On Australian Exceptionalism:
The Role of Home Ownership in Income Mobility, Inequality and Polarization*

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July 26, 2019

Abstract

This is the first paper that uses three harmonized national panels for Australia, the United States and Germany to measure the role of home ownership on income inequality, polarization and intergenerational mobility. Australia stands out as the only country where home ownership drastically changes all three measures. Australian society becomes 22.8% less mobile on average as measured by an intergenerational rank correlation. Transition matrices further show that mobility across income groups becomes less likely, with matrix values becoming more concentrated on the leading diagonal – the lower tertile becomes 4% more concentrated on the leading diagonal, and the higher tertile becomes 5% more concentrated on the leading diagonal. Additionally, regarding equality and polarization outcomes, among elderly Australians home ownership changes inequality by −10.8% and polarization by −36.3%, and among working age Australians it changes inequality by 0.8% and polarization by −14.4%. The results of this paper provide strong reinforcement of the Canberra Group's (2001) recommendations to include all in-kind income sources in cross-country comparisons.

Keywords: intergenerational mobility; income mobility; rental income.
JEL codes: J62, P30.

*I thank A/Prof. Peter Siminski and A/Prof. Olena Stavrunova for their help with this study.
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1 Introduction

The literature on the distribution of economic outcomes and opportunities is principally concerned with the comparison of distributions in quantitative terms across time and space. In its modern form, the literature is a branch of welfare economics; however, it derives much of its intellectual heritage from statistics. The subject is of interest as a discrete area of research, but can also be used to better understand economic growth, aggregate consumption, the occurrence and size of cyclical movements, or the intensity of violent conflicts. The subject has always been taken seriously by policy makers, philosophers and social scientists. As recently discussed in the *Handbook of Income Distribution* (A. Atkinson and Bourguignon 2015), the most renowned measures in this area are income: (1) mobility; (2) inequality; and (3) polarization. All three are distinct, but have close analytical links.

Intergenerational income mobility provides insight into the origins of the distribution of economic outcomes and measures the degree to which children's economic opportunities depend on their parents' economic outcomes. In its modern form, research in this area first began in the mid-1980s with the work of Becker and Tomes (1986). Recently, due to the availability of high-quality datasets, astonishing progress has been made in this area, as exemplified by the work of Chetty et al. (2014), who analyzed 40 million children-parent pairs spaced 17 years apart. Cross-country comparison research shows that mobility is low in countries with high levels of inequality, such as Italy, the United Kingdom and the United States, and is much higher in Nordic countries that have more even levels of income distribution (Corak 2013). The Great Gatsby Curve illustrates the connection between the concentration of income in one generation and the ability of those in the next generation to move further up the economic ladder (Krueger 2012). We also know that intergenerational income persistence is greatest in the upper tail of income distributions; however, the United States stands out due to the particularly high likelihood that children of the poorest parents will remain the poorest members of society (Jantti et al. 2006). Further, research has shown that inclusive and universal education (Pekkarinen et al. 2009) and strong social security systems (Bratsberg et al. 2007) increase mobility.

The comparison of income inequality across countries and over time has a long tradition of being studied in relation to understanding economic outcomes. Indeed, hundreds of researchers have examined income inequality and its effects. Historically, it was of considerable interest to Smith (Book I, Chap-

ter X, 1827), and of even greater interest to Pareto, who in 1897 examined data from the tax returns of several nations across four centuries and concluded that income inequality is constant over time and space (Persky 1992). Pareto contends that the distribution of income reflects a natural distribution of abilities among individuals. It was only after considerable debate, as summarized by Bresciani-Turroni (1939), that the notion of "natural" income inequality was disproved. Consequently, modern understandings of income inequality are almost in a diametric opposition to Pareto's law. Kuznets (1955) was the first to offer a novel conceptualization of inequality. He regards inequality as a product of economic growth and thus sees it as being related to economic policy. There is nothing natural about inequality; like growth, it is influenced by public choice. As for empirical evidence, the United States has had the highest level of disposable income inequality since the end of the 1990s, while northern and central European countries have had the lowest. No common trend in income inequality has been observed since the 1970s across rich nations; however, public redistribution through taxes and benefits affects both levels of, and changes in, inequality. Recently, understandings of inequality have been further enhanced by the research of Piketty (2014), who scrutinized the dynamics of top income earners. He claims that the fundamental dynamics of capitalism create a strong tendency towards the greater inequality of income and dynasties of income, and that both will continue unless this tendency is mitigated by the enactment of appropriate policies (e.g., income tax policies).

Income polarization is a more recent measure of economic outcomes. This measure identifies the degree of within-group similarity and between-group disparity, and characterizes the degree to which the population is segregated into groups. Thus, it captures the phenomena of "a diminishing middle class" or "a divided society" (Chakravarty 2009). Empirical research has shown that income polarization is often a strong predictor of many observed outcomes, including those that have been traditionally linked to inequality. Notably, income polarization has been shown to be a strong predictor of violent conflicts (e.g., Montalvo and Reynal-Querol 2005), disparities in individuals' health (e.g., Pérez and Ramos 2010) and economic growth (e.g., Keefer and Knack 2002). Income polarization has often been studied in relation to inequality (e.g., Duclos, Esteban, et al. 2004; Wang and Wan 2015) and has been compared across time and/or countries (e.g., Chakravarty and D'Ambrosio 2010). Research in the last two areas has shown that rapid economic development may increase income polarization without increasing income inequality. In addition, income is unequal but relatively unpolarized in Canada, Australia and the United States;

whereas, in the Czech Republic income is equal but highly polarized.

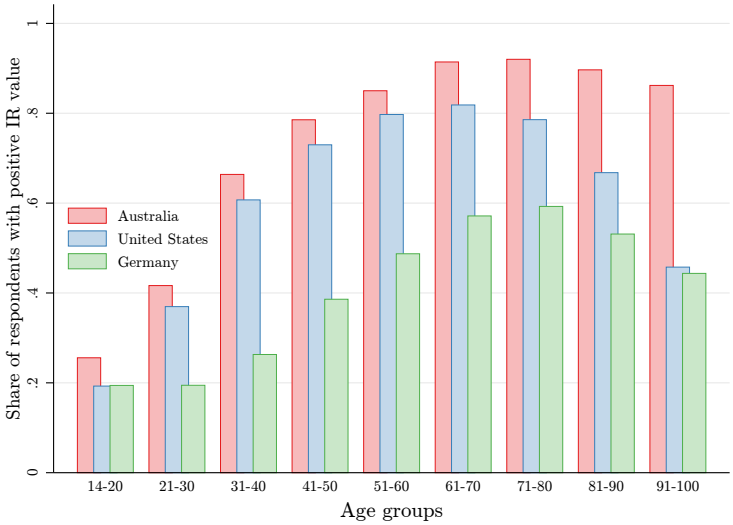
International comparisons of the distribution of economic outcomes and opportunities crucially depend on the underlying measurement assumptions. Researchers have been aware of this issue since Kravis (1962) and Kuznets (1963) and it has been the subject of increasing attention since the mid-1970s (A. B. Atkinson et al. 1970; Lydall 1979; Sawyer and Wasserman 1976). All three of the discussed measures are clearly affected by monetary income and non-monetary or in-kind income components. Countries differ vastly with respect to personal asset ownership (an important factor in cross-country comparisons). One component of non-monetary income that has a particular quantitative significance is imputed rent (IR) from owner-occupied housing. IR refers to income received if an owned property is assumed to be rented out and captures the "intensity" of home ownership.

In as early as 1968, the United Nations argued in favor of capturing IR from owner-occupied housing in national account statistics for international comparisons and later issued formal guidelines for capturing this data (United Nations 1977). The first report by the Expert Group on Household Income Statistics argued that IR (and other in-kind income sources) should be included as a major income component of disposable income (Canberra Group 2001). More recently, the Stiglitz-Sen-Fitoussi Commission recommended that material living standards be considered when measuring economic performance (Stiglitz et al. 2009).

A comparison of home ownership in Australia, the United States and Germany is a good illustration of the importance of the inclusion of IR into disposable income. Figure 1 shows home ownership by age groups in these countries. Clearly, Australians have a substantially larger portion of income "hidden" in their homes. Another noticeable feature is that Australian home ownership does not decrease for elder age groups. In fact, the difference between the number of home owners in Australia vs. the number of home owners in the United States and Germany increases along the "Age groups" axis (i.e., the height of the red bar relative to the blue and green bars is increasing).

