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Keywords

progressive taxes, redistributive transfers, consumption insurance, incomplete markets

JEL Classification

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Abstract

Using household survey data for the U.S. and Australia, we quantify the role of taxes and transfers in providing consumption insurance against income risk. While the two countries differ substantially in their degree of tax and transfer progressivity and the extent to which it reduces the variability of disposable income, we find using a semi-structural model of income, net taxes, and consumption that the overall role of taxes and transfers in affecting the elasticity of consumption with respect to permanent income shocks is similar, with an estimated 5.4 percentage point reduction for the U.S. versus 4.8 for Australia. We interpret this result using a stylized life-cycle model with incomplete markets. Counterfactual analysis for a calibrated version of the structural model shows that, while higher progressivity increases the role of taxes in providing consumption insurance, these effects are partially mitigated by less self-insurance given higher marginal tax rates. The level of wealth relative to income also reduces the effects of progressivity on consumption insurance. Thus, higher wealth-to-income ratios in Australia can explain why, despite higher progressivity, the impact of taxes and transfers on consumption insurance is similar to the U.S.

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1 Introduction

In most economies, income taxes are an important source of government revenue. In addition to generating revenue, the progressivity of these taxes, coupled with government transfers, provides insurance to households against adverse income shocks. When a household encounters a negative income shock, progressive taxes automatically reduce the household's tax obligation. In extreme cases, such as unemployment or disability, government transfers serve as insurance for the household. This paper explores whether progressive taxes and transfers significantly improve households' overall ability to insure against idiosyncratic income risk. This helps further our understanding of the insurance role of taxes and transfers (Hoynes and Luttmer, 2011, Blundell, Graber and Mogstad, 2015, De Nardi, Fella, Knoef, Paz-Pardo and Van Ooijen, 2021, Stepner, 2019) and can potentially inform the design of optimal tax progressivity in the presence of self-insurance mechanisms (Conesa and Krueger 2006, Heathcote, Storesletten and Violante, 2017, Wu and Krueger, 2021, Ferriere, Grübener, Navarro and Vardishvili, 2023).

We empirically examine the consumption insurance embedded in the tax and transfer system for two countries, the U.S. and Australia, which differ substantially in the progressivity of their income taxes. To this end, we extend the standard semi-structural approach to estimating consumption insurance, allowing us to isolate the role of taxes and transfers using publicly available panel data from both countries. Specifically, our extended model allows for an additional permanent-transitory process for net taxes, which enables us to determine whether taxes and transfers play a significant role in mitigating the transmission of income shocks to consumption, thereby increasing consumption insurance. Our first, and possibly surprising, result is that the role of taxes and transfers in providing consumption insurance appears to be similar in the two countries. Taxes and transfers reduce the elasticity of consumption with respect to permanent income shocks by an estimated 5.4 percentage points in the U.S. versus 4.8 percentage points in Australia. This is despite the fact that more progressive taxes and transfers lower the standard deviation of income shocks substantially more in Australia compared to the U.S. These effects of taxes and transfers are also somewhat heterogeneous. In particular, it is younger cohorts that receive more insurance from taxes and transfers in the U.S., while the effects are more uniform across cohorts in Australia. Our second result is that, in the U.S., taxes provide more consumption insurance to households compared to transfers, whereas in Australia, taxes and transfers provide a similar level of consumption insurance.

To interpret our empirical findings, we consider a stylized life-cycle model with incomplete markets. Using a calibrated version of the structural model, we conduct counterfactual exercises to isolate how taxes and transfers interact with households' self-insurance mechanisms in mitigating the transmission of income shocks to consumption. Our first counterfactual exercise shows that, as tax progressivity increases, the role of taxes in reducing the transmission of shocks to consumption increases. However, although the social insurance provided by taxes is larger with higher tax progressivity, higher tax progressivity has an unintended consequence of decreasing consumption insurance via self-insurance as it lowers labor supply and wealth accumulation. Our second counterfactual exercise also highlights this interaction between social insurance and self-insurance. It shows that as wealth relative to income increases, overall consumption insurance increases but the role of taxes in providing consumption insurance diminishes. These results align with the view the social insurance provided by government taxes and transfers can crowd out the self-insurance from wealth accumulation thereby limiting the overall improvement in household consumption insurance from more progressive taxes and transfers (Feldstein and Liebman, 2002 and Gruber, 2015).

The results from our structural model help to reconcile our empirical finding that, despite higher progressivity and a larger reduction in the variability of income shocks, the role of taxes and transfers in mitigating the transmission of income shocks to consumption in Australia is similar to that of the U.S. In particular, Australian households have higher wealth-to-income ratios on average compared to U.S. households[1] By comparing two countries which differ so sub-

[1]Higher wealth held by Australian households is partly due to a persistent housing boom that started in the mid-2000s. See Cho, Li and Uren (2021) and Cho, Li and Uren (2024c) for more details.

stantially in tax and transfer progressivity and wealth, we are thus able to provide insights into the underlying mechanisms that are relevant for consumption insurance, and in particular develop a more nuanced understanding of how tax and transfer progressivity affects household consumption insurance.

Related literature. The empirical analysis in our paper relates to the literature that measures the tax progressivity such as Benabou (2002), Heathcote et al. (2017). While progressive tax systems can distort decisions, they also provide partial insurance against idiosyncratic income shocks. We also contribute to the literature that measures the insurance value of progressive income taxes and transfers. Using administrative data from Norway and the Netherlands, Blundell, Graber and Mogstad (2015) and De Nardi, Fella, Knoef, Paz-Pardo and Van Ooijen (2021) demonstrate that taxes and transfers provide a significant amount of insurance by reducing the variances of permanent and transitory income shocks. Grant, Koulovatianos, Michaelides and Padula (2010) show that redistributive taxation and the standard deviation of consumption are negatively correlated across households in the U.S. Similarly, Hoynes and Luttmer (2011) show using PSID data that the insurance value of state tax-and-transfer programs is increasing in income. Using Canadian tax records data, Stepner (2019) finds that taxes and transfers reduce income risks associated with layoffs and illness by 40% and 60%, respectively.

Our main methodological contribution to the literature is that we develop a semi-structural model that allows us to formally test whether the current tax and transfer system in the two countries plays a significant role in providing consumption insurance. Our framework enables us to measure both the reduction in the variability of post-government income relative to pre-government income due to taxes and transfers and how this variability in post-government income gets transmitted to consumption, which is usually the key variable of interest when considering household welfare. With reference to the existing literature such as Blundell, Pistaferri and Preston (2008), we find that simply examining the reduction in income shock variability does not suffice to conclude that taxes and transfers provide more consumption insurance. Thus, our analysis of consumption insurance builds on a large literature, also including Guvenen and Smith (2014), Blundell, Pistaferri and Saporta-Eksten (2016), Fella, Frache and Koeniger (2020), Chatterjee, Morley and Singh (2021), and Hryshko and Manovskii (2022).

We also contribute to the literature that links tax progressivity and consumption insurance using life-cycle models with incomplete markets. For instance, Wu and Krueger (2021) show a positive relationship between consumption insurance against shocks to male and female wages and tax progressivity. In our analysis, focusing on idiosyncratic household income shocks, we find that, while high tax progressivity increases the insurance value of taxes and transfers, it also lowers household wealth, which in turn reduces consumption insurance against income shocks. Thus, our contribution to this literature lies in emphasizing how tax progressivity and household wealth interact in determining the impact of taxes and transfers on household consumption insurance.

The remainder of this paper proceeds as follows. Section 2 describes the data. Section 3 provides the empirical analysis, including details and estimation of our extended semi-structural model. Section 4 presents counterfactual analysis based on a calibrated structural model. Section 5 concludes.

2 Data

In this section, we briefly describe the data used in our analysis. For full details, refer to Appendix A. For the U.S., we use biennial data from the Panel Study of Income Dynamics (PSID) from 1999-2019. For Australia, we use the Household Income and Labor Dynamics Australia (HILDA) dataset from 2006-2018. We consider both married and single households where the age of the household head is between 23 and 64. We drop households who had missing information on income and key demographic variables or had annual gross income growth higher than 500% or lower than negative 80%. We also drop households who report the annual expenditure on non-durable goods and services less than 100 or more than 500,000 U.S. dollars. We further drop households whose pre- and post-government incomes are less than 100 U.S. dollars per month. Finally, we drop households who have not appeared in the survey for two consecutive periods.

To ensure comparability of results between the two datasets, we apply an identical sampling strategy and use similar variables from the two surveys, except for instances where differences in survey design prevent us from doing so. Our key variables of interest are pre- and post-government income and consumption which we describe below.

Income and consumption in PSID. Following Heathcote et al. (2017), we use two measures of household income: (1) pre-government and (2) post-government income. Pre-government income includes income from labor, business and assets, private transfers, and 50% of FICA tax. Post-government income is pre-government income plus public transfers less total tax liabilities, obtained from NBER's TAXSIM.[2] Our consumption measure includes three broad categories: food, non-durables (excluding food), and housing. Food includes food at home and meals eaten out. Non-durable consumption includes expenditures on public transport, car fuel and maintenance, utilities, and health care services. Although we include the actual amount of rental payment for households in rental housing, we impute rent for homeowners. The annual imputed rent in our analysis is 6% of the self-reported housing value from the PSID survey based on the user-cost estimates of Poterba and Sinai (2010). We deflate income and consumption using the Consumer Price Index (CPI) obtained from the Bureau of Labor Statistics. The data is expressed in 2016 U.S. dollars (USD).

Income and consumption in HILDA. We apply the same definition of pre- and post-government income as in PSID. Pre-government is the total income from labor, business and investment, private pensions and private transfers. The HILDA survey directly reports public transfer and tax liabilities for every household in the survey. As a result, post-government income is pre-government income plus public transfers less income taxes.[3] Since the survey only started collecting rich

[2] Total tax liabilities include federal and state income taxes and the FICA taxes (both employer and employee shares).

[3] Public transfers in PSID include AFCD/TANF, SSI, other welfare receipts, unemployment benefits, workers' compensation, and veteran's pension. Public transfers in HILDA include government pensions, parenting payments, allowances, family payments, government bonus payments, other non-income support payments, and public scholarships. See Appendix C for more

data on expenditures in 2006, our sample starts in 2006 for Australia. As in the PSID, we use three broad categories of expenditure including food (groceries and meals eaten out), non-durable goods and services (public transport, motor vehicle fuel and maintenance, utilities, and healthcare services) and housing (rent and imputed rent). Based on the estimate in Fox and Tulip (2014), the imputed rent for homeowners is approximated as 4.2% of the self-reported housing value from HILDA. We deflate income and consumption using CPI from the Australian Bureau of Statistics. The data is expressed in 2016 Australian dollars (AUD).

3 Empirical analysis

In this section, we describe our empirical methods and discuss our findings using the PSID and HILDA data.

