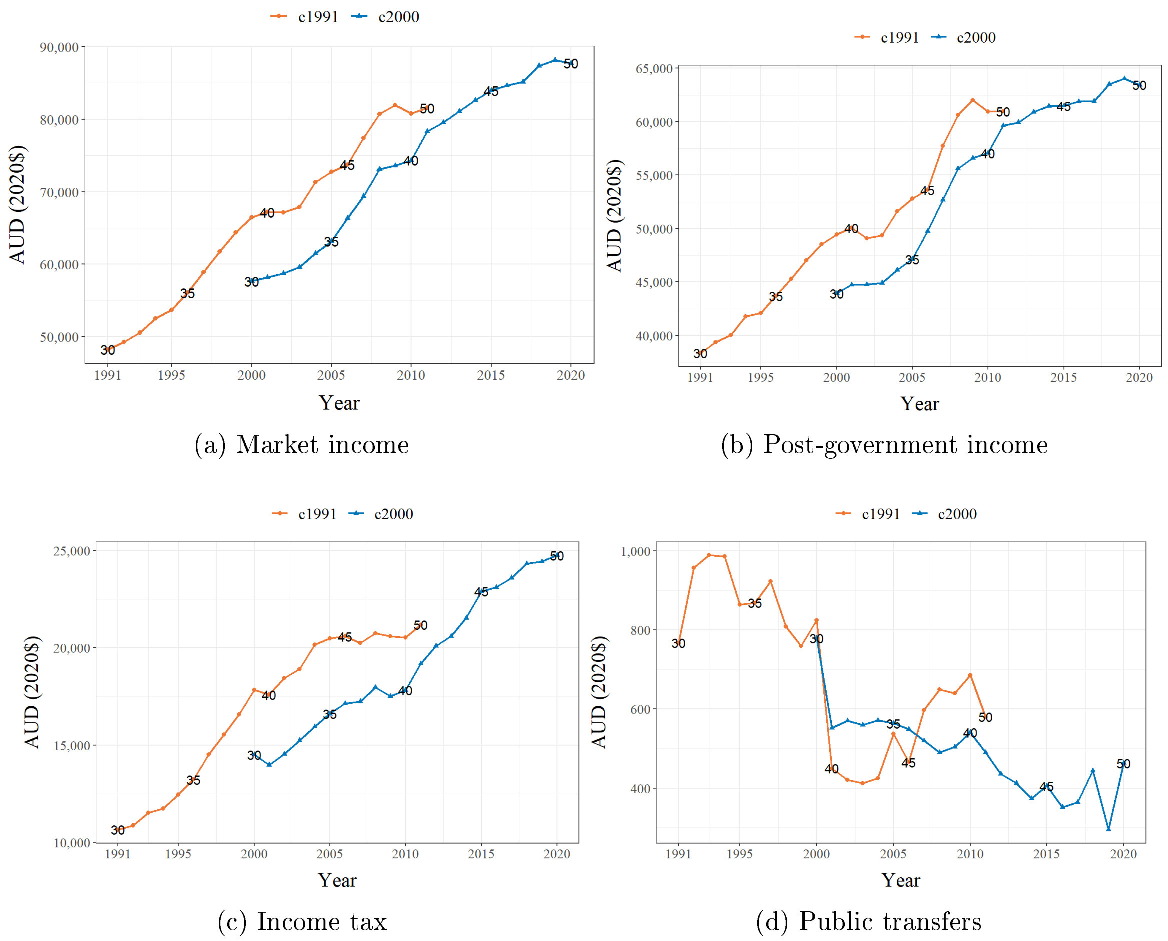
(b) Post-government income

Figure 9: **Average income by age groups.** Note: Panel (a) plots mean market income by age group. Panel (b) plots mean post-government income by age group. (Source: ALife data).

Figure 9 condenses a number of important facts about income growth by age. First is the large gender gap in mean incomes. Although income growth by age group for women was generally higher than for men (see Table 3), the gap still persists after 30 years. Second fact is that average income for the 20-24 year age group has seen little growth, with market income growing by less than 2% over the span of 3 decades. In contrast, we observe a steep increase in average incomes for those between 40 and 59, with cumulative growth rates well above 40%. This disparity in growth rates among different age groups contribute to the upward trend in income inequality that we observe from the point-in-time approach.

Average income over the lifecycle. Differences in income growth by age result in different lifetime income trajectories for different cohorts. In Figures 10a and 10b, we compare lifecycle profiles of mean market and post-government incomes from age 30 - 50 between two cohorts - c1991 (birth cohort 1961) and c2000 (birth cohort 1970). We index cohorts by the year they turn 30.

We observe that while mean market income in Figure 10a is higher for c2000 than c1991 at each age (a consequence of uninterrupted economic growth), the trajectory for c1991 is steeper than that for c2000. This is due to the fact that c1991 experienced high growth in market income between 30 to 48 years, a large majority of which was in the high growth periods of the late 1990s and early 2000s. In contrast, while c2000 experiences a steep increase in their market income from 30 to 39 years (2000-2007), they spend their 40s in the stagnant years of the last decade. As a result, they experience relatively small market income growth, between 45 and 50.



(a) Market income

(b) Post-government income

(c) Income tax

(d) Public transfers

Figure 10: **Average income over the lifecycle (c1991 and c2000).** Note: In each panel, the respective income or tax variable is averaged by age for each cohort. (Source: ALife data).

While c2000 earned higher market income on average at any age compared to c1991, they also faced a higher tax burden (Figure 10c) and received lower public transfers (Figure 10d) as they grew older. An increase in tax and transfer progressivity would result in higher tax burdens at older ages. This is evident when we compare c1991 and c2000 from the age of 40 to 50. The earlier cohort spent their 40s during the tax cuts of the 2000s while the later cohort spent theirs during a more progressive regime where higher incomes were taxed at a higher rate. Consequently, the lifecycle profile of mean post-government income for c2000 flattens out after age 40. Hence, despite an age gap of 10 years, the gap in mean post-government income at age 50 between the two cohorts is quite narrow.

3.4 Lifetime measures

Differences in lifecycle profiles among cohorts impact on their lifetime income. In this section, we present facts on lifetime income growth and distribution for 10 cohorts from the age of 30-50.

Growth in average lifetime income. Table 4 presents mean annualized lifetime income, tax and public transfers and their respective percentage change between cohorts. Over the 30 years, we observe an increase in lifetime market income from one cohort to the next.

Those cohorts who experienced a longer span of their working life in the accelerated growth years of the 1990s experience higher growth than the rest. In contrast, the effects of stagnant economic growth in the last decade can be seen in the low growth rates of market income for c1998 to c2000.

Table 4: **Growth in mean annualized lifetime income and tax from c1991-c2000**

Income	Measure	c1991	c1992	c1993	c1994	c1995	c1996	c1997	c1998	c1999	c2000
Market	Mean	66,939	68,868	69,597	70,678	71,364	73,012	74,463	75,357	75,865	75,263
	Growth (%)	0	2.88	1.06	1.55	0.97	2.31	1.99	1.2	0.67	-0.79
Tax	Mean	16,425	17,087	17,282	17,664	17,741	18,435	18,886	19,148	19,392	18,925
	Growth (%)	0	4.03	1.14	2.21	0.44	3.92	2.44	1.39	1.27	-2.41
Transfers	Mean	494	414	423	398	411	392	366	367	354	389
	Growth (%)	0	-16.23	2.13	-5.83	3.31	-4.83	-6.4	0.09	-3.61	10.07
Post-govt	Mean	51,009	52,195	52,738	53,413	54,034	54,968	55,944	56,575	56,826	56,727
	Growth (%)	0	2.33	1.04	1.28	1.16	1.73	1.78	1.13	0.44	-0.17

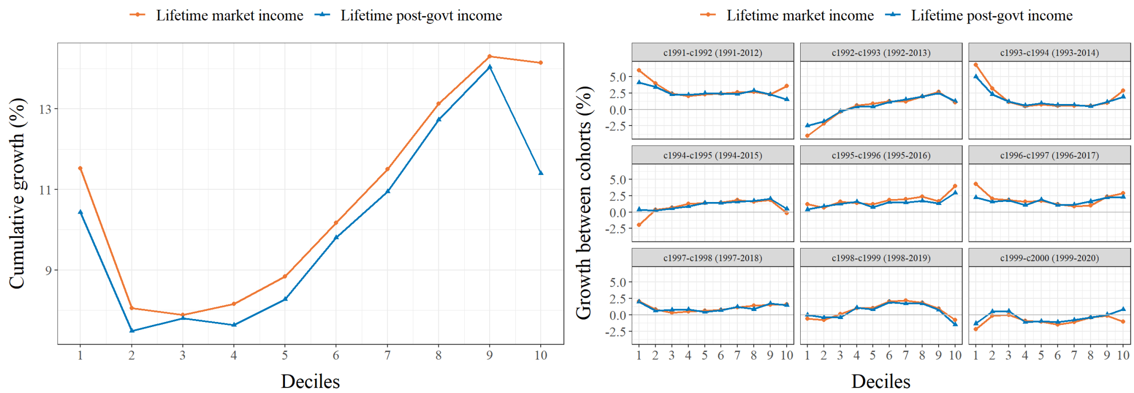
Table 4 also affirms the rising trend in income tax and declining public transfers from the lifetime perspective. Consequently, growth in mean lifetime post-government income generally trends below growth in lifetime market income.

Growth incidence curves of lifetime income. Similar to the point-in-time approach, we examine how growth rates in lifetime income varied across the market income distribution from one cohort to another.

Figure 11a plots the incidence curve for cumulative growth in lifetime market and post-government income from c1991-c2000. In Figure 11b, we break this cumulative growth down into growth from one cohort to the next. We label each respective panel of Figure 11b by the two cohorts that are being compared and in parentheses we reference the point-in-time period that covers the lifetime incomes of the two cohorts.

