Aggregate Implications of Child-Related Transfers with Means Testing

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Child-related transfers in Australia

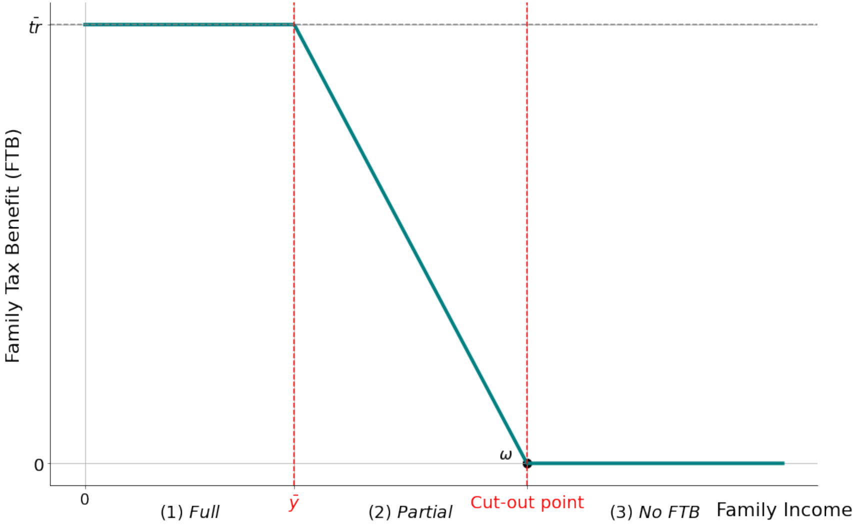
1. Family transfers $\approx$ 2% of GDP over the past decade.

2. 70% of family transfers comprises two child-related transfers:
   - Family Tax Benefit (FTB Part A and Part B)
   - Child Care Subsidy (CCS)

3. Some highlights of the FTB and the CCS:
   - Generous (Average of $8,000); Ext margin: FTB Ext margin: CCS
   - Significant (up to 40% of income for Q1 and Q2); FTB inc. share
   - Not mutually exclusive; Child care usage
   - Complex means-testing (joint inc. + demographic); FTB CCS
   - CCS tests work hours, FTB does not.

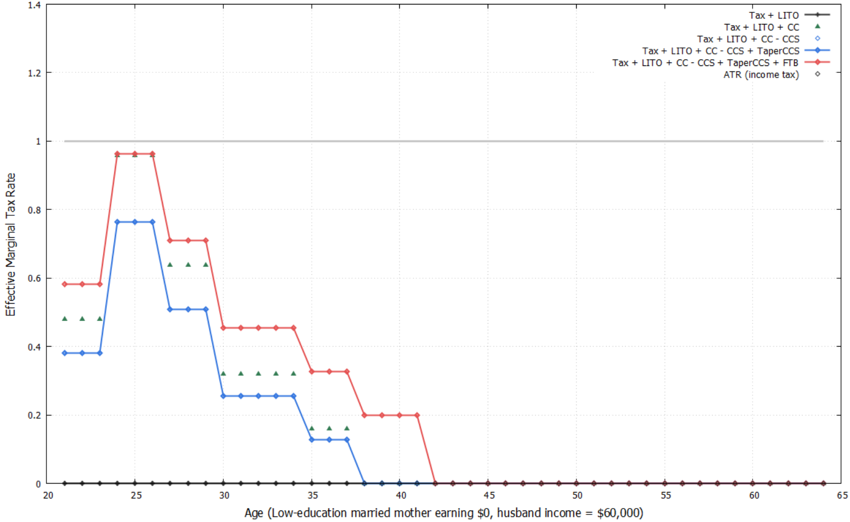
*See Budget Paper 1: Budget Strategy and Outlook page *6-26*

Example benefit schedule



Life cycle EMTRs due to means-testing:

Stay-at-home young mother: low ed, median income husband



◂ Life cycle EMTR: Part-timer ◂ EATR income schedule ◂ EMTR income schedule

Distinct age-profile of full-time share for mothers

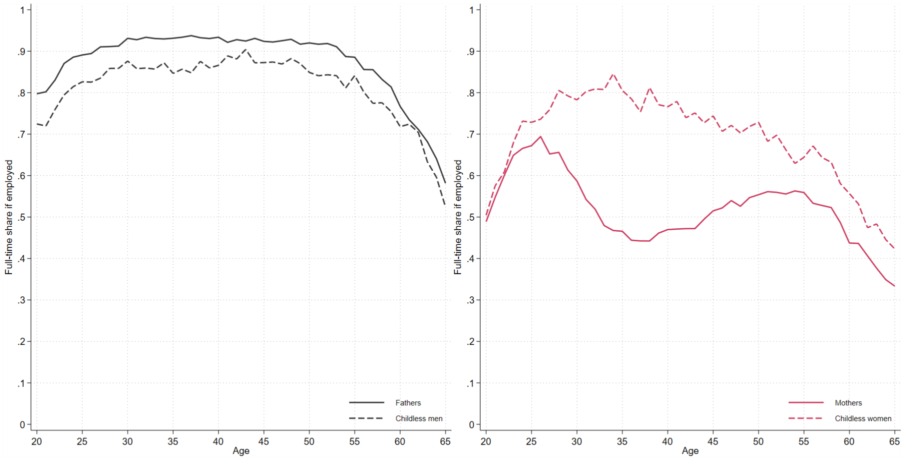


Figure 3: Age-profiles of full-time share of employment by gender and parenthood

◂ Life cycle: Participation

This paper

Addresses three important questions:

1. Are child-related transfers desirable? Yes and No
2. Today's focus: Should child-related transfers be universal?
3. If not, are there better reforms? Incremental reforms

How?

- Data: HILDA 2001-2020, ABS, World bank, etc;
- Methods: Structural model calibrated to Australia 2012-2018;
- Criteria of assessment: **Efficiency**, **Ex-ante welfare**, and **Equity**.

See related literature on tax and transfer using heterogeneous agent model.

Model overview

HA-OLG-GE model of a small open economy, featuring **means-tested child-related transfers with all their kinks and non-linearities**.

1. Households
   - Heterogeneous in age (j), family type (λ), assets (a), female human capital (h), education (θ), transitory shocks (ϵ^m, ϵ^f);
   - Time and monetary costs of children;
   - Longevity risk;
   - Male labor supply is exogenous;
   - **Decisions**: joint c, a^+ and female labor supply, $\ell \in \{0, 1, 2\}$;
2. A representative firm with Cobb-Douglas technology;
3. Government commits to balance the budget every period:
   - income tax, corporate tax, consumption tax, borrowing;
   - general expenditure, age pension, FTB, CCS, debt.

Overview of findings

1. *Should we universalize child-related transfers?*
   - YES $\rightarrow$ Efficiency and overall welfare gains;
   - NO $\rightarrow$ High tax burden. Single mothers lose;
2. Means-testing ensures a positive lifetime outcome for the recipients;
3. *A well-rounded policy*?
   - Incremental reform: Relaxing the Child Care Subsidy's taper rate!

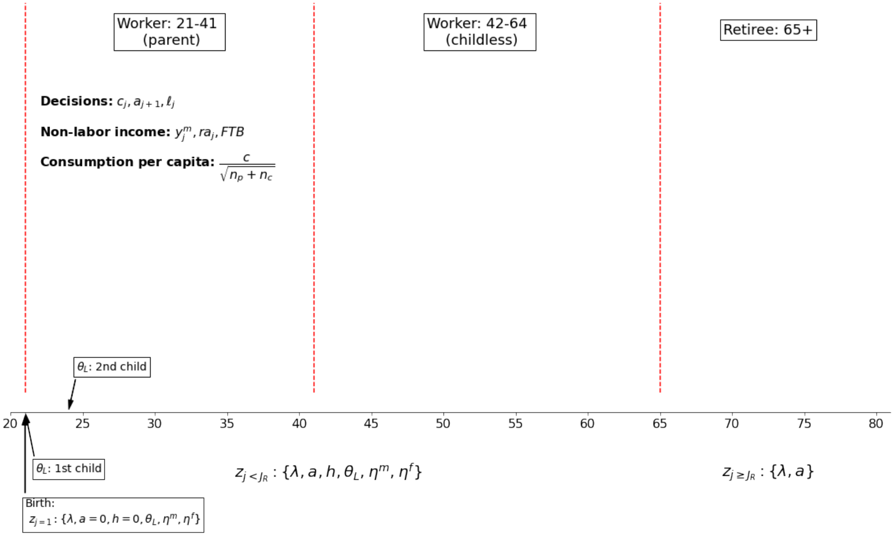
Demographics

- Time-invariant pop. growth rate (n) and survival prob. (ψ_j^m, ψ_j^f);
- Households born as workers at $j = 21$, retire at 65 and can live to 100;
- Three family types:
  - Married parents ($\lambda = 0$),
  - Single childless men ($\lambda = 1$), and
  - Single mothers ($\lambda = 2$);
- Conditional transition probabilities of family type:

$\pi_{\lambda_{j+1}\mid\lambda_j}$	$\lambda_{j+1} = 0$	$\lambda_{j+1} = 1$	$\lambda_{j+1} = 2$
$\lambda_j = 0$	$\psi_{j+1,m}\psi_{j+1,f}$	$\psi_{j+1,m}(1 - \psi_{j+1,f})$	$(1 - \psi_{j+1,m})\psi_{j+1,f}$
$\lambda_j = 1$	0	$\psi_{j+1,m}$	0
$\lambda_j = 2$	0	0	$\psi_{j+1,f}$

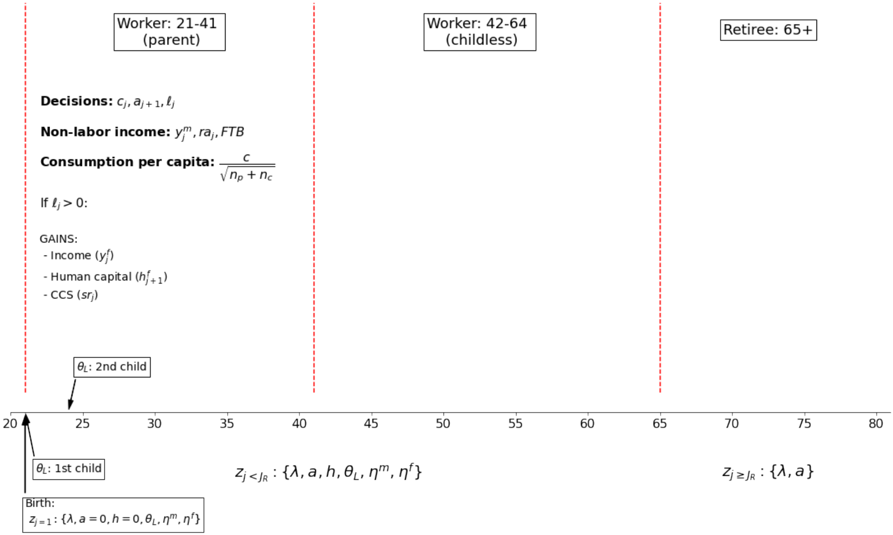
- Exogenous children determined by household's age j and education θ;
- Low education (θ_L) households have children earlier;
- Child spacing is identical for all parents.

Households: Low-education (θ_L)
(Working age)



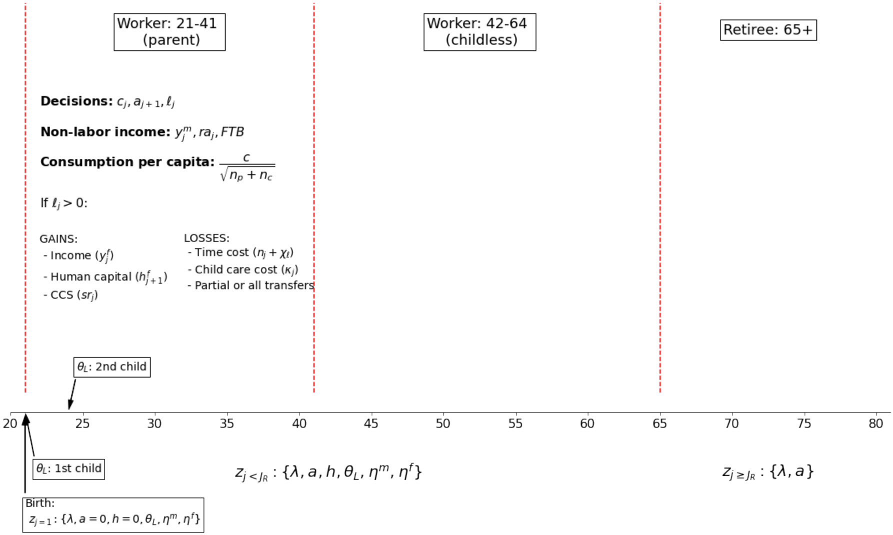
Trade-off for women (Detail) | Time-separable preferences | Overview of decision process

Households: Low-education (θ_L)
(Working age)



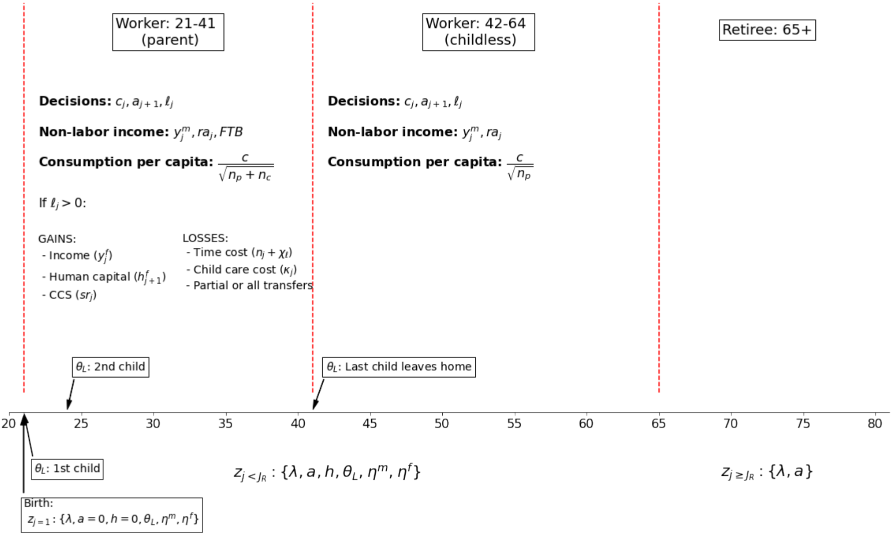
Households: Low-education (θ_L)

(Working age)



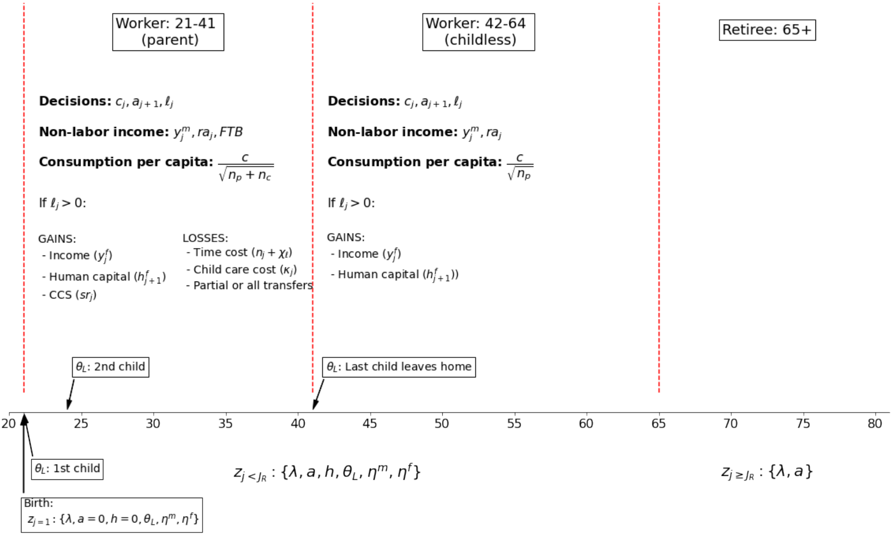
Households: Low-education (θ_L)

(Working age)



Households: Low-education (θ_L)

(Working age)



Households: Low-education (θ_L)

(Working age)

Worker: 21-41 (parent)

Decisions: c_j, a_{j+1}, ℓ_j

Non-labor income: y_j^m, ra_j, FTB

Consumption per capita: $\frac{c}{\sqrt{n_p + n_c}}$

If $\ell_j > 0$:

GAINS:
- Income (y_j^f)
- Human capital (h_{j+1}^f)
- CCS (sr_j)

LOSSES:
- Time cost ($n_j + \chi_\ell$)
- Child care cost (κ_j)
- Partial or all transfers

Worker: 42-64 (childless)

