Effects of Taxes and Safety-Net Pensions on Life-cycle Labor Supply, Savings and Human Capital: The Case of Australia

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The Australian Social Security System

The Australian social security system is ranked among the best in the world by Mercer, the OECD, IMF etc.

Two components:

1. "Superannuation"
   - Defined contribution pension plan
   - Mandatory employer contributions to private accounts (9.5%)
   - Workers choose among investment options
   - Accessible from age 65 (Age 60 if retired)
   - Avoids fiscal burden on government
2. Age Pension
   - Provides safety net at ages 65 +
   - Benefits do not depend on work history (unlike SS in US)
   - Pure means-tested transfer ("welfare") program

Age Pension Benefits

Using HILDA Data, we estimate effective Pension taper rates of only:

- 27.8% on Income
- 0.5% on Assets

The low taper rates lead to very poor targeting (75% get some benefits). This means the Age Pension is a large program:

- Income Taxes = \$ 180 bil. (2014)
- Age Pension = \$ 50 bil. (2014)

Goal: Use structural model to assess:

- Effects of Age Pension on:
    - Labor supply
    - Asset and human capital accumulation
- Effects of changes in Age Pension rules designed to improve targeting of benefits

Literature

Means-tested transfers have potentially important effects on asset and human capital accumulation.

Yet there are very few papers estimating dynamic models with means-tested transfers:

- Keane and Wolpin (IER, 2010)
- Blundell, Costa-Dias, Meghir, Shaw (ECMA, 2016)

These papers do not focus on the targeting issue we emphasize here.

Our Life-Cycle Labor Supply Model

1. Discrete time = Age from 19 to 100 (stochastic survival)
2. Annual decisions on:
   - Consumption/Saving (continuous choice)
   - Hours chosen from [0, 24, 40, 45, 50, 60] per week (discrete choice)
   - Previous Life-cycle labor supply models have not accounted for bunching of hours
3. Human capital accumulation
   - Learning-by-doing
4. Consumers are subject to borrowing constraints
5. We model Age Pension, Superannuation and Tax Rules
6. Observed and unobserved heterogeneity
   - Education $\rightarrow$ Shifts human capital production function
   - Unobserved types $\rightarrow$ Shifts skill endowment and tastes for leisure

Our Life-cycle labor Supply Model

Hours of labor supply $h_t \in H$ (choice variable)

Human capital: $K_t = f\left(\sum_{\tau=1}^{t-1} h_\tau, \text{age}, \text{education}, \text{type}\right)$

Wage: $wage_{t+1} = K_t \cdot R_t \cdot \epsilon_{t+1}^{wage}$,

- $R_t = 1$ is rental rate on human capital,
- Wage draw: $\epsilon_t^{wage} \sim lnN(0, \sigma_t^{wage})$
- Timing: h_t chosen based on K_t, wage draw revealed at $t+1$

$M_t =$ Consumable wealth in the beginning of the period

Consumption $c_t \leq M_t + a_0$ (credit constraint)

Intertemporal budget constraint

$M_{t+1} = \left(M_t - c_t\right)(1+r) + h_t \cdot wage_{t+1} - Tax_{t+1} + transfers_{t+1}$

Our Life-cycle Labor Supply Model

Intertemporal budget constraint (Details on Transfers)

$$M_{t+1} = (M_t - c_t)(1+r) + h_t \cdot wage_{t+1} - Tax_{t+1} + transfers_{t+1}$$

$$\begin{aligned} M_{t+1} = (M_t - c_t)(1+r) + h_t \cdot wage_{t+1} - Tax_{t+1} \\ + pens_{t+1} \cdot \mathbb{1}\{t+1 \geq 65\} \\ + super_{t+1} \cdot \mathbb{1}\{t+1 = 65\} \\ + tr_{t+1} \cdot \mathbb{1}\{t+1 \leq 22\} \end{aligned}$$

where:

- $pens_{t+1}$ denotes Age Pension benefits,
- $super_{t+1}$ denotes the superannuation payment
- tr_{t+1} denotes transfers from parents to youth

The Pension and Super rules are estimated from data (see below)