Figure 11a confirms rising lifetime incomes across the board from 1991-2020. Importantly, there is significant rise in lifetime income for the bottom 10% (almost at the same rate as those in the 70^{th} percentile. Except for the fact that growth at the very top was slightly lower than that at p90, the cumulative growth incidence curves follow a U-shaped pattern, with deciles 2 to 4 experiencing the lowest growth.

When we break this cumulative growth down by cohorts (Figure 11b) it is clear that the overall pattern of growth is largely due to the earlier cohorts (top row), that is those that experienced a larger portion of their 30s in the high growth years of the 1990s and early 2000s. In contrast, growth for the later cohorts (bottom row) is quite modest, with the majority of the income distribution at growth rates at less than 1%.



(a) Cumulative growth by deciles c1991-c2000 (b) Growth between cohorts

Figure 11: **Growth incidence curves of lifetime market and post-government income**

Lifetime income inequality. Growth in lifetime incomes at the bottom has a significant impact on mitigating any rise in inequality arising from growth at the top. As Figure 12a shows, there is only a minute increase in lifetime income inequality from c1991-c2020. Although we observe a rise in the p90/p50 ratios of lifetime income (Figure 12b) that is similar in trend and magnitude to its point-in-time counterpart in Figure 6b, the magnitude of the Gini coefficients for lifetime income inequality are considerably lower compared to those of point-in-time income inequality in Figure 6a.

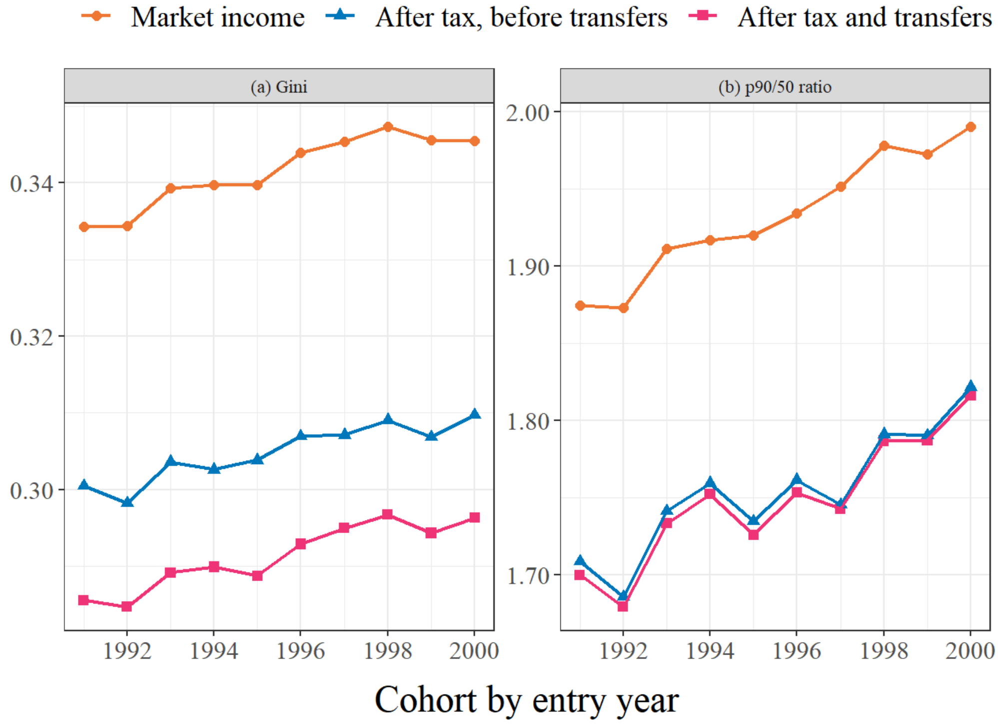


Figure 12: **Trends in lifetime income inequality**

Role of tax and transfers on lifetime income redistribution. Similar to what we observe from the point-in-time perspective in Figure 6, we observe a strong redistributive role of the tax and transfer systems on lifetime income in Figure 12. Lifetime inequality after tax and transfers is much lower than lifetime market income inequality. We also observe a slight upward trend in these measures.

Figure 13 examines redistribution from the tax system further by plotting the redistributive effect of lifetime tax, its progressivity and size. There is a rise in the redistributive effect of tax on lifetime income from c1991-c1999. This is driven by both an increase in progressivity and the average size of tax. There is a reversal in the trends from c1999 to c2020. This echoes the reversal in the trend in point-in-time redistributive effect of tax from 2015-2020 in Figure 7.

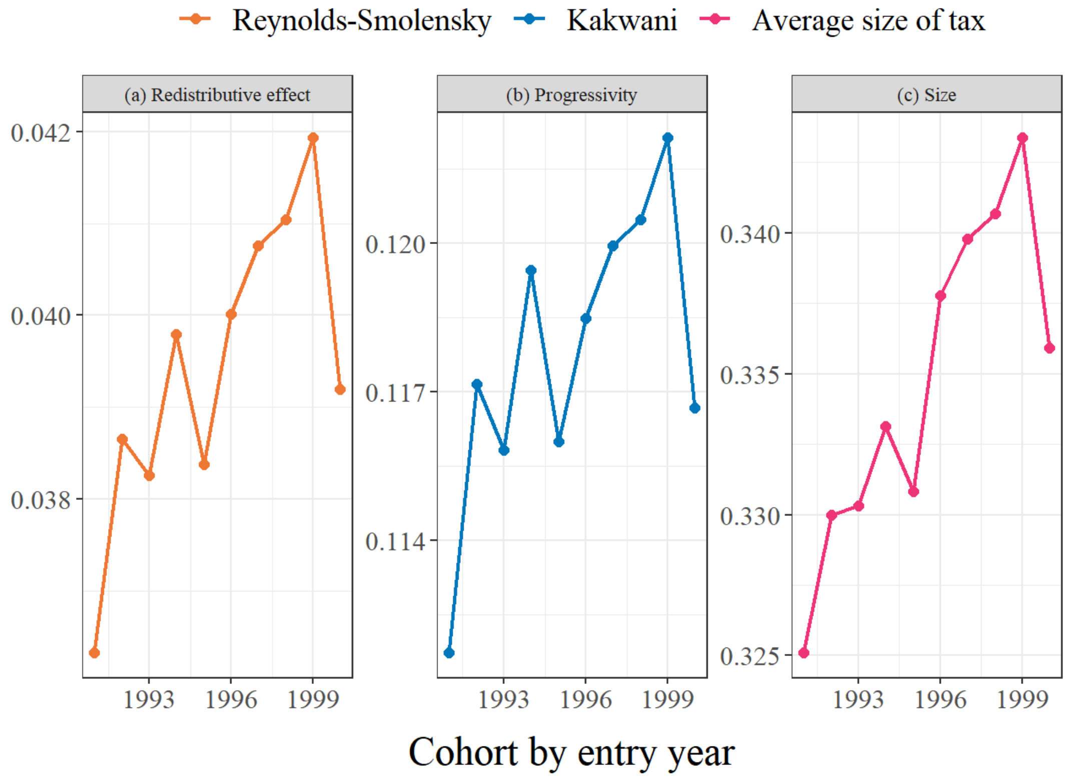


Figure 13: **Lifetime income redistribution with the tax system**

Figure 14 plots the redistributive effect of lifetime transfers, its progressivity and size. Trends in lifetime redistribution closely match their point-in-time counterparts on Figure 8. The redistributive effect of point-in-time transfers sharply declined from 1996 to 2020 owing to a sharp decline in its size. We observe similar sharp declines in 14a and 14c from c1996 to c1999. Likewise, the increase in redistribution from 2019 to 2020 is captured by c2020, the cohort that experiences that reversal.

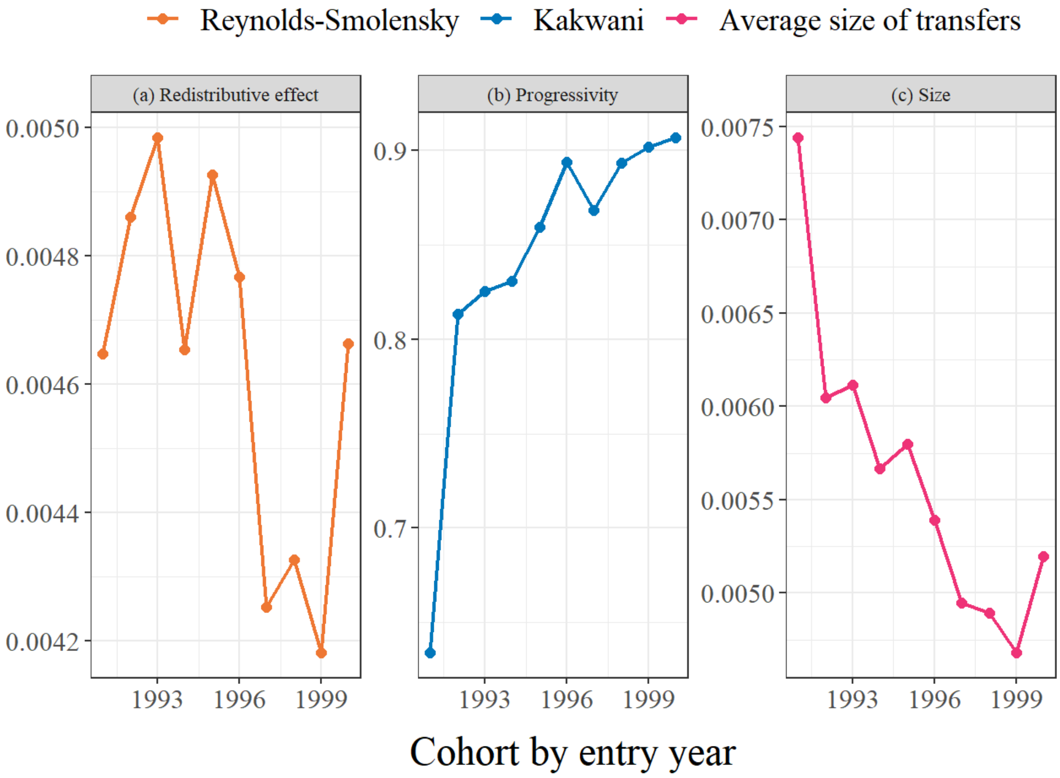


Figure 14: **Lifetime income redistribution with the public transfer system**

3.5 Summary and some caveats

In this section, we presented some key empirical facts on growth and redistribution in Australia, using longitudinal tax records of millions of Australian taxpayers from 1991 to 2020. One general message is that uneven growth across groups impacts individual taxpayers differently over time, and ultimately influences their lifetime incomes. Uneven sharing of income growth in favor of higher income groups results in a rising trend in income inequality. The increased progressivity of the tax and transfer system have played an important role in moderating these uneven gains across groups and over lifetimes. While inter-cohort income inequality increased over time, lifetime inequality within cohorts was relatively lower and more stable, implying biases in cross-sectional analyses.

