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

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ANU-Treasury Fiscal Policy Modelling Workshop
November 19, 2019

Structural micro-econometric approach

Main research question:

- Labor supply responses to Age Pension and taxes
- Over the whole life cycle (long run effects)
- With anticipated and unanticipated policy changes

Structural approach:

1. Develop a theoretical model of behavior
   - Structural parameters $\leftrightarrow$ policy invariant (by reasonable assumption)
   - Policy parameters to facilitate counterfactual scenarios
2. Estimate the model using historical data (HILDA)
3. Simulate counterfactual scenarios of alternative policy settings, both anticipated and unanticipated changes

Solution and estimation

Nested structure:

- Estimation — optimization over parameter vector
- Need to solve the model for each value of parameter vector

1. For given values of parameters,
   solve the theoretical model numerically
2. Compute/simulate the entities entering into the estimator
3. Evaluate the criterion function using the data
4. Find an improved values of parameters for the next iteration
5. Repeat until convergence

Computationally intensive ⇒ Simplifying assumptions for tractability

Controversy of labor supply elasticities

Precise measure of responsiveness of labor to after-tax wages is crucial for effective design of the tax and transfers system.

Reduced form estimation from micro-data ⇒ Small elasticities
MaCurdy (1981, 1983) Altonji (1986) Blundell and Walker (1986) Blomquist (1985) Angrist (1991) Pistaferri (2003)

Calibration of macro models ⇒ Large elasticities are essential

Keane, Rogerson 2011 *NBER*
Reconciling Micro and Macro Labor Supply Elasticities:
A Structural Perspective

- Same issues in modeling the effects of pension system
- Identified sources of discrepancies → in our model

Main model design features

- Labor supply elasticity ⇒ Human capital accumulation
Borrowing constraint
Wage risk and wealth process
- Intensive and extensive margins ⇒ Endogenous retirement without absorption
- Frictions on the labor market ⇒ Discreteness of labor supply
- Heterogeneity in effects ⇒ Observed (education), Unobserved (types) heterogeneity

Results and conclusions

Labor supply

- Large variation of labor supply elasticities by age and education:
  - Labor supply elasticities increase with age
  - Elasticities are smaller for higher education groups

Age Pension

- The program has large negative labor supply effects
- The program is expensive (Largest welfare item in budget)
- It is poorly targeted ⇒ Very low effective taper rates
- Doubling of taper rates combined with budget neutral 5.9% tax cut would lead to Pareto improvement

Summary of the stochastic life cycle model

1. Discrete time = age from 19 to 100 (stochastic survival)
2. Annual decisions on
   - Consumption (continuous choice)
   - Hours from [0, 24, 40, 45, 50, 60] per week (discrete choice)
3. Stochastic elements in the model
   - Survival (longevity risk)
   - Idiosyncratic wage shock
4. Human capital accumulation
   - Learning-by-doing → Accumulating work experience
   - Human capital increases future wage → part of compensation
5. Observed and unobserved heterogeneity in the population
   - Education → Initial endowment and human capital technology
   - Unobserved types → Initial endowment and preference for leisure

Hours, human capital and wage + wealth and consumption

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 $wage_t = K_{t-1} \cdot R_t \cdot \epsilon_t^{wage}$,
$R_t = 1$ is rental rate of human capital,
$\epsilon_t^{wage} \sim lnN(0, \sigma_t^{wage})$

Consumable wealth in the beginning of the period $M_t < M_{max}$

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

Intertemporal budget
$M_{t+1} = \left(M_t - c_t\right)(1 + r) + h_t \cdot wage_{t+1} + \text{transfers}_{t+1}$

State variables

1. Consumable wealth M_t
2. Human capital $K_t = f\left(\sum_{\tau=1}^{t-1} h_\tau, \text{age}, \text{education}, \text{type}\right)$
3. Education
4. Unobserved type

$X_t = (M_t, \mathcal{E}_t, \text{education}, \text{type})$, where $\mathcal{E}_t$ is fraction of total working time to total time budget, i.e. work experience

$0 \leq \mathcal{E}_t \leq 1$

$$\mathcal{E}_t = \frac{1}{t \cdot h_{max}} \sum_{\tau=1}^{t-1} h_\tau \;\Leftrightarrow\; \mathcal{E}_{t+1} = \frac{1}{t+1}\left(\mathcal{E}_t t + \frac{h_t}{h_{max}}\right), \mathcal{E}_0 = 0$$

$$K_t = f\left(\mathcal{E}_t \cdot t \cdot h_{max}, \text{age}, \text{education}, \text{type}\right)$$

Preferences

Utility of consumption

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

Utility of (accidental) bequests

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

$B_t = M_t - c_t$ bequeathed wealth

$b_{scale} > 0,\ \zeta > 0,\ \xi > 0$ parameters to be estimated

a_0 credit constraint (maximum amount of borrowing)

Disutility of work

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

Type: high ($\kappa_{type} = 1$) and low ($\kappa_{type} = 1 + \kappa_1$)

Simple age effects:

