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Policy, demography and market income volatility: What was shaping income distribution in Australia between 2002 and 2016?

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Policy, demography and market income volatility: What was shaping income distribution in Australia between 2002 and 2016?*

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Abstract

Isolating the impact of policy, demographic shifts and market volatility on changes in income inequality is of great interest to policymakers. However, such estimation can be difficult due to the complex interactions and evolutions in the social and economic environment. Through an extended decomposition framework, this paper estimates the effect of four main components (policy, demography, market income and other factors) on the year-over-year changes in income inequality in Australia between 2002 and 2016. This was a period marked by substantial policy, population and economic shifts due to factors such as the mining boom, the global financial crisis and increasing immigration. The framework also incorporates a flexible non-parametric market income model which captures demand-side shock better than a standard parametric model. Our results suggest that market income was the primary driver of income inequality for all segments of the income distribution in Australia over the past 15 years. Policy factors, on the other hand, have had a moderate impact on reducing inequality overall, but a more critical role for lower income earners.

JEL Codes: D31, H23

Keywords: income inequality, inequality decomposition, STINMOD+, policy reform, market income, ageing

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I Introduction

Policymakers are often interested in understanding the contribution of policy, demographic shifts and market income volatility on changes in income distribution, given that social inequality has been shown to have an impact on growth and social cohesion, both in the short and long run (Wilkinson and Pickett, 2009). However, such estimation is often difficult due to the complex interactions and evolutions in the social and economic environment. By extending the decomposition framework suggested by Bourguignon *et al*. (2008), Bargain and Callan (2010), Biewen and Juhasz (2012) and Sologon *et al*. (2018), we explore the year-on-year changes in the Australian income distribution over 15 years and identify what drives changes in income inequality. These potential drivers include not only policy reforms in the tax and transfer system but also fluctuations in market income (wage and non-wage), variations in employment, occupation and industry, and shifts in demography and household composition.

Australia has experienced some significant externally driven shocks, such as the mining boom and global financial crisis, over the past decade. Demographically, population ageing, together with an increasing number of migrants, add a complex mixture to the study of the income distribution over time. Throughout the past decade in Australia, growing attention in both public discourse and the academic literature has been paid to income inequality t (Johnson and Wilkins, 2004, Atkinson and Leigh, 2007, Wilkins, 2014, 2015) as well as to the role of tax and transfer reforms in mitigating inequality (Creedy and Hérault, 2015, Hérault and Azpitarte, 2015, 2016). Despite this growing interest, however, few empirical papers exist in Australia systemically examining the drivers of income inequality over time.

Earlier studies on Australia's income inequality tend to focus solely on the period before and during the global financial crisis in 2007–09. For instance, Hérault and Azpitarte (2015) examine the trends in the redistributive impact of the tax-benefit system in Australia between

1994 and 2009, while Hérault and Azpitarte (2016) investigate the role of tax-transfer policy reforms on income inequality over the 1999–2008 period and Creedy and Hérault (2015) study the period from 2000 to 2006. Our study adds to the understanding of the primary factors driving changes in income inequality in Australia between 2002 and 2016, covering both the pre- and post-crisis phases. It introduces several methodological refinements, described below, including the use of a non-parametric approach to generate the counterfactual annual income distribution and a more accurate policy effect assessment using annual data.

As suggested by the mixed results from European decomposition studies, the role of tax-transfer policy reforms may change during and after the financial crisis in 2007–09. For example, recent findings in Europe on the decomposition of changes in the income distribution following the global financial crisis illustrate that, across 27 European Union (EU) countries, the key drivers influencing inequality were changes in market income and population characteristics, with an inequality-increasing effect, while tax and transfer policies more often reduced inequality (e.g. Paulus and Tasseva, 2017). Similar findings of the inequality-buffer effects of tax-transfer systems have also been found among OECD countries (Jenkins, Brandolini, Micklewright and Nolan, 2011) and in various European economies (Brewer, Browne, Joyce and Sibieta, 2012, Matsaganis and Leventi, 2014, Sologon, *et al*., 2018). However, Bargain, Callan, Doorley and Keane (2017) found mixed outcomes when investigating the role of tax-benefit policies in income distribution variations in four European countries during and after the Great Recession (2008–13). They observe that during the first stage (2008–2010), the policy reaction helped stabilise or reduce inequality and poverty in France, the UK, and Ireland but pushed up poverty rates in Germany when combined with market income changes. Variations in market income (e.g., job losses or wage cuts) also increased France's income inequality and poverty rate. By the later stage of the crisis (2010–13), poverty lessened in France thanks to subsequent policy reforms but rose in Ireland and varied for different subgroups in the UK and Germany due to regressive tax policy and slow increases in social benefits among the poorest groups.

Compared to the decomposition framework used in the earlier literature examining income inequality, this paper is the first attempt to capture year-over-year changes in income inequality. Existing studies investigate each factor's contribution to inequality changes between two single points in time: the beginning and the end of the period (Bargain and Callan, 2010, Bargain, 2012a, 2012b, Bargain *et al*., 2017 for European countries, Creedy and Hérault, 2015, Hérault and Azpitarte, 2015, 2016 for Australia). The findings of these earlier studies, as a result, tend to be sensitive to the years selected and might under- or over-estimate the performance of each factor for the whole period. Exploring the evolution of each factor's contribution to inequality can mitigate these issues, and hence the role of tax and transfer policies can be assessed more appropriately.

Additionally, the detailed information on the annual income distribution shift allows us to nest a non-parametric income model, as opposed to the standard wage model used in the previous literature. The volatility of the market income return in our decomposition model is assumed to be driven by external shocks rather than the gradual change in characteristics of the population. Non-parametric models relax the stringent assumptions imposed in a linear wage model and align better with the economic change in the period we study, where significant external demand shocks, such as changes in international demand for mining commodities and the global financial crisis, are observed. The year-on-year decomposition allows us to capture the shifts caused by the external shocks at a refined granularity.

Finally, the existing literature on the decomposition of income distribution tends not to provide the standard errors of the estimates, which can be used to asess the robustness of the findings. From the replicate weights available in the Household, Income and Labour Dynamics in Australia (HILDA) dataset, we estimate the standard errors of both one-year and accumulated contributions of each component to income inequality.

To capture a complete picture of the income distribution change, we examine the impact of the policy response on not only the Gini index but also the relative income ratio at different sections of the income distribution (P95/P75, P75/P50, P50/P25, P25/P5). The reason for including this analysis is that the overall Gini index may not adequately reflect the intricate patterns and the policy interactions occurring at the different segments of the income distribution.

The remainder of the paper is structured as follows. Section II overviews the policy and economic background in Australia over the period 2002–16. Sections III and IV describe the decomposition method and dataset respectively. These are followed by a presentation of the results in Section V and a robustness check in Section VI. The last section concludes.

II Australian economic and policy background

A number of characteristics distinguish the Australian demographic, economic and policy landscape in the period we examine in this paper. Demographically, Australia faces an ageing population. Despite the relatively large number of young immigrants, the median age of the population was 37.2 years in 2016, compared with 35.7 years in 2001 (Australian Bureau of Statistics, 2017). Over one in seven people in Australia were aged 65 and over in 2017, with many of these older people receiving the public age pension, which is the single largest item of government social welfare spending. The age pension serves as social assistance in Australia, available to anyone above the age threshold meeting the income and asset test criteria.

The Australian social security system relies heavily on means-tested benefits and less on social insurance schemes (Harding, Vu, Payne and Percival, 2009) and is considered as one of the most effective and efficient redistributive tax-transfer systems in the world (Whiteford, 2006). Among the OECD countries, Australia has one of the lowest levels of tax and social expenditures (Whiteford, 2017). Over the last two decades, the welfare system has seen major reforms aimed at reducing welfare dependency and promoting self-reliance through paid work. Australia is often described as a liberal welfare regime with a strong emphasis on welfare provision through market mechanisms (Hérault and Azpitarte, 2015).

Between 2002 and 2016, several major welfare policy reforms were implemented. From July 2004, there was an increase of $613.20 per child in the annual rates of Family Tax Benefit (FTB) Part A – the main welfare payment for families with children in Australia. The withdrawal rate of FTB reduced from 30% to 20% once family income exceeds the designated threshold. At the same time, Families relying largely on a single earner benefited from a more generous treatment of the secondary earner under FTB Part B. A new Maternity Payment of $3,000 for each newborn child was also introduced. These changes in benefits for families, together with the expansion of childcare places, brought more supports to working parents in lower and middle-income families and encouraged women to re-enter the workforce after having children.