Having used 30 years of the administrative tax data we can fully capture the three decades of uninterrupted economic growth in Australia 1991-2020. However, there are a number of limitations. First, our tax data sample is not a representative sample of the Australian population. Second, we are not able to examine a full life cycle that includes periods of education and retirement. Third, our data sample does not capture the full extent of the Australian transfer system. Fourth, our analysis is deficient on work hours, consumption, asset accumulation which can also provide valuable insights into the dynamics of inequality.

Our empirical analysis raises two important questions on whether various tax and transfer reforms such as increasing tax progressivity or transfer generosity could reduce inequality further, and whether such reforms entail large trade-offs in terms of economic growth. To address these questions, in the sections that follow, we build a structural model and conduct experiments with counterfactual tax and transfer systems.

4 A structural model

In this section, we formulate a dynamic general equilibrium overlapping generations model. We calibrate the benchmark model to match the lifecycle behaviors of Australian households as well as macroeconomic performance. We finally use the model to conduct a counterfactual analysis of tax and transfer reforms.

4.1 Demographics, endowments and preferences

Demographics. The model economy is populated by J overlapping generations. In each period, a new generation is born and enters the model at the age of 20, faces random survival probabilities ψ_j, and live to a maximum of J periods. Demographic structure is stationary. The fraction of population of age j at any point in time is given by $\mu_j = \frac{\mu_{j-1}\psi_j}{(1+n)}$, where n is the constant rate of population growth.

Preferences. Households have preferences over streams of consumption c_j and leisure l_j. The period utility function has a form of $u(c_j, l_j)$.

Endowments. Each cohort consists of 3 exogenous skill types that are based on education level $\varrho \in \{\text{low, medium, high}\}$. Those whose highest education attained is high school or below are classified as low skilled, those with a further tertiary training but without a graduate level qualification are classified as medium skilled, and graduates and higher are high skilled. In each period, households are endowed with 1 unit of labor time with labor productivity $\eta_{z,j} \in \{\eta_{1,j}, \eta_{2,j}, \eta_{3,j}, \eta_{4,j}, \eta_{5,j}\}$ which follows a Markov switching process with a transition matrix $\pi_{\varrho,j}(\eta_{z,j+1}|\eta_{z,j})$. This transition matrix differ by skill type, capturing the life cycle shocks faced by those with different levels of education. It also provides for even low skill types to attain higher wage quantiles (albeit with a low probability).

4.2 Technology

We assume a representative, competitive firm that hires capital K and effective labor services H (human capital) to operate the constant returns to scale technology $Y = AK^{\alpha}H^{1-\alpha}$, where $A \geq 0$ parameterises the total factor productivity which grows at a constant rate g and α is the capital share of output. Capital depreciates at a rate δ in every period. The firm choose capital and labor inputs to maximize its profit given the rental rate q and the market wage rate w according to

$$\max_{K,H}\left\{\left(1-\tau^{f}\right)\left(AK^{\alpha}H^{1-\alpha}-wH\right)-qK\right\}, \tag{3}$$

where $\tau^f \in [0,1]$ is the company income tax rate.

4.3 Fiscal policy

Government revenues. The government finances its fiscal programs by collecting tax revenue via a personal income tax $t(y_j)$, consumption tax $t(c_j)$ at the rate $\tau^c \in [0,1]$ and a company income tax at the rate $\tau^f \in [0,1]$. The government levies a progressive income tax on taxable incomey_j that includes both labor income, capital income and pension. We approximate the Australian personal income tax code using the following parametric tax function explained earlier in Appendix A.

$$t(y_j)=\max\left(0, y_j-\lambda y_j^{1-\tau}\right). \tag{4}$$

Total government revenue is given by

$$Tax=\sum_j t(y_j)\,\mu(\chi_j)+\sum_j t(c_j)\,\mu(\chi_j)+\tau^f\left(AK^{\alpha}H^{1-\alpha}-wH\right), \tag{5}$$

where $\mu(\chi_j)$ is the measure of agents in state χ_j.

Government spending. The governments has three main spending programs: an age pension program for those over and above the pension eligibility age J^P, a welfare transfer program for those below J^P, and a general government purchase program.

The amount of pension benefit p_j is means-tested and given by

$$p_j\left(y_j^m\right)=\begin{cases} p^{\max} & \text{if } y_j^m \le \bar{y}_1 \\ p^{\max}-\omega\left(y_j^m-\bar{y}_1\right) & \text{if } \bar{y}_1 < y_j^m < \bar{y}_2 \\ 0 & \text{if } y_j^m \ge \bar{y}_2, \end{cases} \tag{6}$$

where $\bar{y}_1$ and $\bar{y}_2=\bar{y}_1+p^{\max}/\omega_y$ are the income test thresholds and ω is the income taper rate.

The amount of welfare transfers $st_j(\eta_{z,j}, j)$ is age-dependent and conditional on the level of the labor productivity shock $\eta_{z,j}$. This closely approximates the progressive nature of the targeted transfer system, as well as changes in the level of targeted transfers over the life cycle. This welfare transfer program closely reflects the breadth of the social welfare system in Australia.

In addition, the government spends an amount G on general government purchases.

Government budget constraint. Total government expenditure is financed by tax revenues and the issue of new debt which incurs interest payments rD. In steady state, the level of public debt is constant and the government budget constraint is given by

$$Tax = \sum_j p_j \left(y_j^m\right) \mu\left(\chi_j\right) + \sum_j st_j \left(\eta_{z,j}, j\right) \mu\left(\chi_j\right) + G + rD \tag{7}$$

The model allows for the government to have an additional role in distributing bequests (both accidental and intentional) from dead agents to those alive. However, in our baseline experiments we assume that all accidental bequests are taxed away akin to a 100% estate tax.

4.4 Market structure

We assume a small open economy in which that the domestic capital market is fully integrated with the world capital market. Hence, under free inflows and outflows of capital, the domestic interest rate r is exogenously set by the world interest rate r^w. Labor is internationally immobile so that there is no migration. The wage rate w adjusts to clear the labor market in equilibrium.

Markets are incomplete such that households cannot insure against idiosyncratic wage risk and mortality risk by trading state contingent assets. In addition, they are not allowed to borrow against future income, such that asset holdings are non-negative.

4.5 Household optimization problem

Households receive income from labor and capital market activities. Their market income is given by $y_j^m = \eta_{z,j} \cdot w \cdot (1 - l_j) + ra_j$. Households might receive welfare transfers $st_j\left(\eta_z, j\right)$ before the pension eligibility age J^p. Upon reaching the pension eligibility age, they are entitled to a means-tested public pension $p\left(y_j^m\right)$ that is subjected to an income test. Households are required to pay consumption tax at the rate of τ^c on their consumption c_j and income tax t_j on their taxable income $y_j = y_j^m + p_{j \geq J^p}$, which is the sum of their market income and age-pension. Let the state of the household at age j be $\chi_j = (j, \eta_{z,j}, a_j)$. Given time invariant prices, taxes and transfers, the household problem is written recursively as

$$V^j(\chi_j) = \max_{c_j, l_j, a_{j+1}} \left\{ u(c_j, l_j) + \beta\psi_{j+1} \sum_{\eta_{z,j+1}} \pi_{\varrho,j}(\eta_{z,j+1}|\eta_{z,j}) V^{j+1}(\chi_{j+1}) \right\}$$

subject to:

$$a_{j+1} = \overbrace{\underbrace{\eta_{z,j} \cdot w \cdot (1 - l_j) + ra_j}_{y_j^m \text{(market income)}} + p_{j \geq J^p}}^{y_j \text{(taxable income)}} + st_{j<J^p} - t(y_j) - (1 + \tau^c) c_j + a_j,$$

$$a_j \geq 0 \text{ and } 0 < l_j \leq 1. \tag{8}$$

4.6 Equilibrium

Given the government policy settings for the tax system and the pension system, the population growth rate, world interest rate, a steady state competitive equilibrium is such that:

(i) a collection of individual household decisions $\{c_j(\chi_j), l_j(\chi_j), a_{j+1}(\chi_j)\}_{j=1}^J$ solve the household problem given by equation (8);

(ii) the firm chooses effective labor and capital inputs to solve the profit maximization problem in equation (3);

(iii) the government budget constraint defined in equation (7) is satisfied.

