Family Tax Benefits:
A Macroeconomic Analysis

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The election, the promises

Anthony Albanese and Labor have a plan for a better future.

Australians deserve a leader who is not afraid to roll up their sleeves and do the hard work needed to get things done.

But after nearly a decade in office, Scott Morrison still refuses to take responsibility, goes missing in action, blames others and can't admit his mistakes.

From the bushfires to the bungled vaccine rollout to not securing enough rapid tests, Morrison's mistakes have held Australians back.

Australians deserve so much better.

With your support at the 2022 federal election, Anthony Albanese and Labor will:

Strengthen Medicare by making it easier to see the doctor.

Create secure local jobs by investing in Fee-Free TAFE and more university places, and make your job more secure with better pay and conditions.

Make child care cheaper so that it's easier for working families to get ahead.

Make more things here in Australia by working with business to invest in manufacturing and renewables to create more Australian jobs.

Labor will deliver a future where no one is held back and no one is left behind. ?

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.

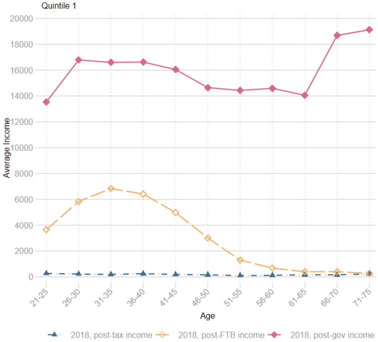
Source: *Australian Institute of Health and Welfare*

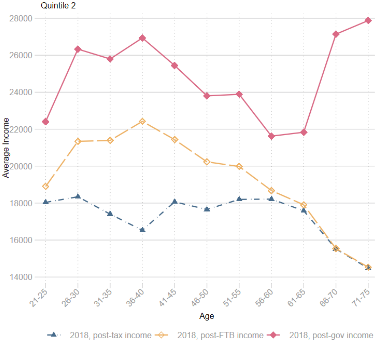
Welfare expenditure to GDP (%) by target groups

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

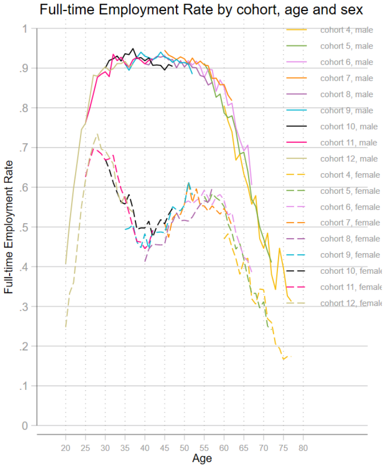
Source: *Australian Institute of Health and Welfare*

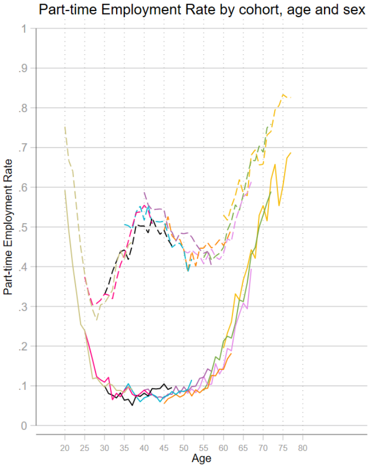
Family Tax Benefits for lower income households