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

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

Bellman equation, without EV(1) taste shocks

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

Note: c_t continuous, h_t discrete

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

$H_t(\tau)$ type-specific choice set in period t

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

δ_t survival probability

Bellman equation with EV(1) taste shocks

Chocie-specific EV i.i.d. taste shocks ϵ_h

$$V_t(X_t) = \max_{h_t \in H_t(\tau)} \left[v_t(X_t, h_t) + \lambda \epsilon_h \right]$$

$$v_t(X_t, h_t) = \max_{0 \le c_t \le M_t + a_0} \Big\{ u(c_t) - \nu_t(h_t, \tau_{uh}) + (1 - \delta_t) w(M_t - c_t) + \delta_t \beta(\tau_{edu}) E \Big[\text{LogSum}\big(v_{t+1}(X_{t+1}, h_{t+1}) \big) \Big| X_t, c_t, h_t \Big] \Big\}$$

$$\text{LogSum}\big(v_t(X_t, h_t)\big) = \lambda \log \left(\sum_{h_t \in H_t(\tau)} \exp \frac{v_t(X_t, h_t)}{\lambda} \right)$$

$$P(h|X_t) = \exp \frac{v_t(X_t, h)}{\lambda} \Big/ \sum_{h_t \in H_t(\tau)} \exp \frac{v_t(X_t, h_t)}{\lambda}$$

Labor supply becomes probabilistic with standard logit choice 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
- Family dynamics, income and labor supply (each year)
- Data on wealth, health and health insurance, retirement, fertility, literacy and numeracy (particular years, reoccurring)
- Approximately 20,000 households in total

Structural estimation sample:

- Single and married men between age 19 and 85
    - 10,133 individuals, unbalanced panel of 81,197 observations
    - Individuals born 1912 - 1997

Australian institutional settings

1. Old Age Pension (safety net)
    - Universal from age 65
    - Not dependent of working history
    - Financed from general revenue
    - Subject to means testing
2. Superannuation (compulsory savings)
    - Defined contribution system, accumulation subject to market risk
    - Individual accounts in private super funds
    - Employers are compelled to contribute a fraction of wage
    - Accessible from age 65

Incorporating institutional settings in the model

Age Pension

$$\text{Pension} = \max\left\{0, \text{full benefit} - \max\{\text{income test}, \text{asset test}\}\right\}$$

$$\begin{aligned}\text{Income test} &= \max\left\{0, \text{income taper rate} \cdot (\text{income} - \text{income threshold})\right\}\\ \text{Asset test} &= \max\left\{0, \text{asset taper rate} \cdot (\text{wealth} - \text{asset threshold})\right\}\end{aligned}$$

- Need to represent within the state space (with minimal additions)
  - Use simplified institutional rules and formulas?
  - Use approximation obtained from observed data? ◀

Age pension equation

$$\text{benefit}_{\max} = \underset{(183.96)}{10{,}759.73} + \underset{(173.52)}{1{,}846.92}(\text{when year} \geq 2010),$$

$$\text{pension} = \max\left\{\text{benefit}_{\max} - \max\left[\max\{\underset{(0.020)}{0.27794}\,\text{wage}, \underset{(0.0004)}{0.00499}(\text{wealth} - \underset{(46{,}895.27)}{117{,}082.60})\}, 0\right]\right\}$$

Superannuation

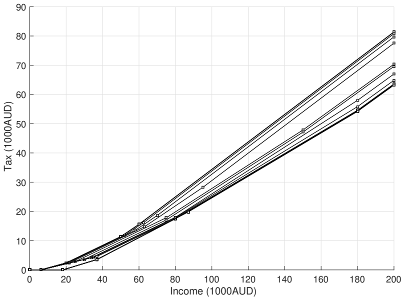
- Superannuation is a function of the labor supply throughout career $\rightarrow$ function of accumulated human capital
- We need to simplify the rules:
- Disregard the details of retirement income $\rightarrow$ paid as lump sum at age 65

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

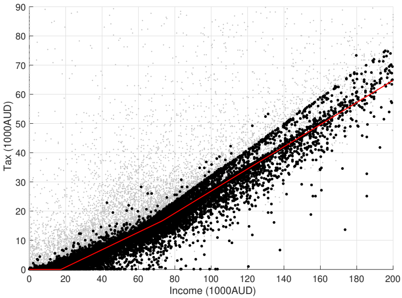
- Not a completely unrealistic assumption: market for annuities is extremely thin

Income tax function

Tax rules



Tax data



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

Intertemporal budget constraint (updated)

$$M_{t+1} = (M_t - c_t)(1+r) + h_t \cdot wage_{t+1} + \text{transfers}_{t+1}$$

$$\downarrow$$

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

$tr_{t+1} \cdot \mathbb{1}\{t+1 \leq 22\}$ transfers from parents to youth

Education levels

Original HILDA classification	N obs	%	Coarsened 3 level classification	N obs	%
Postgrad - masters or doctorate	557	5.50	College	2,391	23.60
Grad diploma, grad certificate	503	4.96			
Bachelor or honours	1,331	13.14			
Advanced diploma, diploma	922	9.10	High school	5,254	51.85
Certificate III or IV	3,178	31.36			
Certificate I or II	0	0.0			
Certificate not defined	0	0.0			
Year 12	1,154	11.39			
Year 11 and below	2,488	24.55	Dropouts	2,488	24.55
Undetermined	0	0.0			
Total	10,133	100.00		10,133	100.00

Choice of discrete levels of hours

K-medians cluster analysis — Correspondence to HILDA

h_t	Nobs	annual	week	Empl FT	Empl PT	Unemp	OLF
0	26,411	0	0	353	1,877	2,216	21,960
1	6,711	1200	24	1,303	5,408	0	0
2	23,387	2000	40	23,212	175	0	0
3	7,622	2250	45	7,622	0	0	0
4	12,115	2500	50	12,115	0	0	0
5	8,368	3000	60	8,368	0	0	0

Model solution: DC-EGM

Iskhakov, Jørgensen, Rust, Schjerning (2017) *QE*
The Endogenous Grid Method For Discrete-Continuous Dynamic Choice Models With (Or Without) Taste Shocks

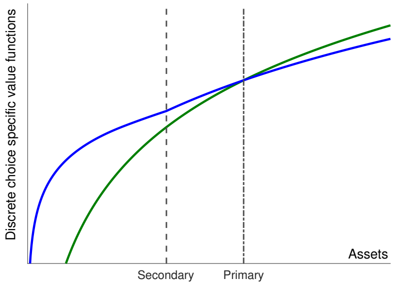
Carroll (2006) *Economics Letters*
The method of endogenous gridpoints for solving dynamic stochastic optimization problems.