(iv) the total lump-sum bequest transfer is equal to the total amount of assets left by all the deceased agents

$$B = \sum_{j \in j} \frac{\mu_{j-1}(1 - \psi_j)}{(1 + n)} \int a_j(\chi_j) d\Lambda_j(\chi_j) \tag{9}$$

(v) the domestic market for capital and labor clear

$$K = \sum_{j \in j} \mu_j \int a_j(\chi_j) d\Lambda_j(\chi_j) + B + A_f \tag{10}$$

$$H = \sum_{j \in j} \mu_j \int (1 - l_j) e_j(\chi_j) d\Lambda_j(\chi_j) \tag{11}$$

and factor prices are determined competitively such that $w = (1 - \alpha)\frac{Y}{H}$, $q = \alpha\frac{Y}{K}$ and $r = q - \delta$;

(vi) the current account is balanced and foreign assets A_f freely adjust so that $r = r^w$, where r^w is the world interest rate.

4.7 Mapping the model to data

We map the steady state equilibrium to reflect key statistics for the Australian economy for $2000-2004$. Choosing the 2000s rather than the 1990s allows us more detailed longitudinal information on public transfers and hourly wage rates from the Household Income and Labour Dynamics in Australia (HILDA) survey.

Table 5 present values for key parameters that were determined by standard and their respective sources or benchmark targets.

Table 5: **Key parameters, targets and data sources**

Parameter	Value	Source/Target
Demographics		
• Population growth rate	$n = 1.3\%$	WDI
• Survival probabilities	ψ_j	Australian Life Tables (ABS)
Technology and market structure		
• Capital share of output	$\alpha = 0.4$	Tran and Woodland (2014)
• GDP per capita growth rate	$g = 2.24\%$	WDI
• Depreciation rate	$\delta = 0.055$	Tran and Woodland (2014)
• Total factor productivity	$A = 1$	(scaling parameter)
• Interest rates	$r = r^w = 1.04\%$	Investment share of GDP
Preferences		
• Inter-temporal elasticity of consumption	$\sigma = 2$	
• Share parameter for leisure	$\gamma = 0.3$	Labour supply over the life cycle
• Discount factor	$\beta = 0.97$	Household savings share of GDP
Fiscal policy		
• Consumption tax rate	$\tau^c = 7\%$	Consumption tax share of GDP
• Income tax	$\lambda = 0.6557$ $\tau = 0.15$	Income tax share of GDP, Suits index and Tax distribution
• Company profits tax rate	$\tau^f = 20\%$	Company tax share of GDP and investment/GDP ratio.
• Pension income test taper rate	$\omega^y = 0.5$	Official taper rate
• Pension maximum payment	p^{max}	Pension share of GDP
• Pension income thresholds	y_1	Pension participation rates

Note: WDI: World Development Indicators, ABS: Australian Bureau of Statistics, OECD-SOCX: Social expenditure database of the OECD.

Demographics. One model period lasts 5 years. Households become economically active at age 20, ($j = 1$). They are eligible for age-pension at age 65 ($j = 10$). Household survival probability becomes zero (die with certainty) at age 90. We set the population growth rate to $n = 1.3\%$. We use Life Tables for the period from the Australian Bureau of Statistics to determine survival probabilities ψ_j.

Preferences. We assume that the period utility function has a form of $u(c,l) = \frac{\left[c_j^{\gamma} l_j^{1-\gamma}\right]^{1-\sigma}}{1-\sigma}$. We set $\sigma = 2$ and $\gamma = 0.3$. The subjective discount factor β is calibrated to match gross household savings to GDP ratio.

Endowments. We estimate the labour productivity process from the Household, Income and Labour Dynamics in Australia (HILDA) longitudinal survey for the years 2001-2018. We follow Nishiyama and Smetters (2007) to approximate the dynamics of labour productivity over the life-cycle. We define working ability/labour productivity as the hourly average wage rate, defined as gross labour income divided by total hours worked. We first group individuals aged between 20 and 64 into cohorts of 5 year age groups. We then classify individuals in each of these age groups in 5 quintiles of hourly wage rate. We assume that labour productivity declines linearly for those age 65 and above, reaching 0 at age 80. The mobility of individuals from quintile to quintile over the life cycle is governed by Markov transition matrices that are skill and age dependent. To make the transition matrix more persistent, we use the average of estimates between 2001 and 2018.

Technology. Production in the economy is characterized by the Cobb-Douglas function $Y = AK^{\alpha}H^{1-\alpha}$. We follow Tran and Woodland (2014) and set the capital share of output $\alpha = 0.4$, the parameter $A = 1$ and the depreciation rate of physical capital $\delta = 0.055$. GDP per capita growth rate g is set at 2.24% which is the average rate for Australia during the period, taken from the World Development Indicators database of the World Bank.

Market structure. We base our model on the small open economy assumption and assume the world interest rate is $r = 4\%$.

Fiscal policy. We calibrate the parameters of the function to approximate the tax-free threshold and average tax rates by income level during the period. We set the tax level parameter $\lambda = 0.6557$ and the curvature parameter $\tau^y = 0.15$ so as to match the income tax share of GDP, the distribution of tax liabilities as per Suits and Kakwani indices, the redistributive effect as per the Reynolds-Smolensky index.

Prior to the age of 65, we lump all welfare transfers other than pension such as family benefits, disability support pension and unemployment benefits in to $st(\eta_j, j)$. We estimate the share of other welfare transfers by wage quintile η_j and age j using HILDA data and set the total amount of welfare transfers to match its share of GDP. From the age of 65, individuals are eligible for means-tested pension subject to an income test. The income test taper rate is set at $\omega^y = 0.5$ which reflect the reduction in pension by 50 cents for every \$1 above the low income threshold $\bar{y}_1$.[7]

[7] In order to test whether the asset test binds in our model, we also calibrate a version with the asset test where the asset test taper rate is $\omega^a = 0.0015$ for every \$1,000 above the low asset threshold $\bar{a}_1$. Below these thresholds, households obtain the maximum pension denoted by $p^{\max}$. We calibrate $p^{\max}$ and the thresholds $\bar{y}_1$and $\bar{a}_1$to match pension participation rates over the life cycle and the public pension to GDP ratio. In our benchmark model economy, the income test binds.

Table 6: **Model performance: Key aggregate variables**

Variable	Model	Target
Domestic investment	17	25
Consumption	51	58
Average hours per week	30	35
Consumption tax	3	3
Company tax	8	5
Total tax revenue	27	29
Government expenditure	17	17

Note: Except for hours worked, all other variables are expressed in percentage share of GDP.

Model performance. Our benchmark model is capable of reproducing the key macroeconomic variables. Table 6 presents key macroeconomic variables in the benchmark economy and their respective targets.

Table 7 presents the main income and tax distributions that were approximated, their respective targets and the values in the benchmark model.

Table 7: **Model performance: Income and redistribution**

	Parameters	Measure	Data	Target
Labour income	Labour productivity process.	Gini	0.5	0.5
Taxable income	Matched using labour productivity.	Gini	0.4	0.4
Income tax	$\lambda = 0.6557$	Share of GDP (%)	16	11
	$\tau^y = 0.15$ (estimated)	Suits index	0.17	0.19
		Kakwani index	0.14	0.17
		Tax size	0.3	0.3
		Re distributive effect	0.04	0.04
Public transfers	Estimated by wage quintile.	Share of GDP (%)	8	8
Pension	$p^{\max} = 0.06$, $\omega^y = 0.5$	Share of GDP (%)	2	2
	$y_1 = 0.0126$	Pension participation rates by skill and age.		
Post-govt income	Matching income distribution	Gini	0.34	0.34

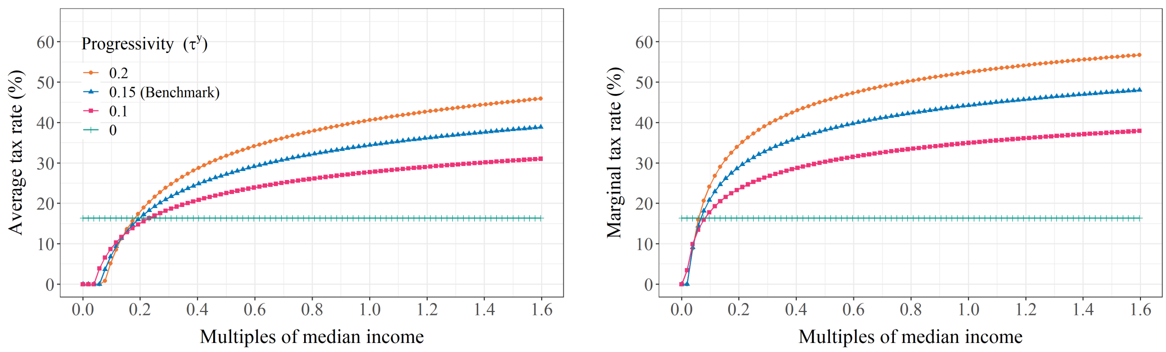
Note: Estimation details are provided in this section. Macroeconomic and fiscal aggregates are sourced from the World Development Indicators (WDI) database. Distributional targets (Gini coefficients) are from ALife data. Data to estimate public transfers and labour productivity are sourced from HILDA.

5 Simulation results

In this section, we use our model to study the effects of progressive income tax on income inequality in the long run. To do so, we make the assumption that the economy is on the balanced growth path where the growth rate is around 2000-2004 levels at $g = 2.24\%$. Then we consider counterfactual steady state economies with alternative income tax codes with different levels of progressivity.

To do so, we keep all other fiscal variables fixed in real terms at benchmark levels and vary the progressivity parameter τ^y between 0 (flat income tax) and 0.2 that is higher than the benchmark level of $\tau^y = 0.15$. In each case, we balance the budget by adjusting the average level of taxation $1 - \lambda$.