3.1 Estimates of tax progressivity

To estimate the income tax progressivity embedded in the tax code, we exploit the parametric tax function by Benabou (2002) that has been subsequently used in related literature such as Heathcote et al. (2017), among others.[4] In particular, the relationship between $Y_{g,i}$, the pre-government "gross" income, and $Y_{d,i}$, the post-government "disposable" income for household i is given as follows:

$$Y_{d,i} = \lambda Y_{g,i}^{1-\varsigma}. \tag{1}$$

Based on this relationship, ς, our key parameter of interest, captures the progressivity of the tax system while λ determines the average level of tax. We estimate ς and λ using ordinary least squares after taking logs of equation (1).

For the U.S., the estimate of ς is 0.167 and λ is 5.25. The implied break-even household income, $Y_{be} = \lambda^{1/\varsigma}$, is USD $20,527, where break-even income is the level below which the household would be a net receiver from the government

details.

[4]In the U.S., married households can either file jointly or individually. In Australia, adult members of a typical household file individually regardless of their marital status. However, to estimate consumption insurance within a household, our unit of analysis in estimating tax progressivity is the household.

with transfers exceeding tax liabilities. Our estimates are largely consistent with the related literature. Using PSID data for a shorter sample, 2000-2006, the estimate of ς in Heathcote, Storesletten and Violante (2017) is 0.181. Wu (2021) finds that the progressivity was 0.187 in the late 1970s and reduced to 0.137 in the 2010s. Finally, Holter, Krueger and Stepanchuk (2019) report a progressivity estimate of 0.137 for the U.S. using OECD data from 2000 to 2007.

For Australia, the estimate of ς is 0.238, λ is 13.3, and the break-even household income is AUD $52,731. Our estimate of ς for Australia is similar to that in Chang, Chang and Kim (2018), where the authors conduct the analysis for OECD countries and find $\varsigma = 0.243$ for Australia. While taxes are more progressive in Australia compared to the U.S and households in Australia pay more taxes relative to their pre-government income compared to the U.S. (0.18 versus 0.12), they also receive more transfers (0.08 versus 0.02). See Appendix C for more details.[5]

3.2 Semi-structural econometric model

As is standard in the related literature, we isolate the idiosyncratic components of income and consumption for each household in our sample by controlling for year and cohort effects, education, race, family size, number of children, presence of an outside dependent, presence of income recipients other than husband and wife, region, residence in a large city, and employment status, allowing for potentially time-varying effects of education, race, region, and employment status by interacting with time dummies. In particular, we regress logs of household pre-government gross income $Y_{g,it}$, post-government disposable income $Y_{d,it}$, and consumption C_{it} on a vector of controls X_{it} to isolate respective residual measures of idiosyncratic log incomes $y_{g,it}$ and $y_{d,it}$ and consumption c_{it} used in the estimation of consumption insurance. Specifically, letting $j \in \{g, d\}$ indicate either pre- or post-government income, the regression equations are given as follows:

$$\ln Y_{j,it} = \beta_j{}' X_{it} + y_{j,it} \tag{2}$$

$$\ln C_{it} = \beta_c{}' X_{it} + c_{it}. \tag{3}$$

[5] Many U.S. households receive subsidies in the form of tax credits, e.g., earned income and child care credits, reducing their tax liabilities. In contrast, Australian households receive such benefits through transfers. To make our definition of transfers more comparable across the two datasets, we add total tax credits to the measures of both taxes and transfers for U.S. households.

We can then define a residual idiosyncratic net tax measure as the difference between the residuals measures of pre-government gross and post-government disposable incomes $\delta_{it} \equiv y_{g,it} - y_{d,it}$.

Our semi-structural econometric model can be written in terms of an unobserved components representation for the idiosyncratic measures of income, net taxes, and consumption. The assumed process for each measure of idiosyncratic income of individual i at time t is given as follows:

$$y_{j,it} = \tau_{j,it} + \epsilon_{j,it} + \theta\epsilon_{j,it-1} \qquad \epsilon_{j,it} \sim i.i.d.(0, \sigma^2_{\epsilon,j}) \tag{4}$$

$$\tau_{j,it} = \tau_{j,it-1} + \eta_{j,it} \qquad \eta_{j,it} \sim i.i.d.(0, \sigma^2_{\eta,j}), \tag{5}$$

where, as specified below, $\tau_{j,it}$ denotes a common stochastic trend for income and consumption (i.e. "permanent income") driven by idiosyncratic permanent income shocks, $\eta_{j,it}$, such as promotion or major health shocks that affect the ability to work. Each household is also subject to idiosyncratic transitory income shocks, $\epsilon_{j,it}$, with temporary dynamic effects on income according to an MA(1) process with an assumed common parameter θ across the two measures of income.[6] Although the income shocks are assumed to be independent for a given j, we note that they will be correlated across $j \in \{g, d\}$.

Because our objective is to quantify the role of net taxes in providing consumption insurance to households, it is helpful for notational convenience when writing our assumed consumption function below to directly specify the implied process for δ_{it}. In particular, net taxes, as measured by δ_{it}, will have a permanent and transitory process as follows:

$$\delta_{it} = \mu_{it} + \omega_{it} + \theta\omega_{it-1} \qquad \omega_{it} \sim i.i.d.(0, \sigma^2_{\omega}) \tag{6}$$

$$\mu_{it} = \mu_{it-1} + \zeta_{it} \qquad \zeta_{it} \sim i.i.d.(0, \sigma^2_{\zeta}) \tag{7}$$

where, from equations (4) and (5), $\mu_{it} \equiv \tau_{g,it} - \tau_{d,it}$ and $\omega_{it} \equiv \epsilon_{g,it} - \epsilon_{d,it}$. These

[6] The assumption of a common θ across the two measures of income is for convenience in allowing the same identity relationship between transitory net tax shocks and the two transitory income shocks as what we assume for net taxes and the two measures of income. If the MA coefficients were different, the difference between the transitory income shocks would not be recoverable from the transitory net tax shocks. In practice, however, we find very similar estimated MA coefficients when considering the two different measures of income separately. Thus, this assumption of convenience in allowing us to specify our model in terms of net taxes is well supported by the data.

idiosyncratic shocks to net taxes are shocks that impact different parts of the income distribution and are not simply proportional to income. Examples of permanent shocks to net taxes, which we have denoted ζ_{it}, include changes to tax brackets and implementations of transfer policies such as universal basic income. Examples of transitory shocks to net taxes, which we have denoted ω_{it}, include tax evasion and audit shocks. An important assumption is the independence of the net tax shocks, which implies that the correlation between the income shocks across $j \in \{g, d\}$ is driven by common disposable income shocks.

To complete the model, we consider a consumption function in terms of permanent and transitory shocks to disposable income and net taxes as follows:

$$c_{it} = \gamma_\eta \tau_{d,it} + \gamma_\mu \mu_{it} + \kappa_{it} + \tilde{\gamma}_\epsilon \epsilon_{d,it} + \tilde{\gamma}_\omega \omega_{it} + v_{it} \qquad v_{it} \sim i.i.d.(0, \sigma_v^2) \tag{8}$$

$$\kappa_{it} = \kappa_{it-1} + \bar{\gamma}_\epsilon \epsilon_{d,it} + \bar{\gamma}_\omega \omega_{it} + u_{it} \qquad u_{it} \sim i.i.d.(0, \sigma_u^2), \tag{9}$$

where the additional stochastic trend of consumption κ_{it} partially reflects idiosyncratic permanent consumption shocks u_{it}, which could result from heterogeneous responses to wealth shocks, while idiosyncratic transitory consumption shocks v_{it} capture surprise household expenditures unrelated to income, idiosyncratic responses to aggregate shocks, or possibly random measurement errors in reported consumption. The key elasticity parameters that are relevant for our analysis are γ_η and γ_μ, which capture the responses of consumption to disposable income shocks and shocks to net taxes, respectively. Here $1 - \gamma_\eta$ corresponds to consumption insurance with respect to permanent disposable income risk. The other γ's capture the impact of transitory disposable income and net tax shocks on consumption. In particular, as in the specification in Blundell et al. (2008) and Chatterjee et al. (2021), $\bar{\gamma}_\epsilon$ captures the impact of transitory disposable income shocks on permanent consumption, while $\tilde{\gamma}_\epsilon$ captures an additional transitory effect of transitory disposable income shocks on consumption following Cho et al. (2024a). The parameters $\bar{\gamma}_\omega$ and $\tilde{\gamma}_\omega$ capture analogous effects of transitory shocks to net taxes.

Blundell et al. (2008) examine the role of taxes in providing consumption insurance against permanent shocks to income by estimating parameters for a simpler consumption function for pre- and post-government income separately and it is illustrative to consider what their approach would be estimating in the context of our model. In particular, we can consider simpler consumption functions in terms of pre- and post-government incomes as follows:

$$c_{it} = \gamma_{\eta,j}\tau_{j,it} + \kappa_{j,it} + \tilde{\gamma}_{\epsilon,j}\epsilon_{j,it} + v_{j,it} \qquad v_{j,it} \sim i.i.d.(0, \sigma^2_{v,j}) \tag{10}$$

$$\kappa_{j,it} = \kappa_{j,it-1} + \bar{\gamma}_{\epsilon,j}\epsilon_{j,it} + u_{j,it} \qquad u_{j,it} \sim i.i.d.(0, \sigma^2_{u,j}), \tag{11}$$

where, again, $j \in \{g, d\}$ and the simpler consumption functions look like the same form as equations (8) and (9), but omitting the terms for responses to net tax shocks.

In the case of disposable income (i.e., setting $j = d$), the simpler specification does not introduce any major issues for estimating the elasticities with respect to permanent and transitory income because the omitted terms will be implicitly captured by more volatile consumption shocks than in our model given the independence assumption for the net tax shocks in equations (6) and (7). That is, the consumption components for this simpler model will be related to our model according to $\kappa_{d,it} = \kappa_{it} + \gamma_\mu\mu_{it}$, $v_{d,it} = v_{it} + \tilde{\gamma}_\omega\omega_{it}$, and $u_{d,it} = u_{it} + \bar{\gamma}_\omega\omega_{it}$, with the estimated elasticities corresponding to the elasticities from our model such that $\gamma_{\eta,d} = \gamma_\eta$, $\tilde{\gamma}_{\epsilon,d} = \tilde{\gamma}_\epsilon$, and $\bar{\gamma}_{\epsilon,d} = \bar{\gamma}_\epsilon$.[7] At the same time, assuming the structure of our more general consumption function is correct, the estimates γ_η, $\tilde{\gamma}_\epsilon$, and $\bar{\gamma}_\epsilon$ may be more precise for our model given the use of more information in estimation.