Main idea of the endogenous grids

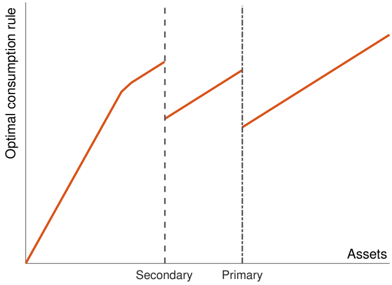
- Instead of searching for optimal decision in each point of the state space (traditional approaches)
- Look for the state variable (level of assets) where arbitrary chosen decision (consumption $\rightarrow$ savings) would be optimal (EGM)

Kinks and discontinuities with discrete-continuous choice

Value functions



Policy function



Primary kinks

1. The *d*-specific value functions intersect
   (due to trade-off between income and disutility of work)
   $\Downarrow$
2. The upper envelope of the value functions has a kink
   (this is what we call a primary kink)
   $\Downarrow$
3. Discrete choice policy is to work on the left of the kink, and to retire on the right of the kink
   $\Downarrow$
4. Working and retiring have different corresponding optimal consumption policies
   $\Downarrow$
5. Combined consumption policy has a discontinuity

Secondary kinks

1. Value function in $t+1$ has a primary kink
   (because d-specific value functions intersect in $t+1$)
   $\Downarrow$
2. In the non-concave region around a primary kink in $t+1$
   the maximand in the Bellman equation has multiple local optima
   $\Downarrow$
3. The Euler equation for the corresponding values of wealth has multiple solutions, all solutions are found in EGM
   $\Downarrow$
4. "Suboptimal" endogenous points have to be dropped: find the point where global maximum shifts from one solution to the other
   $\Downarrow$
5. Optimal consumption rule in period t has a discontinuity, the value function has a corresponding secondary kink

Adding extreme value shocks

Properties of the full solution

1. Value functions are non-concave and have kinks
2. Consumption functions have discontinuities
3. Discontinuities/kinks propagate through time and accumulate

Extreme value distributed taste shocks

- Smooth out primary kinks
- Extreme value distribution → closed form expectations for choice probabilities and expectation of the max (logsum)
- Two interchangeable interpretations
  - Structural: unobserved state variables
  - Logit smoothing: to streamline the solution
- Prevent propagation of kinks and discontinuities
- No complete smoothing in general: secondary kinks may persist

Estimation: Method of Simulated Moments

McFadden (1989) *Econometrica*
A method of simulated moments for estimation of discrete response models without numerical integration

- Method of simulated moment estimator
- Diagonal weighting matrix
- Logit smoothed simulator for better numerical performance
- Non-convex values functions create problems for derivative based methods
- POUNDerS derivative free trust region minimization algorithm

HILDA data

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- Family dynamics, income and labor supply (each year)
- Data on wealth, health and health insurance, retirement, fertility, literacy and numeracy (particular years, reoccurring)
- Approximately 20,000 people in total

Structural estimation sample:

- Single and married men between age 19 and 85
  - 8,836 individuals, unbalanced panel of 56,090 observations
  - Individuals born 1916 - 1993

Choice of moments to match

	High school		Dropouts		College	
Moments	Ages	N	Ages	N	Ages	N
working	19 - 85	67	19 - 85	67	23 - 85	63
hours|working	19 - 75	57	19 - 78	60	23 - 71	49
wage|working	19 - 73	55	19 - 69	51	23 - 69	47
var of wage	19 - 73	55	19 - 69	51	23 - 69	47
hours20	19 - 85	67	19 - 85	67	23 - 85	63
hours40	19 - 85	67	19 - 85	67	23 - 85	63
hours45	19 - 85	67	19 - 85	67	23 - 85	63
hours50	19 - 85	67	19 - 85	67	23 - 85	63
wealth	19 - 85	55	19 - 85	55	23 - 85	49
work2work	19 - 74	56	19 - 77	59	23 - 70	48
nowork2nowork	19 - 85	67	19 - 85	67	25 - 85	61
super lumpsum	65	1	65	1	65	1
Total		681		679		617