Figure15a displays the average tax function, while Figure 15b presents the marginal tax function at various levels of τ^y. We notice that as τ^y increases, both tax functions rotate anti-clockwise, leading to an increase in average and marginal tax rates across a significant portion of the income tax scale. This increase is more pronounced for higher income levels. The anti-clockwise rotation also results in a slight decrease in tax rates at very the lower end of the income tax scale. Moreover, the tax-free threshold (represented by $\lambda^{\frac{1}{\tau^y}}$) increases by a small amount.



(a) Average tax rates

(b) Marginal tax rates

Figure 15: **Average and marginal tax functions at different levels of τ^y**

5.1 Tax progressivity and inequality

Incentive effects and market income inequality. The incentive effects at play determine the effect of changing tax progressivity on market income inequality. The steepening of the tax code shown in Figures 15a and b suggests an increase in the tax burden for those in higher income brackets and a decrease for those in lower income brackets. Furthermore, it indicates a negative incentive effect due to the increase in marginal tax rates for all income groups.

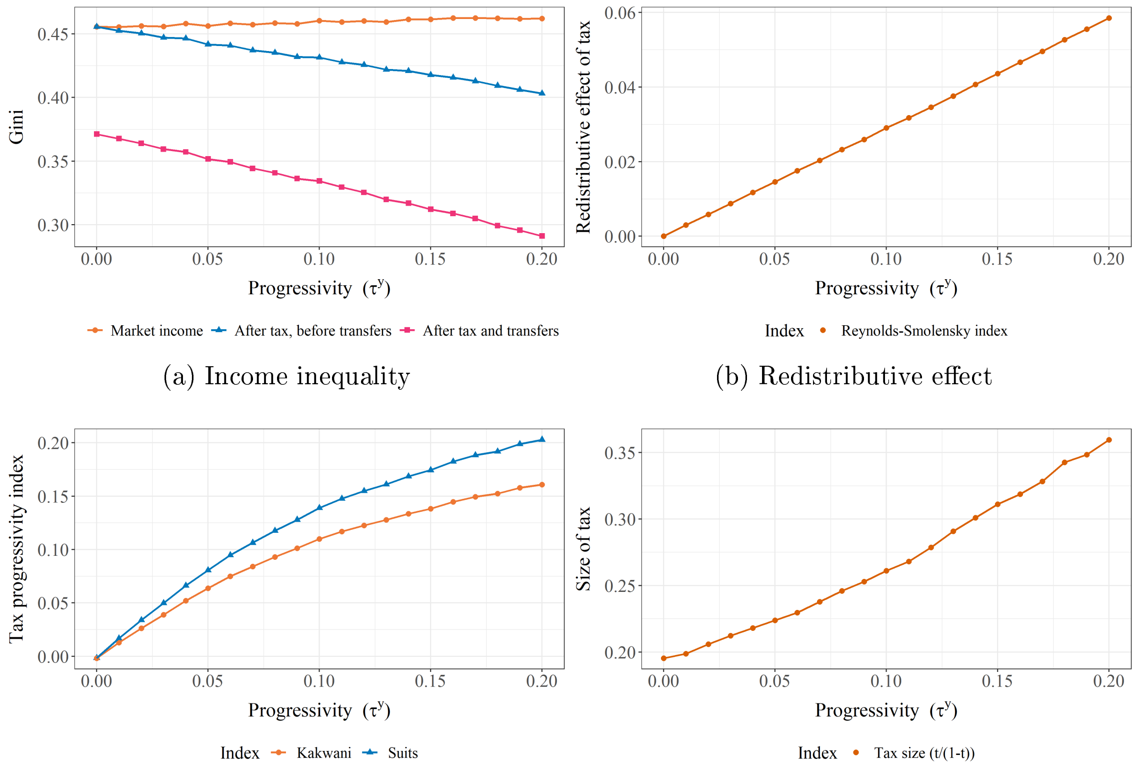
Table 8 shows the percentage change in labour hours and savings by different income types. In our benchmark economy, increasing tax progressivity results in a reduction in labour hours across the income distribution. Further, the percentage change in hours relative to the benchmark is fairly uniform between the skill types. For instance when τ^y is raised from 0.15 to 0.2, all skill types experience a 5-6% reduction in work hours on average. This has minimal impact on labour income inequality with its Gini coefficient at all levels of τ^y around 0.52.

Table 8 further reveals that savings consistently drop by approximately 17-18% for all income categories when progressivity rises. Consequently, capital income inequality remains stable, with a Gini coefficient of around 0.63. Therefore, in our benchmark economy, altering the levels of tax progressivity between 0 and 0.2 has a minimal effect on market income inequality. This observation is also supported by the stable, flat trend of the Gini coefficient for market income inequality depicted in Figure 16a.

Table 8: **The aggregate and distributional effects of tax progressivity**

	$\tau^y = 0.2$ (Higher)	$\tau^y = 0.15$ (Bench.)	$\tau^y = 0.1$ (Lower)	$\tau^y = 0$ (Flat tax)
Output ($\%\triangle^{Bench}$)	-5.16	0.0	6.51	17.61
Labour hours ($\%\triangle^{Bench}$)				
• Aggregate	-5.44	0.0	6.67	18.2
• Low skilled	-6.11	0.0	8.2	20.85
• Medium skilled	-5.56	0.0	6.35	18.22
• High skilled	-4.97	0.0	6.42	16.95
Savings ($\%\triangle^{Bench}$)				
• Aggregate	-17.95	0.0	25.89	83.71
• Low skilled	-16.86	0.0	21.08	67.25
• Medium skilled	-17.85	0.0	27.18	80.87
• High skilled	-18.87	0.0	27.11	99.48
Income inequality (Gini)				
• Labour income	0.52	0.52	0.52	0.51
• Capital income	0.63	0.63	0.63	0.64
• Market income	0.45	0.45	0.45	0.45
• Post-tax income	0.4	0.42	0.43	0.46
• Post-gov. income	0.32	0.34	0.35	0.39
Redistribution				
• Suits index	0.2	0.17	0.14	0
• Kakwani index	0.16	0.14	0.11	0
• Tax size	0.36	0.31	0.26	0.2
• Re distributive effect	0.06	0.04	0.03	0

Note: $\%\Delta^{bench}$ refers to the percentage change in the respective variable relative to its value in the benchmark. Re distributive effect is measured by the Reynolds-Smolensky index. Net redistributive effect is the effect after tax and transfers. Distributional indices are rounded off to two decimal places (ignoring minute decimal point changes).



(a) Income inequality

(b) Redistributive effect

(c) Tax progressivity

(d) Tax size

Figure 16: **Income distribution and redistribution at different levels of tax progressivity** τ^y

Redistributive effect of progressive income tax. Although market inequality remains stable, there is a notable decline in after-tax income inequality, as depicted in 16a. This is because increasing tax progressivity makes the tax system increasingly redistributive. Figure 16b illustrates the Reynolds-Smolensky index of redistributive effect, which shows an increase as tax progressivity (τ^y) rises. This index can be decomposed into two components - tax progressivity presented in Figure 16c and average size of tax in Figure 16d. We observe that both progressivity indices and tax size increase as τ^y increases.

5.2 The importance of the public transfer system

A notable trend in Figure 16a is that at any given level of tax progressivity, post-government income inequality (after tax and transfers) is considerably below that of after tax income inequality. While a detailed investigation of the full array of public transfers is beyond the scope of this paper (and our general equilibrium model), we briefly investigate the role of the public transfer system in mitigating income inequality.

To do so, we examine a counterfactual economy with the benchmark income tax system, but alternative levels of public transfer generosity. In this regard, we examine an economy where all public transfers are 150% of the benchmark, 50% and 0% (no public transfer system). This allows us to quantify the contribution of public transfers to mitigating market income inequality. In each counterfactual economy, to generate the same tax function and tax distribution, we adjust general government purchases to offset the increase or decrease in public transfer expenditure.

Table 9: **The effects of public transfer generosity**

	150%Δ^{bench}	Bench. (Δ^{bench})	50%Δ^{bench}	0%Δ^{bench}
Income inequality (Gini)				
• Labour income	0.54	0.52	0.47	0.45
• Capital income	0.66	0.63	0.55	0.44
• Market income	0.45	0.46	0.44	0.41
• Post-tax income	0.41	0.42	0.40	0.37
• Post-gov. income	0.26	0.31	0.35	0.37
Re distributive effect				
• Tax	0.05	0.04	0.04	0.04
• Tax and transfer (net)	0.13	0.11	0.06	0.04
Hours worked (%Δ^{bench})				
• Aggregate	-8.08	0.0	16.08	29.63
• Low	-10.41	0.0	21.09	38.67
• Medium	-8.90	0.0	17.86	32.99
• High	-5.85	0.0	11.25	20.75
Savings (%Δ^{bench})				
• Aggregate	-16.77	0.0	39.79	107.83
• Low	-19.68	0.0	43.09	116.85
• Medium	-18.35	0.0	43.90	119.05
• High	-12.25	0.0	30.95	83.65

Note: %Δ^{bench} refers to the percentage change in the respective variable relative to its value in the benchmark. Re distributive effect is measured by the Reynolds-Smolensky index. Net redistributive effect is the effect after tax and transfers. The tax progressivity parameter is kept unchanged at the benchmark level.

Table 9 presents interesting results regarding the impact of the transfer system on income inequality and its potential unintended consequences.

The transfer system indeed plays a significant role in reducing inequality, as evidenced by the Reynolds-Smolensky index for tax (0.04) and the overall tax and transfer system (0.11) in the benchmark model. For instance, with a 150% more generous public transfer system, the redistributive effect increases to 0.13; and net income inequality decreases to 0.26 from 0.31 in the benchmark. However, the transfer system also generates substantial disincentives for low and medium skill workers. When public transfers are 150% more generous, work hours reduce across all types of households. Conversely, when transfers are reduced, it results in a substantial increase in hours and an even greater increase in savings. In this regard, eliminating public transfers altogether results in a 39% and 33% increase in hours worked among low and medium skill types respectively. This change also leads to a considerable rise in savings (117% for low skill and 119% for medium skill, compared to 84% for high skill).