Decisions: c_j, a_{j+1}, ℓ_j

Non-labor income: y_j^m, ra_j

Consumption per capita: $\frac{c}{\sqrt{n_p}}$

If $\ell_j > 0$:

GAINS:
- Income (y_j^f)
- Human capital (h_{j+1}^f))

LOSSES:
- Time cost ($n_j + \chi_\ell$)

Retiree: 65+

θ_L: 2nd child

θ_L: Last child leaves home

20 25 30 35 40 45 50 55 60 65 70 75 80

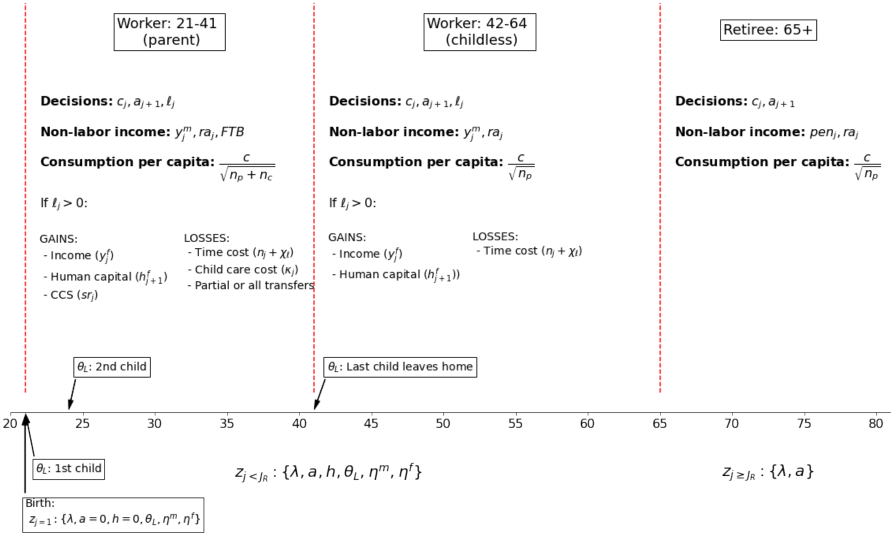
θ_L: 1st child

Birth:
$z_{j=1}: \{\lambda, a = 0, h = 0, \theta_L, \eta^m, \eta^f\}$

$z_{j<J_R}: \{\lambda, a, h, \theta_L, \eta^m, \eta^f\}$

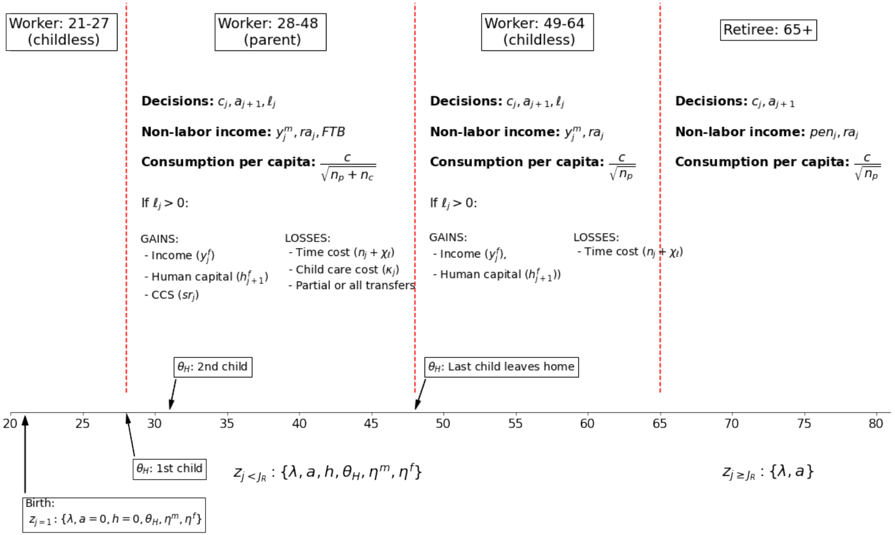
$z_{j \geq J_R}: \{\lambda, a\}$

Households: Low-education (θ_L) (Retirement)



Households: High-education (θ_H)

(Working age + Retirement)



Dynamic Optimization Problem: Working age

Married and single-mother households

$$V(z) = \max_{c,\,\ell,\,a_+} \left\{ u(c, l^m, l^f, \theta, \lambda) + \beta \sum_{\Lambda} \int_{S^2} V(z_+)\, d\Pi(\lambda_+, \eta^m_+, \eta^f_+ \mid \lambda, \eta^m, \eta^f) \right\} \quad (1)$$

s.t.

$$\begin{aligned} (1+\tau^c)c + (a_+ - a) + \mathbf{1}_{\{\ell \neq 0\}} n^f_{\lambda,\ell} \times CE_\theta &= y_\lambda + (nc_\theta \times tr^A + tr^B) - T(y^m, y^f) \\ l^f &= 1 - n^f_{\lambda,\ell} - \mathbf{1}_{\{\ell=1\}}\chi_p - \mathbf{1}_{\{\ell=2\}}\chi_f \\ l^m &= 1 - n^m_\lambda \quad \text{if} \quad \lambda = 0 \qquad (2) \\ c &> 0 \\ a_+ &\geq 0 \end{aligned}$$

where:

- $y_\lambda = \mathbf{1}_{\{\lambda \neq 2\}} y^m + \mathbf{1}_{\{\ell \neq 0\}} y^f + ra$ is the total market income;
- $CE_\theta = w(1 - sr) \sum_{i=1}^{nc_\theta} \kappa_i$ is the net child care cost per hour;
- $T(y^m, y^f)$ is sum of individual taxes based on (22) following Feldstein (1969), Benabou (2000), and Heathcote et al. (2017).

Dynamic Optimization Problem: Working age

Single male

$$V(z) = \max_{c,\, a_+} \left\{ u(c, l^m, \theta, \lambda = 1) + \beta \sum_{\Lambda} \int_{S^2} V(z_+) \, d\Pi(\lambda_+, \eta_+^m \mid \lambda, \eta^m) \right\} \quad (3)$$

s.t.

$$\begin{aligned} (1 + \tau^c)c + (a_+ - a) &= y^m - T(y^m) && (4) \\ l^m &= 1 - n^m_{\lambda=1} \\ c &> 0 \\ a_+ &\geq 0 \end{aligned}$$

where:

- $y^m = wn^m h^m_{\lambda=1} \theta \epsilon^m + ra$ is single male household's market income;
- $T(y^m)$ is single male's tax based on (22).

Dynamic Optimization Problem: **Retirement**

Retiree's state vector is $z^R = \{a, \lambda\}$

- No labour income, no children;
- Pension is dependent on household type and income.

$$V(z^R) = \max_{c,\, a_+} \left\{ u(c,\lambda) + \beta \sum_{\Lambda} V(z_+^R)\, d\Pi(\lambda_+ | \lambda) \right\} \tag{5}$$

s.t.

$$\begin{aligned} (1+\tau^c)c + (a_+ - a) &= ra + pen - T(y^m, y^f) \\ c &> 0 \\ a_+ \geq 0 \quad and \quad & a_{J+1} = 0 \end{aligned} \tag{6}$$

Summary: Internally Calibrated Parameters

Parameter	Value	Target
Households		
Discount factor	$\beta = 0.99$	Saving 5%-8% (ABS 2013-2018)
Taste for consumption	$\nu = 0.375$	LFP for mothers = 68-72%
Fixed time cost of work	$\{\chi_p, \chi_f\} = \{0.1125,\ 0.0525\}$	Second half of LFP and FT profiles
Human cap. gain rates	$(\xi_{1,\lambda,\ell};\ \xi_{2,\lambda,\ell})$	Male age profiles of wages
Human cap. deprec.	$\delta_h = 0.074$	Gender wage gap age 50 (HILDA)
Technology		
Capital depreciation rate	$\delta = 0.07172$	$\frac{K}{Y} = 3.2$ (ABS, 2012-2018)
Transitory shocks, ϵ		
Persistence	$\rho = 0.98$	Literature
Variance of shocks	$\sigma_\epsilon^2 = 0.0145$	Gini of male earnings at age 21, $GINI_{j=1,m} = 0.35$
Fiscal policy		
Maximum pension	$pen^{max} = 30\% \times Y_m$	$\frac{\mathcal{P}_t}{Y_t} = 3.2\%$ (ABS, 2012-2018)

◂ Externally calibrated parameters

Key Macro Variables: Model vs. Data

Moments	Model	Data	Source
Targeted			
Capital, K/Y	3.2	3-3.3	ABS (2012-2018)
Savings, S/Y	4.7%	5-8%	ABS (2013-2018)
Mothers' *LFP*	72.57%	68-72%	HILDA (2012-2018)
Consumption tax, T^C/Y	4.23%	4.50%	APH Budget Review
Corporate tax, T^K/Y	4.25%	4.25%	APH Budget Review
Age Pension, P/Y	3.65%	3.20%	ABS (2012-2018)
Gini (male aged 21)	0.35	0.35	HILDA (2012-2018)
Non-targeted			
Consumption, C/Y	52.80%	54-58%	ABS (2012-2018)
Investment, I/Y	32.29%	24-28%	ABS (2013-2018)
Mothers' full-time share	50.32%	50%	HILDA (2012-2018)
Scale parameter, ζ	0.7417	0.7237	Tran and Zakariyya 2021
Income tax, T^I/Y	14.93%	11%	APH Budget Review
Tax revenue to output	28.36%	25%	ABS(2012-2018)
FTB + CCS	1.7%	1.45%	ABS (2012-2018)

Table 1: Key macroeconomic variables: Model vs. Data moments

Life cycle profile of labour supply: Model vs. Data

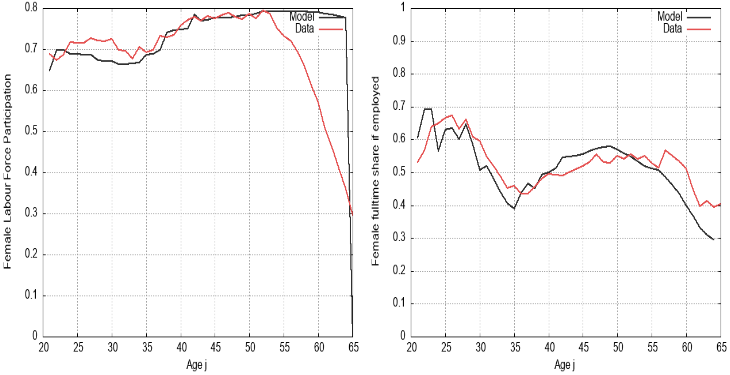


Figure: **Model vs Data: Life-cycle profiles of labor force participation and full-time share of employment of mothers.**

Baseline universal child-related transfers (1)

Aggregate implications of universal FTB and CCS programs

CCS size, %	+129.45	Hour, %	+6.71
FTB size, %	+281.40	Human cap. (H), %	+2.09
Average tax rate, *pp*	+4.20	Consumption (C), %	+0.04
Fe. LFP, *pp*	+2.64	Output (Y), %	+0.11
Fe. Full time, *pp*	+4.39	Welfare (EV), %	+0.85

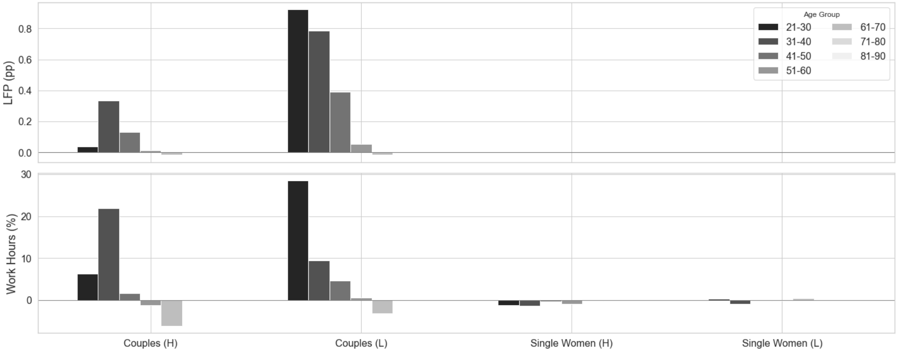
Table 3: Overall efficiency and welfare effects of universalizing the FTB and the CCS

	Couples (H)	Couples (L)	SM (H)	SM (L)	SW (H)	SW (L)
Welfare (%)	+1.36	+1.34	−1.47	−1.20	−0.69	−0.51

Table 4: Heterogeneous welfare effects of universal child-related transfers

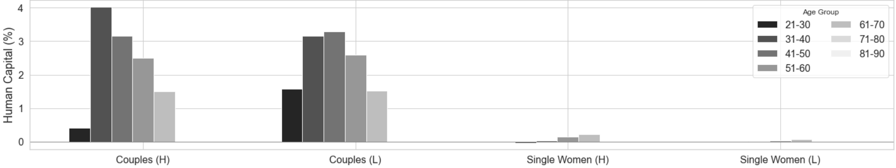
Baseline universal child-related transfers (2)

(Labor supply responses by demographic)



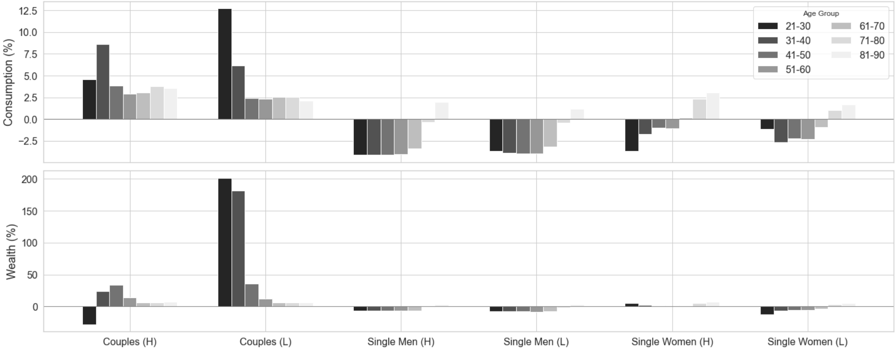
Baseline universal child-related transfers (3)

(Human capital changes by demographic)



Baseline universal child-related transfers (4)

(Consumption and wealth responses by demographic)



Baseline universal child-related transfers (5):
Summary of findings

Pros: **Efficiency and welfare gains**:

1. Work incentive effect due to reduced EMTRs dominates;
2. Married households win:
   - Improved self-insurance via labor supply and savings;
   - Better allocation of labor supply. More leisure taken in their 50s;
   - Higher consumption at young age when MU_c is high and face credit constraint;
3. Reform supported by the majority.

Baseline universal child-related transfers (6):

Summary of findings

Cons: **Inequitable re-distribution**:

1. Significant tax burden;
2. Hurts single mothers, the intended beneficiaries.
   - Universal transfers fail to compensate for decreased take-home earnings over the life cycle;
   - Limited self-insurance via work and savings;
   - Lack family insurance.
3. Inequitable redistribution problem is not resolved with smaller universal benefit rates.

Universal programs varied by benefit rates | Incremental reforms

Conclusion

Key takeaways for policy making:

- If we prioritize equity, child-related transfers are desirable;
- However, means-testing is required for a net positive life cycle outcome;
- Universal transfers can hurt beneficiaries, though supported by the majority;

Important points for quantitative work:

- Family structure and life cycle features are crucial for assessing impacts of child-related transfers;
- Policy interactions and general equilibrium effects (via tax) matter.

Caveats
Future work

Caveats

We abstract from, just to name a few:

1. Labor market and political frictions;
2. Administrative overhead of a complex welfare system;
3. Intensive margin of female labor supply decisions;
4. Male labor supply decisions;
5. Child-less married households and child-less single women;
6. Fertility, education and marriage/divorce decisions;
7. Welfare analysis along the transitional dynamics;
8. Joint optimization over the tax and transfer systems.

Future work

Planned expansion:

1. More labor options (permanent and casual employments);
2. Endogenize intensive margin of labour supply;
3. Richer income process (See De Nardi et al. (2020));
4. More detailed policy experiments;
5. Optimal tax and transfer policy.