In the case of gross income (i.e., setting $j = g$), the estimated elasticities for the simpler consumption function will be a mixture of the responses to disposable income and net tax shocks. In particular, using the process for net taxes in equations (6) and (7) and substituting into equations (10) and (11) for the components of gross income based on the identity $y_{g,it} \equiv y_{d,it} + \delta_{it}$, we get the following implied consumption function in terms of disposable income and net tax shocks:

$$c_{it} = \gamma_{\eta,g}(\tau_{d,it} + \mu_{it}) + \kappa_{g,it} + \tilde{\gamma}_{\epsilon,g}(\epsilon_{d,it} + \omega_{it}) + v_{g,it} \tag{12}$$

$$\kappa_{g,it} = \kappa_{g,it-1} + \bar{\gamma}_{\epsilon,g}(\epsilon_{d,it} + \omega_{it}) + u_{g,it}. \tag{13}$$

[7]There would be an implied dependence between $v_{d,it}$ and $u_{d,it}$ given the presence of ω_{it} in both components. However, in practice, we find that allowing for the dependence when estimating the simpler consumption function for $i = d$ barely affects the estimates compared to assuming independence of the shocks.

That is, the implied consumption function in equations (12) and (13) has the same form as the assumed consumption function in equations (8) and (9), except that the consumption responses to disposable income and net tax shocks are assumed to be the same as each other. In this sense, the coefficients in equations (12) and (13) will capture an averaging of the effects of disposable income and net tax shocks, with the weights on the underlying effects reflecting the relative importance of the shocks. Specifically, defining the difference in the effects of disposable income and net tax shocks as $\gamma_\mu^* \equiv \gamma_\mu - \gamma_\eta$, $\tilde{\gamma}_\omega^* \equiv \tilde{\gamma}_\omega - \tilde{\gamma}_\epsilon$, and $\bar{\gamma}_\omega^* \equiv \bar{\gamma}_\omega - \bar{\gamma}_\epsilon$ and assuming similar effects of one standard deviation shocks to disposable income and net taxes across models implies the following:

$$\gamma_{\eta,g} \approx \gamma_\eta + \frac{\sigma_\zeta}{\sigma_{\eta,d} + \sigma_\zeta} \gamma_\mu^* \tag{14}$$

$$\tilde{\gamma}_{\epsilon,g} \approx \tilde{\gamma}_\epsilon + \frac{\sigma_\omega}{\sigma_{\epsilon,d} + \sigma_\omega} \tilde{\gamma}_\omega^* \tag{15}$$

$$\bar{\gamma}_{\epsilon,g} \approx \bar{\gamma}_\epsilon + \frac{\sigma_\omega}{\sigma_{\epsilon,d} + \sigma_\omega} \bar{\gamma}_\omega^*. \tag{16}$$

When we estimate the joint and separate models, we find these approximations work well, at least in capturing the differences between estimates of the simpler consumption function using the two different measures of income.

Estimation is based on Quasi Maximum Likelihood Estimation (QMLE), as in Chatterjee et al. (2021) and Cho et al. (2024a), with the joint model corresponding to equations (4) and (5) for $j = d$ and equations (6), (7), (8), and (9) and the separate model corresponding to equations (4), (5), (10), and (11) for a given $j \in \{g, d\}$.

3.3 Role of taxes and transfers

Table 1 reports estimates of consumption elasticity with respect to permanent income shocks when estimating parameters for the simpler consumption functions separately using the pre- and post-government measures of income.[8] Broadly consistent with Blundell et al. (2008), we find that net taxes imply the perma-

[8] We report the full set of estimates including the standard deviations of income shocks in Table D.1 in Appendix D. Elasticity estimates for transitory income shocks are smaller, consistent with findings in Cho et al. (2024a), and also suggest some mitigation based on taxes and transfers, but of a magnitude of less than a percentage point. Thus, we focus on results for permanent income shocks in the main text.

Table 1: Estimates using post- and pre-government income separately

	Post-gov. income ($j = d$)	**Pre-gov. income** ($j = g$)
PSID		
$\sigma_{\eta,j}$	0.143 (0.003)	0.163 (0.004)
$\gamma_{\eta,j}$	0.300 (0.017)	0.259 (0.024)
$\gamma_{\eta,g} - \gamma_{\eta,d}$	-0.041	
N	6,572	
HILDA		
$\sigma_{\eta,j}$	0.108 (0.004)	0.149 (0.005)
$\gamma_{\eta,j}$	0.268 (0.038)	0.207 (0.020)
$\gamma_{\eta,g} - \gamma_{\eta,d}$	-0.061	
N	5,060	

Note: The table reports point estimates, with standard errors in parentheses, for separate estimation of semi-structural models of income and consumption using different measures of income.

nent income risk is lower for disposable than gross income. For the U.S. sample, the standard deviation of permanent income risk decreases by 12%, from 0.163 to 0.143, when considering post-government income instead of pre-government income. For the Australian sample, the decline is 28%, from 0.149 to 0.108. We also find that there is a higher estimated passthrough of permanent shocks to disposable income than gross income, suggesting that net taxes play a role in mitigating the transmission of permanent shocks to consumption and therefore provide consumption insurance. Moreover, we find that despite different estimated reductions in income risk, the estimated mitigation of the transmission of permanent income shocks to consumption is reasonably similar, 4 percentage points in PSID versus 6 percentage points in HILDA.[9]

Given separate estimation for pre-and post-government income, it is not straightforward to formally test whether the insurance provided by taxes and transfers is statistically significant. As a result, we proceed to consider our joint semi-

[9]The estimated mitigation is much smaller than the estimated 33 percentage point effect for the U.S. in Blundell et al. (2008), but this could be partly due to imprecision from the estimation method in Blundell et al. (2008) discussed in Chatterjee et al. (2021).

Table 2: Estimates based on the joint model

	PSID	HILDA
	(1)	(2)
$\sigma_{\eta,d}$	0.111 (0.002)	0.085 (0.002)
σ_{ζ}	0.033 (0.001)	0.049 (0.002)
γ_{η}	0.237 (0.016)	0.223 (0.014)
γ_{μ}	0.001 (0.005)	0.093 (0.032)
γ_{μ}^{*}	-0.237 (0.072)	-0.130 (0.018)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.054	-0.048
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-3.277	-7.196
t-statistic$_{H_0:\gamma_{\mu}=0}$	0.109	2.937
N	6,572	5,060

Note: The table reports point estimates, with standard errors in parentheses, for our joint semi-structural model of income, net taxes, and consumption.

structural model of income, net taxes, and consumption, where the formal test of equal effects for both measures of income is $H_0 : \gamma_{\mu} = \gamma_{\eta}$, which is equivalent to $\gamma_{\mu}^{*} = 0$ for the re-parameterization discussed above. In addition, we test whether $H_0 : \gamma_{\mu} = 0$, which corresponds to households not responding to net tax shocks at all.

Table 2 reports estimates related to the impact of net taxes on consumption insurance with respect to permanent income shocks for our joint semi-structural model. Our three key findings when considering all households in the samples, as in Table 1, are the following: First, the implied levels of consumption insurance, $1 - \gamma_{\eta}$, are 0.76 and 0.78, in the U.S. and Australia, respectively. In Cho et al. (2024a), where we also employed QMLE and used the 1998-2016 PSID sample, consumption insurance was estimated to be 0.68. Using the approach of Blundell et al. (2008) and PSID data from 1998-2018, Ghosh and Theloudis (2023) find that the level of consumption insurance is equal to 0.85. Second, we find that net taxes reduce the transmission of permanent income shocks by similar estimated amounts of 5.4 percentage points in the U.S. and 4.8 percentage points in Australia, which are broadly similar to what we found in Table 1. Third, we can reject the hypothesis $\gamma_{\mu} = \gamma_{\eta}$ that elasticities are the same for both measures of income at the 5% level for both countries. Thus, the mitigation by net taxes of the transmission of permanent income shocks is statistically significant. Furthermore, for the PSID sample, we fail to reject the null hypothesis that $\gamma_\mu = 0$. This indicates that U.S. households solely respond to shocks to disposable income, not to net tax shocks. However, we find that γ_μ is significantly positive, although less than γ_η, for the HILDA sample. This suggests that Australian households respond to net tax shocks beyond the changes in disposable income, possibly influenced by anticipation effects or prior knowledge of future taxes or transfers implied by the net tax shocks.

We also consider whether the insurance role of net taxes are heterogeneous across households based on their birth cohorts. The three birth cohorts that we consider are the cohorts born before 1960, between 1960-1979, and after 1979 in the two countries.[10] As reported in Table 3, younger cohorts, households born before 1979 and between 1960 and 1979, benefit more from net taxes in the U.S. where the estimates of the implied difference in elasticities, $\frac{\sigma_\zeta}{\sigma_{\eta,d}+\sigma_\zeta}\gamma_\mu^*$, are 8.0 and 5.8 percentage points. The oldest cohort exhibit the lowest implied difference at 3.7 percentage points. For Australia, the pattern is more similar across cohorts, with a reduction in the transmission of permanent income shocks to consumption of about 4 percentage points for each cohort.

3.4 Are redistributive taxes and transfers equally important?

We now examine whether redistributive taxes and transfers are equally important in mitigating the effects of income shocks on consumption. To answer this question, we isolate the independent implied role of taxes and transfers in providing consumption insurance to households via different channels. In the case of a progressive tax code, when the marginal tax rate is higher than average tax rate for all levels of income, it can alleviate the tax burden of households who experience negative income shocks. Likewise, the transmission of positive income shocks to consumption can be mitigated by a higher tax burden. Transfers, on

[10] Dividing our sample based on birth cohorts does not suffer from endogeneity issues and at the same time allows us to consider how taxes/transfers vary by age. In our PSID sample, the median ages for the birth cohort subgroups are 55 for households born before 1960, 39 for those born between 1960-1979, and 29 for those born after 1979. The corresponding numbers are 58, 43 and 28 in the HILDA sample.

Table 3: Net taxes and their role in providing insurance by birth cohort

	Born after 1979	**Born b/w 1960-79**	**Born before 1960**
	(1)	(2)	(3)
PSID			
$\sigma_{\eta,d}$	0.134 (0.004)	0.119 (0.003)	0.134 (0.005)
σ_{ζ}	0.040 (0.003)	0.034 (0.002)	0.044 (0.004)
γ_{η}	0.313 (0.029)	0.263 (0.023)	0.212 (0.028)
γ_{μ}	-0.036 (0.051)	0.003 (0.027)	0.064 (0.080)
γ_{μ}^{*}	-0.349 (0.106)	-0.260 (0.101)	-0.148 (0.070)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.080	-0.058	-0.037
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-3.294	-2.570	-2.111
t-statistic$_{H_0:\gamma_{\mu}=0}$	-0.703	0.102	0.805
N	1,992	2,610	1,970
HILDA			
$\sigma_{\eta,d}$	0.082 (0.003)	0.084 (0.002)	0.098 (0.005)
σ_{ζ}	0.039 (0.002)	0.053 (0.003)	0.060 (0.005)
γ_{η}	0.257 (0.039)	0.221 (0.024)	0.155 (0.029)
γ_{μ}	0.122 (0.060)	0.118 (0.101)	0.048 (0.050)
γ_{μ}^{*}	-0.135 (0.009)	-0.103 (0.043)	-0.107 (0.051)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.044	-0.040	-0.041
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-1.449	-2.405	-2.117
t-statistic$_{H_0:\gamma_{\mu}=0}$	2.010	1.174	0.960
N	1,831	2,132	1,097

Note: The table reports point estimates, with standard errors in parentheses, for our joint semi-structural model of income, net taxes, and consumption.