These distortions from the transfer system affect market income inequality. As evident, a more generous public transfer system results in large decline in savings for low skill types (20%) relative to the high skilled (12%). This increases capital income inequality. Less generous public transfers incentivises low income types to save. We observe a significant reduction in the Gini coefficient of capital income inequality from 0.66 in the economy with public transfers at 150% of benchmark to 0.44 in the economy with no public transfers. Interestingly, the Gini coefficient for post-government income is only marginally higher at 0.37 without public transfers, compared to 0.31 with public transfers in place. Overall, increasing the generosity of public transfers by 150% results in a small decline in post-government income inequality (Gini of 0.26 compared to the benchmark value of 0.31) due to the increase in capital income inequality.

Thus, the redistributive effect of public transfers are hampered to some extent by higher market income inequality in our general equilibrium framework. Our results highlight the complex interplay between public transfer systems, labor market incentives, and income inequality in a macroeconomic context.

6 Conclusion

We examine the extent to which a progressive tax and transfer system can mitigate the distributional effects of uneven economic growth. Our analysis is centered on the distinct case of Australia, characterized by uninterrupted economic growth from 1991 to 2020 and the implementation of a highly progressive tax and transfer system.

We first analyse the tax records of millions of Australians and find that these economic gains have not been shared evenly across age and income groups over time. The progressive income tax and means-tested transfer system has played a vital role in moderating the distributional impacts of uneven growth in Australia. Moreover, by examining income inequality of 10 cohorts, each over a span of 20 years, we find that lifetime income inequality is relatively lower and more stable. This finding underscores potential bias that could manifest in conclusions based on point-in-time statistics.

Next, we construct a dynamic general equilibrium model to explore the impact of higher tax-transfer progressivity on reducing inequality in Australia. Our simulation results demonstrate that different tax designs have important implications for individual behaviors, aggregate outcomes and inequality in a dynamic general equilibrium framework. Our findings highlight the importance of accounting for trade-offs between efficiency and equity when considering redistributive policies in general equilibrium. Our findings also highlight the limits to which the tax and transfer system in mitigating unequal distributional effects of uneven growth.

In our empirical analysis, our primary data source is the administrative tax data sample from ATO, which is not a representative sample of the entire Australian population. Furthermore, we simplify our analysis by abstracting from deeper roots of income inequality, including health, education, and human capital accumulation. Additionally, we do not explore the role of household income pooling and government transfers in reducing disparities in household income and consumption. We leave these issues for future research that combines household survey and administrative data.

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Appendices

A The parametric tax function

Australia's income tax code is complex, and consists of multiple income thresholds and statutory marginal tax rates that rise as we progress to higher thresholds. Further, those on lower income thresholds receive various credits and offsets. We approximate the Australian income tax code using a parsimonious tax function commonly used in the public finance literature (e.g., see Jakobsson (1976), Persson (1983), Benabou (2002) and more recently Heathcote, Storesletten and Violante (2017)).

Specifically, the total tax liability $t(y)$, average tax rate atr and marginal tax rate mtr take the functional form:

$$t(y) = y - \lambda y^{(1-\tau^y)}, \tag{12}$$

$$atr = 1 - \lambda y^{-\tau^y} \text{ and} \tag{13}$$

$$mtr = 1 - \lambda (1 - \tau^y) y^{-\tau^y}, \tag{14}$$

respectively, where y is taxable income; λ is a scale parameter that controls the level of the average taxation; and τ^y is a curvature parameter that controls the curvature of the function. When $\tau^y = 0$, the tax code is proportional with an average tax rate of $1 - \lambda$. The higher the value of τ^y, the more progressive is the income tax schedule. This tax function is fairly general and captures the common cases:

$$\begin{cases} \text{(1) Full redistribution: } t(y) = y - \lambda \text{ and } t'(y) = 1 & \text{if } \tau^y = 1, \\ \text{(2) Progressive: } t'(y) = 1 - \overbrace{(1-\tau)}^{<1}\lambda y^{(-\tau^y)} \text{ and } t'(y) > \frac{t(y)}{y} & \text{if } 0 < \tau^y < 1, \\ \text{(3) No redistribution (proportional): } t(y) = y - \lambda y \text{ and } t'(y) = 1 - \lambda & \text{if } \tau^y = 0, \\ \text{(4) Regressive: } t'(y) = 1 - \overbrace{(1-\tau)}^{>1}\lambda y^{(-\tau^y)} \text{ and } t'(y) < \frac{t(y)}{y} & \text{if } \tau^y < 0. \end{cases}$$

The curvature parameter τ^y is a closed-form expression of tax elasticity given by $\frac{mtr(y)-atr(y)}{1-atr(y)} = \tau^y$. If the elasticity is larger than unity, $\varepsilon > 1$, additional tax liability on an additional unit of income (marginal rate) exceeds average tax liability at that income level (average rate), i.e., $mtr(y) - atr(y) > 0$.

Estimation of the tax function We estimate the tax function using taxable income and tax liability from ALife data via 2 methods - ordinary least squares estimation of the logarithmic transformation of the function, and non-linear least squares. Both methods yield the similar estimates and exactly the same trend. Table 10 summarizes the OLS estimates of τ^y, their 95% confidence intervals and the adjusted R-squares of the estimations for some selected years. As evident from the table, we can obtain a very precise estimate of τ^y. This confirms that the tax function is a fair approximation of the income tax code in Australia.

Table 10: **OLS estimates of tax progressivity parameter**

Year	1991	2000	2010	2019
τ^y	0.152	0.150	0.129	0.165
95% Confidence interval	(0.151,0.152)	(0.150,0.151)	(0.129,0.129)	(0.165,0.166)
Adjusted R^2	0.97	0.98	0.99	0.99

In our online technical appendix, we provide more detailed information on estimation of the parametric tax function.

B Measuring redistributive effect of taxes and transfers

This appendix presents a comprehensive overview of our measures of income inequality and redistribution, as well as our decomposition method, which is based on the work of Lambert (2001).

B.1 Definitions

In the following exposition, we provide clear definitions for our income distribution concepts, which apply to both the point-in-time and lifetime approaches. To simplify notation, we abstract from indexing time or cohort.

Market income distribution. Let N be the number of income units (population) and x_i define the market income level of unit i. Assume that income is continuously distributed along the income scale $[x_1, x_N]$ such that $x_1 < x_2 < ...x_{N-1} < x_N$ (ranked by ascending order). For convenience, let $x_1 = 0$. Total income in the economy be given by

$$X = \int_0^{x_N} h(x)\, dx \tag{15}$$

where $h(x)$ is the income density function such that $h(x)\, dx$ gives the amount of income held by income units in the range $[x, x + dx]$. Let $f(x)$ define the frequency density function that gives the proportion of N at each income level x. As such $f(x)\, dx$ gives the proportion of the population whose incomes lie in the range $[x, x + dx]$. Given that the income distribution is continuous,

$$h(x) = Nxf(x) \tag{16}$$

$$X = \int_0^{x_N} x f(x)\, dx \tag{17}$$

The cumulative density function is given by

$$F(x) = \int_0^{x} f(t)\, dt \tag{18}$$

Let $p \in (0,1)$ represent the first $100p$ percent of income units. For each $p \in (0,1)$, there is only one income level z with rank p. The Lorenz curve is given by

$$L_X(p) = \int_0^{z} \frac{x f(x)\, dx}{\mu_x} \qquad 0 < p < 1 \tag{19}$$

The Gini coefficient of pre-tax income is

$$G_X = 1 - 2\int_0^1 L_X(p)\, dp \tag{20}$$

Income tax. Let $t(x)$ represent the tax liability at income level x. Total tax revenue is given by

$$T = N\int_0^{x_N} t(x) f(x)\, dx \tag{21}$$

The overall average tax rate is

$$t = \frac{T}{X} \tag{22}$$

Let L_{X-T} and L_T denote the concentration curves for post-tax income, and tax respectively, their concentration coefficients are

$$C_{X-T} = 1 - 2\int_0^1 L_{X-T}(p)\, dp \tag{23}$$

and

$$C_T = 1 - 2\int_0^1 L_T(p)\, dp \tag{24}$$

Note that, both concentration curves are plotted against percentiles of pre-tax income. Thus they both have the same argument p as L_X.

B.2 Progressivity and redistributive effect

Tax progressivity. The Kakwani index of tax progressivity is given by the difference between the tax concentration index (C_T) and the Gini index for pre-tax income.

$$K_T = C_T - G_X \tag{25}$$

The limits of the Kakwani index depends on the degree of pre-tax income inequality. The range is $[-(1+G_X),(1-G_X)]$. The closer to the latter the more progressive is the tax system.

The Suits index S_T is calculated by plotting the cumulative proportion of tax liability ordered by pre-tax income against the cumulative proportion of pre-tax income. The indexed is measured as twice the area between the 45° line and this relative concentration curve. The range of the Suits index is $[-1,1]$.

In the case of both indices, an index value of 0 indicate a proportional tax.

Re distributive effect. We measure the redistributive effect using the Reynolds-Smolensky index of redistributive effect.

$$RS = G_X - G_{X-T} \tag{26}$$

The range of the Reynolds-Smolensky index is $[G_X - 1, G_X]$

Re-ranking. Whenever non-income characteristics (such as marital status, age, and dependents) determine tax liabilities, the post-tax income rank of an income unit may not be the same as their pre-tax rank. Such reversals of rank that occur in the transition from pre-tax to post-tax income would mean that the Lorenz curve for post-tax income will not be the same as the concentration curve for post-tax income. This would imply that $C_{X-T} \neq G_{X-T}$. The re-ranking correction is computed as

$$RC = C_{X-T} - G_{X-T} \tag{27}$$

Note that when there is no re-ranking such that $C_{X-T} = G_{X-T}$, $RS = G_X - C_{X-T}$. (This is relevant for practical purposes. For instance, in computations, if there is no re-ranking inherent in the tax system, one can compute RS without having to re-order data by post-tax income and computing G_{X-T}).