Assessing means-tested child-related transfers (1)

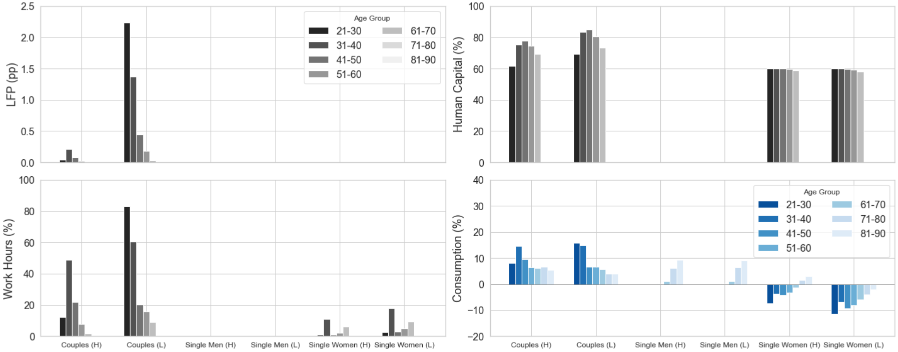
	[1] No FTB	[2] No CCS	[3] No FTB & CCS
CCS size, %	+49.80	–	–
FTB size, %	–	+10.89	–
Average tax rate, *pp*	+2.50	−0.70	+0.99
Fe. Lab. For. Part. (LFP), *pp*	+5.76	−10.00	+10.49
Fe. Full time (FT), *pp*	+9.21	−4.55	+20.38
Human cap. (H), %	+3.88	−4.83	+8.57
Consumption (C), %	+1.10	−3.26	+4.27
Output (Y), %	+1.38	−3.48	+3.86
Welfare, %	−3.70	−1.00	−0.66*

Table 1: Efficiency and welfare effects of eliminating child-related transfer program(s)

	Couples (H)	Couples (L)	SM (H)	SM (L)	SW (H)	SW (L)
Welfare (%)	+1.35	−0.22	+0.02	+0.06	−4.03	−6.53

Table 2: Welfare effects by demographic of removing FTB and CCS

Assessing means-tested child-related transfers (2)



Introduction: This paper

Assessing means-tested child-related transfers (3): Summary of findings

An economy without child-related transfers:

- Efficiency gain (female labor supply + human cap), but welfare loss.
- Redistributive consequence:
  - → Winner: High-educated couples and single males
  - → Small losers: Low-educated couples
  - → Big losers: Single mothers
- Opposed by the majority.

Why single mothers lose?

1. Increased take-home income fails to replace the lost transfers;
2. Limited self-insurance (via labor supply and borrowing).
3. Lack family insurance.

Introduction: This paper

Universal programs varied by size (1)

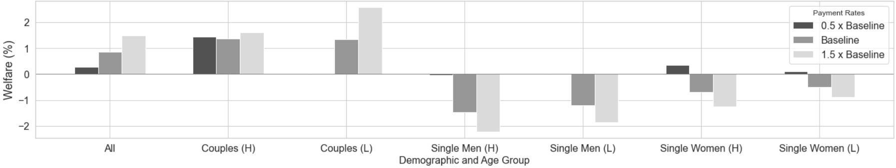
	Universal programs varied by benefit rates (1)		
	0.5×Baseline rates	Baseline rates	1.5×Baseline rates
CCS size, %	−15.45	+129.45	+207.27
FTB size, %	+132.56	+281.40	+430.23
Average tax rate, *pp*	+0.15	+4.20	+6.13
Fe. Lab. For. Part. (LFP), *pp*	+1.06	+2.64	+3.91
Fe. Full time (FT), *pp*	+0.23	+4.39	+6.29
Human cap. (H), %	+0.40	+2.09	+3.09
Consumption (C), %	−0.03	+0.04	+0.08
Output (Y), %	+0.16	+0.11	+0.11
Welfare (EV), %	+0.27	+0.85	+1.50

Table: **Aggregate efficiency and welfare effects of universal child-related transfers varied by size**

Main Section: Universal programs varied by size

Universal programs varied by benefit rates (2)

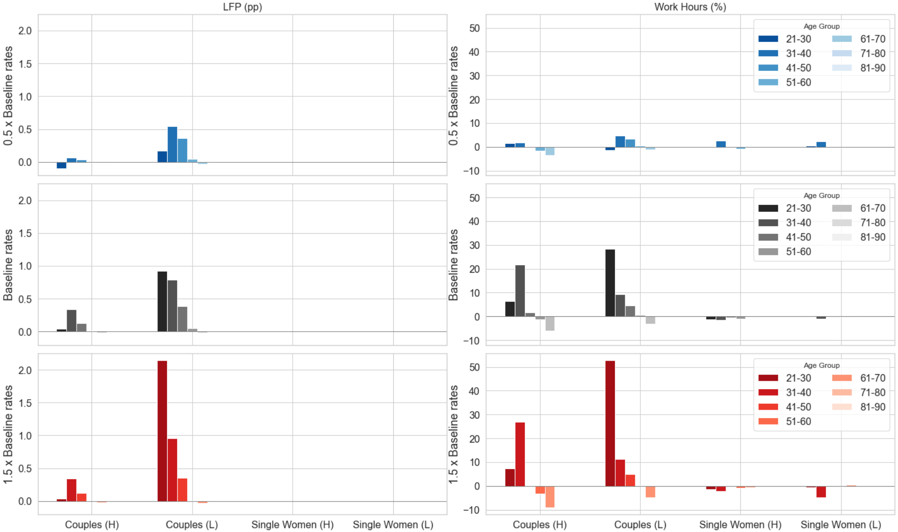
(Welfare changes by demographic)



Baseline universal: Summary of findings

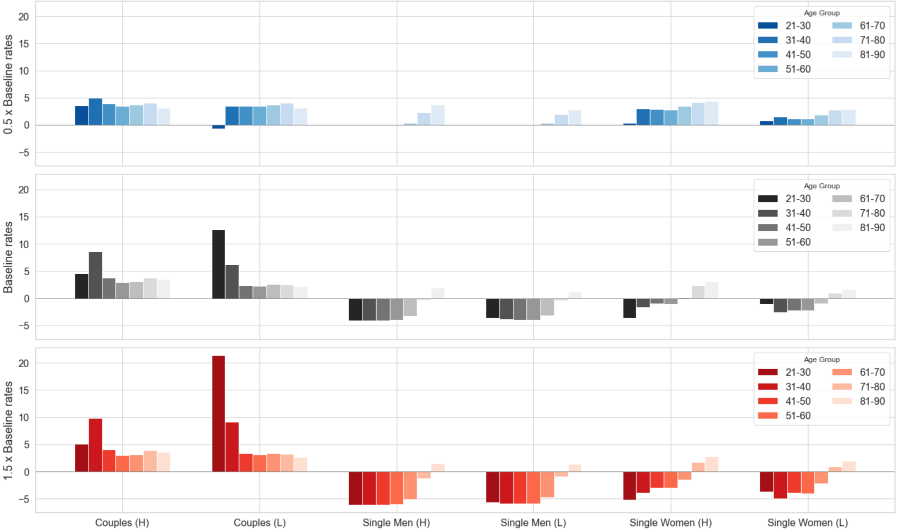
Universal programs varied by benefit rates (3)

(Labor supply responses by demographic)



Universal programs varied by benefit rates (4)

(Consumption changes by demographic)



Universal programs varied by benefit rates (5): Summary of findings

Varying the benefit rates does NOT resolve the inequity issue.

- Larger universal benefits: High tax burden. Single mothers lose.
  1. Lack family insurance;
  2. Costly self-insurance;
  3. Transfers cover short duration, and fail to replace the lost take-home income.
- Contraction:Low-education couples lose.
  1. Sustained increased in labor and consumption after 30, but
  2. Credit constraint;
  3. Cannot earn enough to replace lost transfers at age 21-30.
- Means-testing is necessary to ensure a net positive lifetime outcome for the intended beneficiaries.

Incremental reforms (1)

	Aggregate implications of incremental reforms			
	FTB taper rates		CCS taper rates	
	$0.5 \times \omega^F$	$1.5 \times \omega^F$	$0.5 \times \omega^C$	$1.5 \times \omega^C$
Tax rate, *pp*	+2.08	+3.34	−0.97	+1.28
Fe. LFP, *pp*	+1.69	−2.94	+0.17	−2.66
Fe. Hour, %	+1.13	−5.47	+1.00	−5.32
Fe. Human Cap, %	+0.76	−2.21	+0.22	−2.49
Cons. (C), %	+1.36	−1.55	+0.46	−2.06
Output (Y), %	+0.81	−1.67	**+0.89**	−1.42
Welfare (EV), %	−0.44	−1.41	**+0.37**	−0.61

Table 6: Efficiency and welfare effects of incremental reforms to taper rates.

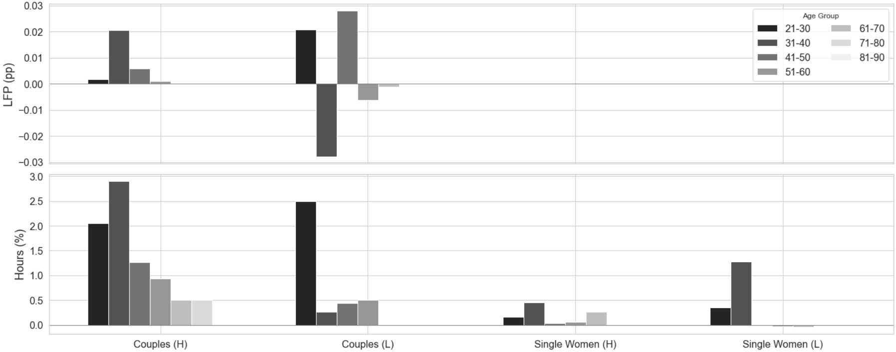
	Couples (H)	Couples (L)	SM (H)	SM (L)	SW (H)	SW (L)
Welfare (%)	+0.42	+0.40	+0.34	+0.24	+0.26	+0.18

Table 7: Heterogeneous welfare outcomes from halving the CCS taper rates.

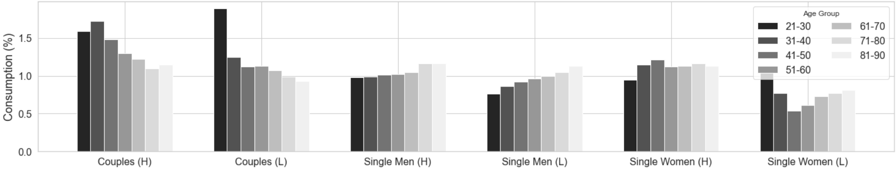
This paper
Baseline universal: Summary of findings

Incremental reforms (2)

(Labor supply responses by demographic)



Incremental reforms (3)
(Consumption responses by demographic)



Incremental reforms (4): Summary of findings

A well-balanced option is relaxing the CCS taper rates:

1. Efficiency and welfare gains;
2. Everyone wins.
   - Lower tax and taper rate of CCS reduce EMTR $\rightarrow$ enhance self-insurance capability via labor supply when MU_c is high and borrowings are NOT possible;
   - FTB is still present.

However, for couples (70% of the population):

1. Universal FTB and CCS: +1.3% welfare
2. Relaxing CCS taper rates: +0.4% welfare

$\rightarrow$ The universal system might still secure the most votes.

Literature

Tax-Transfer in heterogeneous agent models with family structure:

1. Joint-filing income tax
   - For proportional and separate filing income tax in the US (Guner et al., 2012a,b) and in US and 10 EU countries (Bick and Fuchs-Schundeln, 2017)
2. Spousal and survival benefits
   - For elimination (US) (Kaygusuz, 2015; Nishiyama, 2019; Borella et al., 2020)*
3. Child-related transfers
   - Expansion requires stronger evidence (US) (Guner et al., 2020)
   - Negative childcare price elasticity of labour supply (AU) (Doiron and Kalb, 2004)*
4. Old age pension
   - For (at least) partial means-tested (US) (Feldstein, 1987; Braun et al., 2017)
   - Balancing insurance and incentive effects of means-tested Age Pension (AU) (Tran and Woodland, 2014)

Demographics (2)

As in Nishiyama (2019), the household type evolves according to Markov transition probabilities:

$\pi_{h_{j+1}\mid h_j}$	$\lambda_{j+1} = 0$	$\lambda_{j+1} = 1$	$\lambda_{j+1} = 2$
$\lambda_j = 0$	$\psi_{j+1,m}\psi_{j+1,f}$	$\psi_{j+1,m}(1-\psi_{j+1,f})$	$(1-\psi_{j+1,m})\psi_{j+1,f}$
$\lambda_j = 1$	0	$\psi_{j+1,m}$	0
$\lambda_j = 2$	0	0	$\psi_{j+1,f}$

Table: Transition probabilities of household type

Households: Preferences (1)

Every household at time t has preference represented by a time-separable expected utility function:

$$\sum_{j=1}^{J} \beta^{j-1} \left(\prod_{s=1}^{j-1} \pi_{\lambda_{s+1}|\lambda_s} \right) u(c_j, l_j^m, l_j^f, \lambda_j, \theta), \tag{7}$$

- β - discount factor;
- ψ - time-invariant survival probabilities;
- λ - household type (by marital and parental status)
- c - joint consumption;
- l^i - leisure time of $i \in m, f$;

◂ Households: Timeline

Households: Preferences (2)

The periodic household utility functions are:

$$u(c, l^m, l^f, \theta, \lambda = 0) = \frac{\left[\left(\frac{c}{\iota_{1,\theta}}\right)^{\nu} (l^m)^{1-\nu}\right]^{1-\frac{1}{\gamma}} + \left[\left(\frac{c}{\iota_{1,\theta}}\right)^{\nu} (l^f)^{1-\nu}\right]^{1-\frac{1}{\gamma}}}{1-\frac{1}{\gamma}},$$

$$u(c, l^m, \theta, \lambda = 1) = \frac{\left[(c)^{\nu} (l^m)^{1-\nu}\right]^{1-\frac{1}{\gamma}}}{1-\frac{1}{\gamma}},$$

$$u(c, l^f, \theta, \lambda = 2) = \frac{\left[\left(\frac{c}{\iota_{2,\theta}}\right)^{\nu} (l^f)^{1-\nu}\right]^{1-\frac{1}{\gamma}}}{1-\frac{1}{\gamma}},$$

- Spouses are perfectly altruistic;
- $\iota_{\lambda,\theta} = \sqrt{\mathbf{1}_{\{\lambda \neq 1\}} + \mathbf{1}_{\{\lambda \neq 2\}} + nc_{\theta}}$;
- γ - elasticity of intertemporal substitution;
- ν - taste for consumption.

◂ Households: Timeline

Households: Decision process (Overview)

Working-age married and single-mother households

$z_j := \{\lambda_j, a_j, h_j^f, \theta, \eta_j^m, \eta_j^f\} \in Z$ denotes a state vector.

A household aged j goes through the following decision making steps:

1. *Female participation,* $\ell_j \in \{0, 1, 2\}$, which determines
   - Exogenous work hours, $n^f_{\lambda,\ell,j}$,
   - Next-period human capital

   $$log(h^f_{j+1}) = log(h^f_j) + (\xi_{1,\lambda,\ell} - \xi_{2,\lambda,\ell} \times j)\, \mathbf{1}_{\{\ell_j \neq 0\}} - \delta_h (1 - \mathbf{1}_{\{\ell_j \neq 0\}})$$

2. *ℓ-specific next-period assets $a_+(\ell_j, z_j)$ and consumption $c(\ell_j, z_j)$* by solving for optimal value $V(\ell_j, z_j)$;

3. *Optimal allocation at j: $a_+^* = a_+(\ell_j^*, z_j)$, $c^* = c(\ell_j^*, z_j)$* where

   $$\ell_j^* = argmax\,\{MAX\,(V(0, z_j)\,, V(1, z_j), V(2, z_j))\}$$

Households: Timeline

More on children...

5. Households have full information on children (e.g., arrival time, costs and benefits if work, etc);
6. No informal child care available;
7. Childcare quality and cost are identical;
8. Children leave home at 18 years old. This marks the end of the link between parents and their children;
9. No bequest motive.

Back to Main Section

Bick (2016) finds that child care support does not increase the fertility rate in Germany. Discussed in Guner et al. (2020), evidence on child care quality is mixed. Marriage/divorce and education decisions are more likely impacted.

Households: Endowments

Labour income for $i \in \{m, f\}$ in working age $j = 1$ to $j = J_R = 45$:

$$\boldsymbol{y^i_{j,\lambda} = w n^i_{j,\lambda} e^i_{j,\lambda}}$$

- w - wage rate;
- n - exogenous labour hours $(n = 1 - l)$;
- e - earning ability:

Where

$$e^m_{j,\lambda} = \bar{e}_j \left(\theta, h^m_{j,\lambda}\right) \times \epsilon^m_j$$

- *Deterministic*: θ - permanent education; h - human capital;
- *Stochastic*: ϵ - transitory shocks.

Retirees receive means-tested pension $\boldsymbol{pen(y^m_{j,\lambda} + y^f_{j,\lambda},\ a_j)}$.

Households (working age): Men

Men always works and receives labor income:

$$y^m_{j,\lambda} \quad = wn^m_{j,\lambda}\theta h^m_{j,\lambda}\epsilon^m_j$$

n^m and h^m are exogenous.