Table 4: Different effects of taxes and transfers

	Baseline	**Role of transfers**	**Role of taxes**
	(1)	(2)	(3)
PSID			
$\sigma_{\eta,d}$	0.111 (0.002)	0.111 (0.002)	0.111 (0.002)
σ_{ζ}	0.033 (0.001)	0.025 (0.002)	0.024 (0.000)
γ_{η}	0.237 (0.016)	0.234 (0.014)	0.255 (0.013)
γ_{μ}^{*}	-0.237 (0.072)	-0.180 (0.047)	-0.354 (0.046)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.054	-0.033	-0.062
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-3.277	-3.842	-7.621
N	6,572	6,572	6,572
HILDA			
$\sigma_{\eta,d}$	0.085 (0.002)	0.085 (0.002)	0.085 (0.002)
σ_{ζ}	0.049 (0.002)	0.043 (0.000)	0.017 (0.000)
γ_{η}	0.223 (0.014)	0.233 (0.013)	0.253 (0.016)
γ_{μ}^{*}	-0.130 (0.018)	-0.129 (0.020)	-0.228 (0.054)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.048	-0.043	-0.038
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-7.196	-6.297	-4.098
N	5,060	5,060	5,060

Note: The table reports point estimates, with standard errors in parentheses, for our joint semi-structural model of income, net taxes, and consumption.

the other hand, provide insurance by directly increasing resources available to some households. We examine these independent roles of taxes and transfers by repeating our analysis with the joint semi-structural model using two alternative measures of pre-government income when constructing net taxes δ_{it}. First, we use the original pre-government income plus tax liabilities for each household. The estimated implied difference $\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$ then captures the role of transfers in alleviating the transmission of permanent income shocks.[11] Second, to isolate the role of taxes, we use the original pre-government income plus transfers for each household.

[11]For the U.S data, we include tax credits in the definition of public transfers, as more than 60% of households receive tax credits such as the earned income tax credits and child care tax credits. This is consistent with how we consider family payments in Australia.

As reported in Table 4, both taxes and transfers independently and significantly reduce the transmission of permanent shocks to consumption. However for the U.S. households, progressive taxes reduce the transmission of shocks by more compared to redistributive transfers, with reductions of 6.2 versus 3.3 percentage points. By contrast, the roles of taxes and transfers are more similar in Australia, with a reduction of 4.3 percentage points for transfers and 3.8 percentage points for taxes. This could potentially be due to the fact that the median tax-to-pre-government income ratio is almost six times higher than the median transfer-to-pre-government income ratio in the U.S., while it is only 2.3 times higher in Australia (see Figures C–2 and C–3 in Appendix C).

3.5 Summary of main empirical findings

Before turning to our structural model, we summarize our main empirical findings as follows: First, Australia has a more progressive tax system than the U.S., with Australian households paying more taxes but also receiving more transfers. Second, we also find that taxes and transfers reduce the variability of permanent income shocks by more in Australia than they do in the U.S. Third, however, despite higher tax progressivity and a larger reduction in income risk variability in Australia, the overall amount of insurance provided by taxes and transfers is similar to that in the U.S. Fourth, taxes provide more insurance relative to transfers in the U.S., whereas taxes and transfers provide a similar level of insurance in Australia.

4 Structural model

In this section, we consider a stylized life-cycle model with incomplete markets to uncover the mechanisms through which taxes and transfers provide insurance against income risk. The model is partial equilibrium with endogenous labor supply.

4.1 Environment

There is a continuum of households who live up to T periods, working from ages $t = 1$ to $R - 1$ and retire at age R. Household i maximizes lifetime expected utility given by

$$\mathbb{E}_0 \left[\sum_{t=1}^{T} \beta^{t-1} u(C_{it}, H_{it}) \right] \tag{17}$$

where β is the discount rate, C_{it} is non-durable consumption and H_{it} is labor supply for household i in period t. The income of the household for each period during their working life is $Y_{it} = W_{it} H_{it}$, where W_{it} is the wage. During the working life, households receive a deterministic component of wages, χ_t, that depends on age t, but are also subject to permanent idiosyncratic wage risk as captured by τ_{it} given by $\tau_{it} = \tau_{it-1} + \eta_{it}$ where the permanent wage shock is $\eta_{it} \sim i.i.d.N(0, \sigma_\eta^2)$. The initial τ_{i0} is drawn from a Normal distribution with mean zero and variance $\sigma_{\tau 0}^2$. Households also encounter transitory wage risk $\varepsilon_{it} \sim i.i.d.N(0, \sigma_\varepsilon^2)$. The tax function on household labor income, as described in Section 3, is

$$T(Y_{it}) = Y_{it} - \lambda Y_{it}^{1-\varsigma}. \tag{18}$$

where λ and ς represent tax level and progressivity, respectively. Retired households do not face income risk and receive a fixed amount of retirement benefits, b. Households can save in a risk-free asset A_{it} which pays an exogenous return r.

4.2 Household problem

The state variables for a working-age household i of age $t \in \{1, ..., R-1\}$ are risk-free assets A_{it}, permanent income τ_{it}, and transitory income ε_{it}. The control variables are non-durable consumption C_{it}, labor supply H_{it}, and next period's risk-free assets A_{it+1}. For brevity, we drop subscripts i and t. The household problem in period t is given by

$$V_t(A, \tau, \varepsilon) = \max_{C,H,A'} u(C, H) + \beta \mathbb{E}_{(\tau'|\tau),\varepsilon'} \left[V_{t+1}(A', \tau', \varepsilon') \right]$$

subject to

$$\begin{aligned} C + A' &= (1+r)A + Y(\tau,\varepsilon) - T(Y(\tau,\varepsilon)) \\ A' &\geq \underline{A} \\ Y &= WH \end{aligned}$$

The problem for a retired household of age $t \in \{R, ..., T\}$ is identical except that the household does not supply labor and hence does not encounter any income risk. They receive retirement benefit b in each period.

The period utility function during working-age is:

$$u(C,H) = \frac{C^{1-\theta}}{1-\theta} - \varphi \frac{H^{1+\frac{1}{\nu}}}{1+\frac{1}{\nu}}$$

where θ is the risk aversion coefficient while the parameters φ and ν govern the disutility from supplying labor and the Frisch elasticity of labor supply, respectively. The period utility function for a retired households simplifies to:

$$u^{\text{ret}}(C) = \frac{C^{1-\theta}}{1-\theta}.$$

4.3 Calibration

In calibrating our model, we choose values for all but five parameters externally. The remaining five parameters are calibrated internally to match model moments with corresponding data moments from our PSID sample. All our data moments are calculated using the data for 2016. Table 5 reports the values of both externally and internally calibrated parameters, while Table 6 reports the data and moments used to calibrate four parameters of the model. Note that we normalize variables in monetary values using the household median labor income, which is \$63,315 in 2016 dollars.

The model period is one year. Households enter the economy at age 23, work until age 64, and retire thereafter. Households die with certainty at age 82. Thus, households work for 42 years and live for 60 years, i.e. $R = 43$ and $T = 60$. All households start their life-cycle with zero wealth. The annual return on the risk-free asset, r, is 2% and the discount factor, β, is 0.980. Following the macroeconomic literature, the risk aversion parameter, θ, is 2, and the Frisch elasticity, ν, is 0.5.

Table 5: Model parameters

Parameter	Description	Value
T	Length of life	60
R	Retirement age	43
r	Return on risk-free asset	0.02
β	Discount factor	0.98
θ	Risk aversion	2
ν	Frisch elasticity	0.5
χ_t	Deterministic component of wages	PSID
σ_ϵ^2	Var. of transitory wage shock	0.05
ς	Tax progressivity	0.132
λ	Level of tax	3.693
φ	Disutility from labor	46
σ_η^2	Var. of permanent wage shock	0.01
$\sigma_{\tau 0}^2$	Var. of initial permanent income	0.635
$\underline{A}$	Borrowing constraint	0.255
b	Retirement benefit	0.431

Table 6: Internally calibrated parameters and target moments

Parameters	Target moments	Data	Model
φ	Mean household income	1.291	1.295
σ_η^2	Mean variance of before-tax income	0.647	0.691
$\sigma_{\tau 0}^2$	Mean variance of before-tax income for ages 23-30	0.513	0.514
$\underline{A}$	Debt-to-income ratio (mean-to-mean)	0.289	0.288
b	Wealth to income ratio (mean-to-mean)	2.309	2.315

We extract the deterministic age profile of wages, χ_t, from our PSID data.[12] The variance of the transitory wage shock is set at 0.05 following Kaplan and Violante (2010). We estimate the tax parameters based on household labor income data from our PSID sample and obtain $\varsigma = 0.132$ and $\lambda = 3.69$.[13]

Finally the five internally calibrated parameters are φ, σ^2_η, $\sigma^2_{\tau 0}$, $\underline{A}$, and b. The disutility of labor supply is set to $\varphi = 46$ to match the mean household income in our PSID sample. We calibrate the variance of permanent income shocks to match the average variance of before-tax income over the life cycle by setting $\sigma^2_\eta = 0.01$. The variance of the initial permanent income shock is set to 0.653 to match the variance of before-tax income at age 23. We impose the natural debt limit such that households do not die in debt in period T. The borrowing constraint parameter is set to $\underline{A} = 0.255$, which corresponds to \$16,145, to match the ratio of the mean (liquid) debt to the mean annual income for households age between 23 and 35, which is 0.289 in the data. The retirement benefit is set to $b = 0.431$, which corresponds to \$27,300, to match the mean wealth to the mean income ratio in the data.[14] This is comparable to the average pension income in our PSID data, which is \$28,798 in 2016.