The dissimilarities of home ownership have already been extensively explored in relation to income inequality. D. Lerman and R. Lerman (1986) note that IR is more equally distributed than monetary income, thus it reduces inequality. The inclusion of IR, therefore, reduces aggregate inequality. Similarly, Smeeding et al. (1993) show a leveling effect on inequality in Germany, Sweden, Canada and the Netherlands. Yates (1994) documents a slight decline in income inequality in Australia. Buckley and Gurenko (1997) find that the progressive

Figure 1: Home ownership: Australia, United States, Germany



Notes: Share of respondents with positive household IR value by age group. Sample restricted to household head and partner.
Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

impact of housing income provides a cushion against the consequences of transition in Soviet Russia, while Torrey et al. (1999) find similar results for the Czech Republic, Hungary and Poland. Gasparini and Sosa Escudero (2004) show that IR induces a decline in inequality in Argentina. Additionally, Saunders and Siminski (2005) report that IR has an unambiguous equalizing effect on income distribution in Australia; and, similarly, J. R. Frick et al. (2010) show that IR values decline poverty and income inequality in Germany, the United States and the United Kingdom. Onrubia et al. (2009) conclude that the inclusion of IR into income measures evaluated at market prices rather than cadastral values produces an increase in gross income inequality among taxpayers in Spain. Eurostat (2010) reports on the poverty reducing effects of IR in most European Union countries. Garner and Short (2009) report that the impact of IR on aggregate inequality in the United States is either negligible or marginally increasing; and, more recently, J. Frick, Goebel, et al. (2014) find poverty and inequality reductions in Finland, Denmark and France after accounting for IR.

Thus, it is clear that the impact of IR on income inequality depends on the population share of owner-occupiers and housing price patterns. The estimation results are sensitive to the methods of calculating IR, and finding a harmonized method for the calculation of IR represents a major issue for producers and analysts of cross-nationally comparative income data.

This is the first paper to use a dataset of IR values harmonized across countries to study the effects of home ownership on broader measurements of

the distribution of economic outcomes and opportunities. To do this, the paper utilizes the Cross National Equivalent File (CNEF), a dataset for cross-national comparisons that cross-links high-quality national microlevel datasets and which includes similarly calculated IR values for Australia, the United States and Germany. The results support the recommendations of the Canberra Group (2001) that all in-kind income sources should be included in such analyses.

Spearman rank correlation (Dahl and DeLeire 2008) shows that IR value substantially decreases intergenerational relative rank mobility in Australia (by 22.840%), whereas the effect on mobility in both America and Germany is negligible (2.030% and 3.704%, respectively). Home ownership defines a surprising amount of immobility in Australia. This result is statistically similar for all age groups. The results highlight a disturbing fact related to the Australian housing affordability crisis: it is highly unlikely that many of the young private renters affected by the crisis will ever be able to gain access to the economic and social advantages provided by home ownership (Yates 2008, 2016). The decrease in mobility shows that the effects of this rental trap persist across generations.

Australian tertile transition matrices further confirm the decreasing effects of home ownership on intergenerational mobility. Specifically, the results show that children from the poorest households are less likely (4.128%) to move into the higher tertile, children from middle-income households are the least affected (0.654%), and children from the richest household are less likely (5.106%) to move into the lowest tertile. It appears that possessing private property provides a level of insurance for one's children against poverty.

The Gini coefficient shows that IR values have a slightly decreasing effect on income inequality in Australia (–2.348%), a marginally increasing effect in the United States (0.563%), and a borderline effect in Germany (–0.133%). Further, looking at the results for various age groups shows the following: the general direction of the home ownership effect across various age groups is similar across all countries; that is, it decreases among individuals in the elder age group (aged 60+) and increases among individuals in both the pre-working (aged 0–15) and working age groups (aged 15–60). However, in Australia, the effect produces a staggering drop in inequality among individuals in the elder age group (–10.847%), and slightly aggravates inequality among individuals in the pre-working age (3.871%) and working age groups (0.767%). The Australian inequality outcome is driven exclusively by people in the elder age group. Australia is also the only country in which inequality for individuals in the elder age group is much higher than for individuals in the working age groups (29.513%); however, the IR value halves this difference (14.820%). Thus, home ownership

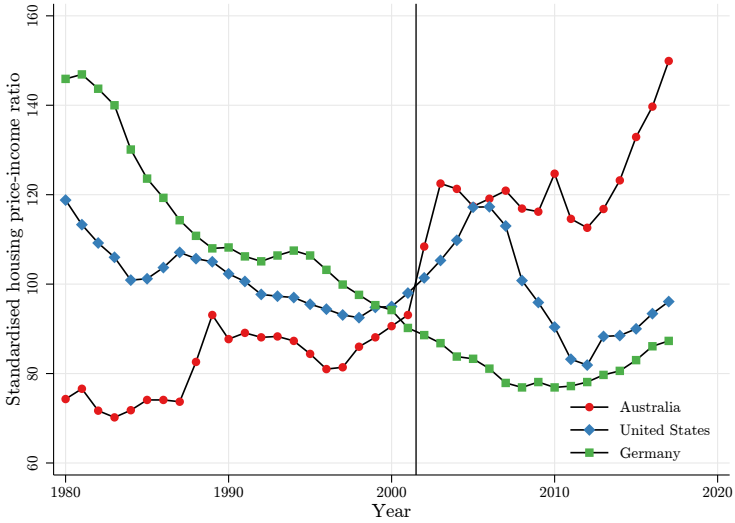
represents a means of providing for the elderly in Australia, but not in Germany, as the inequality among Germans in the elder age group is even lower than the inequality among Germans in the working age group, while IR value has a trivial effect on this difference (–0.735%).

It appears that a rational force drives the unusually high home ownership rates among elderly Australians. In Germany, the public pension system is universal; whereas, in Australia, the Commonwealth-funded age pension is selective and is paid only if a recipient is able to prove an absence of assets or income. In Australia, however, homes are exempted from the asset test and thus have become a device for hiding income or income generating assets. For example, an Australian pensioner whose only asset is their home will receive the Commonwealth-funded pension; however, if that home is traded for cash or other assets, the Commonwealth-funded pension will be canceled. Similarly, to become eligible to receive the Commonwealth-funded pension, a pensioner with cash or assets can purchase a house. It could be that the absence of a universal governmental pension induces inequality among elderly people, who rationally respond by accumulating assets that they are encouraged to buy. This may have contributed to Australia's housing affordability crisis, which began in the early 2000s and continues to dominate the Australian and global media. In relation to the institutional environment, Figure 2 shows the profound increase in housing prices in Australia, while Figure 3 shows that individuals in the younger generations are less likely to become home owners.

The income polarization index shows that Australia is the most polarized society on average and across all age groups (with the exception of the elder age group in which the United States takes the lead). However, IR value substantially depolarizes income in Australia (–17.742%). Conversely, in America the income depolarization is only marginal (–2.408%), and in Germany it is nonexistent (0.000%). An analysis across age groups shows that the Australian results were driven by the elder age group (–36.281%) and the working age group (–14.370%). Thus, IR value has a negative effect on inequality and polarization among individuals in the elder age group, but increases inequality and decreases polarization among those in the working age group. Home ownership makes income groups substantially less diverse and makes the Australian "middle class" more noticeable.

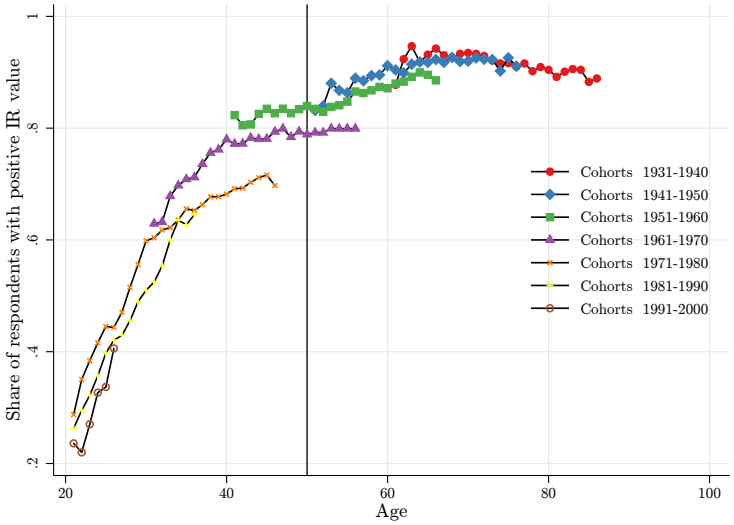
A drop in intergenerational mobility and a decrease in income clustering among individuals in the working age group suggests that owning property is a unique and distinct feature of the well-established, middle-class Australian household (in the sense that not only is an individual, but also their posterity,

Figure 2: House prices to income ratios during 1980–2017: Australia, United States, Germany



Notes: Nominal house prices divided by nominal disposable income per head. Net household disposable income is used. The long-term average is calculated over the whole period. This value is used as a reference value. The ratio is calculated by dividing the indicator source on this long-term average, and indexed to a reference value equal to 100. The vertical line separates 2001 and 2002.
Source: OECD (2019).