Parenting Payment, which is usually available to parents who are out of the labour market, was changed from July 2006, forcing existing recipients to apply for unemployment benefits once their youngest child turned eight for single parents or six for partnered parents. Additionally, the income threshold for FTB Part A increased by $6,639 to $40,000 at the same time, so low-income earners could increase their earnings without affecting family assistance payments. From September 2009, pensioners, including age pensioners were given an increase of up to $1,689 a year. Since mid-2011, a more generous income test for single parents on unemployment benefits has been introduced. FTB Part A was also increased by up to $3,741 per child per year for families with older teenagers.

Between 2000 and 2018, personal income tax was also substantially revised. The tax-free income threshold increased from $7,567 to $10,000 in July 2006 due to an increase in the maximum Low Income Tax Offset (LITO). The second, third and fourth income thresholds increased by 30%, 19% and 58% to $25,000, $75,000 and $150,000, respectively. The third and fourth marginal tax rates were also reduced by two percentage points while the phase-in rate for the Medicare levy was reduced from 20% to 10%. These tax reforms brought greater benefit to more affluent people whose tax burden fell in relative terms compared with low-income earners. Tax reforms continued in July 2012, with the lowest rate increasing from 15% to 19%; this rate commenced after incomes exceeded the tax-free income threshold of $18,200. The 30% threshold rose to $30,000 in 2007–08, $34,000 in 2008–09, $35,000 in 2009–10, and $37,000 in 2010–11. From July 2008, the 40% threshold increased to $80,000, and the 45% threshold went up to $180,000. In July 2014, an additional budget repair rate of 2% was also applied to incomes of $180,000 or above.

In terms of economic development, Australia enjoyed relatively stable growth over the period being examined in our analysis, except for a dip in growth during the 2007–2009 global financial crisis. The mining industry has played a major role in recent economic growth in Australia, as natural resources are significant sources of its export earnings (Sahoo, Sahu, Sahoo and Pradhan, 2014). According to Rahman and Mamun (2016), energy exports explained 31% of total commodity exports in Australia in 2013–14, making Australia the world's eighth largest energy producer. The reliance on the global market means that the Australian domestic economy likely fluctuates in line with the variations in exports to its main trade partners.

Figure 1 shows that Australia's economy continued to grow since the early 2000s until before the worst period of the global financial crisis in 2007–2009. It then quickly recovered but had slowed down again by 2014. These trends were likely to have been associated with the China-driven mining boom period and the fluctuations in the Chinese economy. Downes, Hanslow, and Tulip (2015) estimate that the China-driven mining boom had increased real per capita household disposable income for Australians by 13% in the decade preceding 2013 and raised real wages by 6%, while lowering the unemployment rate by about 1.25 percentage points. However, the boom period ended by 2014 when Chinese economic growth slowed. Associated with a significant decline in mineral prices, this resulted in lowered growth rates in Australia between 2014 and 2016.

[Place Figure 1 here]

The complex landscape across all three of the major dimensions of the socio-economic environment and their interactions means that any point estimates of policy effects must be highly contextual. Therefore, it is essential to capture the complex dynamics of the demographic and economic environment when isolating the contribution of policies on income distribution.

III Methodology

Decomposition framework

We adopt a decomposition framework broadly resembling the approaches used by Bourguignon *et al*. (2008), Bargain and Callan (2010), Biewen and Juhasz (2012) and Sologon *et al*. (2018), with an extension of semi-parametric demographic profile adjustments and a non-parametric market income simulation model. Additionally, we decompose the inequality changes on a year-by-year basis, in contrast to the earlier literature where a selection of two relatively distant time points were used. This allows us to capture better the dynamics of both the different components and the major financial and economic shocks that occurred over the period.

The decomposition separates the contribution of each factor to overall inequality by comparing the income distributions in counterfactuals where marginal changes in each of the examined components are introduced. The counterfactuals are generated through an approach that combines micro-econometric modelling with microsimulation techniques. This approach extends the ubiquitous Oaxaca-Blinder decomposition by accounting for the entire distribution rather than focusing on the mean value. Although the approach cannot claim to identify causal effects, it provides a basis for understanding the complexities inherent in the interactions between tax-benefit rules, market income distributions and the main drivers (namely labour market structures, income processes and demographic profiles) in determining the changes in the distribution of household disposable income.

We decompose year-over-year changes in the inequality measures (I) into four components:

- Changes in the tax and welfare policies (p)
- Changes in the demographic structure of the population (d)
- Changes in the market income distribution (y)
- Other changes in the data (a)

Formally, we can describe the difference in the inequality measures between time $t + 1$ and time t as

$$\begin{aligned}\Delta I_{t,t+1}(p,d,y,a) = \; & I(p_{t+1},d_{t+1},y_{t+1},a_{t+1}) - I(p_t,d_t,y_t,a_t) \\ = \; & \underbrace{I(p_{t+1},d_{t+1},y_{t+1},a_{t+1}) - I(p_t,d_{t+1},y_{t+1},a_{t+1})}_{\text{Policy Effect}} \\ & + \underbrace{I(p_t,d_{t+1},y_{t+1},a_{t+1}) - I(p_t,d_t,y_{t+1},a_{t+1})}_{\text{Demographic Effect}} \\ & + \underbrace{I(p_t,d_t,y_{t+1},a_{t+1}) - I(p_t,d_t,y_t,a_{t+1})}_{\text{Market Effect}} \\ & + \underbrace{I(p_t,d_t,y_t,a_{t+1}) - I(p_t,d_t,y_t,a_t)}_{\text{Residual Effect}}\end{aligned}$$

The framework can be applied to all income distribution measures I, including but not limited to the Gini index. For comparability reasons, we focus on the Gini index as the overall inequality measure, and use P95/P75, P75/P50, P50/P25 and P25/P5 to analyse the changes in income inequality in different segments of the income distribution. The use of more than one measurement will offer a complete picture of the changes in income distribution.

By separating the contributions from each of the four components described above, we will be able to analyse the extent of changes in inequality driven by the identified components over time. The estimation uses information from both the observed data and the detailed tax and transfer policy information incorporated in the simulation process. The additionally injected policy information can be used to better distil the policy impact compared with the alternative decomposition approaches such as the Oaxaca-Blinder method (Blinder, 1973, Oaxaca, 1973) and variance decomposition techniques, where the identification solely relies on the observed data which contains a mixture of policy and interaction effects.

It is worth noting that it is possible to rewrite the equation depending on the order in which variables are introduced, and this may lead to different results. The variation reflects the inherent non-linear nature of the interactions of these components, including the behavioural shifts that are correlated with any of the components. This is also known as the path dependency issue (Shorrocks, 1982). To obtain a stable result, we use the popular Shorrocks-Shapley decomposition technique by averaging each factor's contributions from all possible decomposition paths.[1] The standard errors of the decomposition are estimated using the 45 replicate weights included in the dataset, which capture both the sampling and the estimation uncertainties in this complex decomposition process.

The analytical framework is built based on the ability to estimate $I(p_t, d_t, y_t, a_t)$, which relies on three important methodological components, including a tax benefit model that can accurately simulate taxation and welfare policies, a semi-parametric model which introduces marginal changes in demography in the dataset, and a combination of both semi- and non-parametric models to capture labour structure and market income changes. We now discuss these methodological components in detail.

Demographic model

We use the semi-parametric method from DiNardo, Fortin and Lemieux (1996) to simulate the effect of demographic shifts on the population. To mimic the demographic structure at time $t + 1$ on the population data from time t, we modify the weight of each observation at time t with an estimated adjustment ratio. Specifically, the weight of an individual i from data t can be updated to mimic the population demographic structure at time $t + 1$ by

$$w_{i,t\rightarrow t+1} = w_{i,t} \frac{Pr(t + 1|X_{i,t})}{Pr(t|X_{i,t})} = w_t \frac{Pr(t + 1|X_{i,t})}{Pr(t|X_{i,t})} \gamma_{t,t+1}$$

where

$$\gamma_{t,t+1} = \frac{Pr(t)}{Pr(t + 1)}$$

[1] Four factors are included in the decomposition with values from either $t + 1$ or t, resulting in 2^4 unique states of the income distribution.