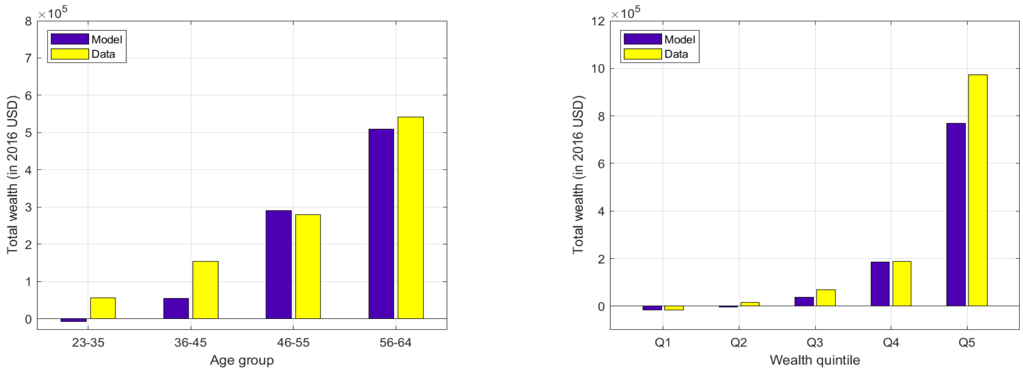
4.4 Model fit

Wealth profiles. Figure 1 plots wealth by age and wealth quintile. The purple and yellow bars represent the mean wealth from the model and data (PSID), respectively. Panel (a) shows that the average wealth increases over the life-cycle although the model underestimates the average wealth for younger households and overestimates for older households. Panel (b) shows that the average wealth is increasing in wealth quintile but the model slightly underestimates the averages. Overall, the model is able to capture not only the average wealth level for all households, as reported in Table 6, but also the qualitative and quantitative

[12]Specifically, it is the estimate of the age coefficients in a regression of the logarithm of wages on age, age squared and year fixed effects using our PSID sample.

[13]Note that based on the measures of pre-government and post-government income, we reported $\varsigma = 0.167$ and $\lambda = 5.25$ in Section 3. As the structural model abstracts from the full institutional setting of the U.S. economy, we replaced the income measure with household labor income from PSID and estimated ς and λ again using the TAXSIM program.

[14]In the data, we define wealth as the sum of cash, bonds, share, business asset, pension, housing asset, car less credit card debt, student debt, and mortgages.



(a) Mean wealth by age (b) Mean wealth by wealth quintile

Figure 1: Average wealth across age groups and wealth quintile: Model vs. Data

patterns and the levels of wealth based on age and wealth quintiles reasonably well.

Life-cycle variances. Figure 2 plots the variances of logarithms of before-tax income, after-tax income, and consumption over the life cycle in the data and implied by our model.[15] The mean variances of logarithm of before-tax income, after-tax income, and consumption in the model are 0.691, 0.521 and 0.353, respectively. In the data, the corresponding values are 0.647, 0.479, and 0.310. As displayed in Figure 2, our model also performs well in matching these moments over the life cycle. In general, while the variance of log income, which is also a proxy for inequality, increases over the life cycle due to the permanent income shocks, the variance of consumption is flatter suggesting that there is less of consumption inequality.

Consumption insurance and the insurance role of taxes and transfers. We compare the model-implied consumption insurance with respect to the permanent income shock with the estimate from our PSID sample. To this end, we use simulated data from our calibrated model and regress $\log Y_{it}$ and $\log C_{it}$ on age fixed effects to obtain idiosyncratic before-tax and after-tax (labor) income y_{it} and consumption c_{it}. Using our empirical approach outlined in Section 3 and estimating the parameters of the simpler consumption functions separately using

[15] Following Aguiar and Hurst (2013), we compute the life-cycle variances of income and consumption by controlling for age, year, family size, and the number of children.

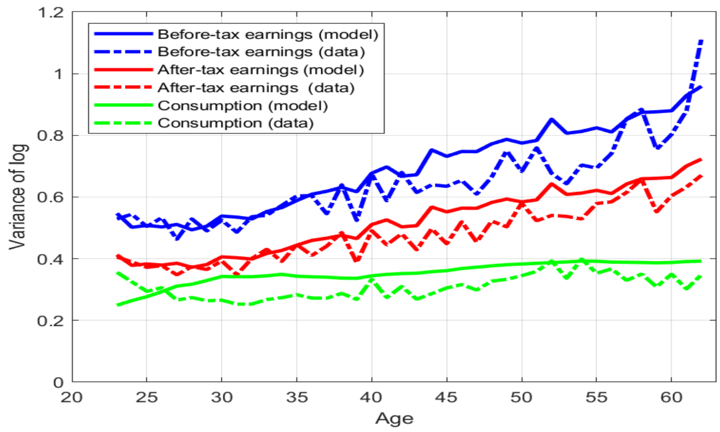


Figure 2: Life-cycle profiles of variances for labor income and consumption

before-tax and after-tax income, the calibrated model generates $\gamma_{\eta,d} = 0.70$ and $\gamma_{\eta,g} = 0.61$. For our PSID sample, $\hat{\gamma}_{\eta,d} = 0.30$ and $\hat{\gamma}_{\eta,g} = 0.26$. The standard incomplete markets model's inability to match the level of consumption insurance seen in the data is however widely known and was first noted in Kaplan and Violante (2010). In addition, the calibrated model overestimates the role of taxes and transfers in providing insurance, potentially because the model underestimates the wealth distribution as seen in Figure 1, compared to our PSID sample, with a 9 percentage point mitigation in the calibrated model versus an estimated 4.1 percentage points in the PSID data as seen in Table 1 when we estimate the elasticities separately.

4.5 Uncovering the mechanisms

We use the structural model to understand our empirical finding that, despite having different levels of tax progressivity, the amount of insurance provided by taxes and transfers is similar between the U.S. and Australia. To uncover the mechanisms underlying this result, we consider two counterfactuals, one in which we vary the tax progressivity and the other in which we vary the wealth-to-income ratio.

In Table 7, we report the estimates of the simpler consumption functions using before-tax and after-tax income while varying the progressivity parameter ς. The difference between the estimates of $\gamma_{\eta,g}$ and $\gamma_{\eta,d}$ helps us understand the role of taxes and transfers in providing consumption insurance. Apart from our baseline

Table 7: Model-based estimates of elasticity with varying tax progressivity

	(1) $\varsigma = 0.050$	(2) $\varsigma = 0.132$	(3) $\varsigma = 0.200$	(4) $\varsigma = 0.300$
$\gamma_{\eta,d}$	0.695	0.702	0.706	0.712
$\gamma_{\eta,g}$	0.661	0.609	0.565	0.498
$\gamma_{\eta,g} - \gamma_{\eta,d}$	-0.035	-0.092	-0.141	-0.213
Δ in wealth (%)	9.42	–	-7.56	-18.14
Δ in labor supply (%)	3.34	–	-0.81	-7.26

Notes: The table reports the estimates of elasticity and percentage changes in wealth and labor supply using the simulated data from the model for different values of tax progressivity.

calibration, reported in column (2), we consider three other values of ς, 0.05, 0.20, and 0.30.[16] There are two results to highlight in particular.

First, the estimate of $\gamma_{\eta,d}$ increases with ς. Thus, higher tax progressivity has the unintended consequence of reducing overall consumption insurance, $1 - \gamma_{\eta,d}$, primarily through the wealth channel in which households endogenously accumulate less wealth when taxes are more progressive. The second last row of Table 7 presents the percentage changes in average wealth for different ς. We observe that, in the model when $\varsigma = 0.05$, the average wealth increases by 9.4% relative to the baseline case where $\varsigma = 0.132$ and, when $\varsigma = 0.30$, it decreases by 18% relative to the baseline case. Therefore, as indicated in the first row of Table 7, the level of consumption insurance decreases as ς increases due to a wealth effect.[17] Also, relative to the baseline case, we note that the average labor supply rises by 3.3% with $\varsigma = 0.05$, but falls by 7.3% with $\varsigma = 0.30$.[18]

Second, the role of taxes in providing consumption insurance increases with higher tax progressivity, see row 3 in Table 7. To understand this result, consider

[16] We also considered the revenue neutral case where we alter the tax level parameter λ when varying ς to preserve revenue neutrality. Our results are robust.

[17] Cho et al. (2024a) and Cho, Kim and Kim (2024b) find that consumption insurance is positively related to household wealth using household survey data in the U.S. and South Korea, respectively.

[18] The decrease in labor supply indicates that in our economy the substitution effect is stronger than the income effect, where the former lowers labor supply and the latter increases labor supply as tax progressivity increases. Wu (2021) also shows a negative relation between labor supply and tax progressivity.

Table 8: Model-based estimates of elasticity with varying wealth-to-income ratio

	(1) $\frac{\mathbb{E}(A)}{\mathbb{E}(Y)} = 1.00$	(2) $\frac{\mathbb{E}(A)}{\mathbb{E}(Y)} = 2.31$	(3) $\frac{\mathbb{E}(A)}{\mathbb{E}(Y)} = 3.50$
$\gamma_{\eta,d}$	0.802	0.702	0.635
$\gamma_{\eta,g}$	0.696	0.609	0.552
$\gamma_{\eta,g} - \gamma_{\eta,d}$	-0.105	-0.092	-0.084

Notes: The table reports the estimates of elasticity using simulated data from the model for different values of wealth-to-income ratio.

the marginal tax rate (MTR) implied by our tax function:

$$MTR = \frac{\partial T(Y)}{\partial Y} = 1 - \lambda(1-\varsigma)Y^{-\varsigma}.$$

Given that $0 < \varsigma < 1$ and $\lambda > 1$, one can show that $\frac{\partial \text{MTR}}{\partial \varsigma} > 0$ for $Y > e^{-\frac{1}{1-\varsigma}}$.[19] Thus, given the range of ς, we have a case where an increase in ς leads to an increase in the marginal tax rate. With a higher marginal tax rate, households can receive more insurance from progressive taxes in the event of a negative shock, as their tax liability would be reduced more compared to when the MTR is lower. Similarly, a higher MTR absorbs positive income shocks by increasing households' tax liability. The insurance role of taxes would therefore improve with a higher MTR. Given that the progressivity is higher in Australia compared to the U.S., one would expect taxes and transfers to play a larger role in providing consumption insurance in Australia compared to the U.S. based on this mechanism alone.

Next, we consider a second counterfactual experiment in which we vary wealth-to-income ratios by changing the discount factor. In columns (1) to (3) of Table 8, with column (2) as the baseline case, we see that, as wealth-to-income ratio increases, consumption insurance $1 - \gamma_{\eta,d}$ increases. Again, this is driven by a wealth channel where consumption insurance is positively correlated with household wealth. Consistent with our first counterfactual exercise, we also find that the role of taxes in providing insurance decreases monotonically with the wealth-to-income ratio. When households have low wealth relative to income,

[19] See Appendix E for more details.