Figure 3: Home ownership by cohorts: Australia



Notes: Share of respondents with positive household IR value by cohort group and by age. Sample restricted to household head and partner. Vertical line roughly corresponds to a drastic increase in the housing price-income ratio in 2002.
Source: HILDA 2001–2017.

noticeably better off).

The reminder of this paper is structured as follows: Section 2 describes the methodology adopted by this study; Section 3 sets out the data; Section 4 presents the results of the research; and Section 5 outlines the conclusions that can be drawn from this research.

2 Methodology

The primary components of the analysis are two distributions of economic outcomes. The distribution excludes IR value and is denoted by $Y^{\overline{r}} \in \mathbb{R}^n$, where n is the number of observations. The second distribution includes IR value and is denoted by $Y^r \in \mathbb{R}^n$. Inequality and polarization analyses were undertaken by examining the differences between these two distributions. Intergenerational mobility analyses were undertaken by examining how the two distributions of an individual's economic outcomes are related to the two income distributions of their parents (denoted X^r and $X^{\overline{r}}$).

2.1 Mobility

In relation to intergenerational mobility, the basic components are two joint distributions, where X is the income of parents and Y is that of children. The first joint distribution excludes an IR value and is denoted by $(X^{\overline{r}}, Y^{\overline{r}}) \in \mathbb{R}^m$, where $m \leq n$ is the number of respondents matched to their parents. The second joint distribution includes an IR value and is denoted by $(X^r, Y^r) \in \mathbb{R}^m$. The most straightforward way to capture the association between X and Y is with the slope coefficient from an ordinary least squares (OLS) linear regression:

$$\ln Y_i^{\mathbb{I}} = \beta_0^{\mathbb{I}} + \beta_1^{\mathbb{I}} \ln X_i^{\mathbb{I}} + \boldsymbol{\Gamma}^{\mathbb{I}} \boldsymbol{V}_i + \varepsilon_i \qquad \mathbb{I} \in \{\overline{r}, r\}. \tag{1}$$

The key estimate $\beta_1^{\mathbb{I}}$ is known as intergenerational elasticity (IGE) of income.[1] Controls include the ages of parents and children in a quadratic form and the gender of the children. Given the key estimate, it is possible to obtain an alternative measure, known as the Pearson (product moment) intergenerational correlation (IGC):

$$IGC^{\mathbb{I}}(\ln Y_i^{\mathbb{I}}, \ln X_i^{\mathbb{I}}) = IGE^{\mathbb{I}} \frac{\sigma(\ln X_i^{\mathbb{I}})}{\sigma(\ln Y_i^{\mathbb{I}})} \qquad \mathbb{I} \in \{\overline{r}, r\}. \tag{2}$$

[1] Solon (2004) shows what functional form assumptions have to be made to microfound this log-linear regression with the Becker and Tomes (1979) model.

Here $\sigma(\cdot)$ stands for standard deviation. From this, one can clearly see $H^{\mathbb{I}} = 1 - IGC^{\mathbb{I}}$ Hart's (1976) index of mobility[2], the most often used index in the intergenerational mobility context. The index ranges from -1 and 1 ($H^{\mathbb{I}} = 0$ in the case of complete immobility).

It should be noted that IGC is IGE after factoring out the cross-sectional dispersion of log earnings in X and Y. Therefore, IGC measures the degree of regression to the (geometric) mean in income between a parent and a child. Conversely, IGE can be higher in one society than in another simply because the variance of log earnings in the child's generation is higher in that society.[3]

Black and Devereux (2011, p. 1490) contend that one measure should not be seen as dominating another; however, unlike IGC, IGE has the practical advantage of not being biased by a classical measurement error in Y and thus is often easier to estimate with real-world data. Jäntti and Jenkins (2015, p. 839) are of the view that the wide employment of IGE is surprising and that its use is related to the inertia of researchers. They argue that the changes in relative position are at the core of the mobility problem; however, IGE and IGC (or H) reflect changes in relative position and changes in wage structures. For example, a perfect linear relationship between Y and X ($IGC = 1$, $H = 0$) could, in theory, be driven exclusively by income growth and unchanged ranks. Using the example of Eberharter (2013), they also show that IGC is more suitable than IGE when undertaking cross-national comparisons.

Differences in marginal distributions can be fully controlled by employing the Spearman intergenerational rank correlation (IRC). Dahl and DeLeire (2008) provided an axiomatic characterization of IRC as a measure of exchange mobility, thus extending it beyond a mere "statistical" index that takes a distribution and returns a real number. To measure IRC, let R_i denote the child i's percentile rank in the income distribution of children within their birth cohorts and let P_i denote parent i's percentile rank in the income distribution of parents. The regression of a child's rank R_i on their parents' rank P_i, controlling for parents' quadratic age and a child's gender, yields the following regression coefficient:

$$IRC^{\mathbb{I}} = Corr(P_i^{\mathbb{I}}, R_i^{\mathbb{I}}) \qquad \mathbb{I} \in \{\overline{r}, r\}. \tag{3}$$

This measure fully controls the change in marginal distributions, as both $P^{\mathbb{I}}$ and $R^{\mathbb{I}}$ have standard uniform distributions.

[2] See A. Shorrocks (1992) for a detailed discussion of the properties of this index.

[3] This is related to the fact that the correlation is bounded between 0 and 1 while the elasticity, in principle, could be greater than 1 and would, for example, equal 2 if people from families who were 10% apart in generation 0 were 20% apart in generation 1.

An apparent advantage of a single-valued mobility index is its capacity for partial rankings that identify general mobility trends in different countries. However, after demonstrating that IR does play an exceptional role in Australia, this paper provides a more detailed characterization of the joint distribution $(X^{\overline{r}}, Y^{\overline{r}})$ and (X^r, Y^r) in 3×3 transition matrices A^r and $A^{\overline{r}}$:

$$Y^{\mathbb{I}} = X^{\mathbb{I}} \times A^{\mathbb{I}} \qquad \mathbb{I} \in \{\overline{r}, r\}. \tag{4}$$

This is another standard tool in the mobility literature (Jäntti and Jenkins 2015, p. 823), which allows the nature of mobility and how it changes after the inclusion of IR to be studied more precisely, but prevents the simple partial ordering of countries.[4]

2.2 Inequality and polarization

In relation to inequality and polarization, the two primary distributions (introduced at the beginning of this section) form the basic components of the analysis; that is, one distribution of income excluding IR values, denoted by $Y^{\overline{r}} \in \mathbb{R}^n$, where $n \geq m$ is the number of observations, and another distribution of income including IR values, denoted by $Y^r \in \mathbb{R}^n$. Inequality and polarization outcomes are produced for both the distributions by applying a polarization index developed by Esteban and Ray (1994):

$$E_\alpha^{\mathbb{I}}(Y^{\mathbb{I}}) = \frac{1}{2\mu^{\mathbb{I}}} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i^{\mathbb{I}} - y_j^{\mathbb{I}}| (\pi_i^{\mathbb{I}})^{1+\alpha} \pi_j^{\mathbb{I}} \qquad \mathbb{I} \in \{\overline{r}, r\}. \tag{5}$$

In the index, α represents a polarization sensitivity factor, $y^{\mathbb{I}}$ represents the individual value of $Y^{\mathbb{I}}$ normalized by twice its mean value, and π represents the proportion of individuals with two or more observations with the same value multiplied by cross-sectional weights (neglected in the formula for expositional purposes). Thus, the number of income groups are equal to the number of distinct values of $Y^{\mathbb{I}}$.