The transitory shocks follow an *AR1* process:

$$\overbrace{\ln\left(\epsilon^m_j\right)}^{=\eta^m_j} = \rho^m \times \overbrace{\ln\left(\epsilon^m_{j-1}\right)}^{=\eta^m_{j-1}} + \upsilon^m_j; \qquad \upsilon^m_j \sim \mathcal{N}(0, \sigma^2_\upsilon) \tag{8}$$

Households: Trade-off for women

Costs of working

If a woman works, she incurs:

1. An ℓ-specific fixed time cost to leisure:

$$l_j^f = \begin{cases} 1 & \text{if } \ell = 0 \\ 0 < 1 - n^f_{j,\lambda,\ell=1} - \chi_p < 1 & \text{if } \ell = 1 \\ 0 < 1 - n^f_{j,\lambda,\ell=2} - \chi_f < 1 & \text{if } \ell = 2 \end{cases}$$

2. Hourly childcare cost per child, κ_j;

3. A partial or total loss of the means-tested FTB transfers.

◂ Households: Decision process (Overview)

◂ Households: Timeline

Households: Trade-off for women

Benefits of working

However, if she works, she gains:

1. Labour income

$$y_j^f = wn_j^f \theta h_j^f \epsilon_j^f$$

$$\ln(\epsilon_j^f) = \rho \times \ln(\epsilon_{j-1}^f) + \upsilon_j^f; \qquad \upsilon_j \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

2. Enhanced human capital for the next period:

$$log(h_{j+1}^f) = log(h_j^f) + (\xi_{1,\lambda,\ell} - \xi_{2,\lambda,\ell} \times j)\, \mathbf{1}_{\{\ell_j \neq 0\}} - \delta_h(1 - \mathbf{1}_{\{\ell_j \neq 0\}})$$

3. Child care subsidy, sr_j, per child

Households: Decision process (Overview)

Households: Timeline

Dynamic Optimization Problem: **Working households**

$$V(z_j) = \max_{c_j,\, \ell_j,\, a_{j+1}} \{ \, u(c_j, l_j^m, l_j^f, \lambda_j, nc_j) + \tag{9}$$

$$\beta \sum_{\Lambda} \int_{S^2} V(z_{j+1})\, d\Pi(\lambda_{j+1}, \eta_{j+1}^m, \eta_{j+1}^f | \lambda_j, \eta_j^m, \eta_j^f)\}$$

s.t.

$$(1+\tau^c)c_j + (a_{j+1} - a_j) + \mathbf{1}_{\{\lambda\neq 1,\, \ell_j \neq 0\}} fcc_j =$$

$$y_{j,\lambda} + \mathbf{1}_{\{\lambda\neq 1\}}(nc_j \times tr_j^A + tr_j^B) + beq_j - tax_j \tag{10}$$

$$l_j^m = 1 - n_{j,\lambda}^m \quad \text{if } \lambda = 0 \text{ or } \lambda = 1 \tag{11}$$

$$l_j^f = 1 - \mathbf{1}_{\{\ell \neq 0\}} n_{j,\lambda,\ell}^f - \mathbf{1}_{\{\ell = 1\}}\chi_p - \mathbf{1}_{\{\ell = 1\}}\chi_f \quad \text{if } \lambda = 0 \text{ or } \lambda = 2 \tag{12}$$

$$c_j > 0 \tag{13}$$

$$a_{j+1} \geq 0 \tag{14}$$

Where:

$z_j = \left\{\lambda_j, a_j, h_{j,\lambda,\ell}^f, \theta, \eta_j^m, \eta_j^f\right\}$ is a state vector for a household aged j;
$y_{j,\lambda} = \mathbf{1}_{\{\lambda\neq 2\}} y_{j,\lambda}^m + \mathbf{1}_{\{\lambda\neq 1,\ \ell_j > 0\}} y_{j,\lambda}^f + ra_j$ is the total pre-tax income; and
$fcc_j = wn_{j,\lambda}^f \sum_{i=1}^{nc_j}(1 - sr_{j,i})\kappa_{j,i}$ is the net formal child care cost.

◂ Households (working age): Benefits of working for women

Dynamic Optimization Problem: **Retirees**

Retiree's state vector is $z_j^R = \{a_j, \lambda_j\}$

- No labour income, no children;
- Pension is dependent on household type only.

$$V(z_j^R) = \max_{c_j,\, a_{j+1}} \left\{ u(c_j, \lambda_j) + \beta \sum_{\Lambda} V(z_{j+1}^R)\, d\Pi(\lambda_{j+1}|\lambda_j) \right\} \tag{15}$$

s.t.

$$(1+\tau^c)c_j + (a_{j+1} - a_j) = ra_j + pen_j - tax_j \tag{16}$$

$$c_j > 0 \tag{17}$$

$$a_{j+1} \geq 0 \quad \text{and} \quad a_{J+1} = 0 \tag{18}$$

◂ Households (working age): Benefits of working for women

Technology

- A firm with Cobb-Douglas production and labour-augmenting technology A (with constant growth rate g):

$$Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}$$

- Firm maximizes profit according to:

$$\max_{K_t, L_t} \quad (1-\tau_t^k)(Y_t - w_t A_t L_t) - (r_t + \delta)K_t \tag{19}$$

- Firm's FOC yields:

$$r_t = (1-\tau_t^k)\alpha \frac{Y_t}{K_t} - \delta \tag{20}$$

$$w_t = (1-\alpha)\frac{Y_t}{A_t L_t} \tag{21}$$

Back to Household's Problem

Government: Tax system

Separate tax filing for $i \in \{m, f\}$ on $\widetilde{y}_j$

$$tax_j^i = \max\left\{0, \;\; \widetilde{y}_j - \zeta \widetilde{y}_j^{1-\tau}\right\} \tag{22}$$

Where

- $\widetilde{y}_j = y^i_{j,\lambda} + \mathbf{1}_{\lambda=0}\frac{ra_j}{2} + \mathbf{1}_{\lambda\neq 0} ra_j$ is the taxable income
- ζ is a scaling parameter
- τ controls progressivity of the tax scheme:
  - $\tau \to \infty \implies$ tax everything;
  - $\tau = 0 \implies (1-\zeta)$ is a flat tax rate.

Back to Household's Problem

Government: Family Tax Benefit part A (1)

The FTB part A is paid per dependent child.

There are 3 pairs of key parameters:

1. **Max** *and* **base** *payments per child*: $\{tr_j^{A1};\ tr_j^{A2}\}$;
2. **Income thresholds** *for max and base payments*: $\{\bar{y}^{tr}_{max};\ \bar{y}^{tr}_{base}\}$;
3. **Taper rates** *for max and base payments*: $\{\omega_{A1};\ \omega_{A2}\}$

Government: Family Tax Benefit part A (2)

The FTB-A payment per child is:

$$tr_j^A = \begin{cases} tr_j^{\mathrm{A1}} & \text{if } y_{j,\lambda} \leq \bar{y}_{max}^{tr} \\ \max\left\{tr_j^{\mathrm{A2}}, \quad tr_j^{\mathrm{A1}} - \omega_{A1}\left(y_{j,\lambda} - \bar{y}_{max}^{tr}\right)\right\} & \text{if } \bar{y}_{max}^{tr} < y_{j,\lambda} < \bar{y}_{base}^{tr} \\ \max\left\{0, \quad tr_j^{\mathrm{A2}} - \omega_{A2}\left(y_{j,\lambda} - \bar{y}_{base}^{tr}\right)\right\} & \text{if } y_{j,\lambda} \geq \bar{y}_{base}^{tr}, \end{cases} \tag{23}$$

Where

- $y_{j,\lambda}$ is the joint income of a household type λ aged j.

◂ Child-related transfers in Australia

Government: Family Tax Benefit part B (1)

The FTB part B is paid per household to provide additional support to single parents and single-earner parents with limited means.

There are 3 pairs of key parameters:

1. **Two max payments** *for households with children aged* $[0, 4]$ *or* $[5, 18]$: $\{tr_j^{\mathrm{B1}};\ tr_j^{\mathrm{B2}}\}$;
2. **Separate income thresholds** *for* y_{pe} *and* y_{se}: $\{\bar{y}_{pe}^{tr};\ \bar{y}_{se}^{tr}\}$;
3. *A* **taper rate** *based on* y_{se}: ω_B

See FTB part B formula.

Government: Family Tax Benefit part B (2)

If $y_{pe} \leq \bar{y}_{pe}^{tr}$, the FTB-B payment per household is:

$$tr_j^B = \begin{cases} \Upsilon_1 \times tr_j^{\text{B1}} + \Upsilon_2 \times tr_j^{\text{B2}} & \text{if } y_{se} \leq \bar{y}_{se}^{tr} \\ \\ \Upsilon_1 \times \max\left\{0,\ tr_j^{\text{B1}} - \omega_B(y_{se} - \bar{y}_{se}^{tr})\right\} & \text{if } y_{se} > \bar{y}_{se}^{tr} \\ +\Upsilon_2 \times \max\left\{0,\ tr_j^{\text{B2}} - \omega_B(y_{se} - \bar{y}_{se}^{tr})\right\} & \end{cases} \tag{24}$$

Where

- $\Upsilon_1 = \mathbf{1}_{\{nc_{[0,4],j} \geq 1\}}$
- $\Upsilon_2 = \mathbf{1}_{\{nc_{[0,4],j}=0 \text{ and } (nc_{[5,15],j} \geq 1 \ \ or \ \ nc_{[16,18]_{AS},j} \geq 1)\}}$
- $y_{pe} = \max(y_{j,\lambda}^m,\ y_{j,\lambda}^f)$ is the primary earner's income
- $y_{se} = \min(y_{j,\lambda}^m,\ y_{j,\lambda}^f)$ is the secondary earner's income

Child-related transfers in Australia

Government: Child Care Subsidy (1)

The Child Care Subsidy (CCS) assists households with the cost of formal care for **children aged 13 or younger**.

The rate of subsidy depends on

1. **Statutory rates**: $sr = \{0.85, 0.5, 0.2, 0\}$;
2. **Income thresholds**: $\bar{y}_i^{sr}$ *for* $i \in \{1, 2, 3, 4, 5\}$;
3. **Hour thresholds** *of recognized activities*;
4. *A* **taper rate**, ω_C^i, *on household income* y_{hh}

See CCS formula.

Government: Child Care Subsidy (2)

The formal child care subsidy rate is:

$$sr = \Psi(y_{j,\lambda}, n^{min}_{j,\lambda}) \times \begin{cases} sr_1 & \text{if } y_{j,\lambda} \leq \bar{y}^{sr}_1 \\ max\{sr_2,\ sr_1 - \omega^1_c\} & \text{if } \bar{y}^{sr}_1 < y_{j,\lambda} < \bar{y}^{sr}_2 \\ sr_2 & \text{if } \bar{y}^{sr}_2 \leq y_{j,\lambda} < \bar{y}^{sr}_3 \\ max\{sr_3,\ sr_2 - \omega^3_c\} & \text{if } \bar{y}^{sr}_3 \leq y_{j,\lambda} < \bar{y}^{sr}_4 \\ sr_3 & \text{if } \bar{y}^{sr}_4 \leq y_{j,\lambda} < \bar{y}^{sr}_5 \\ sr_4 & \text{if } y_{j,\lambda} \geq \bar{y}^{sr}_5 \end{cases} \tag{25}$$

Where

- ω^i_C is the taper rate
- $\Psi(y_{j,\lambda}, n^{min}_{j,\lambda})$ is the adjustment factor, and
- $n^{min}_j = min\{n^m_{j,\lambda}, n^f_{j,\lambda,\ell}\}$

◂ List of calibrated parameters
◂ Model vs Data moments
◂ Child-related transfers in Australia

Goverment: Old Age Pension (1)

Pension is funded by the general government budget.

Pension is available to households aged $j \geq J_R$ and is means-tested (*income and assets tests*).

Income test:

$$\mathcal{P}^y\left(y_{j,\lambda}\right) = \begin{cases} p^{\max} & \text{if } y_{j,\lambda} \leq \bar{y}_1^p \\ \max\left\{0,\ p^{\max} - \omega_y\left(y_j^p - \bar{y}_1^p\right)\right\} & \text{if } y_{j,\lambda} > \bar{y}_1^p, \end{cases} \tag{26}$$

Asset test:

$$\mathcal{P}^a\left(a_j\right) = \begin{cases} p^{\max} & \text{if } a_j \leq \bar{a}_1 \\ \max\left\{0,\ p^{\max} - \omega_a\left(a_j - \bar{a}_1\right)\right\} & \text{if } a_j > \bar{a}_1, \end{cases} \tag{27}$$

Government: Old Age Pension (2)

The amount of pension benefit claimable, pen_j, is the minimum of (26) and (27). That is,

$$pen_j = \begin{cases} \min\left\{\mathcal{P}^a\left(a_j\right), \mathcal{P}^y\left(y_{j,\lambda}\right)\right\} & \text{if } j \geq J_P \text{ and } \lambda = 0 \\ \frac{2}{3}\min\left\{\mathcal{P}^a\left(a_j\right), \mathcal{P}^y\left(y_{j,\lambda}\right)\right\} & \text{if } j \geq J_P \text{ and } \lambda = 1, 2 \\ 0 & \text{otherwise} \end{cases} \tag{28}$$

Government: Budget

Government at time t collects taxes (T_t^c, T_t^K, T_t^I) and issue bond ($B_{t+1} - B_t$) to meet its debt obligation ($r_t B_t$) and its commitment to three spending programs:

- General government purchase, G_t;
- Family transfers (FTB + CCS), Tr_t;
- Old age pension, P_t.

The fiscal budget balance equation is therefore

$$(B_{t+1} - B_t) + T_t^C + T_t^K + T_t^I = G_t + Tr_t + \mathcal{P}_t + r_t B_t. \qquad (29)$$

Competitive Equilibrium: **Measure of Households**

Let $\phi_t(z)$ and $\Phi_t(z)$ denote the population growth- and mortality-unadjusted population density and cumulative distributions, respectively, and Ω_t denotes the vector of parameters at time t.

Initial distribution of newborns:

$$\begin{aligned}\int_{\Lambda\times A\times H\times\Theta\times S^2} d\Phi_t(\lambda,a,h,\theta,\eta_m,\eta_f) &= \int_{\Lambda\times\Theta\times S^2} d\Phi_t(\lambda,0,0,\theta,\eta_m,\eta_f)=1, \quad \text{and} \\ \phi_t(\lambda,0,0,\theta,\eta_m,\eta_f) &= \pi(\lambda)\times\pi(\theta)\times\pi(\eta_m)\times\pi(\eta_f).\end{aligned}$$

The population density $\phi_t(z)$ evolves according to:

$$\begin{aligned}\phi_{t+1}(z^+) = \int_{\Lambda\times A\times H\times\Theta\times S^2} & \mathbf{1}_{\{a^+=a^+(z,\Omega_t),\, h^+=h^+(z,\Omega_t)\}}\times\pi(\lambda^+|\lambda) \\ & \times\pi(\eta_m^+|\eta_m)\times\pi(\eta_f^+|\eta_f)\, d\Phi_t(z) \qquad (30)\end{aligned}$$

Competitive Equilibrium: **Aggregation (Households)**

Given the optimal decisions $\{c(z,\Omega_t),\ \ell(z,\Omega_t),\ a(z,\Omega_t)\}_{j=1}^{J}$, the share of alive households $(\mu_{j,t})$ and the distribution of households $\phi_t(z)$ at time t, we arrive at:

$$C_t = \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} c(z,\Omega_t)\mu_{j,t}\, d\Phi_t(z) \tag{31}$$

$$A_t = \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} a(z,\Omega_t)\mu_{j,t}\, d\Phi_t(z) \tag{32}$$

$$LFP_t = \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} \mathbf{1}_{\{\ell(z,\Omega_t)\neq 0\}}\mu_{j,t}\, d\Phi_t(z). \tag{33}$$

$$LM_t = \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} h^m_{j,\lambda} e^{\theta+\eta_m}\mu_{j,t}\, d\Phi_t(z) \tag{34}$$

$$LF_t = \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} \mathbf{1}_{\{\ell(z,\Omega_t)\neq 0\}} h^f_{j,\lambda,\ell} e^{\theta+\eta_f}\mu_{j,t}\, d\Phi_t(z). \tag{35}$$

Competitive Equilibrium: **Aggregation (Government)**

Given the optimal decisions $\{c(z,\Omega_t),\ \ell(z,\Omega_t),\ a(z,\Omega_t)\}_{j=1}^{J}$, government policy parameters, the share of alive households $(\mu_{j,t})$ and the distribution of households $\phi_t(z)$ at time t, we arrive at:

$$
\begin{aligned}
T_t^C &= \tau_t^c C_t && (36)\\
T_t^K &= \tau_t^k (Y_t - w_t A_t L_t) && (37)\\
T_t^I &= \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} tax_j \mu_{j,t}\, d\Phi_t(z). && (38)\\
Tr_t &= \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} (ftba_j + ftbb_j + ccs_j)\ \mu_{j,t}\, d\Phi_t(z) && (39)\\
\mathcal{P}_t &= \sum_{j=1}^{J} \int_{\Lambda\times A\times H\times\Theta\times S^2} pen_j \mu_{j,t}\, d\Phi_t(z). && (40)
\end{aligned}
$$

Competitive Equilibrium: Definition (1)

Given the household, firm and government policy parameters, the demographic structure, the world interest rate, a steady state equilibrium is such that:

1. The collection of individual household decisions $\{c_j, \ell_j, a_{j+1}\}_{j=1}^{J}$ solve the household problem (9) and (15);
2. The firm chooses labor and capital inputs to solve the profit maximization problem (20);
3. The government budget constraint (29) is satisfied;
4. The markets for capital and labour clear:

$$K_t = A_t + B_t + B_{F,t} \tag{41}$$

$$L_t = LM_t + LF_t \tag{42}$$

Competitive Equilibrium: Definition (2)

5. Goods market clears:

$$Y_t = C_t + I_t + G_t + NX_t \tag{43}$$
$$NX_t = (1+n)(1+g)B_{F,t+1} - (1+r)B_{F,t}$$
$$B_{F,t} = A_t - K_t - B_t$$

Where

- $I_t = (1+n)(1+g)K_{t+1} - (1-\delta)K_t$ is investment
- NX_t is the trade balance, and
- $B_{F,t}$ is the foreign capital required to clear the capital market.