Table 9: The estimates of γ_η from the simulated data: by age

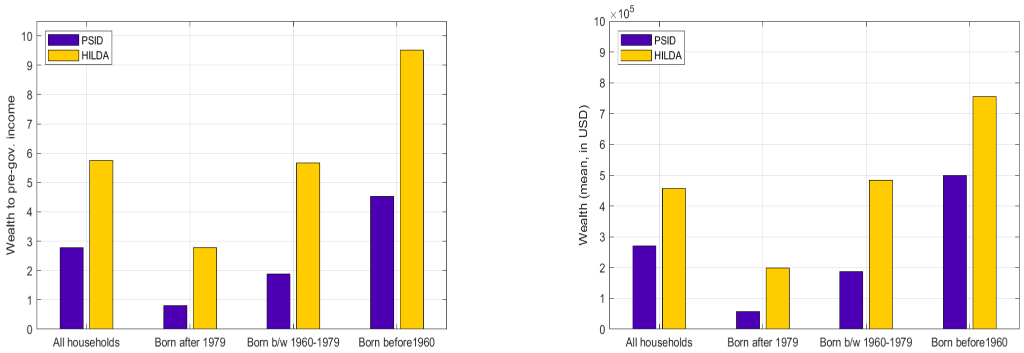
	(1) Age < 40	(2) Age ≥ 40
$\gamma_{\eta,d}$	0.899	0.524
$\gamma_{\eta,g}$	0.780	0.455
$\gamma_{\eta,g} - \gamma_{\eta,d}$	-0.213	-0.069

Notes: The table reports the estimates of γ_η using the simulated data from the model. Columns (1) and (2) report the estimates for households under and over age 40, respectively.

they have limited ability to self-insure against income shocks and in such cases, taxes and transfers play a larger role in providing consumption insurance. Conversely, when households have high wealth relative to their income, they have more access to self-insurance and thus the insurance role of taxes and transfers diminishes. These results are consistent with the view that the role of social insurance diminishes when households already have substantial self-insurance, as noted by Gruber (2015). In our model, this self-insurance is achieved through wealth accumulation.

Because wealth increases over the life cycle in our model, see Figure 1 (a), we conduct a robustness check by examining a subgroup of households based on their age. In simulated data from the baseline model, the mean wealth-to-income ratio is 0.03 for households under age 40, while the ratio for households over age 40 is 3.41. As we report in Table 9, older households have more consumption insurance than younger households, 0.48 versus 0.10, and the role of taxes in providing insurance is lower for older households compared to younger households, 0.07 versus 0.21.

Differences in wealth levels could therefore rationalize our empirical results. As displayed in Figure 3, Australia overall has higher wealth compared to the U.S., which potentially diminishes the role of taxes in reducing the transmission of income shocks to consumption among Australian households. Put differently, because Australian households are wealthier, social insurance provided through taxes and transfers might only crowd out private insurance without providing much additional insurance. As a result, while higher tax progressivity would



(a) Wealth-to-income (b) Average wealth

Figure 3: Wealth-to-income ratio and wealth: PSID vs. HILDA

Notes: We converted the measures from HILDA to USD by applying the exchange rate of 0.74 USD per one AUD, which corresponds to the average exchange rate in 2016. All measures are real with the base year of 2016. In PSID, household wealth consists of the sum of cash, bonds, share, business asset, pension, property assets, cars less credit card debt, student debt, and mortgages. In HILDA, it consists of the sum of bank accounts, shares, life insurance, business assets, property assets, cars less credit card debt, student debt, business debt, and mortgage debt.

increase the role of taxes in providing insurance in Australia compared to the U.S, a higher wealth level in Australia counteracts this and, consequently, the overall role of taxes and transfers in providing consumption insurance ends up being similar in both countries.

5 Conclusion

In our empirical analysis with a semi-structural econometric model, we show that taxes and transfers play a similar role in mitigating the transmission of permanent income shocks to consumption in the U.S. and Australia. Because households ultimately care about consumption, our analysis is able to consider an important potential role of progressivity beyond how it changes the variability of post-government income relative to pre-government income. Through counterfactual analysis with a stylized structural model, we show that, when varying the progressivity of taxes, governments also influence the extent to which households self-insure and thereby can unintentionally offset the social insurance provided by taxes and transfers. We also find that wealth is a key determinant for self insurance, with high wealth-to-income in Australia explaining the similar role of taxes and transfers in providing consumption insurance compared the U.S., despite a substantially higher degree of tax progressivity.

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Appendix

A Data

A.1 Panel Study of Income Dynamics

The PSID is a longitudinal household survey that provides a representative sample of approximately 5,000 U.S. households starting from 1968. Since then, the survey re-interviewed both the original family and their split-offs annually until 1996 and biennially from 1997. Importantly, the PSID started to collect information on household expenditure covering almost 70% of consumption categories in the Consumer Expenditure Survey since 1999. Thus, to obtain measures of income and consumption for each household, we use 11 waves of data from 1999 to 2019. We provide summary statistics for selected variables in Table A.1.

Sample selection for PSID. The initial data set consists of an unbalanced sample of 93,400 observations. Of those households, we drop households who experienced significant changes in their family composition such as the change of head, divorce or death of a partner. We consider households where the age of the household head is between 23 and 64. We drop households who had missing information on key demographic variables including state of residence, education, employment status, and homeownership status. We also drop households with missing income information. Households with annual gross income growth higher than 500% or lower than negative 80%. We also drop households who report the annual expenditure on non-durable goods and services less than 100 or more than 500,000 U.S. dollars. We further drop households whose pre- and post-government incomes are less than 100 U.S. dollars per month. The survey distinguishes between the Core sample and the Survey of Economic Opportunity (SEO) sample which contains a sample of low-income households. We drop households in the SEO sample. Finally, we drop households who have not appeared in the survey for two consecutive periods. In total, our PSID sample consists of 6,572 households and 37,659 observations.

A.2 Household Income and labor Dynamics Australia

The HILDA is a longitudinal household survey that contains a nationally representative sample of Australian households since 2001. A total of 7,682 households, consisting of 19,914 individuals participated in Wave 1. The members of these households form the basis of the panel in subsequent waves as they, including new adult members who are older than age 15, are reinterviewed. The re-interview rates are high, ranging from 87% in Wave 2 to 97% in Wave 15. The survey contains detailed information on income, expenditure, wealth, and other demographic and socioeconomic factors that are standard in a typical household survey.

Sample selection in HILDA. We apply the same sample selection procedure as for the PSID. However, a few exceptions arise due to the difference in the survey structure. First, we do not drop households who experienced significant changes in their family position, as such information is not available in HILDA. Second, HILDA does not make a distinction between core sample and SEO households like the PSID. Instead, we drop households that receive franking credits. Third, the head of households is not directly observed in HILDA. We define the head as a male individual within a family unit who is not a child. In our HILDA sample, we exclude other members of family such as the grandfather or uncle. Overall, our sample from HILDA consists of 5,060 households with 65,780 observations.

Table A.1: Summary statistics

	PSID	HILDA
Non-durable consumption	38,606	37,085
Post-government income	70,401	66,641
Pre-government income	93,393	79,272
Total income taxes	13,974	15,866
Public transfers	787	3,235
Tax credits	1,222	–
Age	42.2	41.6
Fraction of college-educated	0.45	0.72
Fraction of married	0.65	0.77
Fraction of employed	0.90	0.93
Average family size	2.88	2.87
Number of households	6,574	5,060
Number of observations	37,659	65,780

Notes: Consumption, incomes, taxes, and transfers are the mean values. We convert dollar measures from the HILDA to U.S. dollars by applying the exchange rate of 0.74 USD per one AUD, which is the average exchange rate in 2016. All dollar measures are real with the base year of 2016.

B State-space form

In this appendix, we present the state-space form for the unobserved components representation of the our extended econometric model presented in Section 3. For the state-space form of our baseline model, refer to Appendix A in Cho et al. (2024a).

Letting $z_{x,it}$ denote the accumulation of a shock process x_{it}, the observation equation for our model in levels is

$$\mathbf{y_{it}} = \mathbf{H}\mathbf{X_{it}},$$

where

$$\mathbf{y_{it}} = \begin{bmatrix} y_{d,it} \\ \delta_{it} \\ c_{it} \end{bmatrix}, \mathbf{H} = \begin{bmatrix} 1 & \theta & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & \theta & 0 & 0 & 1 & 0 & 0 & 0 \\ \tilde{\gamma}_\epsilon & 0 & \tilde{\gamma}_\omega & 0 & 1 & \gamma_\eta & \gamma_\mu & \bar{\gamma}_\epsilon & \bar{\gamma}_\omega & 1 \end{bmatrix},$$

$$\mathbf{X}_{it} = \begin{bmatrix} \epsilon_{d,it} \\ \epsilon_{d,it-1} \\ \omega_{it} \\ \omega_{it-1} \\ v_{it} \\ \tau_{d,it} \\ \mu_{it} \\ z_{\epsilon,it} \\ z_{z,it} \\ z_{v,it} \end{bmatrix}.$$

The state equation is

$$\mathbf{X_{it}} = \mathbf{F}\mathbf{X_{it-1}} + \mathbf{v_{it}},$$

where

$$\mathbf{F} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{v_{it}} = \begin{bmatrix} \epsilon_{d,it} \\ 0 \\ \omega_{it} \\ 0 \\ v_{it} \\ \eta_{d,it} \\ \zeta_{it} \\ \epsilon_{d,it} \\ \omega_{it} \\ u_{it} \end{bmatrix}.$$

and the covariance matrix of $\mathbf{v}_t$, $\mathbf{Q}$, is given by

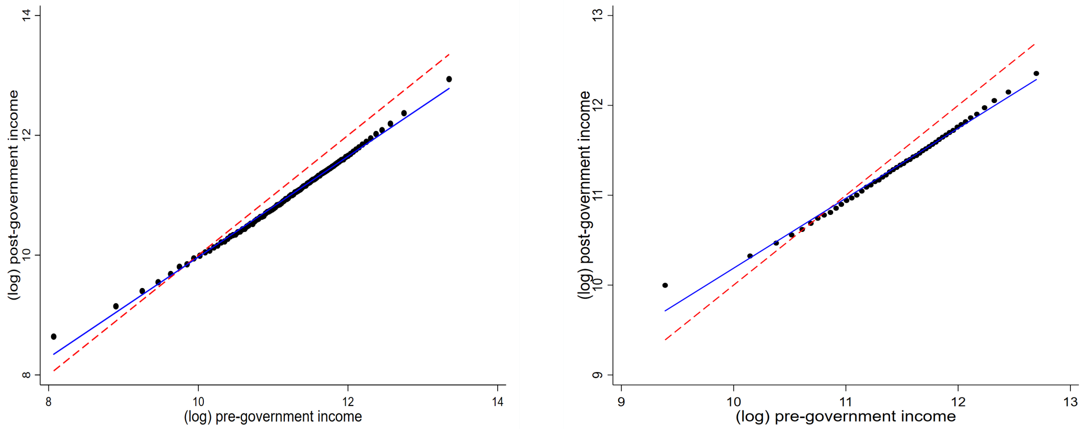
$$\mathbf{Q} = \begin{pmatrix} \sigma^2_{\epsilon,d} & 0 & 0 & 0 & 0 & 0 & 0 & \sigma^2_{\epsilon,d} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \sigma^2_{\omega} & 0 & 0 & 0 & 0 & 0 & \sigma^2_{\omega} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \sigma^2_{v} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \sigma^2_{\eta,d} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \sigma^2_{\zeta} & 0 & 0 & 0 \\ \sigma^2_{\epsilon,d} & 0 & 0 & 0 & 0 & 0 & 0 & \sigma^2_{\epsilon,d} & 0 & 0 \\ 0 & 0 & \sigma^2_{\omega} & 0 & 0 & 0 & 0 & 0 & \sigma^2_{\omega} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \sigma^2_{u} \end{pmatrix}.$$

Given the state-space form, the Kalman filter can then be used to calculate the quasi likelihood based on the prediction error decomposition of a multivariate Normal density and an assumption of independence of idiosyncratic income and consumption across households (i.e. the joint log likelihood is additive in household-specific log likelihoods). We adapt the Kalman filter equations to handle missing observations, which are prevalent in the PSID and HILDA.