When $\alpha = 0$, the index yields a sample weighted Gini coefficient. When $\alpha > 0$, the index captures the clustering of $Y^{\mathbb{I}}$ around income groups. The index implicitly assumes that members of the same income group identify with

[4] Strictly speaking, there is a whole class of mobility indices based on transition matrices; e.g., Normalized Trace Measure (A. F. Shorrocks 1978), that captures the sum of the transition proportions on the leading diagonal, or Average Jump Index (Grimm 1974), that captures the number of income class boundaries crossed by an individual (whether upward or downward), averaged over all individuals. All these measures have been calculated and they do reinforce the main conclusions of this paper. They are not reported for expositional efficiency and can be requested from the author.

each other, while members of different income groups feel alienated from one another. Thus, the greater the level of clustering, or the greater the number of income groups, the greater the level of polarization.

Polarization differs from inequality, as the importance of polarity or (group) homogeneity carries weight, as does the importance of heterogeneity across individuals. Increased distances among individuals of different groups increase both inequality and polarization. Increased bunching among individuals of the same group decreases inequality but raises polarization (Duclos and Taptué 2015, p. 304).

3 Dataset

To address the research question posed by this paper (i.e., the role of home ownership on income inequality, polarization and intergenerational mobility across countries), two samples need to be constructed; one for intergenerational mobility and another for polarization and inequality. However, these samples are constructed such that the polarization and inequality sample envelopes the intergenerational mobility sample. Thus, both samples examine the tendencies of the same population. The construction of the polarization and inequality sample is relatively undemanding, as it only has to be representative of the population being studied for one year. The construction of the intergenerational mobility sample is more challenging, as it has to include the sample of parents' income; to this end, the panel data has to be sufficiently lengthy (and large in order to survive inevitable attrition). Finally, the IR values have to be calculated in a similar fashion.

The CNEF versions of the national datasets comprise comparable data for variables across countries, and notably code household structures identically (J. Frick, Jenkings, et al. 2007). CNEF datasets are available for 10 countries; however, only the following three panels satisfy the aforementioned criteria: the Household, Income and Labour Dynamics in Australia (HILDA) (waves 2001–2017), the United States's Panel Study of Income Dynamics (PSID) (waves 1991–2007), and the German Socio-Economic Panel (SOEP) (waves 1990–2006).

The Swiss dataset includes an IR value, but has to be excluded, as it is too small for an intergenerational mobility analysis. SOEP and PSID first commence in 1984 and 1968, respectively; however, so that the datasets can match the younger Australian panel, SOEP and PSID datasets are narrowed to cover only a 17-year period. Unfortunately, PSID does not report IR values after 2007; thus, the American panel is shifted back. SOEP is also shifted back

to 1990–2006, even though the 2014 wave is the last wave to contain an IR value. This is done to deal with the SOEP sampling rule: the number of children that can be matched to their parents decreases substantially the further away one moves from the first year data because, in SOEP, only members of the first wave and their offspring are followed. At the same time, it is impossible to include data from before 1990, as Eastern German households are excluded prior to that year (Wagner et al. 2007).

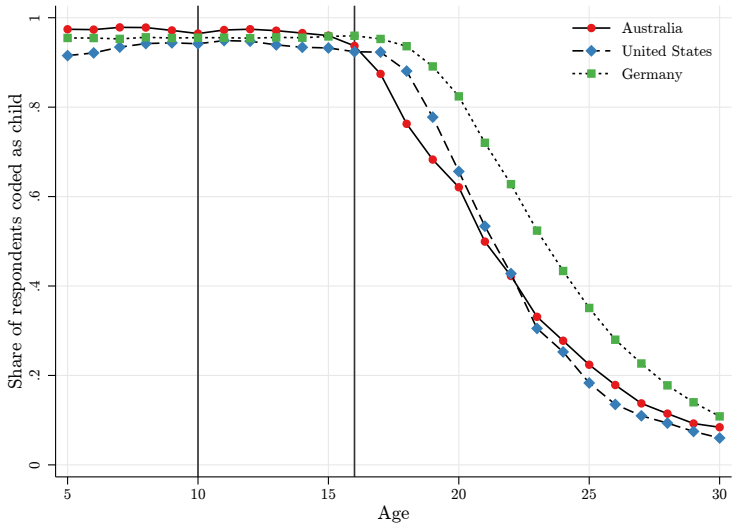
The variable $X^{\overline{r}}$ represents household post-government income (henceforth referred to as income), which refers to the sum of all recorded sources of family income from labor earnings, asset flows, private transfers, private pensions, public transfers and social security pensions, minus total household taxes. The original PSID does not include income derived from non-refundable tax credits (the Earned Income Tax Credit, or EITC) or near-cash benefit income in the form of food stamps (now called the Supplemental Nutrition Assistance Program, or SNAP). CNEF uses the National Bureau of Economic Research TAXSIM model (Feenberg and Coutts 1993) to simulate taxes to derive a harmonized income. Similarly, due to incomplete reporting, Schwarze (1995) methods are used to simulate the tax burden of SOEP.

X^{r} represents a household post-government income plus household IR value (henceforth referred to as the +IR value). Household IR values for HILDA and PSID are calculated based on the market value approach and correspond to a percentage of the difference between the house market value and the remaining mortgage principal. In relation to public-housing tenants, IR refers to the difference between the rent paid and the typical rent for housing in that area (census rental data is used that considers dwelling type, the number of bedrooms, the state and the section of the state). In relation to rent-free housing, IR is defined as the rent that individuals would need to pay to rent the property. If IR is unknown, the census rental data is substituted. The census rental values are taken from an external program that uses census tables to generate these values and imputes equal intervals between the same cells for the intervening non-census years. Medians by state, survey year and time of tenure are substituted for missing data in the public-housing and rent-free groups. Household IR values for SOEP data are based on an opportunity cost approach. At the microlevel, this approach yields information equivalent to that given by the market value approach (Lillard et al. 2015).

To ensure continuity with other studies, the construction of the intergenerational mobility sample adopts the recommendations of Jäntti and Jenkins (2015, p. 892). The sample comprises respondents who were first coded as a

"household child" when they were aged 10–16 in the first wave and were then followed until the last wave. The cohorts are as follows: Australia, 1985–1991; the United States, 1975–1981; and Germany 1974–1980. As Figure 4 shows, including children aged over 16 in the first wave compromises the representativeness of the sample, as a noticeable portion of children began to leave their households at this age.

Figure 4: Share of respondents living with parents



Notes: Mobility sample consists of children living with their parents at age 10 to 16.
Source: HILDA 2001–2005, PSID 1991–1995, SOEP 1990–1994.

Children and their parents are matched using the CNEF household member identifier (i.e., head, partner, child, relative, nonrelative). The parents are identified as the head and the partner of a household to which the children are matched.

Table 1 shows the attrition rates for the three datasets. The accumulated attrition rate is the highest for the German panel, but lower for the American panel, and lower still for the Australian panel. The sample is also limited to respondents who have become a household head or a partner (i.e., respondents who do not live with their parents). The children's income is averaged over the last two available years, and the parents' income over five years. To control for inflation, the values for the parents' income are appropriately scaled up.