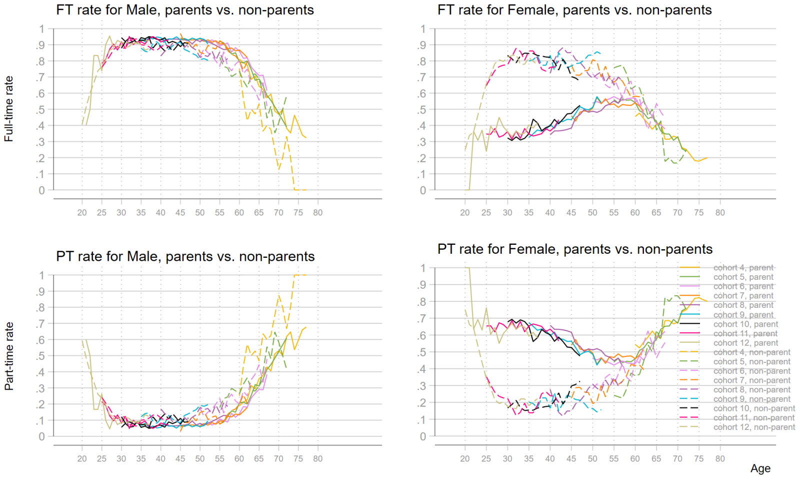


Full-time and part-time employment rates over life cycle





...accounting for parenthood



Evidence from our previous study

1. Government transfers are large for parents;
2. Except against extreme earnings shocks, government insurance dominates family insurance;
3. Spousal response to earnings shocks is limited.

Addressing new questions

1. How do the Family Tax Benefits (FTB) affect households? *Insurance vs. Incentive effects*.

2. Which is "better"?
   - universal vs. means-tested
   - lump sum vs. subsidy
   - conditional vs. unconditional (e.g., on work)

3. What are the intra- and inter-generational redistributive effects?

How?

By incorporating (i) **family structure**, (ii) **time and monetary costs of children**, and (iii) **the FTB and child care schemes** into a *General Equilibrium Heterogeneous-Agent OLG framework*.

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)

Preliminary findings

1. Partially offsetting effects over life cycle
   - The Child Care Subsidy's (CCS) work incentive effect *dominates* the FTB disincentive effect on LFP for young mothers (below 45);
   - The reverse is true for older mothers;

2. Transfer programs interact; e.g., removing the FTB raises savings which make more households ineligible for pension.

3. Assuming an economy populated by only parents,
   - Removing the FTB results in gains in female LFP (+32.35%) and output (+3.15%) if the CCS stays;
   - Removing the CSS results in a huge loss of female LFP (-14.71%) and output (-2.36%) if the FTB stays;
   - Removing both programs result in smaller losses of female LFP (-5.88%) and output (-1.57%) and a fall in labour income tax burden by 22.6%.

Demographics

1. Time-invariant population growth rate (n) and joint survival probability (ψ_j);
2. Populated by couples with dependent children (for now);
3. Couples are born as workers at $j = 1$, retire at $j = 45$ and can live to the maximum age of $j = J = 70$;
4. Children are deterministic and exogenous.
   - the k^{th} child is born to households aged $j = b_k$;
   - the k^{th} child is dependent for 18 years ($j = b_k$ to $j = b_k + 17$);
   - the number of children is

$$nc_j = \sum_{k=1}^{\bar{nc}} \mathbf{1}_{\{b_k \leq j \leq b_k + 17\}}$$

More on children...

1. Low education (θ_L) households have children earlier;
2. Households have full information on children;
3. No informal child care available;
4. Parents are fully committed to allocate a predesignated amount of resource for each child;
5. Children leave home at 18 years old. This marks the end of the link between parents and their children;
6. No bequest motive.

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: Preferences (1)

Households born at time t maximize expected intertemporal utility:

$$\max_{c_j, l_j^f} \sum_{j=1}^{J} \beta^{j-1} \left(\prod_{s=1}^{j} \psi_s \right) \mathbb{E}_t \left[u(c_j, l_j^m, l_j^f) \right] \tag{1}$$

- β - discount factor;
- ψ - time-invariant survival probabilities;
- c - consumption;
- l^m - husband's labour supply (exogenous);
- l^f - wife's labour supply
  (exogenous hours, endogenous entry-exit decision);

Households: Preferences (2)

The instantaneous utility $u(c, l^i)$ for $i \in \{m, f\}$ is given by:

$$u(c, l^i) = \frac{1}{\left(1 - \frac{1}{\gamma}\right)} \left[\left(\frac{c}{\sqrt{2 + nc}} \right)^{\nu} \left(l^i\right)^{1-\nu} \right]^{1 - \frac{1}{\gamma}}$$

The joint utility for every household, $u(c, l^m, l^f)$, is:

$$u(c, l^m, l^f) = u(c, l^m) + u(c, l^f) \quad (2)$$

- Spouses are perfectly altruistic;
- ν - taste for c relative to l;
- γ - intertemporal elasticity of substitution;
- nc - number of dependent children.