We evaluate the quasi likelihood from the second time period of the data in levels using highly diffuse priors on initial values of unobserved stochastic trends centered at $\tau_{d,i0|0} = y_{d,i1}$, $z_{\epsilon,i0|0} = 0$, and $z_{u,i0|0} = c_{i1} - \gamma_{\eta,d} y_{i1}$ (or first available values given missing observations) with variances of 100 along with $\epsilon_{d,i0|0} = \epsilon_{d,i0-1|0} = v_{i0|0} = 0$ and variances of these shocks to initialize the Kalman filter. This approach is equivalent to estimation of the model in growth rates in the absence of missing observations and, therefore, implicitly allows for household-specific fixed effects $\bar{\tau}_{d,i0}$ and $\bar{\kappa}_{i0}$. Standard errors for parameter estimates are calculated using the estimated parameter variance-covariance matrix using the Huber-White sandwich formula. See Chatterjee et al. (2021) for more details on estimation of the BPP model via QMLE and the Kalman filter.

C Additional figures

Figure C–1 plots the statistical fit of the tax function estimated using data from the U.S. and Australia. From these plots, we can see that in Australia, since the taxes are more progressive, the fitted line is flatter suggesting that low-income households receive more transfers while high-income households pay more taxes compared to households in the U.S. The estimated R^2 is 0.96 for the U.S. and 0.90 for Australia.



(a) PSID (b) HILDA

Figure C–1: Statistical fit of tax function

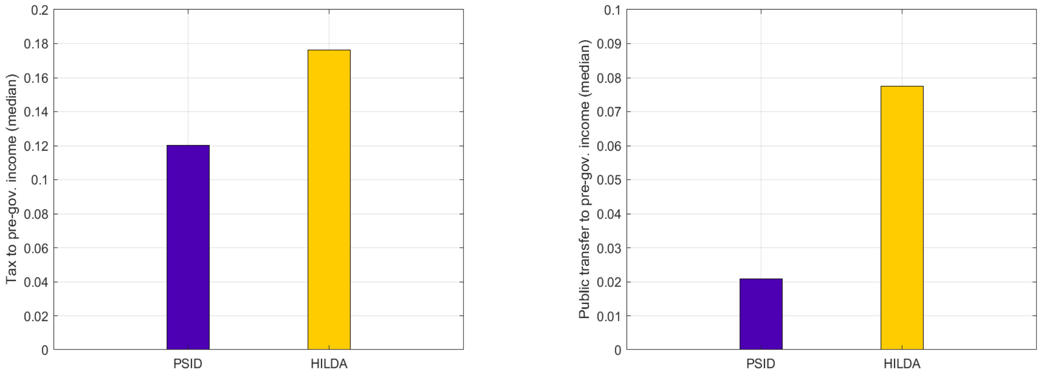
Note: The red line is the 45-degree line. The black dots are mean values of pre/post-government income in each percentile, where all the observations are collapsed into percentiles using pre-government income. The blue line is the fitted line.

Figures C–2 and C–3 plot the tax-to-income ratio and transfer-to-income ratio in our overall sample and across the birth cohort groups in the PSID (blue bar) and HILDA (orange bar). Panel (a) of Figure C–3 displays the tax-to-income ratio increases, albeit marginally, across the birth cohorts, while it is hump-shaped in Australia and Australian households pay more taxes (relative to their income) than U.S. households in the corresponding subgroups. Panel (b) of Figure C–3 shows the median transfer-to-income ratio across the birth cohorts. A couple of interesting patterns emerge from Panel (b) of Figure C–3. First, Australian households tend to receive more transfers (relative to their income) than U.S. households across all birth cohorts.[20] Second, in both surveys, the pattern is declining, that is younger cohorts receive more transfers (relative to their income) than the middle and older cohorts. Both these patterns are also present when we look at the level of taxes and transfers for each birth cohort in Figure C–4. We also provide the level of public transfers by types in Figure C–5. Based on that, we can see that higher transfers for the younger cohorts are largely driven by family payments or tax credits related to parental and family support as well as other allowances, such as child tax credits in the U.S. and child care benefits in Australia. Furthermore, older households in Australia receive more transfer payments than older households in the U.S. through government allowances such as mature age, senior concession and widow allowances.

In PSID, pensions include incomes from pensions, veteran's pensions, and retirement income. Family payments include childcare tax credits both at the federal and state levels. Other income allowances include payments from TANF, social security, unemployment insurance, work compensation, other government transfers, and earned income tax credits.

In HILDA, pensions include age pension funded by the government, service pension, disability support pension, wife pension, carer payment, war widows pension, disability pension and bereavement allowance. Family paymemts include family tax benefits, maternity payment, mobility allowance, carer allowance, telephone allowance, maternity immunisation allowance, seniors concession allowance, double orphan pension, government bonus payments, and parenting payment. Other income allowances include newstart allowance, mature age allowance, sickness allowance, widow allowance, special benefit, partner allowance, youth allowance, austudy, and other non-income support such as mobility and carer allowance.

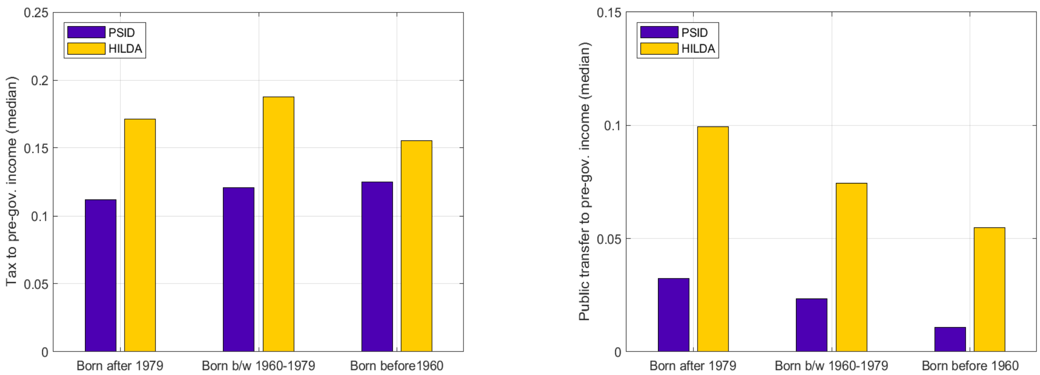
[20]Moreover, a larger fraction of households receive transfers in Australia. While 5,056 out of 5,060 households received transfers from the government for at least one year in our HILDA sample, 5,724 out of 6,572 households received public transfers and/or tax credits for at least one year in our PSID sample.



(a) Tax-to-income ratio (b) Transfer-to-income ratio

Figure C–2: Taxes and transfers in PSID and HILDA

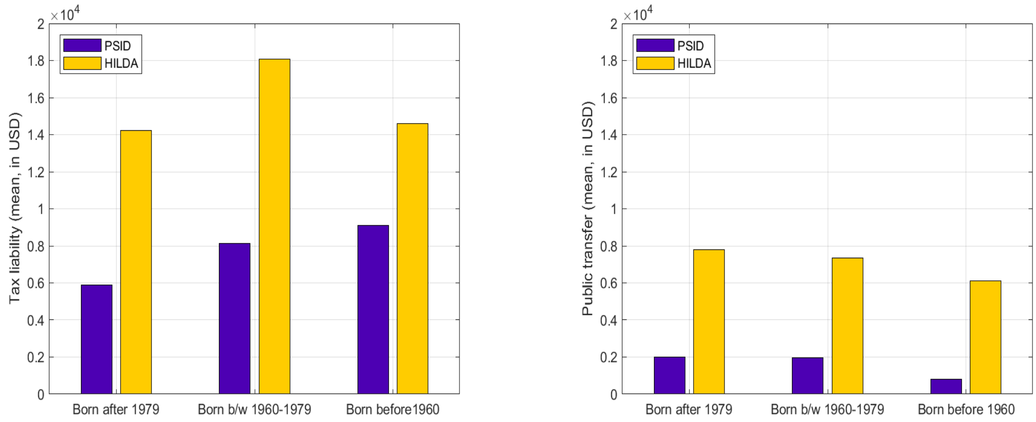
Note: This figure compares the median tax-to-income and transfer-to-income in PSID and HILDA, where income is pre-government income. We include tax credits to the measure of transfers in PSID.



(a) Tax-to-income ratio (b) Transfer-to-income ratio

Figure C–3: Taxes and transfers across birth cohort

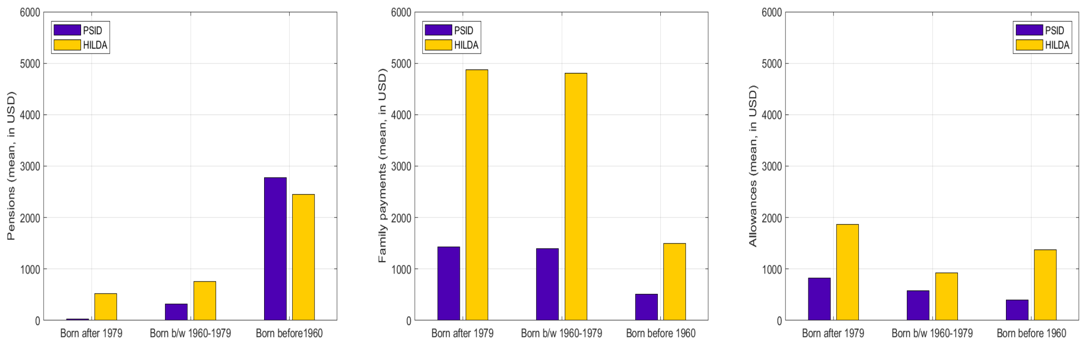
Note: This figure compares the median tax-to-income and transfer-to-income across birth cohort groups from PSID and HILDA, where income is pre-government income. We include tax credits to the measure of transfers in PSID.