The final comment is on families with step-parents. A recent study by Murray et al. (2018) on intergenerational income persistence in Australia matches children to their biological parents. Conversely, the present study considers households led by a child's parent per the CNEF identifier. Thus, this study works with the actual resources available to the child. Also, note that house-

Table 1: Attrition rates

	Australia				United States				Germany		
HILDA wave	Full sample	Born 1985-91	Attrition rate	PSID wave	Full sample	Born 1975-81	Attrition rate	SOEP wave	Full sample	Born 1974-80	Attrition rate
2001	19,914	2,146		1991	19,962	2,307		1990	17,653	1,645	
2002	18,295	1,866	-13.05%	1992	20,334	2,192	-4.98%	1991	17,280	1,566	-4.80%
2003	17,690	1,733	-19.25%	1993	21,450	2,073	-10.14%	1992	16,976	1,515	-7.90%
2004	17,209	1,629	-24.09%	1994	23,622	2,008	-12.96%	1993	16,690	1,452	-11.73%
2005	17,467	1,636	-23.77%	1995	23,184	1,914	-17.04%	1994	16,992	1,363	-17.14%
2006	17,453	1,578	-26.47%	1996	23,060	1,779	-22.89%	1995	17,423	1,281	-22.13%
2007	17,280	1,521	-29.12%	1997	19,132	1,290	-44.08%	1996	17,022	1,219	-25.90%
2008	17,144	1,455	-32.20%			N/A		1997	16,676	1,136	-30.94%
2009	17,632	1,458	-32.06%	1999	19,669	1,182	-48.76%	1998	18,318	1,069	-35.02%
2010	17,855	1,434	-33.18%			N/A		1999	17,605	983	-40.24%
2011	23,415	1,383	-35.55%	2001	20,538	1,151	-50.11%	2000	30,779	905	-44.98%
2012	23,182	1,334	-37.84%			N/A		2001	27,799	834	-49.30%
2013	23,299	1,282	-40.26%	2003	21,277	1,163	-49.59%	2002	29,650	745	-54.71%
2014	23,113	1,246	-41.94%			N/A		2003	27,886	692	-57.93%
2015	23,303	1,225	-42.92%	2005	21,686	1,096	-52.49%	2004	27,034	645	-60.79%
2016	23,504	1,195	-44.32%			N/A		2005	25,875	602	-63.40%
2017	23,415	1,153	-46.27%	2007	20,873	1,088	-52.84%	2006	27,677	559	-66.02%

Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

hold post-government income includes potential child support from a biological parent who does not live with the child in the same household. This matching approach takes advantage of the CNEF's unified coding of household structure. However, as discussed by Jäntti and Jenkins (2015, p. 892), and as the register data works of Björklund and Chadwick (2003), Holmlund et al. (2011) and Björklund et al. (2007) show, the results are relatively insensitive to the definition of a "family".

Table 2 sets out the descriptive statistics for the mobility sample. Notably, the share of parents' IR values in relation to parents' income is 14.5% in Australia. Conversely, it is 6% and 1.5% in the United States and Germany,

Table 2: Descriptive statistics: intergenerational mobility sample

	N	Mean	S.D	Min	0.25	Med	0.75	Max
				Australia				
Parent's IR value	924	14191	16740	0	4505	10568	18066	172136
Parent's income	924	97867	53468	-220362	64739	91447	120202	456222
+ Parent's IR value	924	112077	58252	-48226	73122	102871	137254	503922
Parent's age	924	42	5.6	24	39	42	46	66
Child's IR value	924	5044	8838	0	0	1009	7215	76000
Child's income	924	87864	42756	0	58490	82663	109981	351741
+ Child's IR value	924	92908	46302	0	61361	86426	116537	372641
Child's age	924	29	2	26	27	29	31	32
Female	924	0.53	0.5	0	0	1	1	1
				United States				
Parent's IR value	947	3500	5372	0	185	1888	4482	62771
Parent's income	947	58391	42574	7310	34417	52777	74343	630339
+ Parent's IR value	947	61891	45981	7310	35447	55296	79659	693110
Parent's age	947	44	5.6	30	40	43	47	61
Child's IR value	947	1339	2931	0	0	0	1395	30000
Child's income	947	42604	36302	210	23203	36385	55809	752863
+ Child's IR value	947	43943	37709	210	23702	36978	57434	764563
Child's age	947	28	1.8	26	27	28	30	32
Female	947	0.55	0.5	0	0	1	1	1
				Germany				
Parent's IR Value	410	521	929	-1.1	-0.5	0	820	7035
Parent's income	410	35468	19767	7450	21821	32133	43088	184183
+ Parent's IR Value	410	36200	20243	7449	21842	32349	44127	190588
Parent's age	410	47	5.9	31	43	47	51	65
Child's IR Value	410	590	1423	0	0	0	0	9822
Child's income	410	26485	13080	4170	17953	25467	32764	92614
+ Child's IR Value	410	27075	13501	4359	18133	25598	34099	102436
Child's age	410	29	2	26	27	29	31	32
Female	410	0.56	0.5	0	0	1	1	1

Notes: Income is disposable. Parent and Child's income are averaged for 5 years and 2 years, respectively.
Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

respectively. In relation to children, the share is 5.7% in Australia, 3.1% in the United States and 2.2% in Germany.

The last waves are used as inequality and polarization measurements. Table 3 sets out the descriptive statistics for these measurements. To ensure continuity with previous studies, this sample uses income that is equivalized by the square root of the household size. A similar unique data feature can also be detected in this sample. The share of the IR value in equivalized income is 16.4% in Australia, and 9.4% and 4.6% in the United States and Germany, respectively.

Table 3: Descriptive statistics: inequality and polarization sample

	N	Mean	S.D	Min	0.25	Med	0.75	Max
				Australia				
IR value	23415	9546	13471	0	0	5460	13859	221230
Income	23415	58345	41762	-39700	34523	49959	71813	957626
+IR value	23415	67892	47204	-39700	40023	57969	82437	1200000
HH members	23415	3.2	1.5	1	2	3	4	10
				United States				
IR value	20873	2987	6570	0	0	540	3464	246073
Income	20873	31738	38293	-33625	14057	24179	38712	1000000
+IR value	20873	34725	41683	-29965	14863	25861	42524	1100000
HH members	20873	3.5	1.6	1	2	3	4	10
				Germany				
IR value	27677	1087	1772	0	0	0	1826	26391
Income	27677	23425	25323	0	14228	19596	27674	2000000
+IR value	27677	24512	25801	0	14919	20608	28988	2000000
HH members	27677	3	1.4	1	2	3	4	13

Notes: Income is disposable and equivalized.
Source: HILDA 2017, PSID 2007, SOEP 2006.

4 Results

4.1 Mobility

Table 4 reports on IGE (Equation (1)), IGC (Equation (2)) and IRC (Equation (3)). In addition to the main sample (which comprises individuals aged 26–32), Table 4 also reports the estimates for the cohorts recently analyzed by Murray et al. (2018) in Australia. In their paper, Murray et al. (2018) use HILDA for the period 2001–2015 to follow individuals from 1984–1986 cohorts until they were aged 30–32. Their approach mimics that of Chetty et al. (2014),

who use American tax returns for the period 1996–2012 to follow individuals aged 14–16 in the first year of the dataset. To reduce the notorious left-side life-cycle bias (Haider and Solon 2006) on a rather short dataset, Murray et al. (2018) focus on respondents aged 15–17 in the first wave and 30–32 in the last wave. For CNEF disposable household income averaged over three years, they report an IGE of 0.240 and IRC of 0.219.

Table 4: Intergenerational persistence of income

	IGE			IGC			IRC		
Age	31-33	30-32	26-32	31-33	30-32	26-32	31-33	30-32	26-32
					Australia				
Cohorts	1984-86	1985-87	1985-91	1984-86	1985-87	1985-91	1984-86	1985-87	1985-91
Income	0.260	0.268	0.194	0.250	0.236	0.170	0.221	0.196	0.162
+IR value	0.226	0.210	0.200	0.239	0.208	0.186	0.279	0.229	0.199
Change	-0.034	-0.058	0.006	-0.011	-0.028	0.016	0.058	0.033	0.037
% Change	-13.1%	-21.6%	3.1%	-4.4%	-11.9%	9.5%	26.2%	16.8%	22.8%
N	379	400	924	379	400	924	379	400	924
					United States				
Cohorts	1974-76	1975-77	1975-81	1974-76	1975-77	1975-81	1974-76	1975-77	1975-81
Income	0.472	0.483	0.460	0.420	0.407	0.394	0.419	0.391	0.394
+IR value	0.482	0.485	0.459	0.434	0.418	0.399	0.437	0.410	0.402
Change	0.010	0.002	-0.001	0.014	0.011	0.005	0.018	0.019	0.008
% Change	2.1%	0.4%	-0.2%	3.3%	2.6%	1.3%	4.3%	4.9%	2.0%
N	295	305	947	295	305	947	295	305	947
					Germany				
Cohorts	1973-75	1974-76	1974-80	1973-75	1974-76	1974-80	1973-75	1974-76	1974-80
Income	0.140	0.085	0.112	0.136	0.079	0.101	0.160	0.126	0.135
+IR value	0.149	0.083	0.113	0.144	0.077	0.102	0.165	0.138	0.140
Change	0.009	-0.002	0.001	0.009	-0.001	0.001	0.005	0.012	0.005
% Change	6.4%	-2.5%	0.9%	6.3%	-1.7%	0.7%	3.1%	9.5%	3.7%
N	202	174	410	202	174	410	202	174	410

Notes: Income is disposable. Parent and Child's income are averaged for 5 years and 2 years, respectively. Standard errors are robust and clustered at the parent household level.
Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

When the same cohorts are examined, the results of this study are similar to those found by Murray et al. (2018); albeit, IRC estimates are slightly smaller when the next cohort is observed at a similar age. The differences in the results may be due to different estimates being used for different cohorts or to the life-cycle bias, which arises because the observations used by the present study are for children considerably younger than those in Murray et al.'s (2018) study. Notably, the main results do not appear to be sensitive to which cohort is used.