Households: Endowments

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

$$\boldsymbol{y_j^i = w^i n_j^i e_j^i}$$

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

Where

$$e_j^i = \bar{e}_j(\theta, h_j^i) \times \epsilon_j^i$$

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

Retirees receive means-tested pension $\boldsymbol{pen_t(y_j^m + y_j^f,\ a_j)}$.

Households (working age): Husband

For each household, the husband always works.

$$y_j^m = w^m n_j^m \theta h_j^m \epsilon_j^m$$

n^m and h^m are exogenous.

The transitory shocks follow an *AR1* process:

$$\eta_j^m = \rho \times \eta_{j-1}^m + \epsilon_j^m; \qquad \epsilon_j^m \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

Where $\eta_j^m = ln(\epsilon_j^m)$

Households (working age): Cost of working wife

The household makes decision for the wife to enter or exit the labour force. If she works, she incurs:

1. A **fixed time cost**, χ:

$$l_j^f = \begin{cases} 1 & \text{if not working} \\ \left(1 - n_j^f - \chi \mathbf{1}_{n_j^f > 0}\right) < 1 & \text{otherwise.} \end{cases}$$

2. A **formal (combined) childcare cost** κ_j that is:

- *strictly increasing* in nc_j;
- *strictly decreasing* in age of children

3. A loss of a portion or all of the means-tested child support transfers (FTB part A and B).

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Households (working age): Benefit of working wife

However, if she works, she gains:

1. Labour income

$$y_j^f = w^f \eta_j^f \theta h_j^f \epsilon_j^f$$
$$\eta_j^f = \rho \times \eta_{j-1}^f + \epsilon_j^f; \qquad \epsilon^f \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

2. Child care subsidy s_j;

3. Human capital (h^f) for the next period.

The law of motion of h^f is:

$$log(h_j^f) = log(h_{j-1}^f) + (\xi_1 + \xi_2 \times (j-1))\,\ell_{j-1}^f - \delta_h(1 - \ell_{j-1}^f) \quad (3)$$

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Technology

- A representative firm with Cobb-Douglas production function and labour-augmenting technology A:

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

- Firm maximizes profit according to:

$$\max_{w_t, q_t} \quad (1-\tau_t^k)(Y_t - w_t A_t L_t) - q_t K_t \tag{4}$$

- Firm's FOC yields:

$$r_t = (1-\tau_t^k)\alpha\frac{Y_t}{K_t} - \delta \tag{5}$$

$$w_t = (1-\alpha)\frac{Y_t}{A_t L_t} \tag{6}$$

Government: Tax system

Separate tax filing for $i \in \{m, f\}$

If *proportional*:

$$tax_j^i = \tau^w \times y_j^i \tag{7}$$

If *progressive*:

$$tax_j^i = max\{0,\ y_j^i - \lambda(y_j^i)^{1-\tau}\} \tag{8}$$

Where

- λ is a scaling parameter
- τ controls progressivity of the tax scheme:
  - $\tau = 1 \implies tax_j^i = y_j^i$; i.e., tax everything;
  - $\tau = 0 \implies tax_j^i = (1-\lambda)y_j^i$; i.e., $(1-\lambda)$ is a flat tax rate.

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 asset tests*).

Income test:

$$\mathcal{P}^y\left(y_j^h\right) = \begin{cases} p^{\max} & \text{if } y_j^h \leq \bar{y}_1^p \\ \max\left\{0,\ p^{\max} - \omega_y\left(y_j^p - \bar{y}_1^p\right)\right\} & \text{if } y_j^h > \bar{y}_1^p, \end{cases} \tag{9}$$

Asset test:

$$\mathcal{P}^a\left(a_j\right) = \begin{cases} p^{\max} & \text{if } a_j \leq \bar{a}_1 \\ \max\left\{0,\ p^{\max} - \omega_a\left(a_j - \bar{a}_1\right)\right\} & \text{if } a_j > \bar{a}_1, \end{cases} \tag{10}$$