Competitive Equilibrium: Definition (3)

6. The total lump-sum bequest transfer, BQ_t, is the total assets left by all deceased households at time t:

$$BQ_t = \sum_{j=1}^{J} \int_{\Lambda \times A \times H \times \Theta \times S^2} (1 - \psi_{j,\lambda})(1 + r_t) a(z, \Omega_t)\, d\Phi_t(z). \tag{44}$$

   Bequest to each surviving household aged j at time t is

$$beq_{j,t} = \left[\frac{b_{j,t}}{\sum_{j=1}^{J} b_{j,t}\, m_{j,t}} \right] BQ_t \tag{45}$$

   Assuming bequest is uniform among alive working-age agents, then $b_{j,t} = \frac{1}{JR-1}$ if $j < JR$ and $b_{j,t} = 0$ otherwise. Thus,

$$beq_{j,t} = \frac{BQ_t}{\sum_{j=1}^{JR-1} m_{j,t}} \tag{46}$$

Summary: Externally Calibrated Parameters (1)

Parameter	Value	Target (2012-2018)
Demographics		
Lifespan	$J = 80$	Age 21-100
Retirement	$J_R = 45$	Age Pension age 65
Population growth	$n = 1.6\%$	Average (ABS)
Survival probabilities	$\psi_m,\ \psi_f$	Australian Life Tables (ABS)
Measure of newborns by type	$\{\pi(\lambda_0), \pi(\lambda_1), \pi(\lambda_2)\} = \{0.70, 0.14, 0.16\}$	HILDA 2010-2018
Technology		
Labour augmenting tech. growth	$g = 1.3\%$	Average per hour worked growth rate (World Bank)
Output share of capital	$\alpha = 0.4$	Output share of capital for Australia
Real interest rate	$r = 4\%$	Average (World Bank)
Households		
Relative risk aversion	$\sigma = \frac{1}{\gamma} = 3$	standard values 2.5-3.5
Work hours	$n_{m,\lambda},\ n_{f,\lambda}$	Age-profiles of avg. hours for employees (HILDA)
Male human capital profile	h_λ^m	Age-profile of hourly wages for married men

Internally calibrated parameters

Summary: Externally Calibrated Parameters (2)

Parameter	Value	Target
Permanent shocks		
Value	$\{\theta_L, \theta_H\} = \{0.745, 1.342\}$	College-HS wage ratio of 1.8 (HILDA, 2012-2018)
Measure of $\{\theta_L, \theta_H\}$ type households	$\{\pi(\theta_L),\ \pi(\theta_H)\} = \{0.7,\ 0.3\}$	College-HS ratio (ABS, 2018)
Fiscal Policy		
Income tax progressivity	$\tau = 0.2$	Tran and Zakariyya (2021)
Consumption tax	$\tau_c = 8\%$	$\tau_c \dfrac{C_0}{Y_0} = 4.5\%$; $\dfrac{C_0}{Y_0} = 56.3\%$
Company profit tax	$\tau^k = 10.625\%$	$\tau^k \left(\frac{Y-WL}{Y}\right) = 4.5\%$; $\frac{WL}{Y} = 1 - \alpha$
Gov't debt-to-GDP	$\dfrac{B}{Y} = 20\%$	Average (CEIC data, 2012-2018)
Gov't general purchase	$\dfrac{G}{Y} = 14\%$	Net of FTB, CCS and Age Pension (WDI and AIHW)
FTB, CCS and pension parameters		HILDA Tax-Benefit model

Internally calibrated parameters

Calibration: Demographics (1)

1. Since child-related transfers are concentrated during child-bearing and raising age, we set one model period to correspond to 1 year of life to better capture behavioural responses;

2. Time-invariant n, ψ_m and ψ_m induce an unchanging population structure in every period t (see share of survivors).

Calibration: Demographics (2)

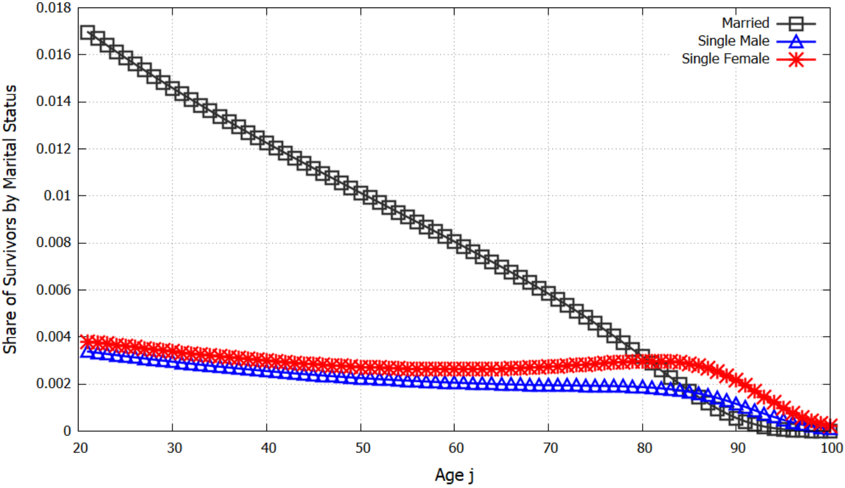


Figure: Share of survivors over life cycle

Calibration: Endowment (Deterministic) (1)

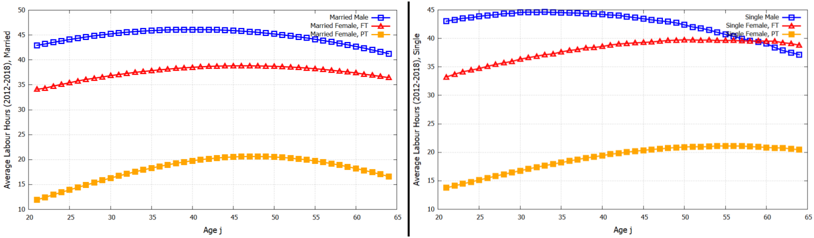


Figure: Age profiles of average labor hours

Calibration: Endowment (Deterministic) (2)

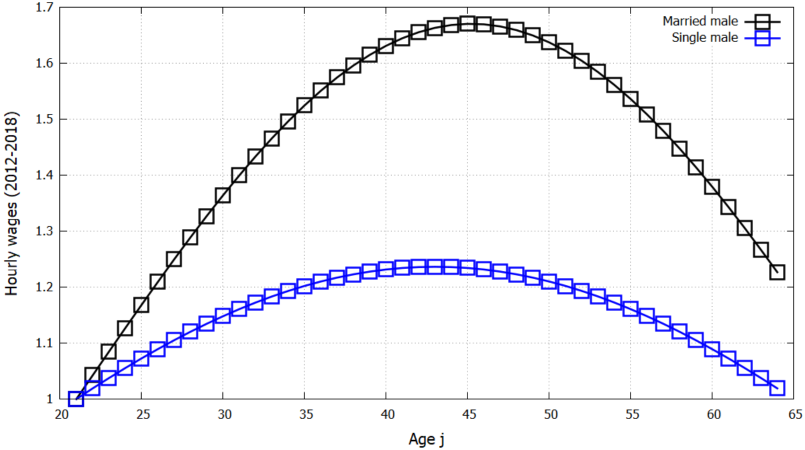


Figure: Age profiles of male hourly wages

Calibration: Endowment (Deterministic, Female)

We calibrate the female human capital accumulation rate that their human capital profiles match those of their male counterparts:

- if the wife works without time off over life cycle, and
- assuming ex-ante assortative matching of couples in terms of skills.

Our estimates are:

- Married mothers working full time: $(\xi_{1,\lambda=0,\ell=1}, \xi_{2,\lambda=0,\ell=1}) = (0.0450, -0.00175)$
- Married mothers working part time: $(\xi_{1,\lambda=0,\ell=2}, \xi_{2,\lambda=0,\ell=2}) = (0.0350, -0.00135)$
- Single mothers working full time: $(\xi_{1,\lambda=2,\ell=1}, \xi_{2,\lambda=2,\ell=1}) = (0.0206, -0.00088)$
- Single mothers working part time: $(\xi_{1,\lambda=2,\ell=2}, \xi_{2,\lambda=2,\ell=2}) = (0.0179, -0.00060)$

Calibration: Endowment (Deterministic, Children)

Children:

1. Assign *first and second child births* to
   - type θ_H households aged $\{28, 31\}$;
   - type θ_L households aged $\{21, 24\}$ (See LSAC and AIHW reports)
2. Child care service fee is \$12.5/*hour* or 48% of age 21 married male hourly wage.
3. Assume for child care service and school fees, parents pay
   - 100% of the fee for pre-school age children (0-5);
   - 1/3 of the fee for school age children;

Calibration: Endowment (Stochastic income process)

We calibrate the AR1 stochastic process, η^i, for $i \in \{m, f\}$ as follows:

- Discretized into 5 grid points:

$$\eta^i = \{0.29813,\ 0.54601,\ 1,\ 1.83146,\ 3.35424\}$$

- Transition probabilities obtained via Rouwenhorst method:

$$\begin{bmatrix} 0.9606 & 0.0388 & 0.0006 & 0 & 0 \\ 0.0097 & 0.9609 & 0.0291 & 0.0003 & 0 \\ 0.0001 & 0.0194 & 0.9610 & 0.0194 & 0.0001 \\ 0 & 0.0003 & 0.0291 & 0.9609 & 0.0097 \\ 0 & 0 & 0.0006 & 0.0388 & 0.9606 \end{bmatrix}$$

Calibration: Endowment (Stochastic income process)

- Persistence: $\rho = 0.98$;
- Variance of the innovation to shocks: $\sigma_\epsilon^2 = 0.0145$ to achieve a Gini coefficient of age 21 male wage distribution of 0.35;
- The set-up results in $\text{GINI} = 0.3766$ for wage distribution of work-age male population (not targeted).

Lorenz Curve (male wages at aged 21 and 22)

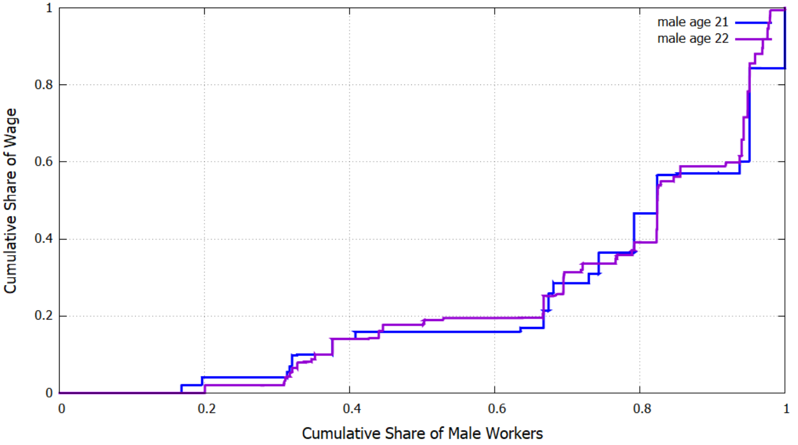


Figure: Lorenz curves of the distributions of married male wages at age 21 and 22

Lorenz Curve (male wages at working age)

gini_workingage1.png

Overview of counterfactual policy experiments

With *income tax as a budget-balancing tool*,

1. Are child-related transfers socially desirable?
   - Experiment 1: Abolish FTB;
   - Experiment 2: Abolish CCS;
   - Experiment 3: Abolish FTB and CCS;
2. Should child-related transfers be means-tested or universal?
   - Experiment 4: Universalize FTB and CCS;
3. **Extensions:**

   a). Experiment 5-6: Does adjusting the size of universal transfer address the inequity issue?

   b). Experiment 7-14: Is there a simple and well-rounded incremental reform?

Are child-related transfers desirable? Heterogeneous consumption and welfare responses

C (%)	M (H)	M (L)	SM (H)	SM (L)	SW (H)	SW (L)
Age 21-30	+8.12	+15.74	−0.11	−0.07	−7.74	−11.55
Age 31-40	+14.59	+14.83	−0.06	−0.06	−3.04	−6.88
Age 41-50	+9.65	+6.71	−0.03	−0.01	−4.20	−9.39
Age 51-60	+6.80	+6.59	+0.03	+0.07	−3.22	−8.03
Age 61-70	+6.24	+5.69	+1.12	+1.44	−1.32	−6.00
Age 71-80	+6.61	+4.10	+6.10	+6.36	+1.66	−3.09
Age 81-90	+5.48	+1.80	+9.83	+9.11	+2.13	−3.06
Welfare (%)	+1.35	−0.22	+0.02	+0.06	−4.03	−6.53

Table: **Heterogeneous consumption and welfare effects of abolishing the FTB and the CCS** (*M*: Married, *SM*: Single men, *SW*: Single women (Single mothers); *H*: High education and *L*: Low education)**.**

Main Section: Are child-related transfers desirable

Are child-related transfers desirable?
CVs of output and consumption

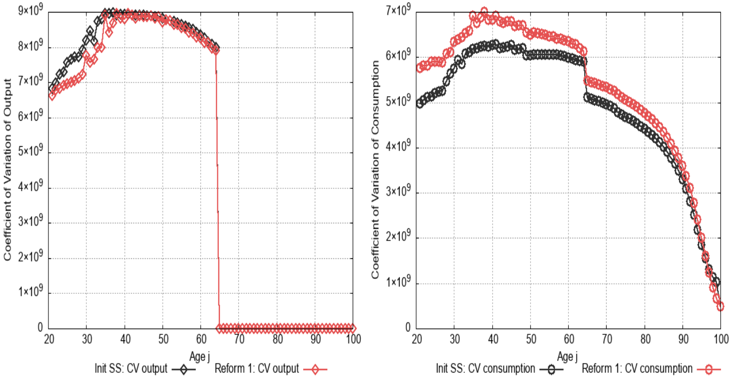


Figure: **Coefficients of variation of log output and log consumption: Benchmark (black) vs FTB and CCS elimination reform (red).**

◂ Main Section: Are child-related transfers desirable

Means-testing or Universal?
Heterogeneous labour supply responses

Labor supply responses by mothers to universalized child-related transfers											
LFP (*pp*)	21–30	31–40	41–50	51–60	61–70	*FT* (*pp*)	21–30	31–40	41–50	51–60	61–70
M (H)	+0.039	+0.335	+0.132	+0.013	−0.016	M (H)	+0.478	+1.079	−0.029	−0.088	−0.081
M (L)	+0.923	+0.784	+0.390	+0.054	−0.015	M (L)	+2.356	+0.497	+0.322	+0.018	−0.086
S (H)	0	0	0	0	0	S (H)	−0.031	−0.019	−0.004	−0.009	0
S (L)	0	0	0	−0.001	+0.001	S (L)	+0.013	−0.028	−0.002	−0.004	+0.003

Hour (%)	21–30	31–40	41–50	51–60	61–70
M (H)	+6.33	+21.87	+1.69	−1.25	−6.12
M (L)	+28.49	+9.42	+4.64	+0.60	−3.11
S (H)	−1.26	−1.40	−0.32	−0.89	−0.12
S (L)	+0.24	−0.88	−0.06	−0.20	+0.48

Table: **Heterogeneous labor supply responses by married (M) and single (S) female households to universal child-related transfers** (*H*: high education, and *L*: low education).

◂ Main Section: Means-testing or Universal?