The decreasing effect related to the inclusion of younger children in the Australian estimates is also observed in another recent work on Australian intergenerational income persistence by Deutscher and Mazumder (2019, Figure 3), who uses Australian tax income data from 1991 to 2015 and focuses on cohorts from 1978 to 1982. Again, adopting the approach of Chetty et al. (2014),

the authors report an IGE of 0.175, an IGC of 0.148, and an IRC of 0.211 for household disposable income.

According to all of the measures in Table 4, after Germany, Australia is the second most income mobile country, followed by the United States. This is in line with the existing literature. In Germany and the United States, the inclusion of IR values barely changes the estimates. Conversely, in Australia, the inclusion of an IR value has quite a strong effect, where, according to the most reliable measure, IRC, the inclusion of an IR value decreases mobility by approximately 22.8%.

The effect of the IR value on IGE appears to be age dependent. IR value decreases IGE for children aged 31–33 and 30–32 and increases IGE for children aged 26–32. A similar pattern is found in relation to IGC. Thus, changes in wage dispersions across generations do not appear to be the reason for age dependency. Given the small sample size, it is most likely a result of the fragility of OLS in the intergenerational context. Alternately, it could also be that home ownership has different effects on mobility depending on children's life cycles. This is further explored in Section 6.

Table 5: Australian transition matrices

	Child			
Parent	1	2	3	
1	44%	33%	22%	Income + IR value
	40%	34%	26%	Income
	4%	0%	-4%	Difference
2	31%	37%	31%	Income + IR value
	31%	37%	33%	Income
	1%	1%	-2%	Difference
3	24%	29%	46%	Income + IR value
	29%	30%	41%	Income
	-5%	0%	5%	Difference

Notes: Household disposable income. Parent and child's income are averaged for 5 years and 2 years, respectively. Each cell has 103 observations on average. Calculations are performed with a code by Savegnago (2016).
Source: HILDA 2001–2017.

Table 5 shows how home ownership affects transitions from one income group into another. The mass appears more concentrated on the main diagonal, showing that Australian society becomes more rigid. Children in the lowest tertile

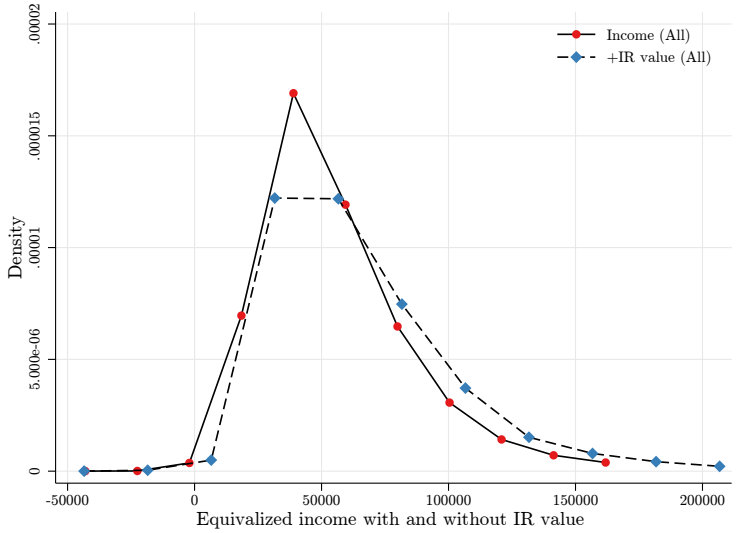
are 4% more likely to stay in the same income group. Children in the second tertile are not practically affected. Children in the highest tertile are 5% more likely to remain the richest. Thus, home ownership in Australia has an unmistakable effect on the tails of income distribution.

4.2 Inequality and polarization

Figure 5 shows both X^r and $X^{\overline{r}}$ for the whole Australian sample. The inclusion of IR unambiguously flattens the density (i.e., decreases polarization), but its effect on spread (i.e., inequality) is less clear. The left tail of X^r is less spread out, but the opposite tail appears to be slightly longer. The Gini coefficient would allow us to see whether the right tail eventually dominates the left one. Figure 6 shows the densities in relation to the 60+ age group. Without an IR value, the density has an obvious peak; however, the inclusion of an IR value noticeably depolarizes the peak. The effects of an IR value on inequality are more difficult to determine from the shape.

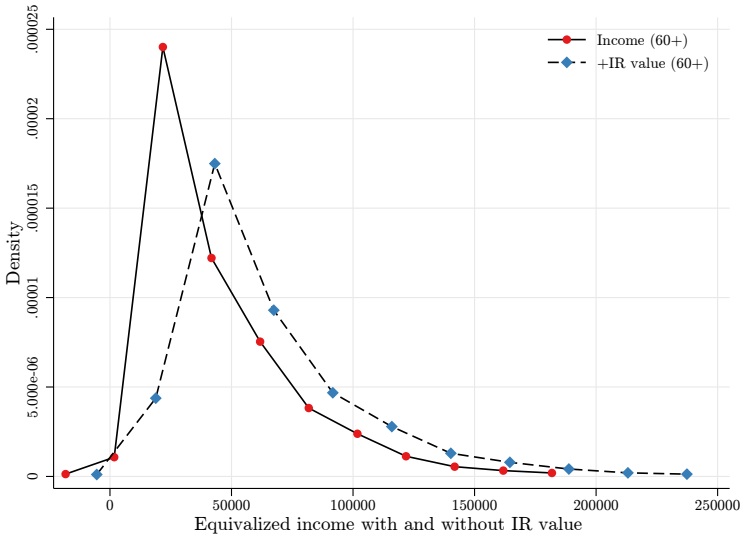
Table 6 sets out measurements of inequality according to the Gini coefficient. Similar to the results of Saunders and Siminski (2005) and Yates (1994), the inclusion of an IR value decreases inequality in Australia. Conversely, similar to the results of Garner and Short (2009), it marginally increases inequality in the United States, while in Germany inequality remains the same. These results reflect the fact that Germany has the lowest home ownership rate in

Figure 5: Income densities for Australia: full sample



Notes: Densities of equivalized income with and without IR value estimated with adaptive kernel (Van Kerm 2012).
Source: HILDA 2017.

Figure 6: Income densities for Australia: limited sample



Notes: Densities of equivalized income with and without IR value estimated with adaptive kernel (Van Kerm 2012).
Source: HILDA 2017.

Europe (Eurostat 2010), but slightly contradict the findings of J. Frick, Goebel, et al. (2014), who found a 1.3% decrease in the 2003 wave of SOEP; however, it should be noted that J. Frick, Goebel, et al. (2014) did not rely on CNEF harmonized data. In general, Germany is the most equal society, followed by Australia, and then the United States, and IR values have no effect on these countries' equality rankings.

The age restricted samples unmask a noticeable heterogeneity. The direction of the IR effect across restricted age groups is similar across all three countries. The IR value exacerbates inequality in the 0–15 age group, has a slight effect on the 15–60 age group, and noticeably decreases inequality in the 60+ age group. Australia, again, has the largest home ownership effect across all age groups, excepting the 15–60 age group (in relation to this age group, the effect is the strongest in the United States). The effect is not sufficiently strong to affect the country's ranking; however, values for the 0–15 age groups in Australia and Germany are very close to one another and may be reversed in a repeated sample. In a comparison of age groups within the countries, Australia again differs. If the IR value is not included, the inequality for the 60+ age group jumps by a staggering 23.1% in comparison with the 15–60 age group; however, if the IR value is included, this figure decreases to 14.8%. Although IR has an equalizing effect, the Australian 60+ age group is still the most unequal in comparison with fellow citizens of a younger age.