Government: Old Age Pension (2)

The amount of pension benefit claimable, pen_j, is the minimum of (9) and (10). That is,

$$pen_j = \begin{cases} \min\left\{\mathcal{P}^a\left(a_j\right), \mathcal{P}^y\left(y_j^h\right)\right\} & \text{if } j \geq j^P \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

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*: $\{\bar{y}_{max}^{tr};\ \bar{y}_{base}^{tr}\}$;
3. **Taper rates** *for max and base payments*: $\{\omega_{A1};\ \omega_{A2}\}$

Government: Family Tax Benefit part A (2)

Let $y_j^h = y_j^m + y_j^f + ra_j$. The benefit received per child, $\boldsymbol{tr_j^A}$, is:

$$tr_j^A = \begin{cases} tr_j^{\mathrm{A1}} & \text{if } y_j^h \leq \bar{y}_{max}^{tr} \\ \max\left\{tr_j^{\mathrm{A2}},\ tr_j^{\mathrm{A1}} - \omega_{A1}\left(y_j^h - \bar{y}_{max}^{tr}\right)\right\} & \text{if } \bar{y}_{max}^{tr} < y_j^h < \bar{y}_{base}^{tr} \\ \max\left\{0,\ tr_j^{\mathrm{A2}} - \omega_{A2}\left(y_j^h - \bar{y}_{base}^{tr}\right)\right\} & \text{if } y_j^h \geq \bar{y}_{base}^{tr}, \end{cases} \tag{12}$$

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

Where

- $y_{pe} = \max(y_j^m, y_j^f)$ is the primary earner's income
- $y_{se} = \min(y_j^m, y_j^f)$ is the secondary earner's income

Government: Family Tax Benefit part B (2)

The benefit received per household, $\boldsymbol{tr_j^B}$, is given by:

$$tr_j^B = \tag{13}$$

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

Where

- $\Upsilon_1 = \mathbf{1}_{\{nc_{[0,4],j} \geq 1\}}$
- $\Upsilon_2 = \mathbf{1}_{\{nc_{[0,4],j} = 0 \text{ and } (nc_{[5,15],j} \geq 1 \ \ or \ \ nc_{[16,18]_{AS},j} \geq 1)\}}$

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}

Government: Child Care Subsidy (2)

The rate of subsidy, $\boldsymbol{sr_j}$, is given by:

$$sr_j = \Psi(y_{hh},\ n_j^h,\ n_j^w) \times \begin{cases} sr_1 & \text{if } y_{hh} \leq \bar{y}_1^{sr} \\ max\{sr_2,\ sr_1 - \omega_C^1\} & \text{if } \bar{y}_1^{sr} < y_{hh} < \bar{y}_2^{sr} \\ sr_2 & \text{if } \bar{y}_2^{sr} \leq y_{hh} < \bar{y}_3^{sr} \\ max\{sr_3,\ sr_2 - \omega_C^3\} & \text{if } \bar{y}_3^{sr} \leq y_{hh} < \bar{y}_4^{sr} \\ sr_3 & \text{if } \bar{y}_4^{sr} \leq y_{hh} < \bar{y}_5^{sr} \\ sr_4 & \text{if } y_{hh} \geq \bar{y}_5^{sr} \end{cases} \tag{14}$$

Where

- $\omega_C^i = \dfrac{y_{hh} - \bar{y}_i^{sr}}{\$3,000}$
- Let $n_j^{min} = min\{n_j^h, n_j^w\}$. The adjustment factor is

$$\Psi(y_{hh}, n_j^h, n_j^w) = 0.24_{\{y_{hh} \leq \bar{y}_1^{sr},\ n_j^{min} \leq 8\}} + 0.36_{\{8 < n_j^{min} \leq 16\}} + 0.72_{\{16 < n_j^{min} \leq 48\}} + 1_{\{n_j^{min} > 48\}}$$

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 + Child Care Subsidy), Tr_t;
- Old age pension, P_t.