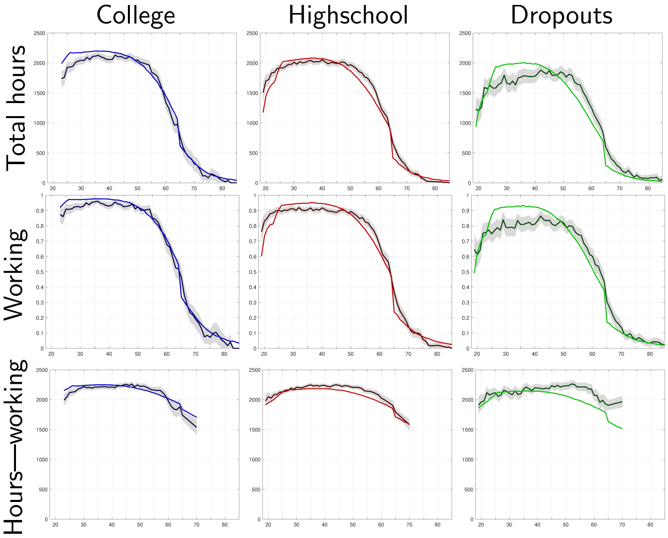
Estimates of the preference parameters

Parameter	Description	Estimate	Std.Err.
ζ	CRRA coefficient in consumption	0.80989	0.06206
γ_1	Disutility of working 1000 hours (20 per week)	0.92654	0.24025
γ_2	Disutility of working 2000 hours (40 per week)	0.82177	0.16702
γ_3	Disutility of working 2250 hours (45 per week)	1.64690	0.39486
γ_4	Disutility of working 2500 hours (50 per week)	1.51608	0.35264
γ_5	Disutility of working 3000 hours (60 per week)	2.16258	0.57946
$\kappa_1(\tau = \text{low})$	Correction coefficient with disutility of work	0.61153	0.58616
κ_2	Quadratic coefficient on age for older workers	0.00142	0.00062
κ_3	Linear coefficient on age for young workers	0.04804	0.03242
ξ	CRRA coefficient in utility of bequest	0.46775	0.48061
b_{scale}	Scale multiplicator of the utility of bequest	0.67227	2.02012
$\beta(\tau = \text{hs})$	Discount factor, highschool	0.96944	0.00297
$\beta(\tau = \text{dr})$	Discount factor, dropouts	0.96970	0.00403
$\beta(\tau = \text{cl})$	Discount factor, college	0.96963	0.00367
λ	Scale of EV taste shocks	0.83949	0.39929

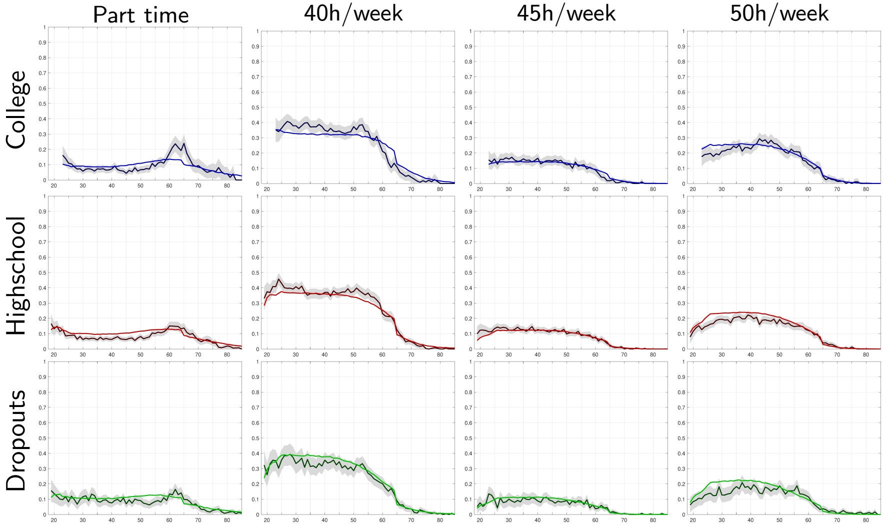
Human capital accumulation process

Parameter	Description	Estimate	Std.Err.
$\eta_0(\tau = \text{cl})$	Constant for college	2.93936	1.37286
$\eta_0(\tau = \text{hs})$	Constant for high school	2.61254	1.56208
$\eta_0(\tau = \text{dr})$	Constant for dropouts	2.38097	1.38154
$\eta_0(\tau = \text{high})$	Constant for high type	0.13360	1.60836
η_1	Age (time index)	0.02753	0.01937
η_2	Age (time index) square	-0.00076	0.00044
$\eta_3(\tau = \text{cl})$	Work experience for college	0.03125	0.02754
$\eta_3(\tau = \text{hs})$	Work experience for high school	0.02200	0.02893
$\eta_3(\tau = \text{dr})$	Work experience for dropout	0.01991	0.03011
$\eta_4(\tau = \text{cl})$	Work experience square for college	-0.00017	0.00130
$\eta_4(\tau = \text{hs})$	Work experience square for high school	-0.00002	0.00120
$\eta_4(\tau = \text{dr})$	Work experience square for dropout	-0.00000	0.00118

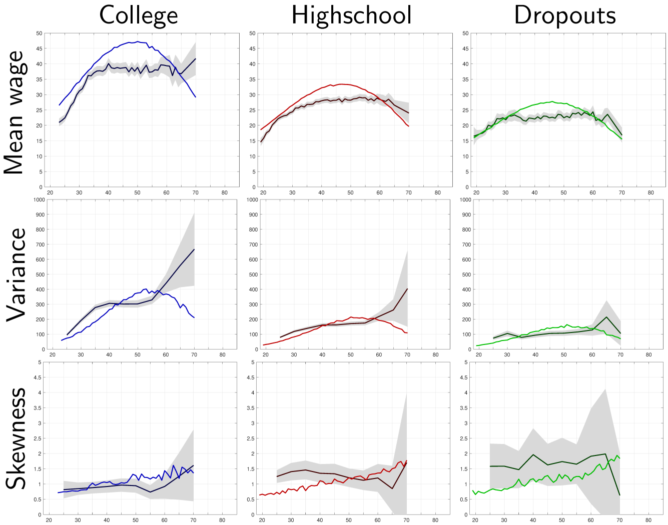
Goodness of fit: total hours and participation