The absence of a universal governmental pension in Australia may induce

Table 6: Income inequity: Gini coefficient

	$E_{\alpha=0}$			
Age	All	0-15	15-60	60+
	Australia			
Income	0.307	0.268	0.288	0.373
+IR Value	0.300	0.279	0.290	0.333
Change	-0.007	0.010	0.002	-0.040
% Change	-2.3%	3.9%	0.8%	-10.8%
N	23415	5084	14098	4750
N, share	100%	22%	60%	20%
	United States			
Income	0.438	0.420	0.430	0.476
+IR Value	0.441	0.432	0.435	0.457
Change	0.002	0.012	0.006	-0.019
% Change	0.6%	2.8%	1.3%	-4.0%
N	20873	5821	13441	2133
N, share	100%	28%	64%	10%
	Germany			
Income	0.297	0.266	0.302	0.299
+IR Value	0.296	0.268	0.303	0.296
Change	0.000	0.002	0.001	-0.002
% Change	-0.1%	0.8%	0.3%	-0.7%
N	27677	4471	17286	6362
N, share	100%	16%	62%	23%

Notes: Income is disposable and equivalized. Calculations are performed with a code by Gradin (2014).
Source: HILDA 2017, PSID 2007, SOEP 2006.

inequality among elderly people, who rationally respond by accumulating property, as it is exempt from the asset test. This result speaks to previous works that analyze the Australian asset test (Cho and Sane 2013; Kudrna and Woodland 2011).

Table 7 sets out the measures in relation to polarization. Germany is the least polarized country, followed by the United States and Australia. In relation to the United States, the results reflect those of Duclos, Esteban, et al. (2004), who show that density in the United States is quite unique for its flatness in the middle, but contradict their findings in relation to Australia, whose level of polarization is equal to that of the United States. It should be noted that their study uses the Luxembourg Income Study: the 1991 wave for the United States and the 1994 wave for Australia. Going back to Table 7, the inclusion of home

Table 7: Income polarization

	$E_{\alpha=1.6}$			
Age	All	0-15	15-60	60+
	Australia			
Income	0.124	0.327	0.254	0.441
+IR Value	0.102	0.330	0.218	0.281
Change	-0.022	0.003	-0.037	-0.160
% Change	-17.7%	0.9%	-14.4%	-36.3%
N	23415	5084	14098	4750
N, share	100%	22%	60%	20%
	United States			
Income	0.031	0.250	0.043	0.640
+IR Value	0.030	0.259	0.042	0.580
Change	-0.001	0.009	-0.001	-0.060
% Change	-2.4%	3.6%	-2.6%	-9.4%
N	20873	5821	13441	2133
N, share	100%	28%	64%	10%
	Germany			
Income	0.018	0.301	0.037	0.073
+IR Value	0.018	0.301	0.037	0.071
Change	0.000	0.000	0.001	-0.002
% Change	0.0%	0.2%	1.4%	-2.1%
N	27677	4471	17286	6362
N, share	100%	16%	62%	23%

Notes: Income is disposable and equivalized. For readability, measurements are multiplied by 1,000,000. Calculations are performed with a code by Gradin (2014).
Source: HILDA 2017, PSID 2007, SOEP 2006.

ownership has no effect on German polarization, marginally decreases American polarization, but drastically decreases Australian estimates. An inspection of the effect by the age groups demonstrates that a sizable contribution is made not by respondents from the 60+ age group, but by the 15–60 age group (note that the 15–60 age group is three times larger than the 60+ age group).

Thus, IR value has a similar effect on inequality and polarization in the 60+ age group, but an opposite effect in the 15–60 age group. In relation to the 60+ age group, a decrease in polarization suggests less clustering; however, a decrease in both polarization and inequality suggests that the distance across both individuals and income groups becomes smaller. In relation to the 15–60 age group, a decrease in polarization again suggests that there is less clustering;

however, an increase in inequality suggests that the distance across individuals becomes larger.

5 Conclusion

This paper has used three harmonized national panels from Australia, the United States and Germany to measure the effect of home ownership on income inequality, polarization and intergenerational mobility. Australia is the only country in which home ownership drastically changes all three measures. On average, members of Australian society become 22.8% less mobile, as measured by IRC, after accounting for home ownership. The transition matrices further show that values become more concentrated on the leading diagonal. The lower tertile is 4% more concentrated on the leading diagonal, while the higher tertile is 5% more concentrated on the leading diagonal. Further, among elderly people, home ownership changes inequality by –10.8% and polarization by –36.3%, while among working age people, it changes inequality by 0.8% and polarization by –14.4%.

As the first Canberra Group report (2001) notes, the under coverage of property and self-employment income, own account production, IR of owner-occupied dwellings, in-kind social transfers, capital gains, and other unrealized income from wealth are major issues that need to be addressed to expand internationally comparable income measures. The results of this paper reinforce the Canberra Group's recommendations that all in-kind income sources must be included.

Notably, the results change understandings of mobility in Australia and challenge the best available calculations performed by Deutscher and Mazumder (2019) on tax data. Generally, calculations based on tax data are impressive in precision; however, they may be biased, since the data is not representative of income, as the Australian example shows. Many sources of income from capital (e.g., interest income, returns on pension funds and IR) may not be included in an income tax base, as these types of income are fully exempt from taxation or may be taxed separately. Thus, Deutscher and Mazumder's (2019) comparison of their calculations to American and Swedish calculations is not very well grounded, albeit all three use tax data.

6 Additional Result

This section examines why IR value has a different effect on intergenerational mobility across different age groups when measured by IGE or IGC, but not when measured by IRC (see Table 4).

Table 8 and Table 9 consider IGE and IRC, respectively, in relation to age across all three countries by allowing the slope to vary by the different cohorts. IRC estimates fall within each other's confidence intervals and the enormous effects related to IR values persist across all of the age groups in Australia. This is not true of the IGE results. The German estimates are not informative, as only the coefficient for the 1975 cohort differs statistically from zero. American estimates are positive, but again are barely affected by IR value. Among Australians aged 29–32, the IR value decreases IGE, but for the other age groups increases it substantially.

These differences are next explored using quantile regression (QR), another

Table 8: Intergenerational persistence of income by age: IRC

	$P \times \mathbb{1}\{Age\}$						
Age	32	31	30	29	28	27	26
	Australia						
Cohorts	1985	1986	1987	1988	1989	1990	1991
Income	0.197	0.114	0.184	0.134	0.175	0.140	0.201
+IR value	0.247	0.154	0.216	0.167	0.202	0.178	0.242
Change	0.050	0.040	0.032	0.033	0.027	0.038	0.041
% Change	25.6%	35.4%	17.5%	24.4%	15.5%	27.3%	20.5%
	United States						
Cohorts	1975	1976	1977	1978	1979	1980	1981
Income	0.435	0.394	0.376	0.392	0.402	0.357	0.448
+IR value	0.448	0.402	0.387	0.400	0.410	0.363	0.454
Change	0.013	0.008	0.011	0.007	0.008	0.006	0.006
% Change	2.9%	2.1%	2.8%	1.8%	1.9%	1.8%	1.4%
	Germany						
Cohorts	1974	1975	1976	1977	1978	1979	1980
Income	0.134	0.146	0.129	0.151	0.133	0.112	0.139
+IR value	0.137	0.155	0.136	0.153	0.138	0.115	0.144
Change	0.002	0.009	0.007	0.002	0.005	0.003	0.005
% Change	1.8%	6.3%	5.8%	1.2%	3.5%	2.4%	3.4%

Notes: Income is disposable. Parent and Child's income are averaged for 5 years and 2 years, respectively.
Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

Table 9: Intergenerational persistence of income by age: IGE

	$\ln X \times \mathbb{1}\{Age\}$						
Age	32	31	30	29	28	27	26
	Australia						
Cohorts	1985	1986	1987	1988	1989	1990	1991
Income	0.313	0.232	0.168	0.150	0.133	0.135	0.175
+IR value	0.290	0.200	0.140	0.136	0.142	0.184	0.273
Change	-0.023	-0.032	-0.028	-0.014	0.009	0.049	0.098
% Change	-7.3%	-13.8%	-16.7%	-9.3%	6.8%	36.3%	56.0%
	United States						
Cohorts	1975	1976	1977	1978	1979	1980	1981
Income	0.485	0.481	0.481	0.459	0.452	0.443	0.436
+IR value	0.490	0.484	0.483	0.459	0.451	0.441	0.433
Change	0.005	0.003	0.002	0.000	-0.001	-0.002	-0.003
% Change	1.0%	0.6%	0.4%	0.0%	-0.2%	-0.5%	-0.7%
	Germany						
Cohorts	1974	1975	1976	1977	1978	1979	1980
Income	0.144	0.160	0.144	0.125	0.110	0.052	0.008
+IR value	0.138	0.162	0.149	0.131	0.115	0.050	-0.002
Change	-0.006	0.002	0.005	0.006	0.005	-0.002	-0.010
% Change	-4.2%	1.3%	3.5%	4.8%	4.5%	-3.8%	-125.0%