Our Life-cycle Labor Supply Model

- Human Capital Production Function
- Let $\mathcal{E}_t$ denote the ratio of total work time to maximum work time up through t-1, i.e. "normalized" work experience, $0 \leq \mathcal{E}_t \leq 1$

$$\mathcal{E}_t = \frac{1}{t \cdot h_{max}} \sum_{\tau=1}^{t-1} h_\tau$$

$$K_t = \exp\left(\eta_{0,edu} + \eta_{0,type} + \eta_{1,edu} \cdot t\mathcal{E}_t + \eta_{2,edu} \cdot (t\mathcal{E}_t)^2 + \eta_3 t + \eta_4 t^2\right)$$

where $t \cdot \mathcal{E}_t$ is total work experience.

- Heterogeneity: education and type specific intercepts in wage function

Our Life-Cycle Labor Supply Model

- Preferences for Consumption and Bequests

$$u(c_t) = \frac{c_t^{1-\zeta} - 1}{1-\zeta}$$

$$w(B_t) = b_{scale} \cdot \frac{(B_t + a_0)^{1-\xi} - a_0^{1-\xi}}{1-\xi}$$

- $B_t = M_t - c_t$ is bequeathed wealth (if person dies at age t)
- $\zeta > 0$, $\xi > 0$, $b_{scale} > 0$ are parameters to be estimated
- a_0 = credit constraint (maximum amount of borrowing)

Our Life-cycle Labor Supply Model

- Preferences: Disutility of Work Hours

$$v_t(h_t) = \mathbb{1}\{h_t > 0\} \cdot \kappa_{type}(\tau_{uh}) \cdot \kappa_{age}(t) \cdot \gamma(h_t)$$

$\gamma = (\gamma^{(1)}, \ldots, \gamma^{(5)})$ disutilities of the five discrete hours levels

Type: high ($\kappa_{type} = 1$) or low ($\kappa_{type} = \kappa_1 > 1$)

Age effects:

$$\kappa_{age}(t) = 1 + \kappa_2 (t - 40)^2 \cdot \mathbb{1}\{t > 40\} + \kappa_3 (t - 25) \cdot \mathbb{1}\{t < 25\}$$

Age effects may proxy for declining health at older ages

Our Life-Cycle Labor Supply Model

- State vector $X_t = (M_t, \mathcal{E}_t, \text{education}, \text{type})$
- Bellman Equation

$$V_t(X_t) = \max_{\substack{0 \leq c_t \leq M_t + a_0, \\ h_t \in H_t}} \Big\{ u(c_t) - v_t(h_t, \tau_{uh}) + \delta_t \beta(\tau_{edu}) E\left[V_{t+1}(X_{t+1}) \,|X_t, c_t, h_t \right] + (1 - \delta_t) w(M_t - c_t) \Big\},$$

Note: c_t continuous, h_t discrete

$\tau = (\tau_{uh}, \tau_{edu})$ types for education and taste of work

H_t choice set in period t

$\beta(\tau_{edu})$ discount factor dependent on education

δ_t survival probability

HILDA Data

Household, Income and Labor Dynamics in Australia survey (HILDA)

- The primary source of data is the Household, Income and Labor Dynamics in Australia Survey (HILDA).
- Annual waves 2001-2016, Australian national representative sample
- Data on income, wages and labor supply (each year)
- Data on wealth in particular years
- First wave administered to 19,914 people

Structural estimation sample:

- Single and married men between age 19 and 89
    - 10,133 individuals, unbalanced panel of 81,197 observations
    - Born 1916 - 1997

Putting Institutional Settings in the Model

Approximate Pension, Super and Tax Rules

- We approximate the rules as functions of variables in our model
- We fit the approximate rules using the HILDA data

Age Pension Benefit Rule, 2001-2016

- We use the same equation we presented in the Intro:

$$
\begin{aligned}
\text{benefit}_{\text{max}} &= \underset{(183.96)}{10,759.73} + \underset{(173.52)}{1,846.92}(\text{when year} \geq 2010), \\
\text{pension} &= \max\left\{\text{benefit}_{\text{max}} - \max\left[\max\{\underset{(0.020)}{0.27794}\,\text{income}, \underset{(0.0004)}{0.00499}(\text{wealth} - \underset{(46,895.27)}{117,082.60})\}, 0\right]\right\}
\end{aligned}
$$