Means-testing or Universal
Heterogeneous consumption and welfare outcomes

C (%)	M (H)	M (L)	SM (H)	SM (L)	SW (H)	SW (L)
Age 21-30	+4.56	+12.70	−4.12	−3.65	−3.64	−1.12
Age 31-40	+8.59	+6.18	−4.11	−3.90	−1.69	−2.65
Age 41-50	+3.82	+2.40	−4.08	−3.97	−0.96	−2.25
Age 51-60	+2.92	+2.30	−4.03	−3.97	−1.05	−2.30
Age 61-70	+3.02	+2.56	−3.35	−3.13	+0.15	−0.93
Age 71-80	+3.81	+2.54	−0.31	−0.44	+2.34	+1.03
Age 81-90	+3.53	+2.12	+1.96	+1.21	+3.08	+1.70
Welfare (%)	+1.36	+1.34	−1.47	−1.20	−0.69	−0.51

Table: **Heterogeneous household consumption and welfare responses to universal child-related transfers** (*M*: Married, *SM*: Single men, *SW*: Single women (Single mothers); *H*: High education and *L*: Low education)**.**

◂ Main Section: Means-testing or Universal

Universal programs varied by size: Heterogeneous labor supply responses

Labor supply responses by mothers								
	0.5 × Benchmark rates				1.5 × Benchmark rates			
LFP (*pp*)	21-30	31-40	41-50	51-60	21-30	31-40	41-50	51-60
M (H)	−0.0935	+0.0634	+0.0397	−0.0149	+0.0379	+0.3452	+0.1266	+0.0019
M (L)	+0.1662	+0.5453	+0.3592	+0.0440	+2.1401	+0.9600	+0.3522	+0.0051
S (H)	0	0	0	−0.0004	0	0	0	−0.0004
S (L)	0	0	−0.0002	−0.0018	0	0	−0.0001	−0.0002
HOURS (*pp*)	21-30	31-40	41-50	51-60	21-30	31-40	41-50	51-60
M (H)	+1.60	+1.88	−0.29	−1.51	+7.47	+26.81	+0.33	−3.12
M (L)	−1.31	+4.78	+3.44	+0.48	+52.70	+11.41	+5.05	+0.14
S (H)	+0.14	+2.66	−0.30	−0.79	−1.31	−2.20	−0.34	−0.91
S (L)	+0.55	+2.27	−0.06	−0.25	−0.58	−4.86	−0.07	−0.22

Table: **Heterogeneous labor supply responses by married (M) and single (S) female households to universal child-related transfers varied by transfer size** (H: high education, and L: low education)**.**

Main Section: Universal programs varied by size

Incremental reforms to payment rates

	Aggregate implications of incremental reforms			
	FTB payment rates		CCS subsidy rates	
	$0.5 \times tr$	$1.5 \times tr$	$0.5 \times sr$	$1.5 \times sr$
Tax rate, *pp*	-0.36	$+0.19$	-1.37	$+0.69$
Fe. LFP, *pp*	-5.65	$+1.00$	$+1.13$	-2.87
Fe. Hour, %	-10.89	$+3.67$	$+3.28$	-5.05
Fe. Human Cap, %	-4.95	$+0.93$	$+0.92$	-2.22
Cons. (C), %	-2.41	$+1.03$	-0.17	-1.09
Output (Y), %	-1.52	$+2.20$	$+0.88$	-1.08
Welfare (EV), %	-0.41	-0.02	-0.82	$+0.28$

Table: **Aggregate efficiency and welfare effects of incremental reforms payment/subsidy rates**

◂ Main Section: Incremental reforms to taper rates

Incremental reforms: Heterogeneous consumption and welfare outcomes

C (%)	M (H)	M (L)	SM (H)	SM (L)	SW (H)	SW (L)
Age 21-30	+1.59	+1.89	+0.98	+0.76	+0.95	+1.06
Age 31-40	+1.72	+1.25	+0.99	+0.86	+1.15	+0.77
Age 41-50	+1.48	+1.12	+1.01	+0.92	+1.02	+0.54
Age 51-60	+1.30	+1.13	+1.02	+0.96	+1.05	+0.60
Age 61-70	+1.22	+1.07	+1.05	+1.00	+1.17	+0.76
Age 71-80	+1.20	+0.99	+1.16	+1.03	+1.16	+0.87
Age 81-90	+1.15	+0.93	+1.19	+1.01	+1.13	+0.88
Welfare (%)	+0.42	+0.40	+0.34	+0.24	+0.26	+0.18

Table: **Heterogeneous household consumption and welfare responses to halving the CCS taper rates** (*M*: Married, *SM*: Single men, *SW*: Single women (Single mothers); *H*: High education and *L*: Low education)**.**

◂ Main Section: Incremental reforms to taper rates

Findings: Means-testing or Universal? (2)

Consumption and welfare changes by household type												
	0.5×Baseline payment rates						1.5×Baseline payment rates					
C (%)	M (H)	M (L)	SM (H)	SM (L)	SW (H)	SW (L)	M (H)	M (L)	SM (H)	SM (L)	SW (H)	SW (L)
21-30	+3.6	−0.7	−0.1	−0.1	+0.4	+0.8	+5.1	+21.4	−6.2	−5.6	−5.2	−3.8
31-40	+5.0	+3.5	−0.1	−0.1	+3.0	+1.5	+9.9	+9.2	−6.1	−5.9	−3.9	−5.0
41-50	+3.9	+3.5	−0.1	−0.1	+2.9	+1.2	+4.0	+3.3	−6.1	−5.9	−3.0	−4.0
51-60	+3.5	+3.7	−0.1	−0.1	+2.8	+1.2	+3.0	+3.1	−6.0	−5.9	−3.0	−4.1
61-70	+3.8	+4.1	+0.3	+0.3	+3.4	+1.8	+3.1	+3.3	−5.1	−4.7	−1.5	−2.1
71-80	+4.6	+3.8	+2.3	+2.0	+4.2	+2.8	+4.0	+3.3	−1.3	−0.9	+1.7	+0.9
81-90	+4.3	+3.1	+3.7	+2.8	+4.4	+2.9	+3.6	+2.7	+1.5	+1.4	+2.8	+2.0
Welfare (%)	+1.4	−0.02	−0.04	−0.02	+0.4	+0.1	+1.6	+2.6	−2.2	−1.9	−1.3	−0.9

Table 5: Heterogeneous consumption and welfare changes from varying the universal system's payment rates.

◂ Overall efficiency and welfare changes
◂ Heterogeneous labour responses

Average taxes over time

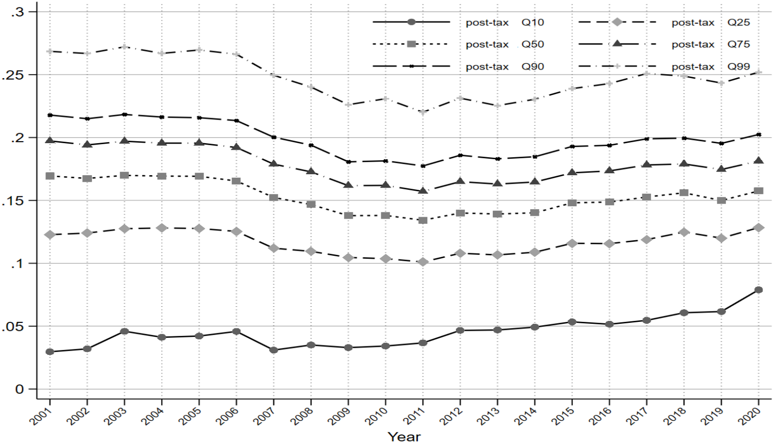


Figure: **Estimates of average taxes by quantiles over time using the parametric tax function.**

Welfare expenditure in Australia

Financial year	Welfare ($b)	Welfare-GDP (%)	Welfare-Revenue (%)
2010–11	140.19	8.43	34.04
2011–12	149.66	8.7	34.2
2012–13	153.24	8.89	33.62
2013–14	155.68	8.88	33.47
2014–15	165.13	9.41	35.15
2015–16	167.68	9.47	34.59
2016–17	165.76	8.95	33.02
2017–18	171.62	8.99	32
2018–19	174.24	8.8	31.18
2019–20	195.71	9.86	36.05

Note: $ value is expressed in 2019–20 prices.

Source: *Australian Institute of Health and Welfare*

Welfare expenditure to GDP (%) by target groups

Financial year	Families & children	Old people	Disabled	Unemployed	Others
2009-10	2.51	3.33	1.87	0.48	0.40
2010-11	2.39	3.33	1.94	0.44	0.34
2011-12	2.33	3.43	1.98	0.44	0.52
2012-13	2.31	3.57	2.00	0.49	0.52
2013-14	2.26	3.47	2.02	0.55	0.57
2014-15	2.33	3.79	2.09	0.59	0.61
2015-16	2.32	3.86	2.08	0.60	0.62
2016-17	2.02	3.72	2.01	0.57	0.63
2017-18	1.94	3.67	2.18	0.56	0.65
2018-19	1.81	3.63	2.22	0.49	0.64
2019-20	1.92	3.85	2.53	0.93	0.62

Source: Australian Institute of Health and Welfare

Back to Introduction

Proportion of children in child care by child age and FTB receipt

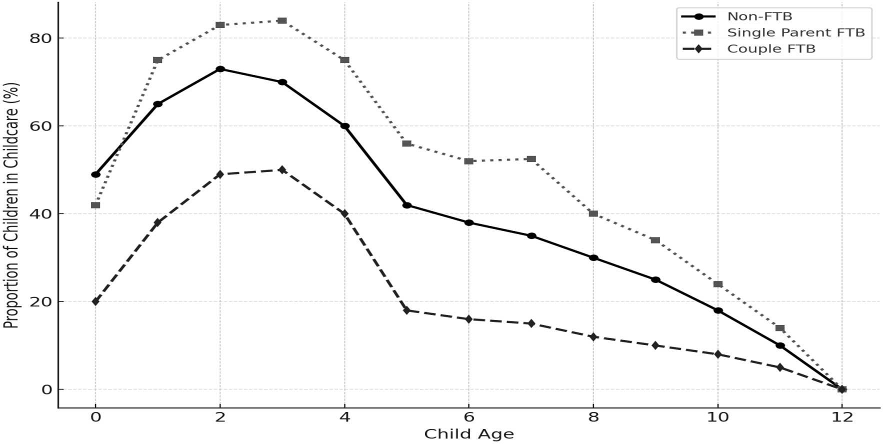


Figure: **Proportion of children in child care by child age and FTB receipt**

Child-related transfers in Australia

FTB-A: Base payment rates

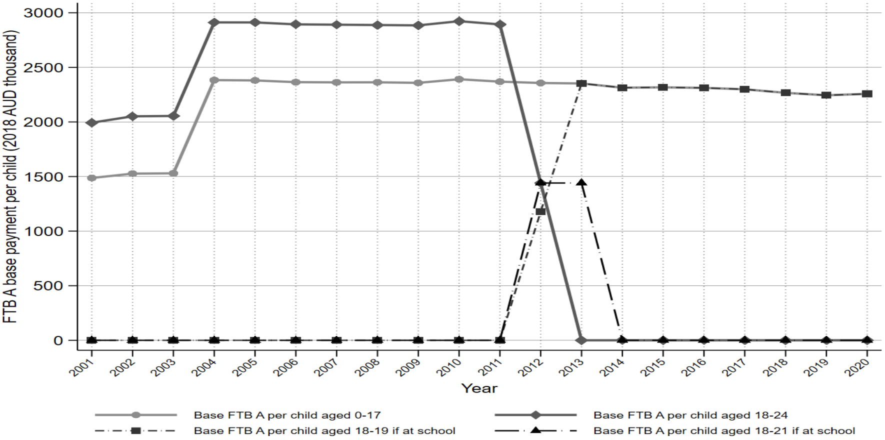


Figure: **Base FTB-A payment rates per qualified child.**

FTB-A: Maximum payment rates

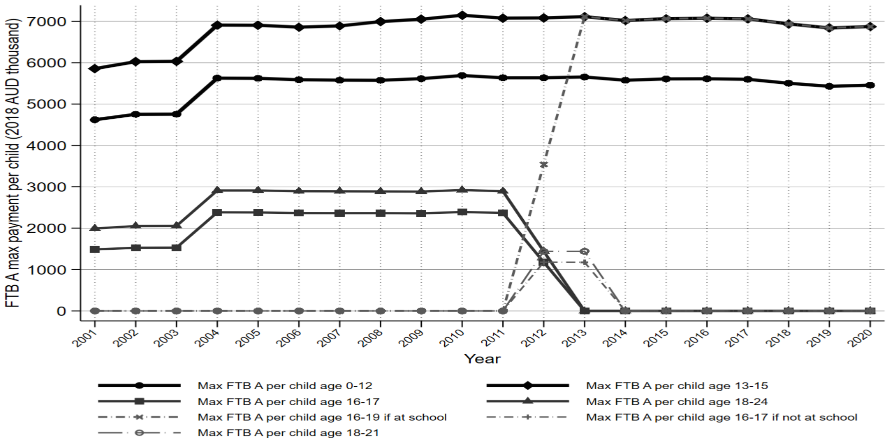
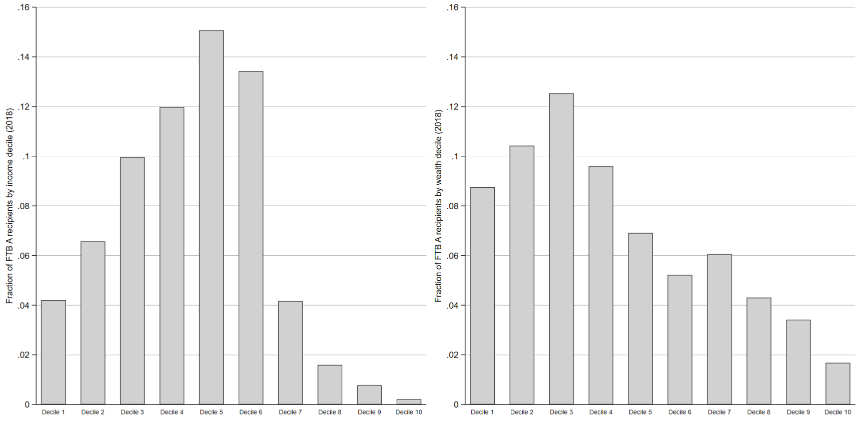


Figure: **Maximum FTB-A payment rates per qualified child.**

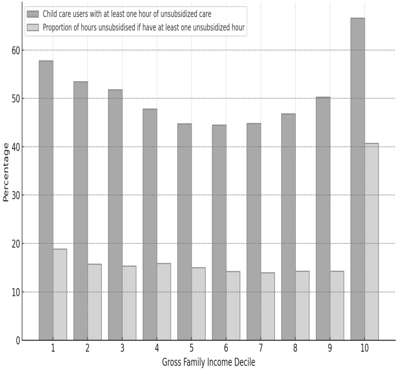
Fraction of FTB recipients by income and wealth deciles



Fraction of FTB recipients by income and wealth deciles

◂ Child-related transfers in Australia

Extensive and Intensive Margins of Child Care Subsidy



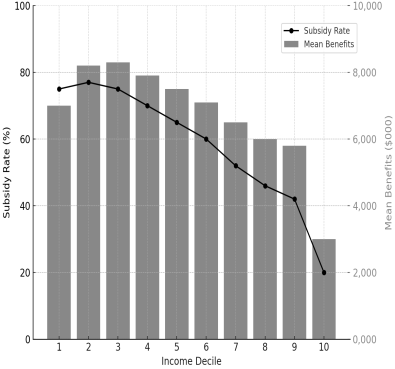


Figure: **Left: Proportion of hours paid for that are unsubsidized. Right: Child Care Subsidy rates and Mean Benefits.**

Child-related transfers in Australia

FTB-A: Fractions of recipients and average payment over time

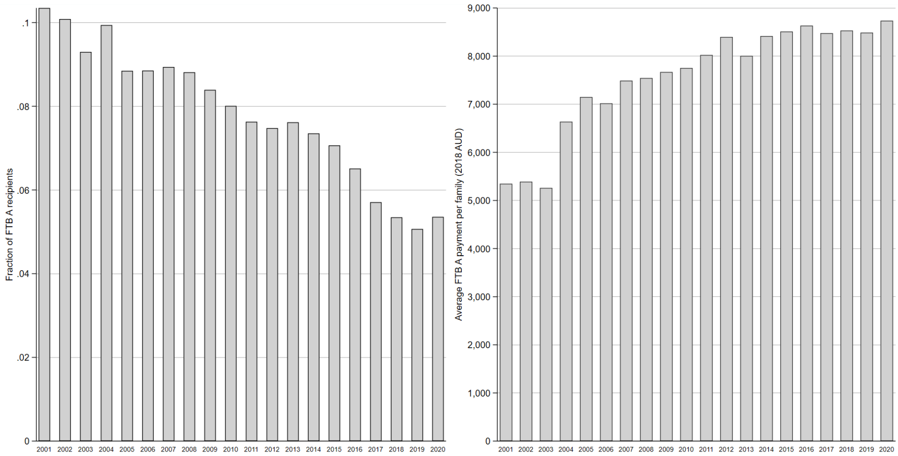


Figure: **Fractions of FTB-A recipients and average FTB-A payment per family (2018 AUD) over time.**