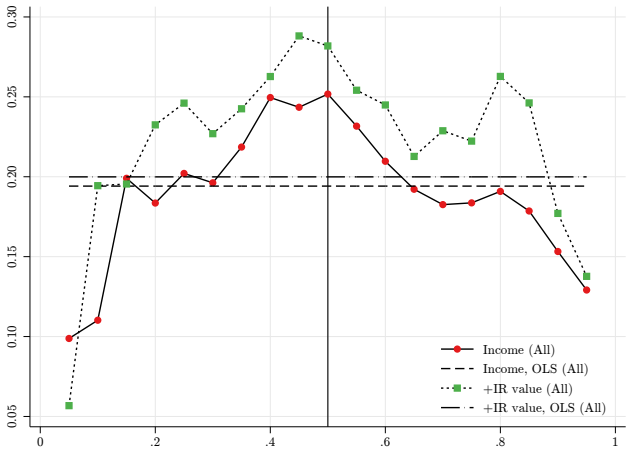
Notes: Income is disposable. Parent and Child's income are averaged for 5 years and 2 years, respectively.
Source: HILDA 2001–2017, PSID 1991–2007, SOEP 1990–2006.

tool for measuring intergenerational income persistence. In the United States, Grawe (2004) uses this tool on a sample of 354 observations and finds that IGE is higher at the median than at the tails (i.e., an inverse U-shaped pattern). Similarly, Eide and Showalter (1999) examine a sample of 612 observations in the United States and find a continuous (almost linear) decrease in IGE as income distribution increased. More recently, Palomino et al. (2018) consider 25,084 observations and find a pronounced U-shape pattern in relation to quintile estimates. Estimates for Brazil by Tejada et al. (2015) show a similar pattern to the estimates found for the United States by Palomino et al. (2018) (i.e., IGE has higher values at both ends of the income distribution). Bratberg et al. (2007) apply QR in relation to earnings data from Norway and find that the relationship between IGE and earnings distribution positions decreases (i.e., IGE is higher at the bottom tail, but lower at the top of the earnings distribution).

Figure 7 and Figure 8 show IGE results estimated from a QR for the full sample and for a sample restricted to the 29–32 age group (an age group that

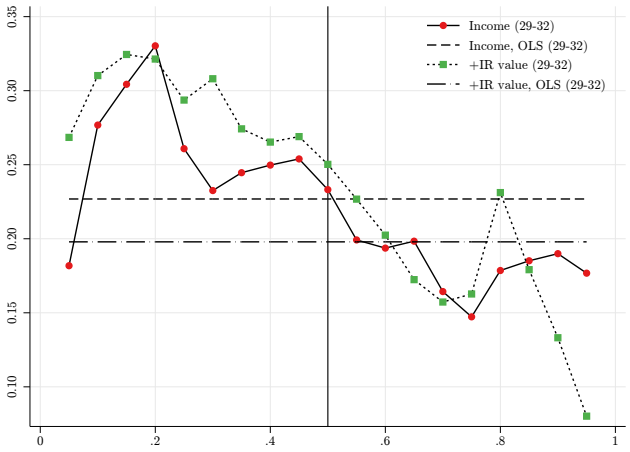
demonstrates the irregularity of the IR value effect). Table 10 further summarizes the effects of IR value on both these figures.

Figure 7: IGE by quantiles for Australia: full sample



Notes: Intergenerational earning elasticity by quintiles with and without IR value ($n = 924$) estimated with quantile regression (Koenker and Bassett 1978).
Source: HILDA 2001–2017.

Figure 8: IGE by quantiles for Australia: limited sample



Notes: Intergenerational earning elasticity by quintiles with and without IR value ($n = 522$) estimated with quantile regression (Koenker and Bassett 1978).
Source: HILDA 2001–2017.

The full sample shows that IR value usually increases IGE (as the main text of Table 4 shows). However, children who fall into the middle part of the distribution show the highest degree of intergenerational income persistence, while top incomes and, more specially, low incomes are more independent of childhood economic circumstances. These differences may reflect Bratsberg et al.'s (2007) famous study, which showed that in countries with strong social

Table 10: IGE by quantiles for full and limited samples

Quantiles	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95
Age										26-32									
Income	0.1	0.11	0.2	0.18	0.2	0.2	0.22	0.25	0.24	0.25	0.23	0.21	0.19	0.18	0.18	0.19	0.18	0.15	0.13
+IR value	0.06	0.19	0.2	0.23	0.25	0.23	0.24	0.26	0.29	0.28	0.25	0.24	0.21	0.23	0.22	0.26	0.25	0.18	0.14
Change	-0.04	0.08	0	0.05	0.05	0.03	0.02	0.01	0.05	0.03	0.02	0.03	0.02	0.05	0.04	0.07	0.07	0.03	0.01
% Change	-40%	73%	0%	28%	25%	15%	9%	4%	21%	12%	9%	14%	11%	28%	22%	37%	39%	20%	8%
Age										29-32									
Income	0.18	0.28	0.3	0.33	0.26	0.23	0.24	0.25	0.25	0.23	0.2	0.19	0.2	0.16	0.15	0.18	0.19	0.19	0.18
+IR value	0.27	0.31	0.32	0.32	0.29	0.31	0.27	0.27	0.27	0.25	0.23	0.2	0.17	0.16	0.16	0.23	0.18	0.13	0.08
Change	0.09	0.03	0.02	-0	0.03	0.08	0.03	0.02	0.02	0.02	0.03	0.01	-0	0	0.01	0.05	-0	-0.1	-0.1
% Change	50%	11%	7%	-3%	12%	35%	13%	8%	8%	9%	15%	5%	-15%	0%	7%	28%	-5%	-32%	-56%

Notes: Income is disposable. Parent and Child's income are averaged for 5 years and 2 years, respectively.
Source: HILDA 2001–2017.

security the relationship between the log earnings of sons and fathers is flat in the lower segments of fathers' earnings distributions and is increasingly positive. Thus, sons who grow up in the poorest households have the same earnings prospects as adults as sons who grow up in moderately poor households.

Further, IR value unequivocally increases intergenerational income persistence across all quantiles, except at the left most end of the tail. The shape of the curve remains about the same, excepting the pronounced spikes at the 8th and 8.5th quantiles. For example, a hypothetical shift in one dollar of parental income without an IR value would shift children's average income in the 8.5th quantiles by 0.18, but with an IR value would shift it by 0.25 (a 39% increase). In Australia, home ownership represents a remarkable portion of capital income and is attained by only the richest of individuals. It may be that as higher earners do not need mortgages, the correlation between parental and children incomes at the upper part of the distribution is higher.

Notably, when the sample is restricted to those aged 29–32, the results differ. IGE increases up until the second percentile, but then decreases. In the higher quantiles, the IR value decreases the intergenerational income persistence; however, in the lower quantiles, the IR value increases the persistence. Thus, later in life, home ownership appears to have a greater effect on relatively poor households, while its effects on mid- and high-income households are fairly negligible. This may be because education and social networks matter more for high income earners.

The most striking effect occurs on the edges of the distribution. If IR values are not included, the estimates on the edges are fairly close to one another; however, if IR values are included, the persistence of intergenerational income mobility on the lower edge of the distribution is clearly higher. At the 0.5th percentile, IGE increases from 0.18 to 0.27 (a 50% increase). At the 9.5th percentile, IR value decreases the persistence from 0.18 to 0.08 (a –56% decrease). Australian public policies that aim to equalize opportunities are more valuable for those in the lower quantiles; however, it appears that home ownership is

having a strong opposite effect.

It should be noted that this analysis is seriously limited by the available data; however, the results do suggest that IR values may have a different effect on different portions of children's life cycles. This could represent an interesting area for future analysis as the HILDA dataset grows.

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