Putting Institutional Settings in the Model

Superannuation:

- Superannuation is a function of earnings throughout one's career
  $\rightarrow$ Human capital at age 65 is a good proxy for lifetime earnings
  $\rightarrow$ Both depend on skill endowment and lifetime hours

- Disregard the details of retirement income products (e.g. annuities)
  $\rightarrow$ Assume super is paid as lump sum at age 65

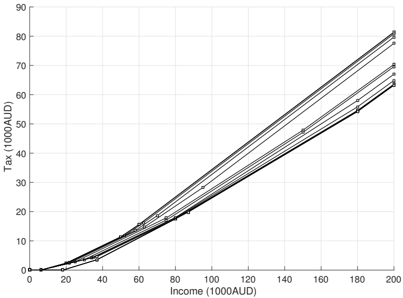
$$super_t = \rho_0 + \rho_1(\tau_{edu}) \cdot K_t, \; t = 65$$

- Not an unrealistic assumption:
  - Market for annuities is very thin,
  - Most people take lump sum payout.

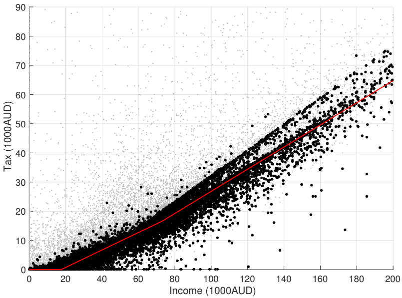
Putting Institutional Settings in the Model

Income Tax Rule, 2001-2016

Tax rules



Tax data



$$\text{tax} = \begin{cases} 0, & \text{if income} < \text{thld}_1 = \underset{(0.10016)}{17.39184}, \\ \underset{(0.00096)}{0.29907} \cdot (\text{income} - \text{thld}_1), & \text{if } \text{thld}_1 \leq \text{income} < \text{thld}_2, \\ \underset{(0.00556)}{0.37930} \cdot (\text{income} - \text{thld}_2) + \underset{(0.00096)}{0.29907} \cdot \text{thld}_1, & \text{if income} \geq \text{thld}_2 = \underset{(0.59292)}{73.17661}, \end{cases}$$

Estimation: Method of Simulated Moments

	High school		Dropouts		College	
Moments	Ages	N	Ages	N	Ages	N
Work status by age	19 - 86	67	19 - 88	70	23 - 89	64
hours when working	19 - 70	48	19 - 70	48	23 - 70	44
wage when working	19 - 70	48	19 - 70	48	23 - 70	44
variance of wage	19 - 70	10	19 - 70	10	23 - 70	10
skewness of earnings	19 - 85	13	19 - 85	13	23 - 85	13
hours = 20	19 - 86	67	19 - 86	68	23 - 89	64
hours = 40	19 - 82	61	19 - 84	64	23 - 79	57
hours = 45	19 - 77	55	19 - 83	56	23 - 76	51
hours = 50	19 - 76	58	19 - 88	66	23 - 77	53
wealth	25 - 85	13	25 - 85	13	25 - 85	13
work to work	19 - 70	48	19 - 70	48	23 - 70	44
nowork to nowork	19 - 70	48	19 - 70	48	23 - 70	44
super	65	1	65	1	65	1
Total		537		553		502

Estimates of the preference parameters

Parameter	Description	Estimate	Std.Err.
ζ	CRRA coefficient in consumption	0.79488	0.07327
γ_1	Disutility of working 1000 hours (20 per week)	1.4139	0.38508
γ_2	Disutility of working 2000 hours (40 per week)	2.0088	0.59712
γ_3	Disutility of working 2250 hours (45 per week)	2.9213	0.78915
γ_4	Disutility of working 2500 hours (50 per week)	2.8639	0.80946
γ_5	Disutility of working 3000 hours (60 per week)	3.8775	1.05032
κ_1	Correction coefficient for low type with disutility of work	0.50321	0.17973
κ_2	Quadratic coefficient on age for older workers	0.00008	0.00004
κ_3	Linear coefficient on age for young workers	0.05083	0.01554
ξ	CRRA coefficient in utility of bequest	0.48834	0.34766
b_{scale}	Scale multiplicator of the utility of bequest	0.68659	1.42044
β_{cg}	Discount factor, college	0.96963	0.00238
β_{hs}	Discount factor, highschool	0.96732	0.00189
β_{dr}	Discount factor, dropouts	0.96806	0.00138
λ	Scale of EV taste shocks	0.29950	0.08825