FTB-A: Average payment per family by marital status

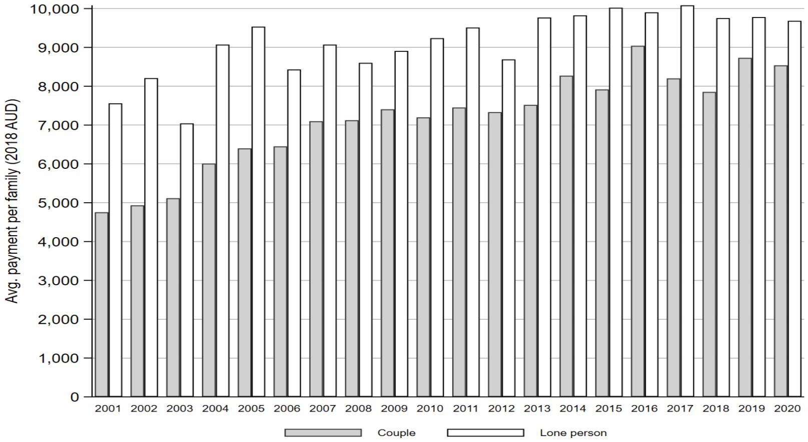


Figure: **Average FTB-A payment per family by marital status over time**

FTB-A: Income test thresholds

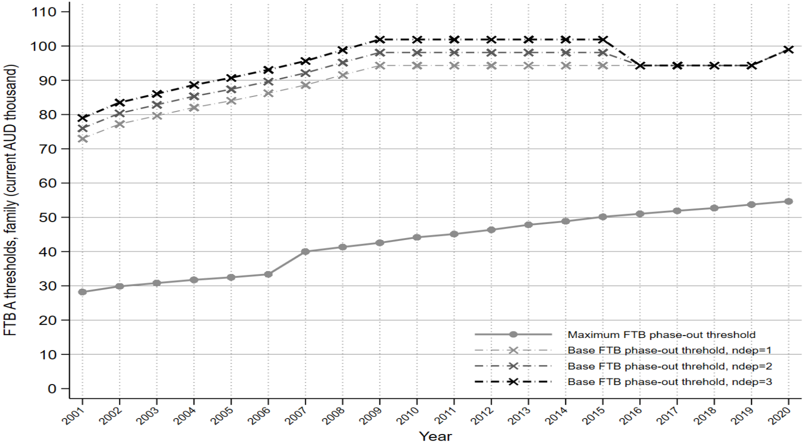


Figure: **FTB-A income test thresholds for maximum and base payment rates.**

FTB-A: Taper rates

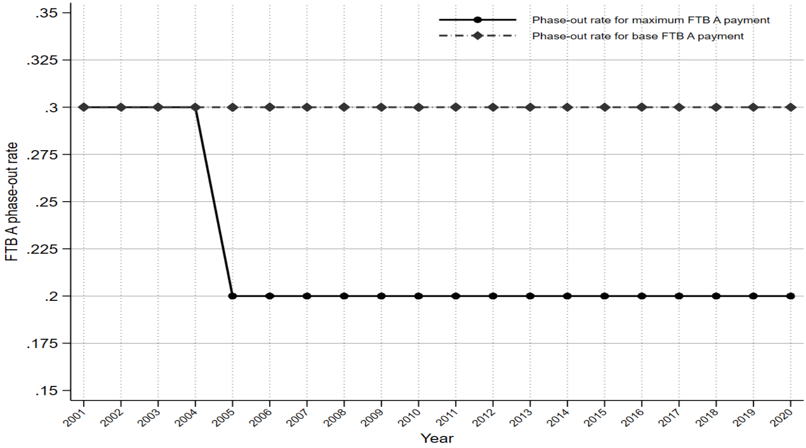


Figure: **FTB-A taper/phase-out rates for maximum and base payments.**

FTB-B: Payment rates

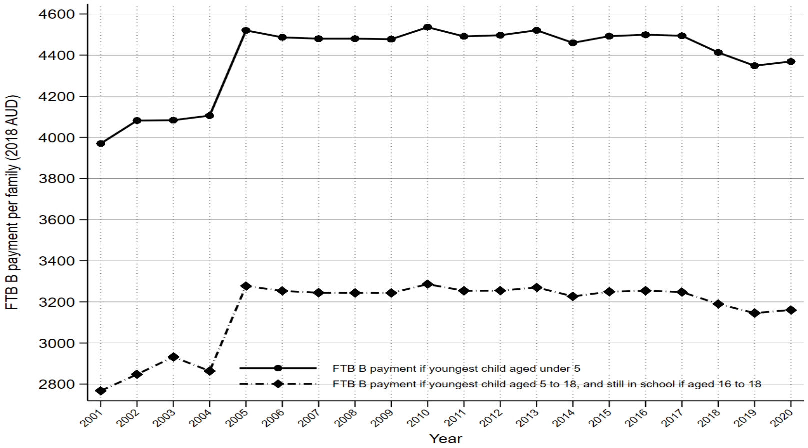


Figure: **FTB-B payment rates per family by age of the youngest child in the family.**

FTB-B: Fractions of recipients and average payment

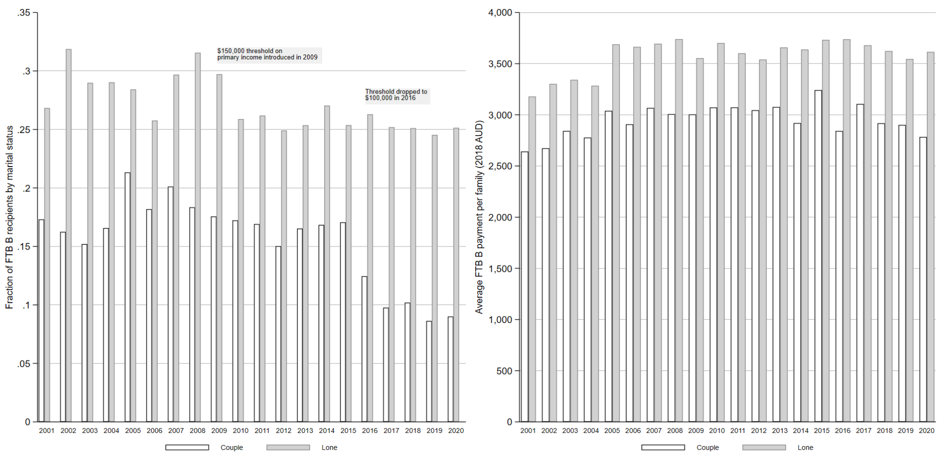


Figure: **Fractions of FTB-B recipients and average FTB-B payment per family by marital status.**

FTB-B: Income test thresholds

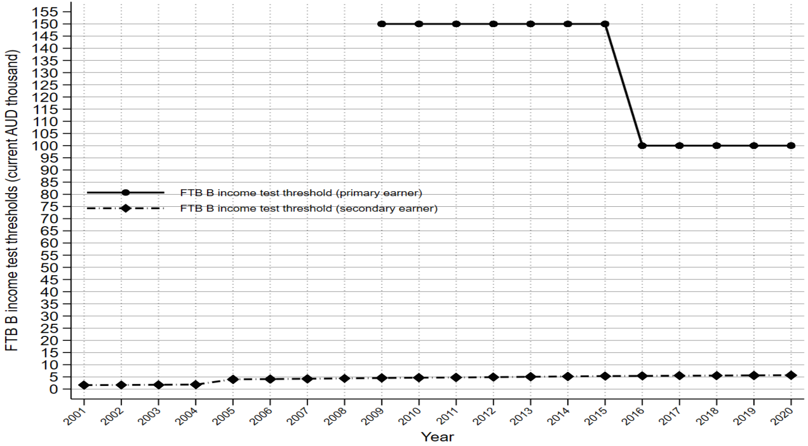


Figure: **FTB-B thresholds over time on primary and secondary earners over time.**

FTB-B: Taper rates

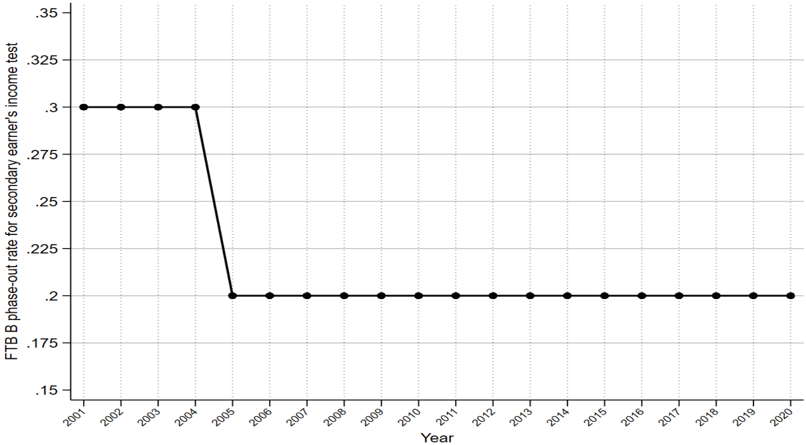


Figure: **FTB-B taper rates (on secondary earners' earnings) over time.**

FTB-B: Fractions of recipients and average payment over time

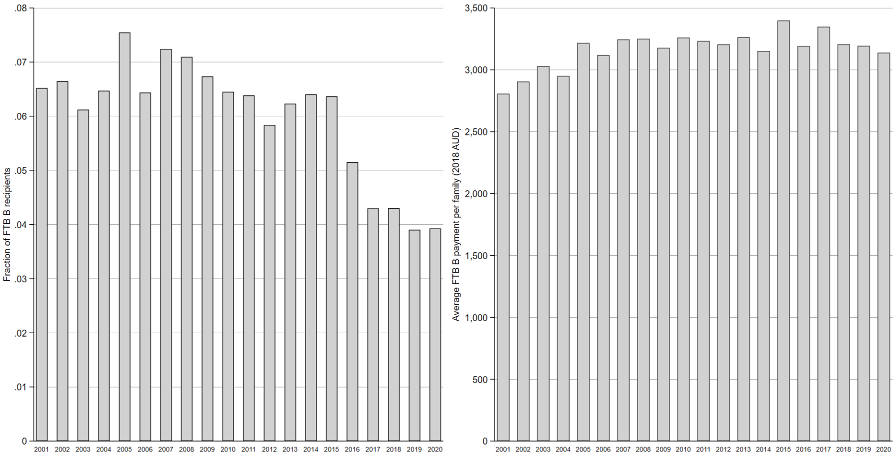
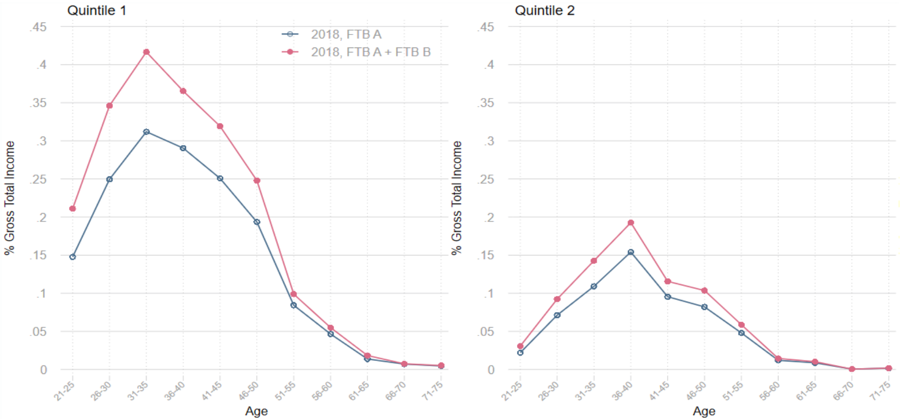


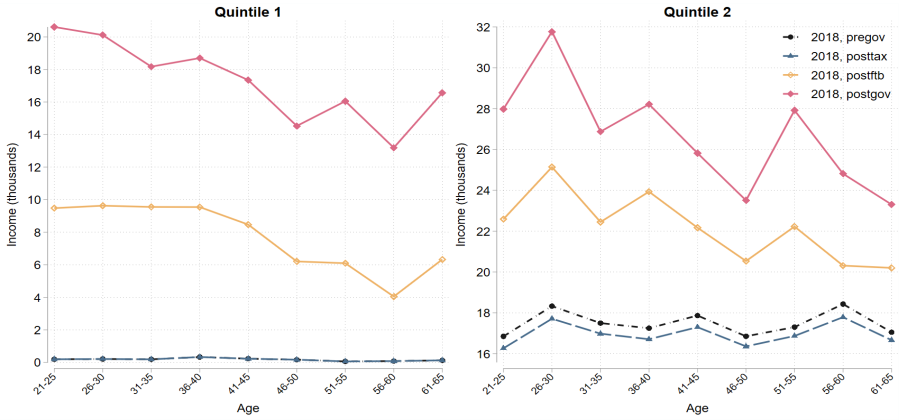
Figure: **Fractions of FTB-B recipients and average FTB-B payment per family (2018 AUD) over time.**

FTB income share for households



Child-related transfers in Australia

FTB transfers for parents



Child-related transfers in Australia

Life-cycle profiles of normalized weekly earnings

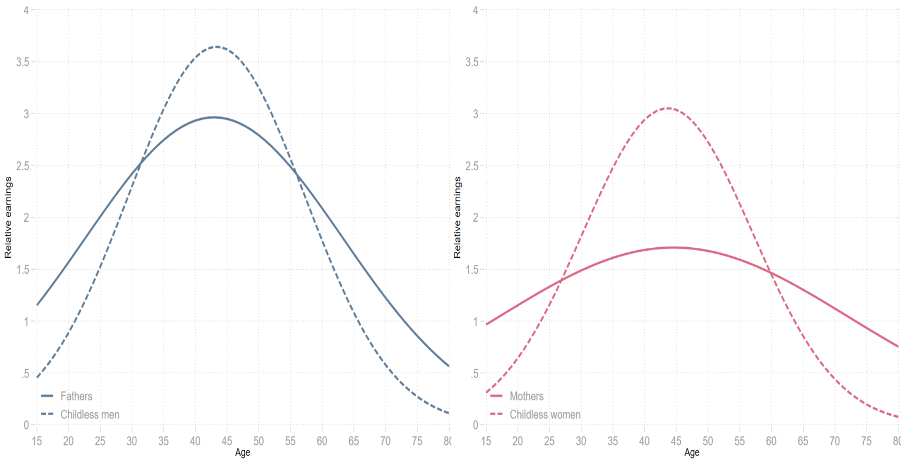
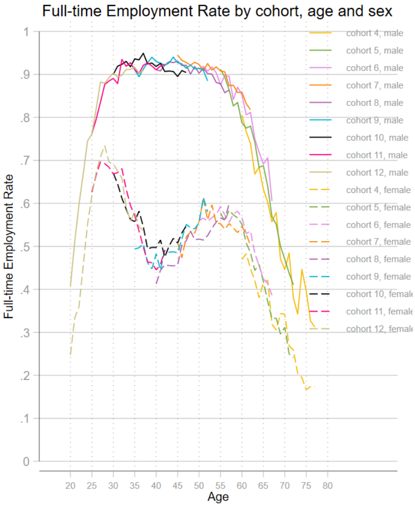
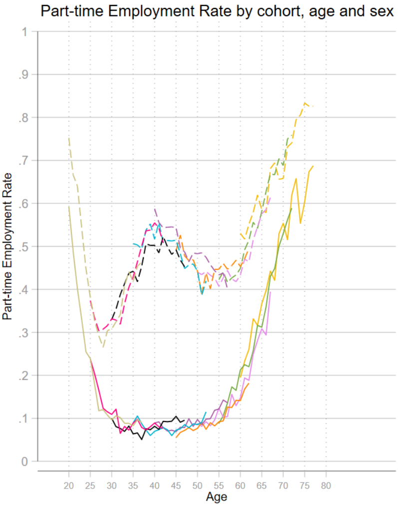


Figure: **Age profiles of normalized weekly earnings (against age-21 worker's average earnings) by key demographics (gender and parenthood).**