Decomposing the redistributive effect. The RS index can be decomposed as follows.

$$RS = \overbrace{\frac{t}{1-t}}^{\text{Average rate of tax on \textbf{net} income}} \times \underbrace{K_T}_{\text{Kakwani index}} + \overbrace{(C_{X-T} - G_{X-T})}^{\text{Reranking correction}} \tag{28}$$

Following a similar approach we can construct the distributions of public transfer, post-transfer income and post-government income, concentration curves, and transfer progressivity and redistributive effects of public transfer. In Australia, the re-ranking effect of tax and transfer systems is close to zero and we abstract from it.

C Further empirical details

In this section, we provide more information on means and shares by quantiles of the income distribution for some select years. We document more aspects of growth, redistribution and inequality in Australia 1991-2020 and report these empirical facts and additional information in our accompanying online technical appendix.

C.1 Point-in-time statistics by quantiles

Table 11: **Average income by quantiles (select years)**

Year	Income	Q1	Q2	Q3	Q4	Q5	Top 10%	Top 1%	Top 0.1%
1991	Market income	4,753	22,332	40,339	56,251	96,691	119,723	264,072	645,013
1991	Income tax	232	2,163	5,896	11,101	24,763	32,225	68,037	131,686
1991	Public transfers	5,554	1,907	588	316	516	740	2,671	7,206
1991	Post-govt income	10,076	22,076	35,032	45,467	72,444	88,238	198,706	520,533
1995	Market income	3,689	20,893	39,892	57,210	101,509	127,166	294,220	757,518
1995	Income tax	187	1,833	5,790	11,286	26,222	34,854	80,128	170,978
1995	Public transfers	5,839	2,424	627	233	282	397	1,595	3,478
1995	Post-govt income	9,341	21,484	34,729	46,158	75,569	92,709	215,687	590,018
2000	Market income	5,570	25,090	44,468	64,000	123,780	161,657	466,063	1,784,982
2000	Income tax	333	2,670	7,642	14,154	36,564	50,425	149,915	589,395
2000	Public transfers	5,406	1,833	471	205	269	393	1,548	5,326
2000	Post-govt income	10,643	24,252	37,297	50,050	87,485	111,624	317,697	1,200,913
2005	Market income	5,358	25,630	45,215	65,992	130,983	172,321	491,024	1,615,385
2005	Income tax	277	2,785	7,931	14,041	37,938	54,422	177,257	571,430
2005	Public transfers	4,425	1,832	381	101	134	211	1,109	4,197
2005	Post-govt income	9,506	24,677	37,665	52,052	93,179	118,110	314,876	1,048,152
2010	Market income	4,928	25,124	46,099	69,225	142,563	188,487	519,132	1,584,564
2010	Income tax	108	1,221	5,042	12,406	36,864	52,907	173,380	546,778
2010	Public transfers	4,222	1,726	406	121	181	253	1,016	6,678
2010	Post-govt income	9,042	25,629	41,462	56,941	105,880	135,834	346,768	1,044,465
2015	Market income	6,127	27,330	48,357	72,764	153,907	204,815	552,073	1,717,235
2015	Income tax	149	1,581	6,491	14,549	44,542	64,197	210,810	686,453
2015	Public transfers	4,251	1,633	382	123	102	122	240	657
2015	Post-govt income	10,229	27,382	42,248	58,338	109,467	140,740	341,502	1,031,438
2020	Market income	5,505	28,141	50,072	75,357	157,005	207,571	578,927	1,997,987
2020	Income tax	164	1,962	7,153	15,481	46,812	66,955	221,523	777,353
2020	Public transfers	4,918	1,903	541	165	121	147	796	5,382
2020	Post-govt income	10,259	28,082	43,460	60,041	110,314	140,764	358,200	1,226,016

Note: All income and tax variables are expressed in 2020 Australian dollars. Columns Q1-Q5 give the averages by each respective quintile.

Table 12: **Share of income by quantiles (select years)**

Year	Income	Q1	Q2	Q3	Q4	Q5	Top 10%	Top 1%	Top 0.1%
1991	Market income	2.16	10.13	18.31	25.53	43.88	27.16	5.99	1.46
1991	Income tax	0.52	4.90	13.35	25.14	56.08	36.49	7.70	1.49
1991	Public transfers	62.54	21.47	6.62	3.56	5.81	4.17	1.50	0.41
1991	Post-govt income	5.44	11.93	18.93	24.56	39.14	23.84	5.37	1.41
1995	Market income	1.65	9.36	17.87	25.63	45.48	28.49	6.59	1.70
1995	Income tax	0.41	4.04	12.78	24.90	57.86	38.45	8.84	1.89
1995	Public transfers	62.08	25.77	6.67	2.48	3.00	2.11	0.85	0.18
1995	Post-govt income	4.99	11.47	18.54	24.65	40.35	24.75	5.76	1.57
2000	Market income	2.12	9.54	16.91	24.34	47.08	30.74	8.86	3.39
2000	Income tax	0.54	4.35	12.45	23.07	59.59	41.09	12.21	4.80
2000	Public transfers	66.06	22.40	5.75	2.50	3.28	2.40	0.95	0.33
2000	Post-govt income	5.07	11.56	17.78	23.86	41.71	26.61	7.57	2.86
2005	Market income	1.96	9.38	16.55	24.16	47.95	31.54	8.99	2.95
2005	Income tax	0.44	4.42	12.59	22.30	60.25	43.21	14.07	4.53
2005	Public transfers	64.38	26.65	5.55	1.47	1.95	1.53	0.81	0.31
2005	Post-govt income	4.38	11.37	17.35	23.98	42.92	27.20	7.25	2.41
2010	Market income	1.71	8.73	16.01	24.04	49.51	32.73	9.01	2.75
2010	Income tax	0.19	2.19	9.06	22.30	66.25	47.54	15.58	4.91
2010	Public transfers	63.44	25.93	6.09	1.82	2.71	1.90	0.76	0.50
2010	Post-govt income	3.78	10.73	17.35	23.83	44.31	28.42	7.26	2.18
2015	Market income	1.99	8.86	15.68	23.59	49.89	33.20	8.95	2.78
2015	Income tax	0.22	2.35	9.64	21.61	66.17	47.69	15.66	5.10
2015	Public transfers	65.48	25.16	5.89	1.89	1.58	0.94	0.18	0.05
2015	Post-govt income	4.13	11.06	17.06	23.56	44.20	28.41	6.89	2.08
2020	Market income	1.74	8.90	15.84	23.84	49.67	32.84	9.16	3.16
2020	Income tax	0.23	2.74	9.99	21.63	65.41	46.77	15.48	5.43
2020	Public transfers	64.30	24.88	7.08	2.16	1.58	0.96	0.52	0.35
2020	Post-govt income	4.07	11.14	17.24	23.81	43.75	27.91	7.10	2.43

Note: Each cell represents the percentage of income/tax by a quantile. Columns Q1-Q5 show the share by each respective quintile.

C.2 Lifetime statistics by quantiles

Table 13: **Average lifetime income by quantiles**

Cohort	Income	Q1	Q2	Q3	Q4	Q5	Top 10%	Top 1%	Top 0.1%
c1991	Market income	22,771	42,989	57,934	75,773	135,251	173,743	448,113	1,335,006
c1991	Income tax	3,713	7,799	12,069	17,935	40,615	55,581	154,892	452,730
c1991	Public transfers	1,102	562	293	138	376	688	6,359	0
c1991	Post-govt income	20,159	35,753	46,158	57,976	95,012	118,850	299,580	882,276
c1992	Market income	23,836	43,941	59,289	77,783	139,492	180,023	465,028	1,075,936
c1992	Income tax	3,960	7,918	12,312	18,421	42,825	59,403	176,056	441,125
c1992	Public transfers	1,027	540	304	142	58	44	1	0
c1992	Post-govt income	20,904	36,564	47,281	59,504	96,724	120,663	288,974	634,811
c1993	Market income	23,166	44,022	59,937	79,038	141,821	182,015	453,839	1,175,608
c1993	Income tax	3,782	7,946	12,563	18,618	43,499	59,897	169,456	396,758
c1993	Public transfers	1,091	533	282	144	64	55	4	0
c1993	Post-govt income	20,475	36,609	47,656	60,564	98,385	122,174	284,387	778,850
c1994	Market income	24,199	44,387	60,335	79,502	144,992	187,272	459,151	1,050,135
c1994	Income tax	4,068	7,979	12,549	18,692	45,037	62,770	180,707	416,583
c1994	Public transfers	1,019	523	263	128	58	53	8	0
c1994	Post-govt income	21,149	36,932	48,048	60,938	100,013	124,555	278,452	633,552
c1995	Market income	24,091	44,842	61,213	80,871	145,826	187,026	469,898	1,173,640
c1995	Income tax	3,991	8,159	12,733	19,057	44,771	61,867	183,877	516,333
c1995	Public transfers	1,113	516	248	134	45	37	0	0
c1995	Post-govt income	21,214	37,199	48,729	61,948	101,099	125,196	286,021	657,307
c1996	Market income	24,300	45,521	62,173	82,650	150,415	194,455	485,105	1,138,835
c1996	Income tax	4,045	8,278	13,071	19,809	46,975	65,577	192,959	476,662
c1996	Public transfers	1,113	497	211	100	36	26	18	0
c1996	Post-govt income	21,369	37,740	49,313	62,942	103,476	128,904	292,163	662,174
c1997	Market income	24,984	46,316	63,074	83,449	154,521	200,142	500,163	1,147,399
c1997	Income tax	4,225	8,513	13,247	19,727	48,726	68,256	205,403	513,109
c1997	Public transfers	1,002	465	217	99	49	39	4	0
c1997	Post-govt income	21,761	38,268	50,044	63,821	105,844	131,926	294,764	634,291
c1998	Market income	25,297	46,508	63,519	84,541	156,949	203,313	524,778	1,459,987
c1998	Income tax	4,336	8,397	13,392	20,149	49,479	69,481	215,006	600,177
c1998	Public transfers	1,042	458	205	87	41	44	6	0
c1998	Post-govt income	22,003	38,569	50,332	64,480	107,512	133,876	309,778	859,809
c1999	Market income	25,118	46,800	64,514	86,264	156,656	201,710	489,885	1,121,268
c1999	Income tax	4,197	8,496	13,675	20,745	49,858	69,827	207,916	556,394
c1999	Public transfers	1,034	416	201	87	30	16	6	0
c1999	Post-govt income	21,954	38,720	51,040	65,606	106,828	131,899	281,975	564,874
c2000	Market income	24,897	46,555	63,679	85,647	155,553	199,631	471,797	1,127,572
c2000	Income tax	4,112	8,434	13,396	20,506	48,184	66,639	181,264	433,586
c2000	Public transfers	1,131	475	220	85	34	24	3	0
c2000	Post-govt income	21,917	38,595	50,503	65,225	107,404	133,016	290,536	693,986