$X_{i,t}$ is a vector containing the observed demographic attributes that reflect the gradual changes in the population's demographic structure. This includes gender, age, marital status and income unit size. Additionally, we also introduce age squared and interactions between age and marital status to allow a flexible specification of the demographic evolution. The prior of the adjustment ratio, $\gamma_{t,t+1}$ is the unconditional probability of observing the individuals from the different period. It is equal to $Pr(t)/Pr(t+1)$, which is simply the relative ratio of the population. The conditional probability $Pr(t|X)$ is estimated using a standard probit model.

Income model

There are two steps involved in the simulation of the counterfactual household income profiles, which capture both the labour market structure changes and the shifts in labour and capital returns. The first step adjusts the industrial and occupational distribution and the second step adjusts wages and other incomes.

The weighting of the individuals is updated in the same fashion as the demographic model to adjust for the changes in the occupational, industrial and employment structures. This model semi-parametrically adjusts the weights in the dataset so that the labour market structure resembles the targeted distribution. The variables used in the reweighting process include industries, occupations and the number of working hours (grouped) interacted with gender to mimic the conditional distribution of the main labour characteristics.

In the second step, we derive the income rank function $\Lambda(\cdot)$ of income source k under the observed market structure and income levels. Mathematically, the income of an individual i at time t can be expressed via this non-parametric function, where

$$y_{i,k,t} = \Lambda_{k,t}(r_{i,k,w_{it}})$$

$r_{k,w_{it}}$ is the observed income rank of individual i in the income category k, which could be wage, business or investment income, at time t. The rank parameter ranges between zero and one and is only computed for those with non-zero income in the category. The estimation is weight-adjusted to reflect the observation's position in the total population.

Once the underlying employment structure has been adjusted, we can recalculate the individual ranks based on the changes in weights and the counterfactual income at time $t+1$ under the market structure at time t which can be simulated as

$$y^*_{i,k,t+1} = \Lambda_{k,t+1}(r_{i,k,w_{i,t\to t+1}})$$

If a simulated ranking falls between two observed rankings, the earnings are linearly extrapolated using the two nearest values. Wage-earning, business and investment income are simulated separately using the same method. As $\Lambda(\cdot)$ is non-parametrically derived, we do not need to impose any distributional assumption, and it captures both the changes in the wage distribution and heterogeneous changes to wage levels at different income segments simultaneously. Other income items, such as foreign transfers and incidental income, are assumed to be constant in real terms in our analysis.

This approach differs from some existing literature such as Bourguignon *et al.* (2008) and Sologon *et al.* (2018), where each of the employment-related variables is parametrically estimated using logistic, log-linear or Singh-Maddala models based on the Ordinary Least Squares or Maximum Likelihood techniques. The underlying assumption under the parametric model approach is that market income is mostly driven by the observed supply-side changes, (e.g. education) echoing human capital theory. In the non-parametric approach, we adopt, the overall wage distribution is assumed to be determined by the observed changes in the market structure and the jobs available, which has a closer link to the demand shift.

Both the traditional parametric approach and the non-parametric approach have their merits. In this paper, we prefer to use the non-parametric specification as the economic fluctuations in Australia over the selected period were mostly driven by external forces. These fluctuations include rises and falls in the demand for mining commodities by China, and the global financial crisis which originated in the United States. Additionally, the short-term fluctuations in investment returns and business outcomes are arguably more driven by the market demand change than human capital during this period. The non-parametric income model also allows us to deploy a consistent modelling framework for all income sources without imposing structural assumptions on the earning equations, which often contain a sizeable component that cannot be explained by the observed characteristics.

Tax and transfer policy model

The decomposition framework requires disposable incomes to be re-estimated under each counterfactual scenario given the changes in household characteristics and policies. We use an Australian tax-transfer model (STINMOD+) to numerically calculate household disposable income based on the corresponding tax and social transfer rules. STINMOD+ comprehensively covers all personal taxation and federally administered welfare payments and replicates the implementation of the social security system in real life, incorporating elements such as income and asset testing (Li and La, 2018). The model covers tax and transfer policy parameters from 2001 to the present, which enables us to estimate disposable income accurately using the same model over time.

The Australian welfare system, as noted earlier, is highly means-tested and the majority of the eligible conditions do not depend on previous contributions or complex employment history. This characteristic is utilised in our model to estimate disposable incomes accurately. STINMOD+ simulates almost all of the government welfare payments, except for benefits given in exceptional circumstances, which constitute less than 1% of the total welfare payment expenditure. The model includes a behavioural component where households seek to maximise their disposable income should they have a choice between two or more welfare options. Multiple welfare eligibilities tend to be rare due to designed policy principles but may happen occasionally. Overall, the model shows a high degree of consistency with both survey and administrative data sources.

Most welfare payments in Australia are indexed. A range of different methods such as indexation based on the consumer price index (CPI), (e.g. Family Tax Benefit and unemployment benefit), indexation based on growth in average weekly earnings (AWE)(e.g. pensions), and other methods are used to adjust the values of tax and transfer payments quarterly. The indexation method itself may have implications for income distribution. Callan, Coleman, and Walsh (2006), Sutherland, Hancock, Hills and Zantomio (2008) and Bargain (2012a) have previously discussed this issue. As the data processed by tax-benefit microsimulations may apply policies from a year different from the year to which the market income corresponds, we adjust all income values to match the policy year, using an uprating factor. We use CPI as the primary uprating factor as it can be considered as a median value of all indexation approaches used by the government. We also use the AWE series, which is usually higher than CPI, as a robustness check to examine the sensitivity of the results to the indexation assumptions.

Limitations

Although our decomposition framework provides a practical approach to distilling the complex effects of policy, demographic, and market income changes on the income distribution, it does have some limitations. Most notably, we do not explicitly model the behavioural responses to policy changes, except for the behavioural response to benefit choices in the STINMOD+

model. These exclusions include, but are not limited to, changes in decisions about labour supply, fertility, education, consumption, savings, and household formation and dissolution. The inherent non-linear transformation of the income distribution means that such effects are likely to be allocated across all components, including the residual terms (Biewen, 2014).

Not specific to this paper, the behavioural response is often excluded in income distribution decomposition exercises. Where behavioural responses are incorporated, attempts are generally limited to modelling labour supply responses (see Bargain, 2012a, Hérault and Azpitarte, 2016, Sologon *et al*. 2018). Papers that include labour supply response tend to decompose changes between two points in time that are relatively far from each other, where sufficient policy variations can be introduced. In our case, however, we focus on the year-over-year effect which means the policy changes tend to be incremental and the labour supply response, as a result, tends to be moderate. Additionally, incorporating a behavioural model from the supply side, such as the standard labour supply model, means that some strong assumptions need to be made about human behaviour, and structural adjustment in the event of an external shock. These extra assumptions could further bias our estimates compared with our chosen approach. Given that the shocks to market income are likely greater than the ones introduced by the policy structure under the incremental nature of reforms, demand-side factors are likely to dominate the limited supply-side responses during the period we are studying. As a result, the absence of the cross-sectional supply-side models would be unlikely to pose any major change to the general conclusions in our estimation.

IV Data

This paper draws data from a nationally representative survey, the Household, Income and Labour Dynamics in Australia (HILDA) survey. HILDA is a longitudinal survey conducted annually since 2001, with 19,914 individuals and 7,682 households included in the first wave. It records a wide range of socio-economic characteristics, including detailed individual employment and income characteristics that are required to estimate potential welfare eligibility and tax payments (Wooden, Freidin and Watson, 2002).

This paper uses waves 2 to 16 of HILDA, which corresponds to the years 2002 to 2016, to examine the redistribution effects of tax and transfer policies. The first wave of HILDA is used to construct the lag variables which are required to accurately estimate tax liability and benefit payments. We group income into four categories: wages and salaries, business income, investment income and other income. The first three are considered as market income.

Disposable income is equivalised with the OECD-modified scale,[2] consistent with the methodology used by the Australian Bureau of Statistics. Although the income variables, the primary variables used from the HILDA, do not contain missing values, some variables, such as household asset value, were only collected once in every four waves. Some imputations are therefore required. Generally, we use contextual information (e.g. age) to infer the value of the variable. If it is inconclusive, we use the nearest observed value for the same individual for discrete variables and linear interpolation for the continuous variables. For example, in the case of the household asset variable, which is observed only in waves 2, 6, 10 and 14, we use a linear interpolation technique to impute the missing values. For the occasional missing value in the working hours variable, we assign the working hours based on the reported employment status. For study load, we assume that all individuals aged between 5 years and under 15 years are studying at school if the study load is not reported. Table 1 describes the extent of the imputation. It should be noted that our imputations do not alter age and private income, which are the primary determinants of benefit payments in Australia. As the variables we impute

[2] The OECD-modified scale assigns value of 1 to the first adult in the household, 0.5 to the second and each subsequent person aged 15 and over and 0.3 to each child aged 14 or under.

constitute only a small part of the sample (1.5%) and they play only a minor role in tax and transfer policy, the use of imputation is unlikely to have any significant impact on the results.