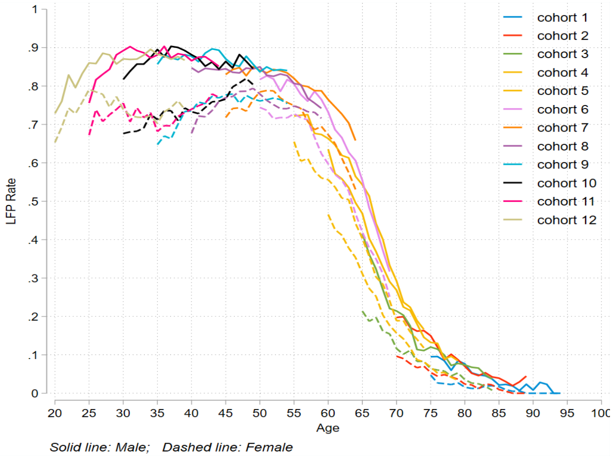
Full time employment rate by gender





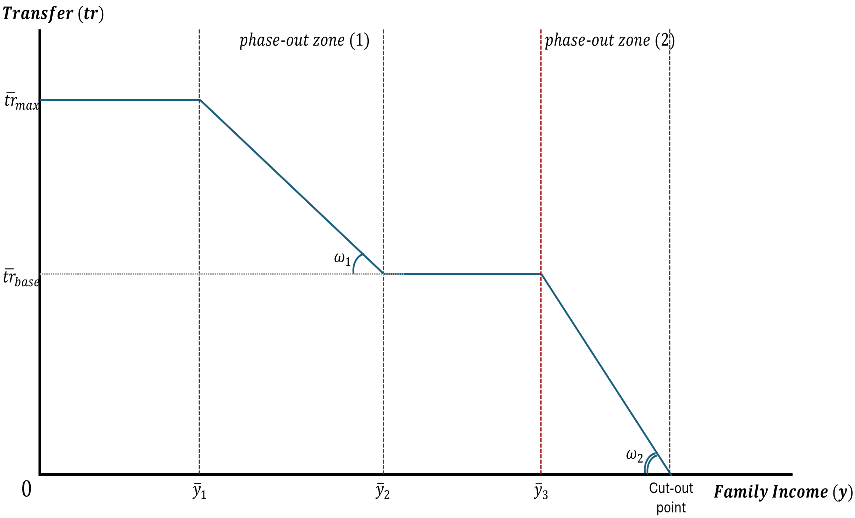
Back to Introduction

Labour force participation rate by gender



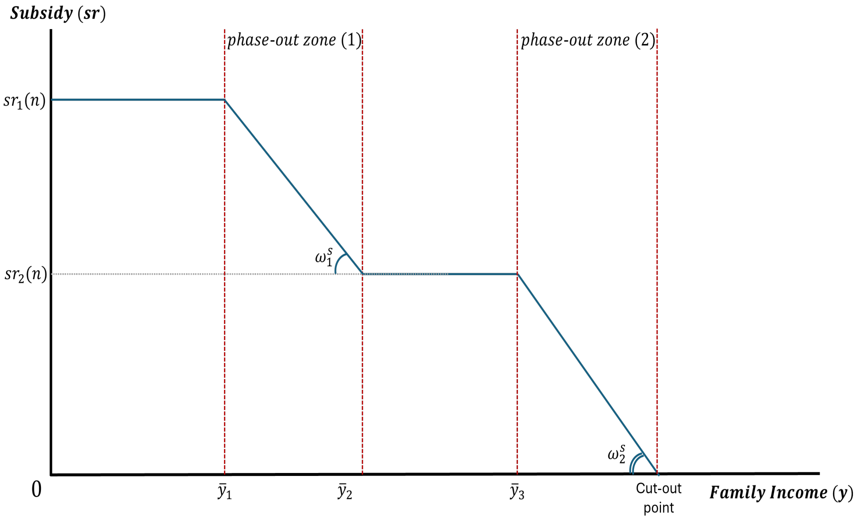
Back to Main Section

Example FTB schedule



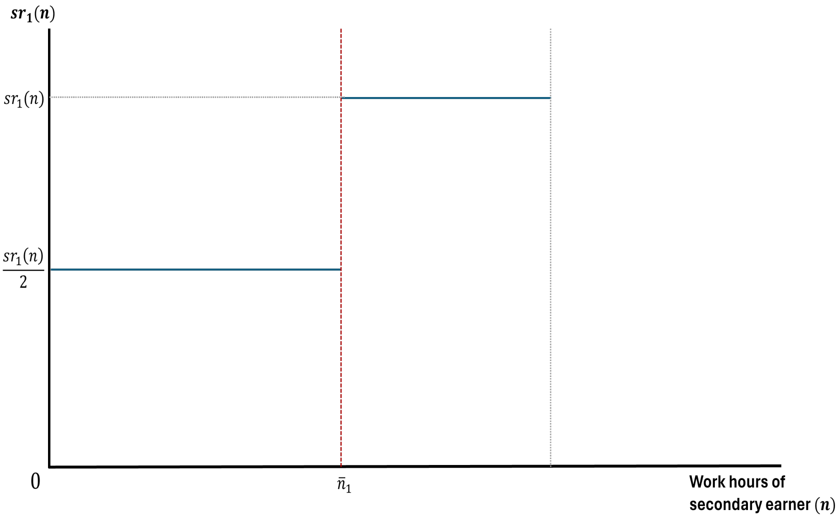
◂ FTB formula

Example CCS schedule: Income test



◂ CCS formula

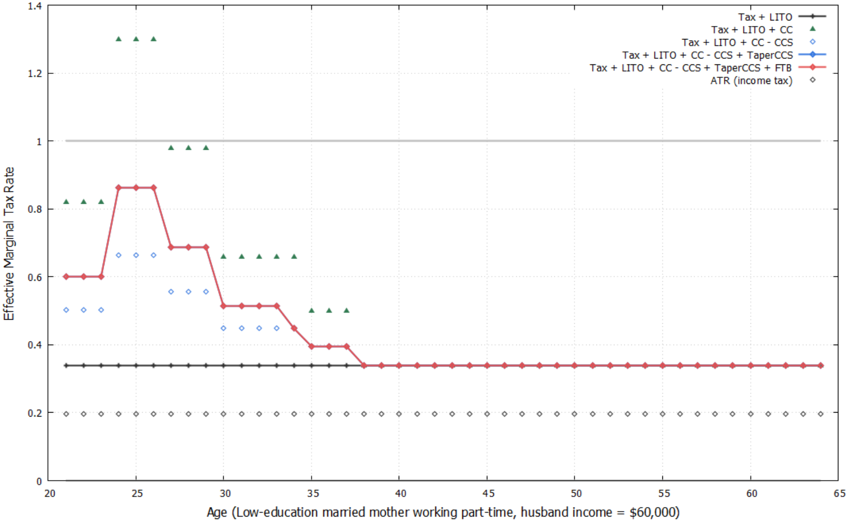
Example CCS schedule: Work hour test



◂ CCS formula

Life cycle EMTRs due to means-testing: Part-timer

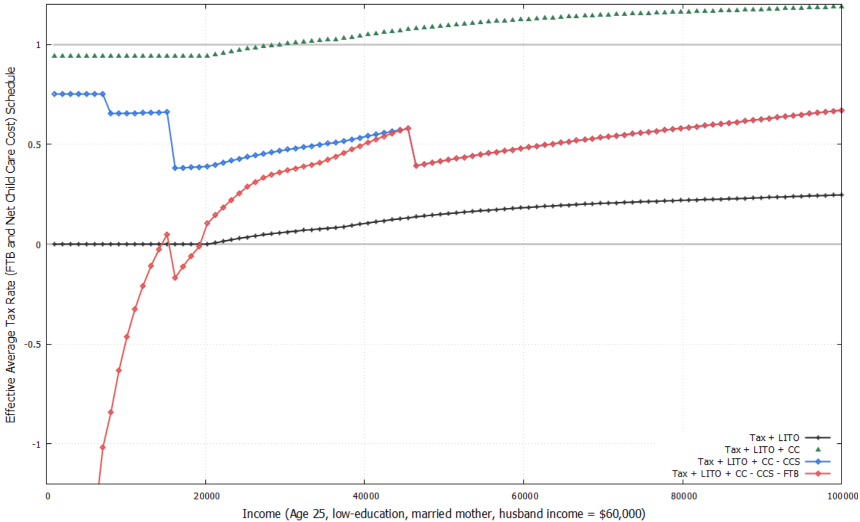
Young mother: two children, low ed, **husband earning** $\$60,000$



◂ Life cycle EMTR: Stay-at-home

Effective Average Tax Rate (EATR) Schedule

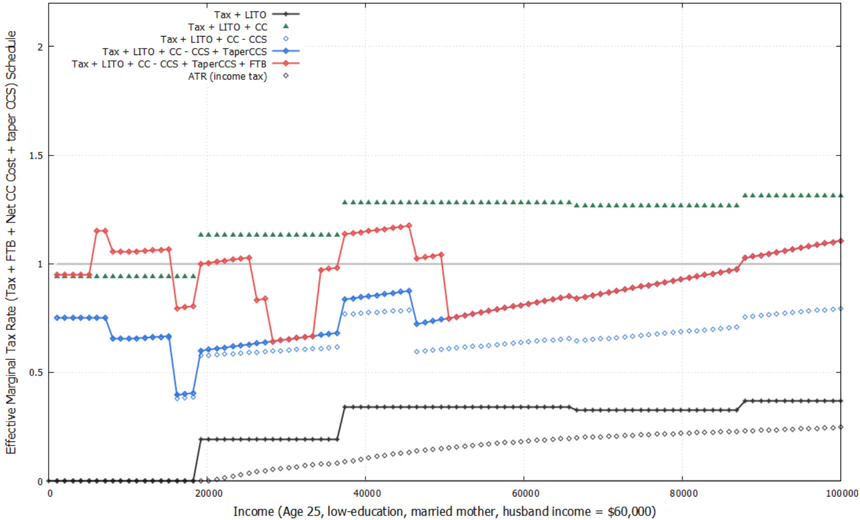
Young mother with: two children, low education, husband earning $60,000



◂ Life-cycle EMTR: Stay-at-home ◂ Life-cycle EMTR: Part-time

Effective Marginal Tax Rate (EMTR) Schedule

Young mother with: two children, low ed, **husband earning** $60,000

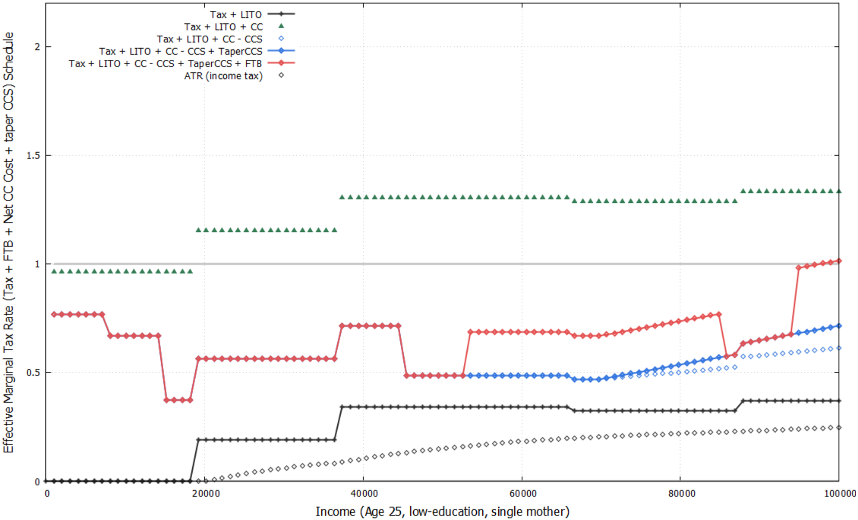


◂ Life-cycle EMTR: Stay-at-home

◂ Life-cycle EMTR: Part-time

Effective Marginal Tax Rate (EMTR) Schedule

Young mother with: two children, low ed, **single**

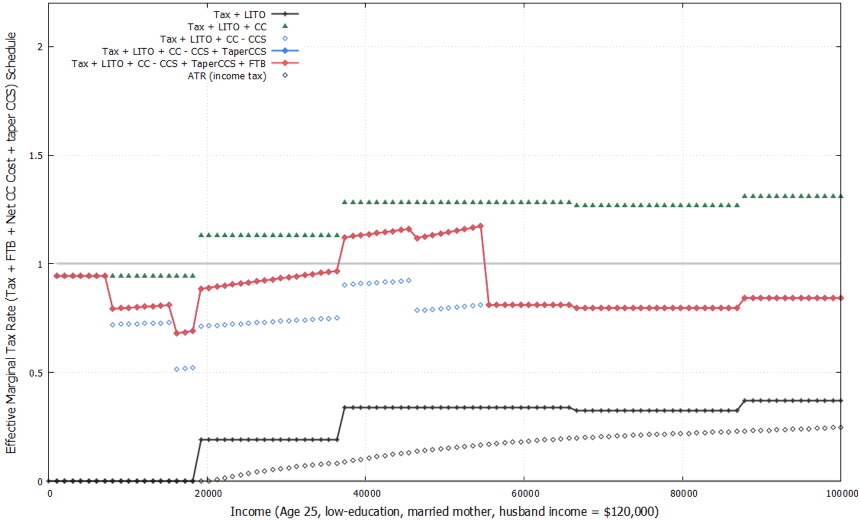


Life-cycle EMTR: Stay-at-home

Life-cycle EMTR: Part-time

Effective Marginal Tax Rate (EMTR) Schedule

Young mother with: two children, low education, husband earning $\$120,000$



◂ Life-cycle EMTR: Stay-at-home

◂ Life-cycle EMTR: Part-time

Distinct age-profile of participation for mothers

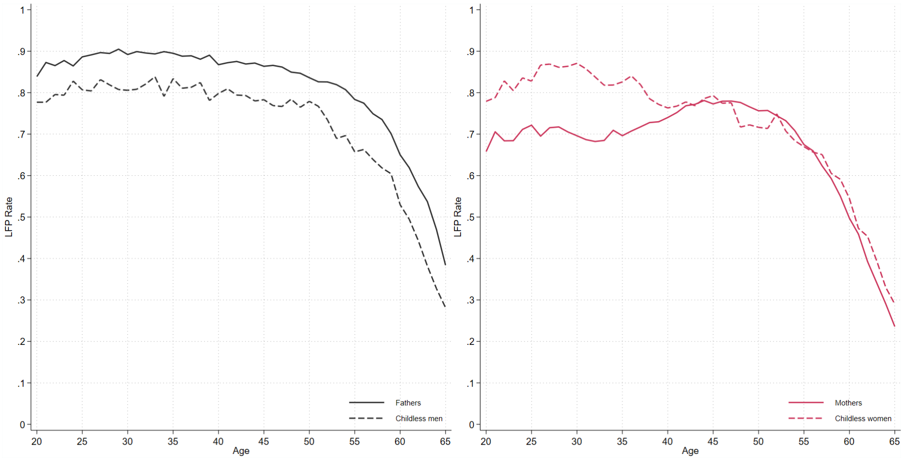


Figure 2: Age-profiles of labour force participation by gender and parenthood

◂ Life cycle: Full-time

Computing the Steady State: Algorithm (1)

We solve the benchmark model (*small open economy*) for its initial balanced-growth path steady state equilibrium.

1. Parameterize the model and discretize assets on $[a_{min}, a_{max}]$ such that:
   - Number of grid points, $N_A = 70$;
   - $a_{min} = 0$ (No-borrowing constraint);
   - The grid if fairly dense near a_{min} so households are not restricted by an all-or-nothing decision;
   - a_{max} is sufficiently large so that (i) *households are not bound by a_{max}*, and (ii) *there is enough room for upward movement induced by new policy regimes*.

   and for human capital grids on $[h^f_{min}, h^f_{max}]$:
   - Number of grid points, $N_H = 25$;
   - $h^f_{min} = h^m_{j=21} = 1$;
   - $h^f_{max} = h^m_{j=50} = 1.546$;

Computing the Steady State: Algorithm (2)

2. Guess K_0 and L_0, endogenous government policy variables, and w_m, taking $r = r^w$ as given;

3. Solve the firm's problem for $(w_m,\ w_f)$;

4. Given the factor prices (w_m, w_f, r) and the initial steady state vector of parameters (Ω_0), solve the household problem for decision rules on $\{a^+, c, l^f\}$ by backward induction (from $j = J$ to $j = 1$) using *value function iteration*;

$w_m = w_f = w$ in this basic version of our model.

Computing the Steady State: Algorithm (3)

5. Starting from a known distribution of newborns, compute the measure of households across states by forward induction, using
   - the computed decision rules,
   - ψ,
   - η and its Markov transition probabilities, and
   - the law of motion of female human capital (**??**).
6. Accounting for the share of alive agents, sum across states for aggregate variables: A, C, L, T and Tr. Update L, K, I and Y (convex update). Solve for endogenous government policy variables.

Computing the Steady State: Algorithm (4)

7. Given the updated variables, compute the goods market convergence criterion for a small open economy:

$$Y = C + I + G + NX$$

   - $B_F = A - K - B$;
   - $NX = (1 + r)B_{F,t} - (1 + n)(1 + g)B_{F,t+1}$;
   - $NX < 0$ implies a capital account surplus (increase in foreign indebtedness).

8. Return to step 3 until the convergence criterion is satisfied.

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