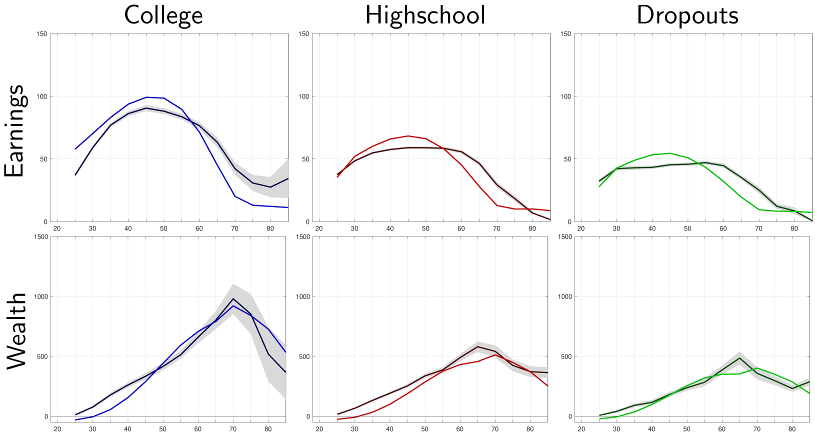
Goodness of fit: discrete level of hours



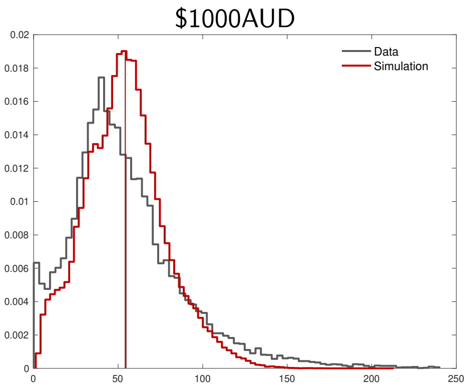
Goodness of fit: lifecycle wage distribution

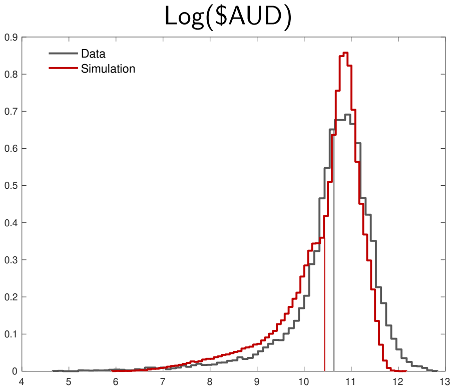


Goodness of fit: earnings and wealth



Goodness of fit: overall income distribution





Policy simulations

Baseline: No policy change

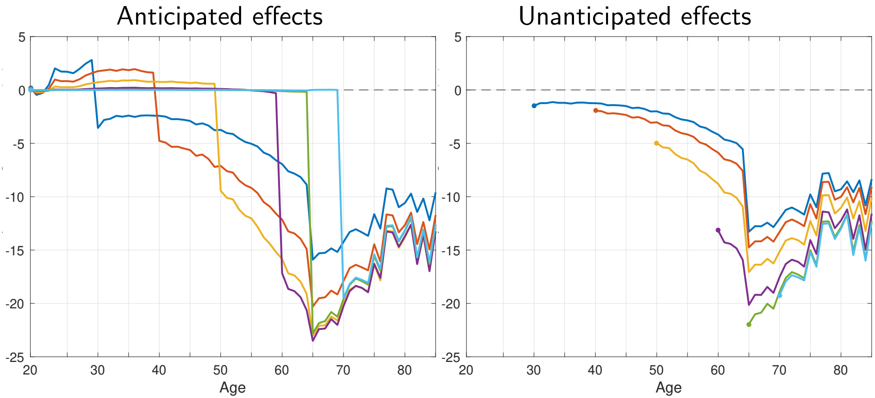
Anticipated: Fully anticipated policy change

Unanticipated: Exogenous shift from regime 1 to regime 2

- 1000 individuals in each education/type
- Identical sequence of (pseudo) random variables in all simulations
- Varying revelation age