[Place Table 1 here]

Table 2 provides some key demographic descriptive variables for the sample. All estimates are adjusted with population weights. The ageing of the Australian population is evident: the average age of the population has increased from just under 36 to 37 and a half during the 15 years of the survey. At the same time, the proportion of the population in domestic partnerships has more or less been stable, with only a marginal increase from 47.8% in 2002 to 48.0% in 2016. The average age of single people has also increased slightly over the period. There are also slight drops in the average size of an income unit,[3] and the average number of dependent children over time. Demographically, we are looking at a population that got older and had slightly smaller families over the course of the 2002 to 2016 period.

[Place Table 2 here]

Table 3 describes the changes in the employment and the income of the population. The first two columns report the changes in average working hours among those who work. There seems to be a slight reduction in the average working hours for men, but not much change for women. Columns three to five report the average fortnightly income, conditional on a non-zero value. The average values for wage and business income have increased by 70~90% through the period, while average investment income has more than doubled during the same period despite some fluctuations during the years of the global financial crisis. Among the adult population in Australia, there is an increasing proportion receiving wage income while a decreasing share of the population has business and investment income. Given that business and investment income

[3] An income unit is a tax unit in Australia, which consists of a maximum of two partnered adults and their dependent children (if any) for those in a partnership, and one adult and his or her dependent children for singles. Most households in Australia contain only one income unit.

are much more unequally distributed compared with wage income, the changes in the income composition over the period will contribute to the overall change in the income distribution.

[Place Table 3 here]

V Results

Overall Inequality Trends

Table 4 reports the inequality trends in Australia both in terms of the Gini index and the four different percentile ratios of the income distribution. As presented, the Gini coefficients for both gross income and disposable income have been relatively stable since 2002, although fluctuations are observed throughout the period, especially in the years immediately after the global financial crisis. The difference between the lowest and the highest Gini is .03 for gross income and .02 for disposable income. Most of the fluctuations in the Gini can be observed between 2003 and 2008, which covers the period of the global financial crisis and the periods immediately preceding it.

[Place Table 4 here]

Looking at the relative income ratio across the different segments of the income distribution, the gradual change in the income components seems to affect different segments of the income distribution differently. The lower income part of the distribution seems to have experienced an increase in inequality, as reflected in the P25/P5 results, in the years prior to the financial crisis, before being restored to its original level in 2010. The richer part of the income distribution (P95/P75), shows a small increase in the income gap despite a dip during the financial crisis period.

Our results about income inequality are generally consistent with others' estimates derived using HILDA, such as those presented in Wilkins (2014) and Wilkins (2015). Trends and patterns are comparable with earlier literature and also the disposable income Gini published by the Australian Bureau of Statistics based on the Survey of Income and Housing (Australian Bureau of Statistics, 2016).

Decomposition results

Table 5 reports the overall change in the Gini index compared to the previous year (column 10), the single contribution of each component to this change (columns 2–5) and the accumulated contribution of these components (columns 6–9). The policy contribution (columns 2 and 6) reflects how tax and welfare policy change affects the income distribution in Australia. The estimates of the standard errors are shown in parentheses in the table for both single year contributions and the accumulated contributions since 2002. Figure 2 visualises each component's contributions over time.

[Place Table 5 here]

Results from Table 5 suggests that the policy effect appears to be a moderate contributor to the changes in the income distribution between 2002 and 2016, especially outside 2006–2009. Generally, changes in the tax and transfer policy system in Australia reduce overall income inequality, except for the 2006–07 financial year when a large tax cut was implemented. Given the deterministic nature of the policy simulation in the decomposition framework, the standard errors tend to be small both at the cross-sectional level and for the accumulated results.

Demographic factors seem to play a minor role in income inequality during the period of study. As shown in the early descriptive summaries (Table 2), the average age of the population is one of the factors that experienced a steady change over time among the key covariates controlled in the demographic variables. Other demographic variables tend to be relatively stable, which explains the absence of major fluctuations in the contribution of the demographic component. Theoretically, ageing is likely to lead to greater income inequality as the within-cohort earning inequality tends to rise as the cohort gets older and the differences in human capital accumulation increase for the majority of the working population (Deaton and Paxson, 1997). Its effect, however, is relatively limited based on the Gini measure in Australia, with only a net 0.001 gain in Gini throughout the period that can be attributed to demographic change alone.

Market income induced inequality change is volatile before and during the global financial crisis as shown in Figure 2. The most substantial impact of the market income change is observed between 2006 and 2008, the years around the financial crisis. The shifts in market income increased the Gini by more than 0.010 in 2006–07, the year leading up to the crisis period. However, the increase was offset in the year after with a decline of more than 0.012 in 2007–08. The decline in income inequality was largely due to the sudden drop in investment returns, which effectively lowered the net income for the middle and high end of the income distribution which hold investment assets. While the single year contribution of the market factor may not be statistically significant due to the short time period and the absence of the strong assumptions in the decomposition model, the standard errors of the accumulated contribution estimates take into account the correlation over time and can better reflect the impact of market changes that span across several years. Between 2002 and 2016, the market factor is the largest contributor to income inequality, and significantly increased the Gini in Australia, and has generally acted to increase income inequality since the end of the financial crisis.

[Place Figure 2 here]

The residuals of the decomposition (which reflect behavioural change), shifts in unobserved characteristics and the non-linearity of the decomposition, also play a role in shaping inequality. The contributions from the residuals tend to be larger when the absolute contributions from other factors are substantial. This may be due to a more aggressive behavioural adjustment when a significant policy or market shock is introduced.

Throughout the whole period of study, a 0.017 reduction in the Gini can be attributed to the accumulated policy change and 0.001 from demographic change. Market income pushes income inequality higher, raising the Gini measure by 0.014. The accumulated effect of the residuals accounts for around 0.007 of the total change in the Gini.

Besides the Gini results, Figure 3 and Figure 4 present further insights into the effects from the four contributing factors on the income distribution by examining the changes occurring at different income levels. These figures demonstrate substantial heterogeneities in the effects of policy, demographic ageing and market income at different parts of the income distribution. The estimates and the standard errors used in the figures are reported in the Appendices.

[Place Figure 3 here]

[Place Figure 4 here]

Market income seems to be the primary driver pushing inequality higher for all parts of the income distribution. The average accumulated effect of the market income change also appears to be the largest for the lower end of the income distribution compared with its impact on the other segments of the population. We see a small decline of market income contribution for P25/P5 in the years since the financial crisis. For other segments of the income spectrum, we can see the accumulated contribution of market income increases from 2009 onwards.

Policy reforms seem to have the most heterogeneous effects on the income distribution, depending on the relative position in this spectrum. While policy reform tends to reduce income inequality overall, this is not the case for the upper quartile, where policy reforms increase income inequality. Much of this impact can be attributed to the various tax cuts offered to the higher income group during the 2006–07 financial year. This particular tax reform also has moderate effects on the lower end of the income distribution, increasing income inequality in this poorest part of the population during this period. In contrast, there was a sharp decline in the income inequality of this segment in 2010. The decline was largely due to the increased rate of the age pension, which, as previously noted, is the single largest welfare payment in Australia. Retirees receiving the age pension tend to be in the bottom quartile of the income distribution given the income test constraints of the benefit. Additionally, the policy effect plays an apparently positive role in the lower half of the income distribution in the years following the financial crisis. This may reflect the income distribution's sensitivity to the level of benefit payments in a highly means-tested welfare system. Policy changes had much less effect on the other segments of the income distribution.

It should be noted that the standard errors for the percentile income ratio (P95/75/50/25/5) contribution estimates seem to be higher compared with the estimates for the Gini, both in absolute and relative terms. It should, be considered, however, that these estimates are contributions in absolute terms, and also capture the uncertainties in the index itself. The percentile income ratio values are calculated based on two percentile values, and thus are more violative when additional sampling errors are considered. This uncertainty is also reflected by the standard error of the income ratios themselves. However, the patterns from the point estimates are generally clear and consistent with the policy expectations.