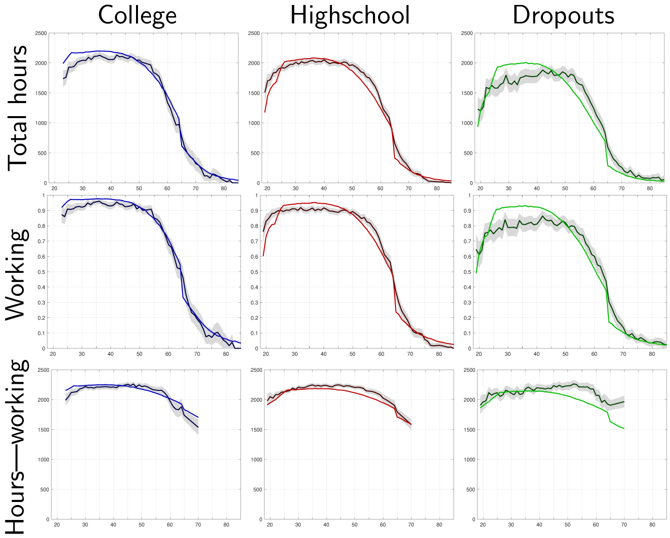
Human capital accumulation process

Parameter	Description	Estimate	Std.Err.
$\eta_{0,\text{cg}}$	Constant for college	2.78766	0.41169
$\eta_{0,\text{hs}}$	Constant for high school	2.56761	0.36634
$\eta_{0,\text{dr}}$	Constant for dropouts	2.45647	0.33269
$\eta_{0,\text{high}}$	Constant for high type	0.39311	0.41893
$\eta_{1,\text{cg}}$	Work experience for college	0.03041	0.00796
$\eta_{1,\text{hs}}$	Work experience for high school	0.02164	0.00768
$\eta_{1,\text{dr}}$	Work experience for dropout	0.01974	0.00682
$\eta_{2,\text{cg}}$	Work experience square for college	-0.00017	0.00021
$\eta_{2,\text{hs}}$	Work experience square for high school	-0.00002	0.00018
$\eta_{2,\text{dr}}$	Work experience square for dropout	0.00000	0.00010
η_3	Age (time index)	0.02676	0.00280
η_4	Age (time index) square	-0.00076	0.00004

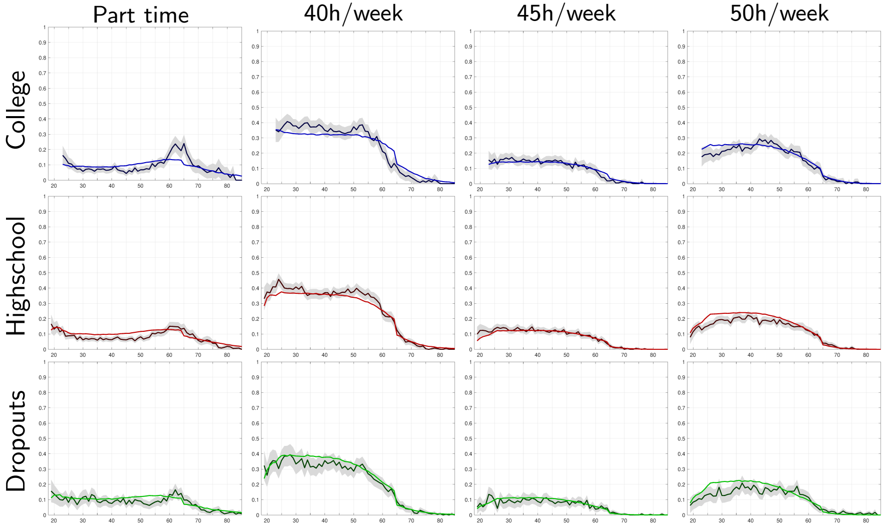
Estimates of other structural parameters