(a) Tax liability (b) Public transfers

Figure C–4: Taxes and transfers across birth cohort

Note: This figure compares the average taxes and public transfers across birth cohort groups from PSID and HILDA. We include tax credits to the measure of public transfers in PSID. We converted the measures from HILDA to USD by applying the exchange rate of 0.74 USD per AUD, which corresponds to the average exchange rate in 2016. All measures are real with the base year of 2016.



(a) Pensions (b) Family payments (c) Other inc. allowances

Figure C–5: Subcomponents of public transfers across birth cohort

Notes: This figure compares the subcategories of public transfers across birth cohort groups from PSID and HILDA. We converted the measures from HILDA to USD by applying the exchange rate of 0.74 per one AUD, which corresponds to the average exchange rate in 2016. All measures are real with the base year of 2016.

D Full sets of estimates for semi-structural models

Table D.1: Full estimates using post- and pre-government income separately

	Post-gov.income ($j = d$)	**Pre-gov. income** ($j = g$)
PSID		
$\sigma_{\eta,j}$	0.143 (0.003)	0.163 (0.004)
$\sigma_{\epsilon,j}$	0.276 (0.004)	0.335 (0.004)
$\sigma_{u,j}$	0.085 (0.003)	0.085 (0.003)
$\sigma_{v,j}$	0.274 (0.003)	0.274 (0.003)
$\gamma_{\eta,j}$	0.300 (0.017)	0.259 (0.024)
$\bar{\gamma}_{\epsilon,j}$	0.019 (0.008)	0.024 (0.008)
$\tilde{\gamma}_{\epsilon,j}$	0.044 (0.007)	0.037 (0.016)
N	6,572	6,572
HILDA		
$\sigma_{\eta,j}$	0.108 (0.004)	0.149 (0.005)
$\sigma_{\epsilon,j}$	0.198 (0.003)	0.260 (0.004)
$\sigma_{u,j}$	0.085 (0.002)	0.085 (0.002)
$\sigma_{v,j}$	0.159 (0.002)	0.159 (0.002)
$\gamma_{\eta,j}$	0.268 (0.038)	0.207 (0.020)
$\bar{\gamma}_{\epsilon,j}$	0.000 (0.02)	-0.001 (0.004)
$\tilde{\gamma}_{\epsilon,j}$	0.062 (0.025)	0.051 (0.006)
θ	0.125 (0.020)	0.136 (0.017)
N	5,060	5,060

Table D.2: Full estimates for joint semi-structural model: PSID

	All	**Born after 1979**	**Born b/w 1960-79**	**Born before 1960**
$\sigma_{\eta,d}$	0.111 (0.002)	0.134 (0.004)	0.119 (0.003)	0.134 (0.005)
σ_{ζ}	0.033 (0.001)	0.040 (0.003)	0.034 (0.002)	0.044 (0.004)
$\sigma_{\epsilon,d}$	0.295 (0.003)	0.312 (0.007)	0.260 (0.004)	0.306 (0.006)
σ_{ω}	0.129 (0.003)	0.129 (0.006)	0.121 (0.004)	0.130 (0.005)
σ_{u}	0.075 (0.001)	0.081 (0.004)	0.084 (0.002)	0.087 (0.004)
σ_{v}	0.280 (0.002)	0.366 (0.006)	0.259 (0.003)	0.254 (0.005)
γ_{η}	0.237 (0.016)	0.313 (0.029)	0.263 (0.023)	0.212 (0.028)
$\bar{\gamma}_{\epsilon}$	0.016 (0.009)	0.078 (0.031)	0.025 (0.036)	-0.008 (0.031)
$\tilde{\gamma}_{\epsilon}$	0.078 (0.010)	0.046 (0.029)	0.067 (0.018)	0.071 (0.023)
$\bar{\gamma}_{\omega}$	0.060 (0.022)	0.05 (0.023)	0.074 (0.037)	0.077 (0.064)
$\tilde{\gamma}_{\omega}$	0.043 (0.018)	0.123 (0.057)	0.034 (0.041)	0.010 (0.035)
γ_{μ}	0.001 (0.005)	-0.036 (0.051)	0.003 (0.027)	0.064 (0.080)
γ_{μ}^{*}	-0.237 (0.072)	-0.349 (0.106)	-0.260 (0.101)	0.148 (0.070)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.054	-0.080	-0.058	-0.037
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-3.277	-3.294	-2.570	-2.111
t-statistic$_{H_1:\gamma_{\mu}=0}$	0.109	-0.703	0.102	0.805
N	6,572	1,992	2,610	1,970

Table D.3: Full estimates for joint semi-structural model: HILDA

	All	**Born after 1979**	**Born b/w 1960-79**	**Born before 1960**
$\sigma_{\eta,d}$	0.085 (0.002)	0.082 (0.003)	0.084 (0.002)	0.098 (0.005)
σ_{ζ}	0.049 (0.002)	0.039 (0.002)	0.053 (0.003)	0.060 (0.005)
$\sigma_{\epsilon,d}$	0.206 (0.002)	0.221 (0.004)	0.184 (0.003)	0.227 (0.006)
σ_{ω}	0.114 (0.002)	0.127 (0.004)	0.104 (0.003)	0.111 (0.005)
σ_{u}	0.069 (0.001)	0.064 (0.002)	0.073 (0.002)	0.071 (0.003)
σ_{v}	0.164 (0.001)	0.187 (0.003)	0.153 (0.002)	0.155 (0.003)
γ_{η}	0.223 (0.014)	0.257 (0.039)	0.221 (0.024)	0.155 (0.029)
$\bar{\gamma}_{\epsilon}$	0.004 (0.002)	0.017 (0.020)	0.005 (0.011)	-0.012 (0.007)
$\tilde{\gamma}_{\epsilon}$	0.055 (0.009)	0.112 (0.024)	0.043 (0.013)	0.014 (0.010)
$\bar{\gamma}_{\omega}$	0.013 (0.005)	-0.034 (0.058)	0.040 (0.051)	0.035 (0.028)
$\tilde{\gamma}_{\omega}$	0.077 (0.013)	0.097 (0.051)	0.022 (0.024)	0.138 (0.034)
γ_{μ}	0.093 (0.032)	0.122 (0.060)	0.118 (0.101)	0.048 (0.050)
γ_{μ}^{*}	-0.130 (0.018)	-0.108 (0.050)	-0.103 (0.043)	-0.107 (0.051)
θ	0.177 (0.015)	0.212 (0.026)	0.174 (0.021)	0.089 (0.037)
$\frac{\sigma_{\zeta}}{\sigma_{\eta}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.048	-0.044	-0.040	-0.041
t-statistic$_{H_0:\gamma_{\mu}=\gamma_{\eta}}$	-7.196	-1.449	-2.405	-2.117
t-statistic$_{H_0:\gamma_{\mu}=0}$	2.937	2.010	1.174	0.960
N	5,060	1,831	2,132	1,097

Table D.4: Insurance roles of taxes and transfers

	Role of transfers			Role of taxes		
	Born after 1979	**Born b/w 1960-79**	**Born before 1960**	**Born after 1979**	**Born b/w 1960-79**	**Born before 1960**
PSID						
$\sigma_{\eta,d}$	0.132 (0.004)	0.119 (0.003)	0.133 (0.005)	0.134 (0.005)	0.119 (0.003)	0.134 (0.004)
σ_{ζ}	0.023 (0.001)	0.026 (0.002)	0.036 (0.005)	0.019 (0.001)	0.020 (0.000)	0.023 (0.001)
γ_{η}	0.287 (0.030)	0.254 (0.019)	0.210 (0.027)	0.337 (0.026)	0.281 (0.022)	0.228 (0.030)
γ_{μ}^{*}	-0.297 (0.117)	-0.157 (0.074)	-0.140 (0.083)	-0.587 (0.154)	-0.429 (0.153)	-0.305 (0.105)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.057	-0.028	-0.030	-0.074	-0.060	-0.045
t-statistic$_{H_0:\gamma_{\mu}^{*}=0}$	-2.550	-2.131	-1.689	-3.818	-2.806	-2.893
N	1,992	2,610	1,970	1,992	2,610	1,970
HILDA						
$\sigma_{\eta,d}$	0.084 (0.003)	0.084(0.003)	0.099 (0.006)	0.082 (0.002)	0.086 (0.002)	0.093 (0.005)
σ_{ζ}	0.033 (0.002)	0.046 (0.003)	0.061 (0.011)	0.015 (0.000)	0.017 (0.001)	0.022 (0.001)
γ_{η}	0.254 (0.029)	0.226 (0.028)	0.180 (0.064)	0.259 (0.025)	0.211 (0.022)	0.240 (0.035)
γ_{μ}^{*}	-0.117 (0.068)	-0.094 (0.041)	-0.046 (0.041)	-0.380 (0.103)	-0.013 (0.004)	-0.146 (0.088)
$\frac{\sigma_{\zeta}}{\sigma_{\eta,d}+\sigma_{\zeta}}\gamma_{\mu}^{*}$	-0.033	-0.033	-0.056	-0.007	-0.002	-0.072
t-statistic$_{H_0:\gamma_{\mu}^{*}=0}$	-1.703	-2.264	-1.651	-1.138	-3.350	-5.040
N	1,897	2,126	1,037	1,897	2,126	1,037

Note: The table reports the point estimates of our joint model of income, net taxes, and consumption. The standard errors are in parentheses.

E Marginal tax function

Here, we provide the proof of our claim which the derivative of the marginal tax function (MTR) with respect to tax progressiviy, ς is strictly positive for a certain range of pre-government income. To begin with, recall that our tax function is given by

$$T(Y) = Y - \lambda Y^{1-\varsigma}$$

which gives the expression for MTR as

$$MTR = \frac{\partial T(Y)}{\partial Y} = 1 - \lambda(1-\varsigma)Y^{-\varsigma}.$$

Now, we take the derivative of MTR with respect to ς given as below

$$\frac{\partial MTR}{\partial \varsigma} = \lambda Y^{-\varsigma}\left(1 + (1-\varsigma)\ln(Y)\right).$$

Since $0 < \varsigma < 1$ and $\lambda > 0$, $\frac{\partial MTR}{\partial \varsigma} > 0$ if $1 + (1-\varsigma)\ln(Y) > 0$. This requires $Y > e^{-\frac{1}{1-\varsigma}}$. Therefore, as long as $Y > e^{(-1)} \approx 0.368$, an increase in ς will increase MTR.

F Computational details

This section of the appendix describes computational details. The household optimization problem involves four state variables including, age, asset, permanent and transitory components of wages. We obtain the household policy functions by solving the problem backward from the last period, and we apply the endogenous grid method proposed by Carroll (2006). The grid for asset has 100 points. Following Wu and Krueger (2021), we allow the distance between grid points to increase with the asset level such that the grid has more points around the low asset levels. For the labor income process, we approximate the permanent component of wages using the discrete Markov process with 39 equally spaced points and the corresponding transition matrix in the spirit of Tauchen (1986). The transitory component is approximated with 19 equally spaced points.

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