Permanent 10% wage decrease ⇝ % change in hours

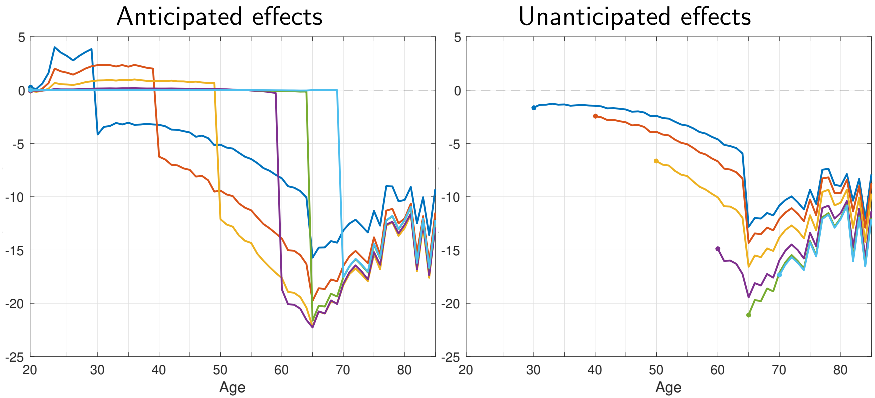
High school graduates



No compensation ⟶ Marshall effects

Permanent 10% wage decrease ⇝ % change in hours

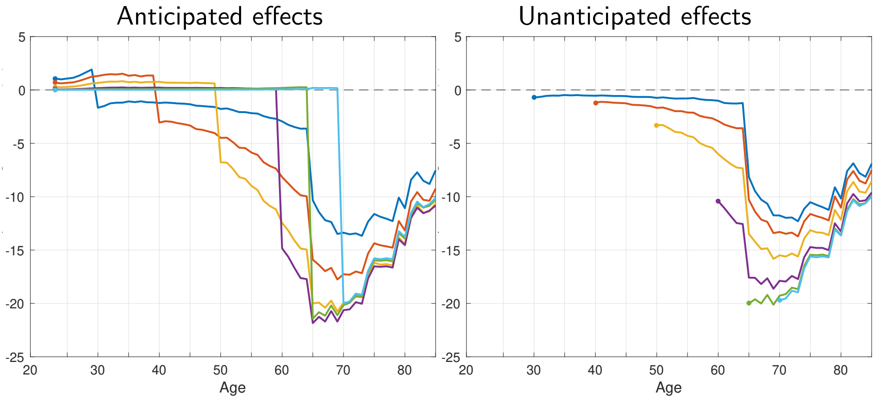
High school dropouts



No compensation ⟶ Marshall effects

Permanent 10% wage decrease ⇝ % change in hours

College graduates

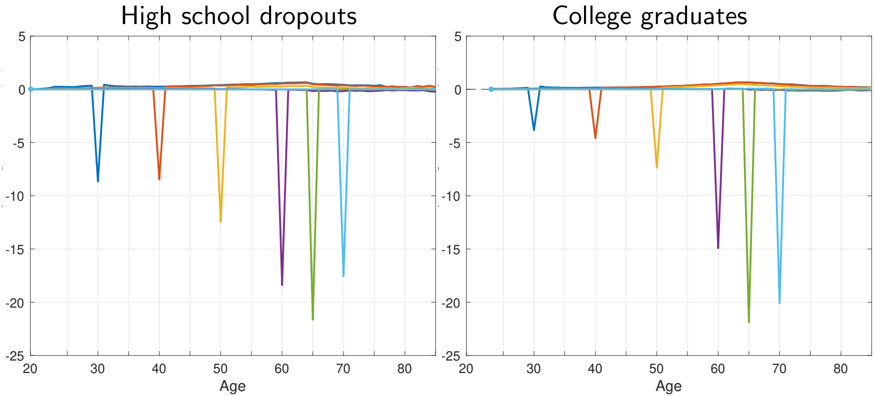


No compensation ⟶ Marshall effects

Permanent 10% wage decrease $\rightsquigarrow$ hours

- Larger decline in hours if policy is anticipated: labor supply is shifted towards the beginning of life cycle where wage is not yet decreased
- Effect is very different at different points of the life cycle
- Much larger hours decline if wage decrease occurs at older ages
- Elasticities smaller for college grads than HS grads at younger ages
- But catch up at older ages
- Key Point: Effect of HC on labor supply elasticities not changed by hours bunching

Transitory 10% wage decrease ⇝ % change in hours



Anticipated effects ⟶ Frisch elasticities

Frisch elasticities

- Frisch elasticities increase with age
- The increase is greater for the more educated
- Consistent with earlier papers on US data:

Imai and Keane 2004 *International Economic Review*
Intertemporal labor supply and human capital accumulation.

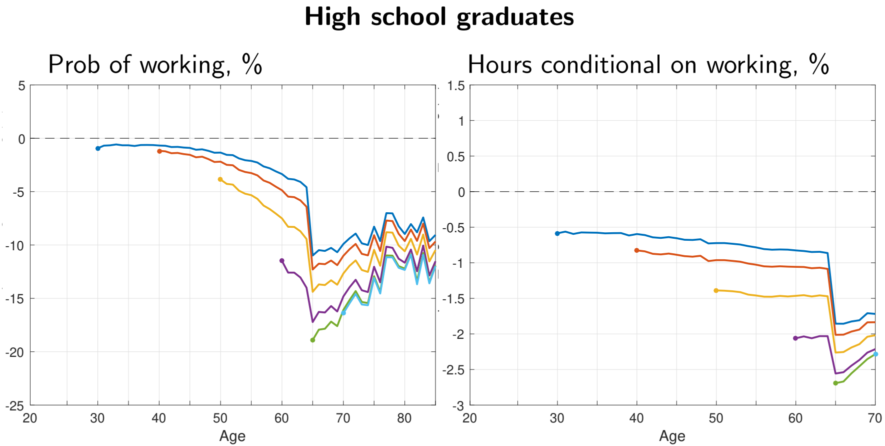
Keane and Wasi 2016 *The Economic Journal*
Labour supply: the roles of human capital and the extensive margin.

Intensive vs. extensive margin in labor supply elasticities

- Permanent 10% wage decrease $\rightsquigarrow$ probability of working
- Permanent 10% wage decrease $\rightsquigarrow$ hours conditional on working
- Relative changes (%)
- Unanticipated wage decrease

- Evidence of significantly higher elasticity on the extensive margin

Intensive vs. extensive margin



Note the difference in scales: extensive margin clearly dominates.

Effects of changes in age pension rules

Policy parameters in age pension:

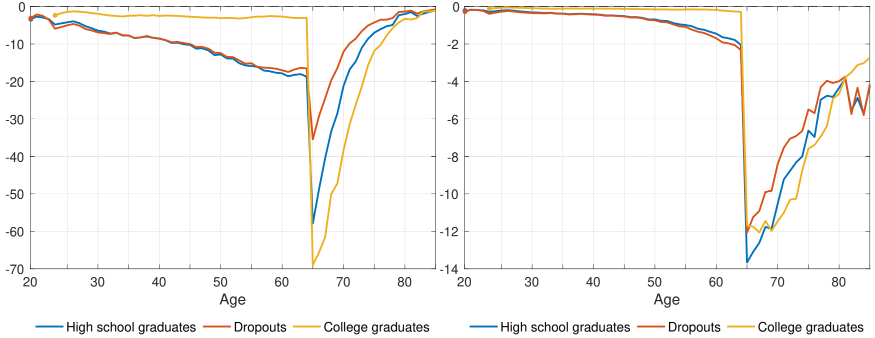
- Maximum pension benefit (+25%)
- Taper rate in income test (-10%)
- Taper rate in asset test (-10%)

Effects on:

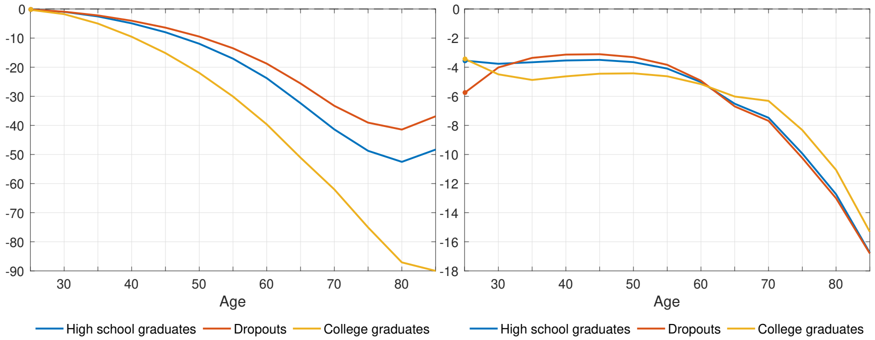
1. $\rightsquigarrow$ hours of labor supply (hours per annum)
2. $\rightsquigarrow$ wealth (\$1000)
3. $\rightsquigarrow$ consumption (\$1000)

- Only high school graduates

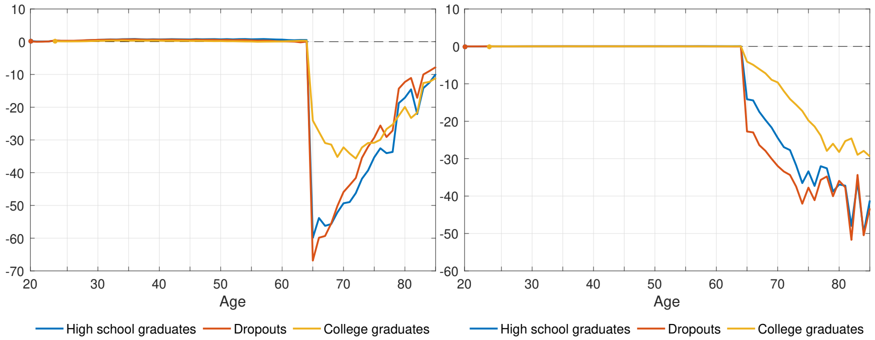
Maximum age pension +25% ⇝ hours (annual and %)



Doubling asset taper rate ⇝ wealth (annual and %)



Doubling income taper rate ⇝ hours (annual and %)



Effects of the age pension

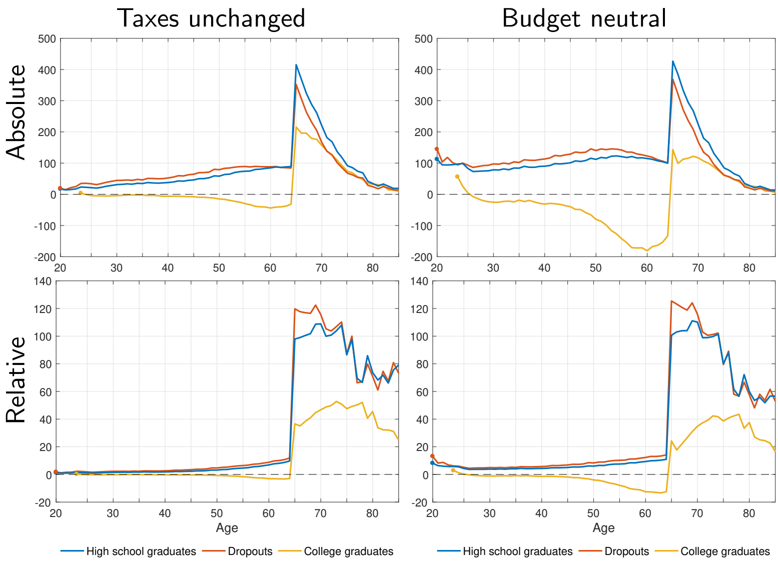
Simulate the world without Age Pension

1. Cost of program is 1/3 of income tax revenue
2. Elimination allows 33% tax cut (if no behavioral response)

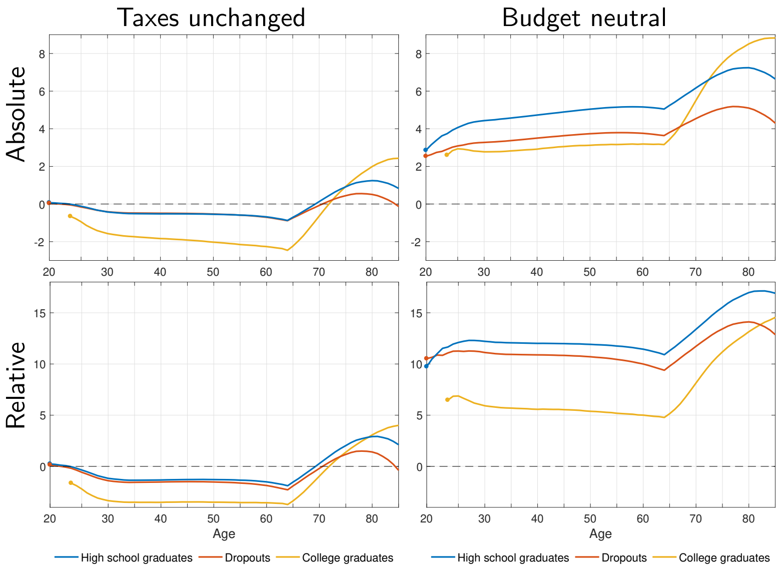
Unchanged taxes vs. Revenue neutral

- Elimination of Age Pension generates 5.8% increase in labor supply
- This allows a 37% cut in income tax rates in budget neutral simulation