Demographic factors seem to matter more in the lower end of the income distribution, where they impose a small downward pressure on inequality – a different direction than the overall Gini results indicated. This is likely due to the existence of the public old-age pension ('age pension') in Australia, which does not depend on work history or contributions. The benefit is generally tax-free,[4] and the amount is inversely correlated with private income, with a maximum of up to nearly half of average employee earnings post-tax. The absence of the contribution requirement reduces income inequality among retirees, contributing to the compression of the income distribution among the lower income population. For the high income population, which mostly consists of working individuals, the demographic change

[4] A recipient may still need to pay tax if he or she has income other than the age pension.

pushes income inequality upwards slightly in the top quartile over the past decade, consistent with findings in some of the earlier literature such as Dolls *et al*. (2018).

Residuals also play a non-negligible role compared with the size of the other factors in almost all sections of the income distribution, suggesting interactions and possible behavioural responses due to the changing economic and policy environment. The residual term, which captures the behavioural response and the non-linearity of the system, seems to be more significant for the more affluent part of the population relative to the contribution of other components, suggesting possibly greater capacity for behavioural adaptations in this population group.

The absence of an explicit labour supply model in our framework could mean that certain secondary effects of the policies are not entirely attributed to the policy component. Earlier literature using Australian data (Hérault and Azpitarte, 2015, 2016) suggests policy effects could be overestimated without a labour supply model. Given that policy changes tend to be gradual and the policy component has only moderate impacts according to our decomposition exercises, the major contribution patterns from the different components would likely remain unchanged if a standard structural labour supply model was introduced although the uncertainties around the policy contribution estimates might increase.

VI Robustness check

As noted before, the tax-transfer system in Australia, including welfare payments, is annually adjusted according to a mixture of Consumer Price Index, Average Weekly Earnings (AWE) and other indices. As we do not directly observe how policies at time t are implemented at time $t + 1$ should there be no policy change, we adjust the income of time $t + 1$ to time t by CPI so that the income level is comparable with the threshold and the benefit level for which the policies are designed. The adjustment, however, may not always match the actual indexation of welfare policies, given the mixture of indices used, and the fact that AWE is often higher than CPI (see Australian Bureau of Statistics, 2018a, 2018b). Changes in the policy assumptions may also affect the estimations of the other components due to the non-linearity of the decomposition. It is therefore important to check the stability of the results with alternative assumptions.

Table 6 describes each component's contribution to overall Gini change under a different policy uprating assumption. Among all four components, the overall policy effect shows the largest change, which is unsurprising given that the use of AWE instead of CPI has a direct impact on policy implementation. Numerically, the policy factor shows a weakened effect in reducing inequality, although the general pattern over time remains stable and is at the same magnitude for different assumptions. The difference between the CPI based estimates and AWE based estimates of the policy contribution is about 0.001 per annum for the overall Gini measure, and accounts for a small proportion of the total change in a year. This suggests the assumptions used to uprate the policy parameter variables only have a limited impact on the overall estimates. Both series seem to indicate the reforms implemented in 2006 tend to have the largest impact on income inequality in Australia over the period studied.

[Place Table 6 here]

The demography and market income components in the alternative assumption model show very similar results to their original contributions as reported in Table 5, indicating these estimates are not sensitive to varying assumptions for certain policies. The results for the residual term largely mirror the changes in the policy factor contribution in the opposite direction.

VII Conclusion

We decompose the changes in inequality in Australia into factors directly related to tax and welfare policy change, shifts in market income, demographic change and the contribution of other factors. In terms of methodology, we extend the counterfactual income distribution decomposition framework used by Bourguignon *et al*. (2008), Bargain and Callan (2010), Biewen and Juhasz (2012) and Sologon *et al*. (2018) by allowing a more accurate impact assessment through analysing year-on-year data, incorporating a flexible non-parametric market income model which better captures the demand-side shocks during the global financial crisis compared with a standard parametric model, and deriving the standard errors of the estimates with the replicate weights from the survey. The ability to tease out the differences year on year may help policymakers pinpoint what works and what does not in particular social and economic contexts, and may partially mitigate the sensitivity of the results due to the selection of the years.

We find that the level of inequality in Australia was more volatile before the financial crisis and has become more stable following that period. The highest level of inequality was observed in 2006–07 when changes in both market income and policies contributed to increased inequality. The financial crisis seemingly reduced income inequality in Australia with a drop of both gross and disposable income Gini in 2007 and 2008.

Decomposition using annual data between 2002 and 2016 suggests the primary driver of income inequality in Australia over the past decade is market income for all segments of the income distribution. The financial crisis in 2007–08, despite the dramatic drop in the stock markets worldwide, only temporarily reduced income inequality for the upper end of the income distribution. Compared with the two-timepoint decomposition in the existing literature, the year-on-year analysis can help to pinpoint the exact policy change responsible for the income distribution shift and paints a more comprehensive picture of the distribution change over time.

During the period we studied, changes in market income are generally associated with increases in income inequality in Australia over the past decade while policy shifts reduced income inequality, particularly at the lower end of the income distribution. Demographic and household composition changes had a minor impact in compressing the income distribution for the poor, but were associated with a slight increase in the income gap in the top quartile of the income distribution. Policy factors, on average, have a moderate role in shaping inequality although this component seems to drive higher inequality for the higher end of the income distribution and reduce income inequality for P75 or below. The standard errors of the estimates suggest we have robust estimates for the policy contribution. However, the single year contributions from the market component tend to have greater uncertainties although this component's accumulated contributions are generally significant across most years.

In our analysis, we also noted that the residual term, which reflects the non-linearity of the interactions of the components and some behavioural adjustments, seems to be relatively important for the upper end of the income distribution, suggesting possible behavioural adjustment for the wealthier segment of the population.

The decomposition results are not sensitive to the uprating factor for the analysis. While the numeric values of the policy factor contribution in each year did change somewhat under an alternative indexation assumption, the overall pattern and the relative importance of each significant factor remained largely the same, suggesting our conclusion is robust against an alternative indexation assumption.

Our findings suggest policymakers would need to go beyond tax and transfer policy if suppressing the growth of income inequality is one of the policy objectives. The complex interactions between economic, demographic and policy factors suggest the need to regularly review policies in order to understand the impact of policies in the context of changes in the population and economic environment. The year-on-year analysis allows a more accurate allocation of the policy effects, as we can limit the policy changes to what happened in a single year. This seems not only useful in identifying policy effects, but also necessary when there are significant shocks into the system. For both policy and research purposes, examining the policy effects for the entire distribution reveals much more information than a single inequality index, given policy's highly heterogeneous impact on different income distribution segments over time. Future research may consider further decomposing the policy components so that more targeted policy recommendations can be made.

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Tables

TABLE 1

Imputation statistics of the estimation sample

Total number of enumerated persons in HILDA (Wave 2–16)	40,746
Total number of observations in HILDA	317,738
Proportion of imputed working hours	4.3%
Proportion of imputed study load	24%
Proportion of imputed salary sacrifice for superannuation	3%
Proportion of imputed salary sacrifice for non-superannuation	5%
Proportion of imputed household asset values	70%
Proportion of imputed values among all STINMOD+ input variables	1.5%

TABLE 2

Population characteristics, 2002–2016

Year	***Average age***	***Partnered (%)***	***Average age of singles***	***Income unit size***	***Number of dependent children***
2002	35.93	47.81	40.47	2.77	1.08
2003	36.07	47.95	40.20	2.78	1.09
2004	36.28	47.73	40.25	2.75	1.07
2005	36.47	48.31	40.36	2.75	1.07
2006	36.57	48.27	40.71	2.76	1.07
2007	36.68	48.01	41.06	2.74	1.06
2008	36.76	48.58	40.99	2.73	1.04
2009	36.82	48.15	40.78	2.74	1.05
2010	36.92	48.26	41.15	2.73	1.04
2011	37.10	47.94	41.13	2.74	1.06
2012	37.17	48.17	41.35	2.74	1.05
2013	37.22	48.02	41.47	2.75	1.06
2014	37.35	48.35	41.51	2.77	1.08
2015	37.47	47.51	41.68	2.74	1.06
2016	37.59	48.02	41.48	2.74	1.05