Parameter	Description	Estimate	Std.Err.
ς_0	St.dev. in shock distribution: constant	0.24485	0.24055
ς_1	St.dev. in shock distribution: age	0.00421	0.00935
tr	Transfer from parents	5.51308	1.43804
ρ_{cg}	Superannuation: human capital — college	6.30347	2.58472
ρ_{hs}	Superannuation: human capital — high school	5.43473	3.30737
ρ_{dr}	Superannuation: human capital — dropouts	6.47838	3.95647
ς_{w_0}	Initial wealth sigma	1.48960	6.69399
p_{cg}	High type proportion — college	0.90089	0.04952
p_{hs}	High type proportion — high school	0.80130	0.04366
p_{dr}	High type proportion — dropout	0.69306	0.04411

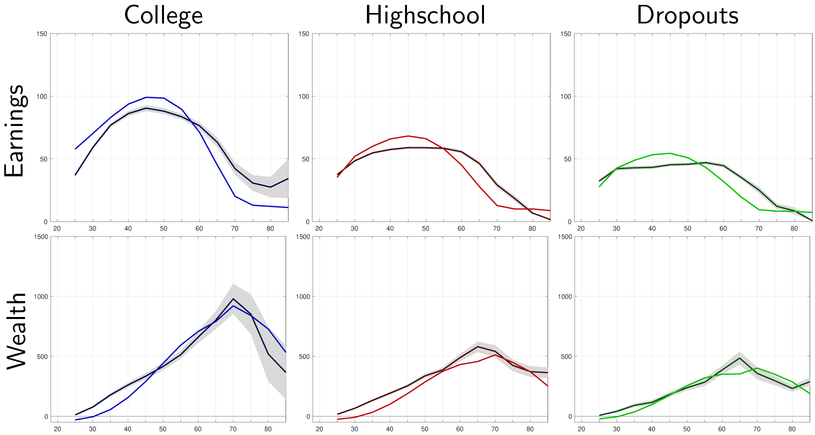
Goodness of fit: total hours and participation



Goodness of fit: discrete level of hours



Goodness of fit: earnings and wealth



Policy simulations

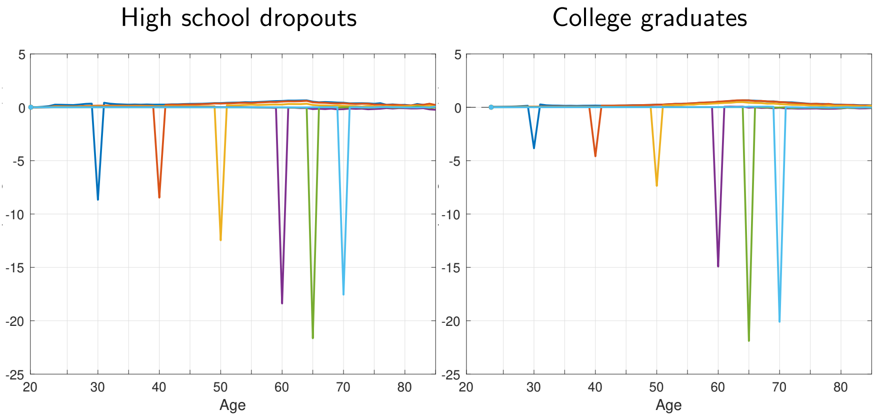
The good fit of the model gives us some confidence in using it to predict policy impacts

Policies to be simulated:

1. Transitory wage/tax changes
2. Improved Targeting of Age Pension
   - Change income and asset taper rates

Frisch Elasticities

Transitory 10% wage decrease $\rightsquigarrow$ % change in hours



(Anticipated effects)

Frisch elasticities

- Results for inter-temporal substitution elasticities:
- Frisch elasticities increase with age, very large at 65+
- The increase is greater for the more educated
- Consistent with Imai-Keane (2004) and Keane-Wasi (2016)