Elimination of Age Pension ⇝ hours



Elimination of Age Pension ⇝ consumption, $1000 AUD



Effects of the age pension

The world without the age pension (revenue neutral):

- Labor supply increases for dropouts and HS graduates at all ages
- Labor supply decreases for college graduates pre 65 (income effects), but increases greatly at 65+
- Tax rates fall by 37% in budget neutral simulation
- About 90% of workers prefer to live in a world with no age pension and lower taxes
- Only 10% of low skill type individuals experience decrease in welfare
- This result reflects the poor targeting of the Age Pension program and large labor supply distortion it creates

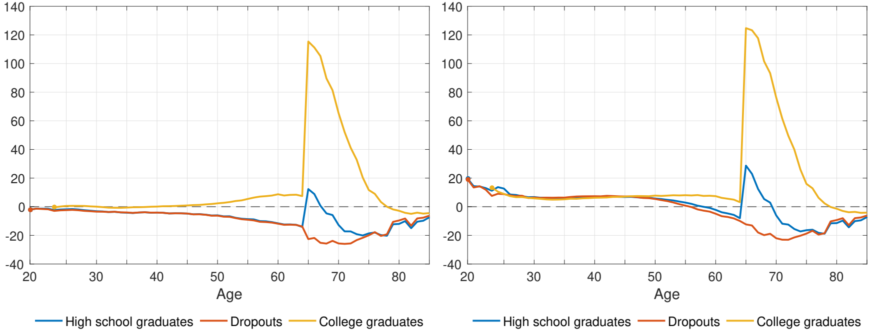
Better targeting the Age Pension

- 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%
  - Top rate reduced from 37.9% to 35.7%
  - Middle rate reduced from 29.9% to 28.1%

Better Targeting the Age Pension

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

Taxes unchanged Budget neutral

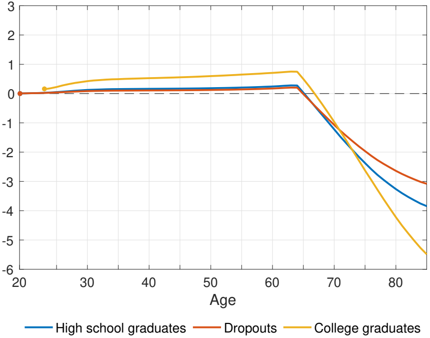


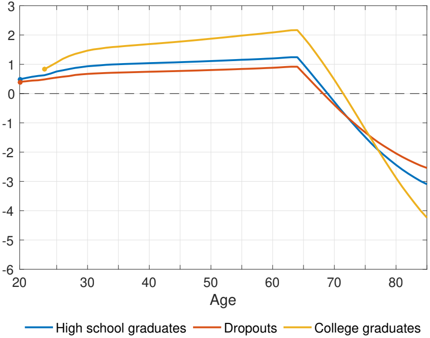
Note: Change in annual hours

Better Targeting the Age Pension

Doubling of income/asset tapers ⇝ Effects on Consumption

Taxes unchanged | Budget neutral



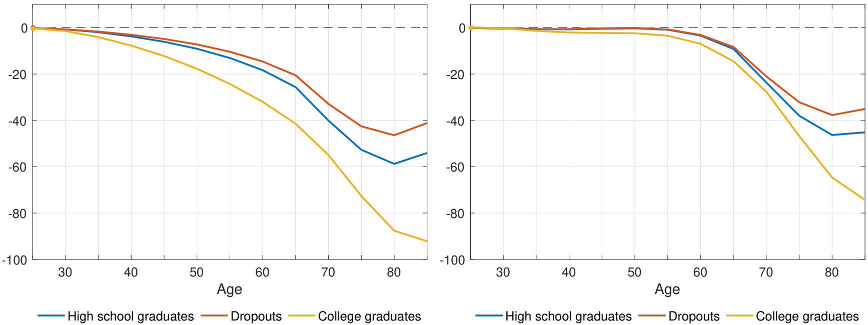


Note: Change in $1000 AUD

Better Targeting the Age Pension

Doubling of income/asset tapers ⇝ Effects on Assets

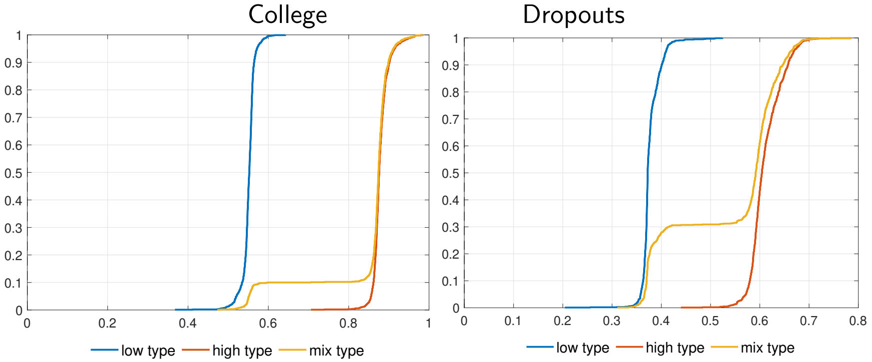
Taxes unchanged | Budget neutral



(Note: Change in $1000 AUD)

Better Targeting the Age Pension

Doubling Tapers + Tax Cut ⇝ Effects on ex-ante utility



Note: Change in expected utility at the beginning of life

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%
- 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%
    - 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

Labor supply

- Large variation of labor supply elasticities by age and education:
  - Labor supply elasticities increase with Age
  - Elasticities are smaller for higher education groups

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