Note: All income and tax variables are annualised by dividing total lifetime values by the number of years (21 years). Columns Q1-Q5 give the averages by each respective quintile.

Table 14: **Share of lifetime income by quantiles**

Cohort	Income	Q1	Q2	Q3	Q4	Q5	Top 10%	Top 1%	Top 0.1%
c1991	Market income	7	13	17	23	40	26	7	2
c1991	Income tax	5	9	15	22	49	34	9	3
c1991	Public transfers	45	23	12	6	15	14	13	0
c1991	Post-govt income	8	14	18	23	37	23	6	2
c1992	Market income	7	13	17	23	41	26	7	1
c1992	Income tax	5	9	14	22	50	35	10	2
c1992	Public transfers	50	26	15	7	3	1	0	0
c1992	Post-govt income	8	14	18	23	37	23	6	1
c1993	Market income	7	13	17	23	41	26	6	2
c1993	Income tax	4	9	15	22	50	35	10	2
c1993	Public transfers	52	25	13	7	3	1	0	0
c1993	Post-govt income	8	14	18	23	37	23	5	1
c1994	Market income	7	13	17	22	41	26	6	1
c1994	Income tax	5	9	14	21	51	36	10	2
c1994	Public transfers	51	26	13	6	3	1	0	0
c1994	Post-govt income	8	14	18	23	37	23	5	1
c1995	Market income	7	13	17	23	41	26	7	2
c1995	Income tax	5	9	14	21	50	35	10	3
c1995	Public transfers	54	25	12	7	2	1	0	0
c1995	Post-govt income	8	14	18	23	37	23	5	1
c1996	Market income	7	12	17	23	41	27	7	2
c1996	Income tax	4	9	14	21	51	36	10	3
c1996	Public transfers	57	25	11	5	2	1	0	0
c1996	Post-govt income	8	14	18	23	38	23	5	1
c1997	Market income	7	12	17	22	41	27	7	2
c1997	Income tax	4	9	14	21	52	36	11	3
c1997	Public transfers	55	25	12	5	3	1	0	0
c1997	Post-govt income	8	14	18	23	38	24	5	1
c1998	Market income	7	12	17	22	42	27	7	2
c1998	Income tax	5	9	14	21	52	36	11	3
c1998	Public transfers	57	25	11	5	2	1	0	0
c1998	Post-govt income	8	14	18	23	38	24	5	1
c1999	Market income	7	12	17	23	41	27	6	1
c1999	Income tax	4	9	14	21	51	36	11	3
c1999	Public transfers	58	24	11	5	2	0	0	0
c1999	Post-govt income	8	14	18	23	38	23	5	1
c2000	Market income	7	12	17	23	41	27	6	1
c2000	Income tax	4	9	14	22	51	35	10	2
c2000	Public transfers	58	24	11	4	2	1	0	0
c2000	Post-govt income	8	14	18	23	38	23	5	1

Note: Each cell represents the percentage of income/tax by a quantile. Columns Q1-Q5 show the share by each respective quintile.

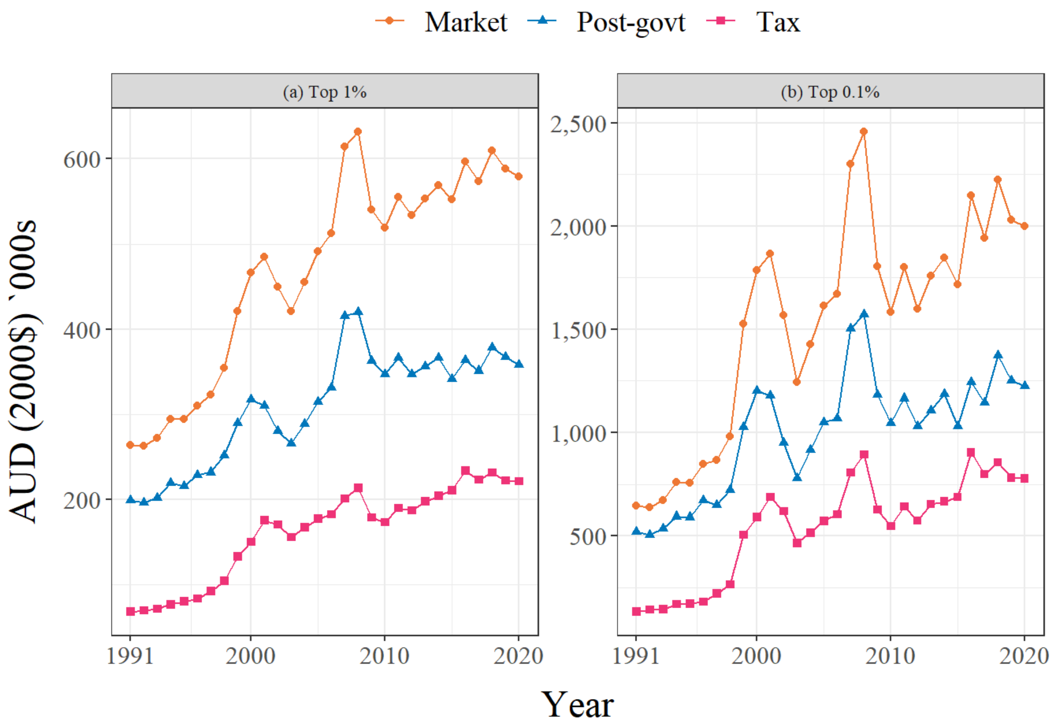

Figure 17: Mean market income, post-government income and tax at the top 1% and top 0.1%

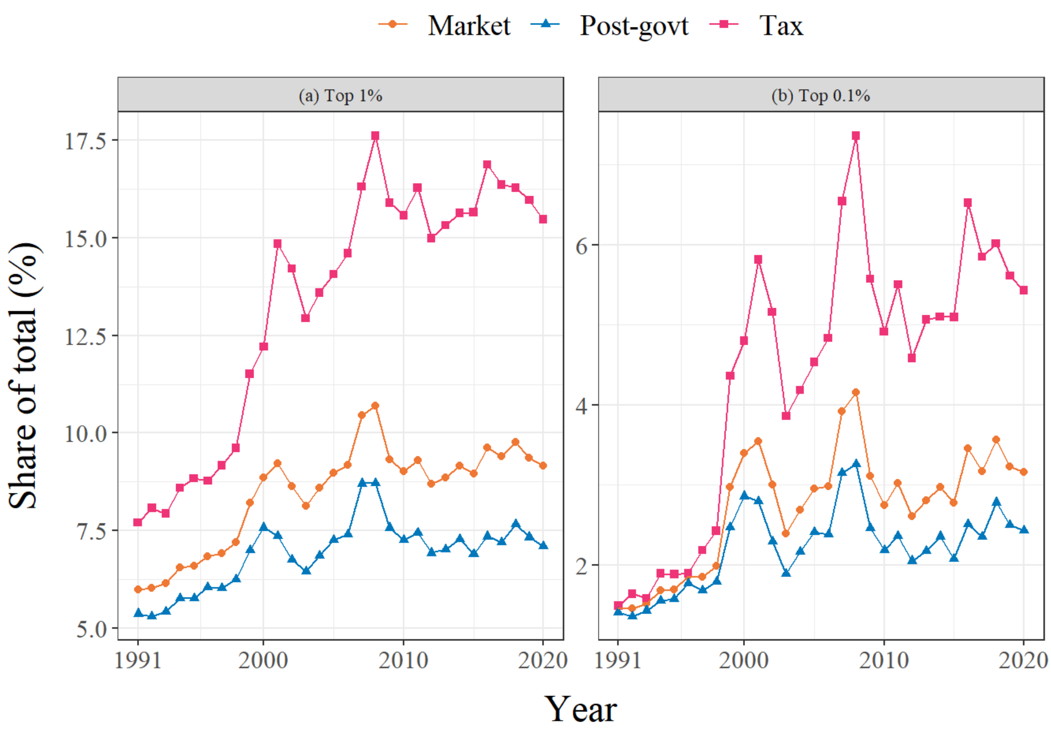

Figure 18: Share of market income, post-government income and tax at the top 1% and top 0.1%