- Implication is that labor supply at 65+ will be very sensitive to relative wage at 65+

- A higher relative wage at 65+ will cause people to shift labor supply towards those years

Better Targeting the Age Pension

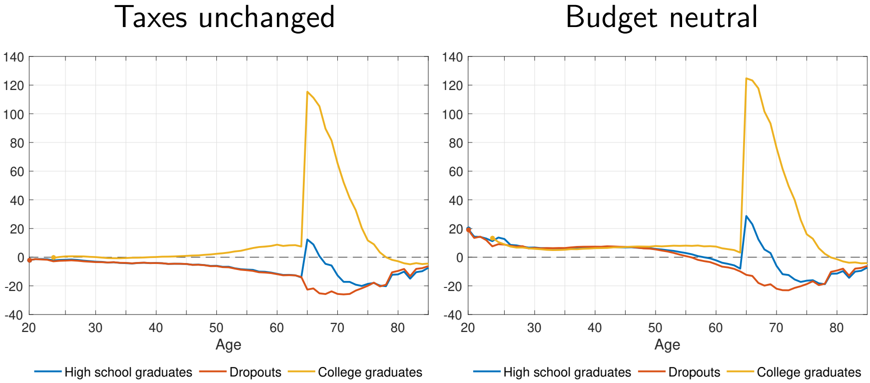
Program Changes we Simulate:

- Double Income and Asset taper rates:
- Double effective income taper rate from 27.7% to 55.5%
- Double effective asset taper rate from 1/2 cent on the dollar to one cent on the dollar
- In budget neutral simulation we can cut income tax rates by 5.9% - i.e., top rate reduced from 37.9% to 35.7%

Important: The effect of higher taper rates on labor supply is theoretically ambiguous

Better Targeting the Age Pension

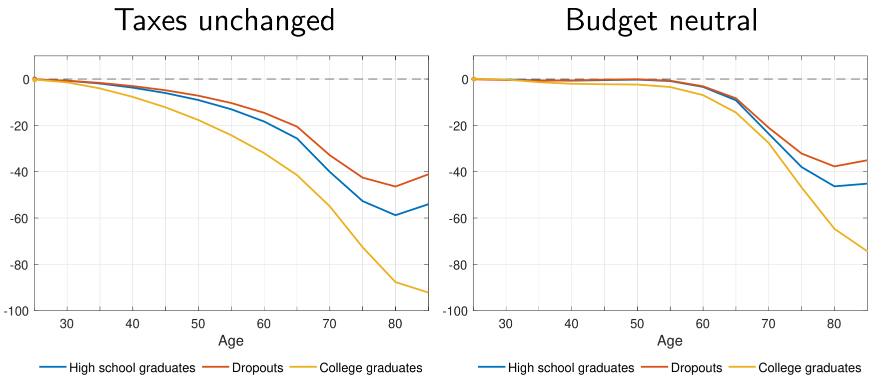
Doubling of income/asset tapers ⇝ Effects on Hours of Work



(Note: Change in annual hours)

Better Targeting the Age Pension

Doubling of income/asset tapers ⇝ Effects on Assets



(Note: Change in $1000 AUD)

Better Targeting the Age Pension

Double Taper Rates + Tax cut $\rightsquigarrow$ Results:

- At age 65+ labor supply of college grads increases by 20% while that of dropouts falls by 8%
  - With higher tapers, college grads lose eligibility so they work more
- College grads rely on age pension less while dropouts rely on it more - better targeting
- In budget neutral simulation we cut income tax rates by 5.9% - i.e., top rate reduced from 37.9% to 35.7%
  - This causes small increase in labor supply prior to age 65
- All types better off - CEVs are \$1.4k, \$1.5k, \$1.7k for dropouts, HS, college types, respectively

Results and conclusions

Age Pension

- The program has large negative labor supply effects
- The program is expensive (Largest welfare item in budget)
- It is poorly targeted $\Rightarrow$ Very low effective taper rates
- Doubling of Taper Rates combined with 5.9% tax cut would be Pareto improvement

Limitations

- Our results are only for men
  - Need to verify same result for women
- In practice, increase in effect taper rates means reducing exemptions