TABLE 3

Employment and income characteristics, 2002–2016

Year	***Male working hours***	***Female working hours***	***Average wage***	***Average business income***	***Average investment income***	***(%) has wage***	***(%) has business income***	***(%) has investment income***
2002	42.9	31.3	1360.2	764.2	145.8	62.1	8.1	42.3
2003	42.4	31.2	1393.6	719.2	149.9	62.1	8.5	41.4
2004	42.0	31.1	1444.3	758.1	184.2	62.2	8.6	40.7
2005	42.1	31.2	1520.8	845.2	207.6	63.5	8.5	41.0
2006	41.9	31.5	1619.4	852.8	260.0	64.2	8.1	41.8
2007	41.9	31.7	1747.8	866.5	238.7	64.9	7.6	42.9
2008	41.9	31.5	1832.6	903.0	270.0	65.3	7.3	41.5
2009	41.4	31.4	1887.7	950.7	259.2	65.3	7.6	41.7
2010	41.1	31.5	1975.7	1032.5	234.3	65.6	7.6	42.0
2011	40.6	31.2	2036.4	1211.4	247.6	64.8	7.5	41.8
2012	40.5	31.4	2112.8	1171.5	265.2	65.0	7.4	41.4
2013	40.2	31.2	2210.8	1282.5	273.3	64.5	7.2	41.3
2014	40.2	31.1	2241.1	1363.0	298.9	64.4	6.6	41.3
2015	40.2	31.2	2296.2	1491.9	309.9	64.6	6.6	39.1
2016	39.9	31.4	2346.3	1408.0	310.4	64.2	6.7	37.4

Notes: Columns 2 to 6 are fortnight estimates conditional on non-zero values. Columns 7 to 9 are estimates for the adult population only.

TABLE 4

Income inequality in Australia, 2002–2016

Year	***Gini (gross)***	***Gini (disp.)***	***P95/P75***	***P75/P50***	***P50/P25***	***P25/P5***
2002	0.475	0.330	1.685	1.444	1.497	1.571
	(0.007)	(0.008)	(0.038)	(0.014)	(0.017)	(0.020)
2003	0.477	0.332	1.692	1.426	1.509	1.560
	(0.008)	(0.008)	(0.030)	(0.023)	(0.021)	(0.022)
2004	0.459	0.314	1.683	1.407	1.493	1.572
	(0.006)	(0.005)	(0.027)	(0.024)	(0.024)	(0.012)
2005	0.455	0.313	1.670	1.389	1.494	1.591
	(0.007)	(0.007)	(0.035)	(0.018)	(0.018)	(0.034)
2006	0.462	0.329	1.685	1.423	1.433	1.650
	(0.007)	(0.008)	(0.030)	(0.018)	(0.018)	(0.036)
2007	0.459	0.332	1.708	1.395	1.500	1.724
	(0.009)	(0.008)	(0.023)	(0.019)	(0.032)	(0.033)
2008	0.448	0.323	1.705	1.428	1.447	1.689
	(0.007)	(0.007)	(0.054)	(0.017)	(0.026)	(0.044)
2009	0.448	0.320	1.672	1.404	1.486	1.750
	(0.006)	(0.005)	(0.025)	(0.020)	(0.032)	(0.040)
2010	0.451	0.316	1.659	1.400	1.470	1.556
	(0.006)	(0.005)	(0.040)	(0.026)	(0.017)	(0.030)
2011	0.454	0.319	1.707	1.439	1.450	1.515
	(0.006)	(0.005)	(0.029)	(0.010)	(0.011)	(0.020)

2012	0.452	0.321	1.683	1.436	1.453	1.520
	(0.006)	(0.007)	(0.037)	(0.018)	(0.026)	(0.046)
2013	0.455	0.319	1.678	1.443	1.449	1.594
	(0.007)	(0.005)	(0.049)	(0.015)	(0.017)	(0.079)
2014	0.457	0.319	1.683	1.430	1.466	1.498
	(0.006)	(0.005)	(0.036)	(0.022)	(0.016)	(0.047)
2015	0.453	0.314	1.684	1.427	1.442	1.454
	(0.006)	(0.006)	(0.030)	(0.013)	(0.014)	(0.031)
2016	0.456	0.322	1.700	1.415	1.422	1.557
	(0.007)	(0.007)	(0.036)	(0.019)	(0.018)	(0.030)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

TABLE 5

Component contribution to changes in Gini (unit:0.01)

Year	*Single year contribution*				*Accumulated contribution from 2002*				***Δ**Gini*
	Policy	*Demography*	*Market*	*Residual*	*Policy*	*Demography*	*Market*	*Residual*	*(Single year)*
2002 - 2003	-0.16	0.06	0.40	-0.12	-0.16	0.06	0.40	-0.12	0.18
	(0.01)	(0.02)	(0.31)	(0.76)	(0.01)	(0.02)	(0.31)	(0.76)	(0.79)
2003 - 2004	-0.14	-0.00	-0.65	-1.01	-0.29	0.05	-0.25	-1.13	-1.80
	(0.01)	(0.02)	(0.37)	(0.57)	(0.01)	(0.03)	(0.27)	(0.84)	(0.73)
2004 - 2005	-0.32	0.04	0.26	-0.10	-0.62	0.09	0.01	-1.23	-0.13
	(0.01)	(0.02)	(0.29)	(0.58)	(0.02)	(0.03)	(0.33)	(0.91)	(0.63)
2005 - 2006	0.14	-0.01	0.64	0.86	-0.48	0.09	0.65	-0.37	1.63
	(0.01)	(0.02)	(0.38)	(0.73)	(0.02)	(0.03)	(0.41)	(1.02)	(0.79)
2006 - 2007	0.45	-0.01	1.04	-1.23	-0.03	0.08	1.68	-1.60	0.25
	(0.05)	(0.03)	(0.66)	(0.75)	(0.05)	(0.03)	(0.63)	(0.90)	(0.90)
2007 - 2008	0.01	0.02	-1.21	0.29	-0.02	0.10	0.47	-1.31	-0.89
	(0.02)	(0.02)	(0.64)	(0.70)	(0.06)	(0.03)	(0.39)	(0.93)	(0.81)
2008 - 2009	-0.45	-0.01	0.31	-0.16	-0.47	0.09	0.79	-1.47	-0.31
	(0.01)	(0.02)	(0.26)	(0.64)	(0.06)	(0.04)	(0.41)	(0.88)	(0.67)
2009 - 2010	-0.32	0.01	0.45	-0.49	-0.79	0.10	1.23	-1.96	-0.36
	(0.02)	(0.02)	(0.25)	(0.49)	(0.06)	(0.04)	(0.38)	(0.91)	(0.54)
2010 - 2011	-0.08	0.02	0.13	0.25	-0.87	0.12	1.36	-1.71	0.32
	(0.01)	(0.02)	(0.37)	(0.54)	(0.06)	(0.04)	(0.51)	(0.83)	(0.62)
2011 - 2012	-0.14	-0.00	-0.26	0.54	-1.01	0.11	1.10	-1.16	0.14
	(0.02)	(0.02)	(0.26)	(0.59)	(0.06)	(0.05)	(0.46)	(0.91)	(0.61)
2012 - 2013	-0.25	0.03	0.51	-0.44	-1.26	0.15	1.61	-1.61	-0.15
	(0.02)	(0.03)	(0.21)	(0.54)	(0.07)	(0.05)	(0.54)	(0.80)	(0.64)
2013 - 2014	-0.12	-0.02	-0.07	0.16	-1.38	0.12	1.54	-1.45	-0.05
	(0.02)	(0.02)	(0.23)	(0.44)	(0.07)	(0.05)	(0.48)	(0.86)	(0.53)
2014 - 2015	-0.31	0.00	-0.13	-0.02	-1.69	0.13	1.42	-1.47	-0.45
	(0.02)	(0.02)	(0.21)	(0.53)	(0.07)	(0.05)	(0.51)	(0.84)	(0.52)
2015 - 2016	0.03	0.01	0.01	0.76	-1.66	0.13	1.42	-0.71	0.80
	(0.01)	(0.03)	(0.18)	(0.78)	(0.08)	(0.05)	(0.52)	(0.97)	(0.82)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

TABLE 6

Single year contribution to changes in Gini under the alternative indexation assumption (unit:0.01)

Year	***Policy***	***Demography***	***Market income***	***Residual***
2002 - 2003	0.17	0.06	0.40	-0.45
	(0.00)	(0.00)	(0.05)	(0.11)
2003 - 2004	-0.08	-0.00	-0.65	-1.07
	(0.00)	(0.00)	(0.06)	(0.09)
2004 - 2005	-0.13	0.04	0.26	-0.29
	(0.00)	(0.00)	(0.04)	(0.09)
2005 - 2006	0.19	-0.01	0.64	0.80
	(0.00)	(0.00)	(0.06)	(0.11)
2006 - 2007	0.68	-0.01	1.04	-1.46
	(0.01)	(0.00)	(0.10)	(0.11)
2007 - 2008	-0.07	0.02	-1.21	0.38
	(0.00)	(0.00)	(0.10)	(0.10)
2008 - 2009	-0.12	-0.01	0.31	-0.49
	(0.00)	(0.00)	(0.04)	(0.10)
2009 - 2010	-0.20	0.01	0.45	-0.62
	(0.00)	(0.00)	(0.04)	(0.07)
2010 - 2011	-0.05	0.02	0.13	0.22
	(0.00)	(0.00)	(0.06)	(0.08)
2011 - 2012	0.12	-0.00	-0.26	0.28
	(0.00)	(0.00)	(0.04)	(0.09)
2012 - 2013	-0.16	0.03	0.51	-0.53
	(0.00)	(0.00)	(0.03)	(0.08)
2013 - 2014	-0.23	-0.02	-0.07	0.26
	(0.00)	(0.00)	(0.03)	(0.07)
2014 - 2015	-0.31	0.00	-0.13	-0.02
	(0.00)	(0.00)	(0.03)	(0.08)
2015 - 2016	0.06	0.01	0.01	0.73
	(0.00)	(0.00)	(0.03)	(0.12)

Notes: Standard errors in parentheses. Average weekly earnings series (Australian Bureau of Statistics, 2018b) is used for indexation. 45 sets of replicate weights used in the estimation.

Figures

Figure 1. GDP quarterly growth rate in current price (trend) between 2001 and 2017

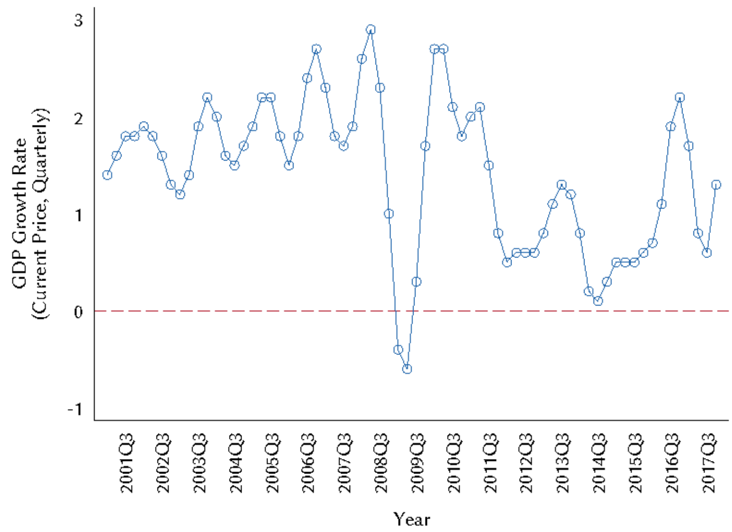


Figure 2. Decomposition of Gini changes between 2002 and 2015 in Australia

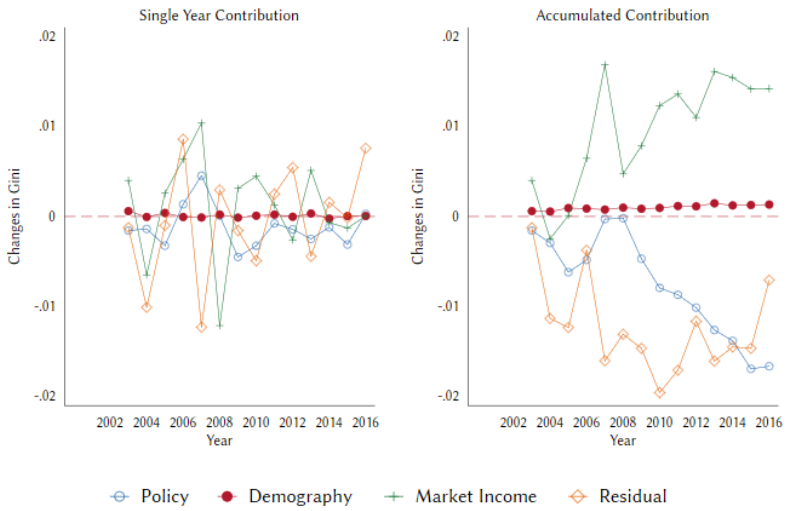


Figure 3. Decomposition of P95/P75 and P75/P50 ratio between 2002 and 2015 in Australia (Accumulated)

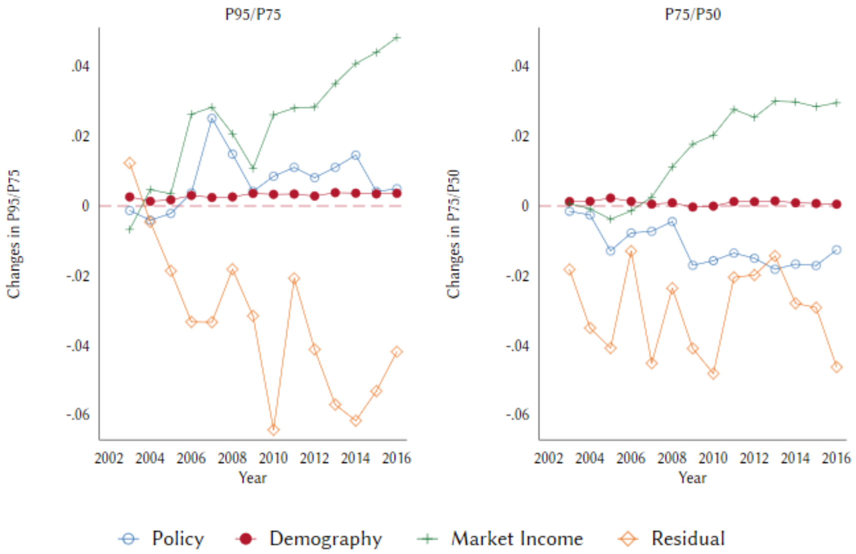
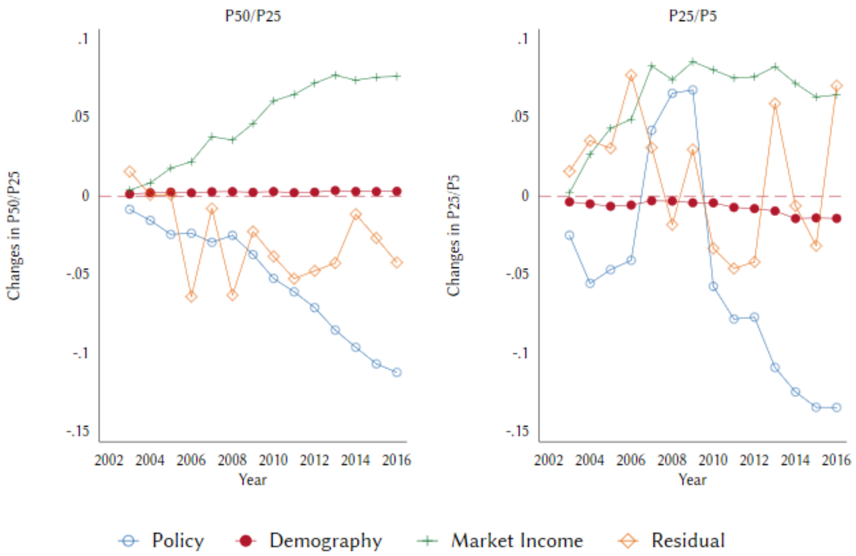


Figure 4. Decomposition of the P50/P25 and P25/P5 ratio between 2002 and 2015 in Australia (Accumulated)



Appendices

TABLE A1

Accumulated contribution to changes in P25/P5 (unit: 0.01)

Year	Policy	Demography	Market Income	Residual	Change in P25/P5
2002 - 2003	-2.49	-0.37	0.20	1.58	-1.08
	(0.39)	(0.35)	(1.00)	(2.32)	(2.37)
2003 - 2004	-5.56	-0.50	2.66	3.53	0.13
	(0.63)	(0.36)	(1.45)	(1.85)	(1.83)
2004 - 2005	-4.68	-0.65	4.32	3.04	2.03
	(0.96)	(0.38)	(1.58)	(3.41)	(3.91)
2005 - 2006	-4.09	-0.57	4.88	7.70	7.92
	(0.98)	(0.81)	(2.75)	(4.07)	(3.65)
2006 - 2007	4.19	-0.30	8.28	3.09	15.26
	(2.26)	(0.89)	(3.09)	(4.28)	(3.75)
2007 - 2008	6.54	-0.31	7.41	-1.82	11.82
	(2.18)	(1.27)	(3.73)	(5.78)	(4.30)
2008 - 2009	6.75	-0.42	8.55	2.97	17.85
	(2.24)	(1.06)	(3.83)	(4.26)	(3.34)
2009 - 2010	-5.75	-0.43	8.03	-3.33	-1.48
	(4.53)	(1.16)	(4.35)	(5.64)	(3.56)
2010 - 2011	-7.82	-0.72	7.51	-4.61	-5.64
	(4.68)	(1.26)	(4.17)	(6.50)	(2.36)
2011 - 2012	-7.71	-0.80	7.59	-4.19	-5.10
	(6.13)	(1.32)	(4.64)	(7.18)	(4.99)
2012 - 2013	-10.91	-0.95	8.24	5.89	2.27
	(6.10)	(1.65)	(5.09)	(10.20)	(8.63)
2013 - 2014	-12.47	-1.43	7.17	-0.62	-7.34
	(5.93)	(2.08)	(5.10)	(7.95)	(5.24)
2014 - 2015	-13.44	-1.39	6.31	-3.16	-11.69
	(6.56)	(2.22)	(5.33)	(8.75)	(4.07)
2015 - 2016	-13.45	-1.42	6.44	7.03	-1.40
	(6.55)	(2.22)	(5.69)	(8.81)	(3.91)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

TABLE A2

Accumulated contribution to changes in P50/P25 (unit: 0.01)

Year	Policy	Demography	Market Income	Residual	Change in P50/P25
2002 - 2003	-0.85	0.13	0.38	1.57	1.23
	(0.40)	(0.32)	(0.83)	(2.48)	(2.42)
2003 - 2004	-1.55	0.21	0.84	0.08	-0.42
	(0.66)	(0.39)	(1.13)	(2.14)	(2.80)
2004 - 2005	-2.44	0.25	1.78	0.09	-0.32
	(0.78)	(0.46)	(1.24)	(2.26)	(2.30)
2005 - 2006	-2.36	0.20	2.19	-6.39	-6.36
	(0.79)	(0.61)	(1.45)	(1.99)	(2.18)
2006 - 2007	-2.94	0.27	3.78	-0.79	0.33
	(1.07)	(0.70)	(1.43)	(2.75)	(3.22)
2007 - 2008	-2.50	0.29	3.57	-6.30	-4.94
	(1.11)	(0.72)	(1.77)	(2.72)	(2.57)
2008 - 2009	-3.72	0.24	4.62	-2.26	-1.12
	(1.11)	(0.77)	(1.90)	(2.87)	(3.31)
2009 - 2010	-5.24	0.29	6.06	-3.84	-2.73
	(1.44)	(0.72)	(2.10)	(2.42)	(2.19)
2010 - 2011	-6.10	0.21	6.47	-5.25	-4.67
	(1.67)	(0.94)	(2.40)	(2.82)	(1.95)
2011 - 2012	-7.10	0.25	7.19	-4.76	-4.42
	(1.74)	(0.96)	(2.71)	(3.41)	(3.06)
2012 - 2013	-8.53	0.35	7.69	-4.27	-4.75
	(1.72)	(0.99)	(2.54)	(3.27)	(2.13)
2013 - 2014	-9.62	0.29	7.38	-1.15	-3.10
	(1.80)	(1.04)	(2.72)	(3.21)	(2.52)
2014 - 2015	-10.68	0.29	7.57	-2.67	-5.49
	(1.77)	(1.07)	(2.74)	(3.08)	(2.24)
2015 - 2016	-11.22	0.31	7.62	-4.23	-7.52
	(1.85)	(1.13)	(2.87)	(4.00)	(2.56)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

TABLE A3

Accumulated contribution to changes in P75/P50 (unit: 0.01)

Year	Policy	Demography	Market Income	Residual	Change in P75/P50
2002 - 2003	-0.15	0.13	0.07	-1.82	-1.77
	(0.46)	(0.31)	(0.75)	(2.36)	(2.49)
2003 - 2004	-0.26	0.13	-0.08	-3.49	-3.70
	(0.64)	(0.36)	(1.21)	(2.65)	(2.62)
2004 - 2005	-1.29	0.23	-0.38	-4.07	-5.51
	(0.89)	(0.36)	(1.41)	(2.63)	(2.29)
2005 - 2006	-0.77	0.13	-0.14	-1.29	-2.07
	(1.01)	(0.59)	(1.33)	(2.15)	(2.26)
2006 - 2007	-0.72	0.05	0.26	-4.50	-4.92
	(1.35)	(0.63)	(1.59)	(2.78)	(2.64)
2007 - 2008	-0.45	0.09	1.12	-2.35	-1.59
	(1.24)	(0.74)	(1.80)	(2.84)	(2.05)
2008 - 2009	-1.70	-0.03	1.77	-4.08	-4.03
	(1.18)	(0.88)	(1.88)	(2.37)	(2.43)
2009 - 2010	-1.57	-0.00	2.03	-4.80	-4.34
	(1.38)	(0.85)	(1.99)	(2.83)	(3.00)
2010 - 2011	-1.35	0.13	2.76	-2.04	-0.50
	(1.28)	(1.02)	(1.89)	(2.54)	(1.53)
2011 - 2012	-1.50	0.12	2.54	-1.98	-0.81
	(1.36)	(1.02)	(2.11)	(2.61)	(2.18)
2012 - 2013	-1.81	0.15	3.00	-1.43	-0.10
	(1.44)	(1.04)	(2.14)	(2.71)	(2.22)
2013 - 2014	-1.66	0.09	2.98	-2.79	-1.38
	(1.55)	(1.04)	(2.64)	(3.11)	(2.59)
2014 - 2015	-1.71	0.07	2.84	-2.91	-1.70
	(1.59)	(1.15)	(2.61)	(2.78)	(1.95)
2015 - 2016	-1.25	0.05	2.95	-4.61	-2.86
	(1.66)	(1.18)	(2.62)	(3.42)	(2.20)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

TABLE A4

Accumulated contribution to changes in P95/P75 (unit: 0.01)

Year	Policy	Demography	Market Income	Residual	Change in P95/P75
2002 - 2003	-0.13	0.26	-0.67	1.23	0.69
	(0.51)	(0.71)	(1.88)	(4.08)	(3.58)
2003 - 2004	-0.41	0.13	0.47	-0.46	-0.26
	(0.83)	(0.65)	(2.64)	(4.31)	(4.02)
2004 - 2005	-0.21	0.18	0.35	-1.86	-1.54
	(1.37)	(0.60)	(3.30)	(5.42)	(4.65)
2005 - 2006	0.37	0.30	2.63	-3.32	-0.02
	(1.56)	(0.75)	(3.91)	(5.46)	(4.78)
2006 - 2007	2.51	0.24	2.83	-3.33	2.25
	(2.27)	(0.73)	(4.63)	(5.92)	(4.36)
2007 - 2008	1.49	0.26	2.07	-1.81	2.00
	(2.28)	(1.18)	(5.50)	(8.43)	(5.67)
2008 - 2009	0.42	0.36	1.08	-3.15	-1.29
	(2.52)	(1.29)	(5.84)	(7.63)	(4.33)
2009 - 2010	0.85	0.33	2.61	-6.41	-2.62
	(2.77)	(1.43)	(5.54)	(6.52)	(4.91)
2010 - 2011	1.11	0.34	2.80	-2.07	2.18
	(2.65)	(1.57)	(5.68)	(6.92)	(4.11)
2011 - 2012	0.81	0.29	2.83	-4.11	-0.18
	(2.68)	(1.66)	(5.75)	(7.78)	(5.30)
2012 - 2013	1.11	0.38	3.51	-5.69	-0.69
	(2.69)	(1.79)	(5.63)	(8.80)	(5.38)
2013 - 2014	1.46	0.37	4.08	-6.15	-0.25
	(2.88)	(2.00)	(6.45)	(7.59)	(4.28)
2014 - 2015	0.41	0.35	4.40	-5.30	-0.14
	(2.92)	(2.01)	(5.96)	(7.76)	(4.18)
2015 - 2016	0.49	0.36	4.83	-4.17	1.51
	(2.83)	(2.17)	(5.70)	(7.42)	(4.91)

Notes: Standard errors in parentheses. 45 sets of replicate weights used in the estimation.

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