The fiscal budget balance equation is therefore

$$(B_{t+1} - B_t) + T_t^C + T_t^K + T_t^I = G_t + Tr_t + \mathcal{P}_t + r_t B_t. \tag{15}$$

Dynamic Optimization Problem: **Working households**

$V(z_j)$ denotes the value function for a household aged j with state $z_j = \{a_j, h_j^f, \theta, \epsilon_j^m, \epsilon_j^f\}$.

$$V(z_j) = \max_{c_j,\, l_j^f,\, a_{j+1}} \left\{ u(c_j, l_j^m, l_j^f) + \beta \psi_j \mathbb{E}\left[V(z_{j+1}|z_j)\right] \right\} \tag{16}$$

s.t.

$$\begin{aligned}(1+\tau^c)c_j + a_{j+1} + \mathbf{1}_{\{\ell_j^f > 0\}}(w^f n_j^f \sum_{i=1}^{nc_j} \kappa_i - s_j) \\ = (1+r)a_j + y_j + nc_j \times tr_j^A + tr_j^B + beq_j - tax_j\end{aligned} \tag{17}$$

$$a_{j+1} \geq 0 \tag{18}$$

Dynamic Optimization Problem: **Retirees**

Retiree's state vector is $z_j = a_j$. Why?

- No labour income, no children, no child-related transfers;
- Pension is independent of labour earnings history.

$$V(z_j) = \max_{c_j,\, a_{j+1}} \{u(c_j) + \beta\psi_j \mathbb{E}\left[V(z_{j+1}|z_j)\right]\} \tag{19}$$

s.t.

$$(1+\tau^c)c_j + a_{j+1} = (1+r)a_j + pen_j - tax_j \tag{20}$$

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:

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

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

$$\begin{aligned} \phi_{t+1}(z^+) = \int_{A\times H\times\Theta\times S^2} & \mathbf{1}_{\{a^+=a^+(z,\Omega_t),\, h^+=h^+(z,\Omega_t)\}} \\ & \times\pi(\eta_m^+|\eta_m)\times\pi(\eta_f^+|\eta_f)\, d\Phi_t(z) \end{aligned} \tag{21}$$

Competitive Equilibrium: **Aggregation (Households)**

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

$$C_t = \sum_{j=1}^{J} \int_{A \times H \times \Theta \times S^2} c(z, \Omega_t) \mu_{j,t} \, d\Phi_t(z) \tag{22}$$

$$A_t = \sum_{j=1}^{J} \int_{A \times H \times \Theta \times S^2} a(z, \Omega_t) \mu_{j,t} \, d\Phi_t(z) \tag{23}$$

$$LM_t = \sum_{j=1}^{J} \int_{A \times H \times \Theta \times S^2} \text{eff}_j e^{\theta + \eta_m} \mu_{j,t} \, d\Phi_t(z) \tag{24}$$

$$LF_t = \sum_{j=1}^{J} \int_{A \times H \times \Theta \times S^2} e^{\theta + \eta_f} l^f(z, \Omega_t) \mu_{j,t} h_j \, d\Phi_t(z) \tag{25}$$

Competitive Equilibrium: **Aggregation (Government)**

Given the optimal decisions $\{c(z,\Omega_t),\ l^f(z,\Omega_t),\ a(z,\Omega_t)\}_{j=1}^{J}$, 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:

$$T_t^C = \tau_t^c C_t \tag{26}$$

$$T_t^A = \tau_t^k (Y_t - w_t A_t L_t) \tag{27}$$

$$T_t^I = \sum_{j=1}^{J} \int_{A\times H\times\Theta\times S^2} tax_j \mu_{j,t}\, d\Phi_t(z) \tag{28}$$

$$Tr_t = \sum_{j=1}^{J} \int_{A\times H\times\Theta\times S^2} \left(nc \times tr_j^A + tr_j^B + s_j\right) \mu_{j,t}\, d\Phi_t(z) \tag{29}$$

$$\mathcal{P}_t = \sum_{j=1}^{J} \int_{A\times H\times\Theta\times S^2} pen_j \mu_{j,t}\, d\Phi_t(z) \tag{30}$$

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 $\left\{c_j, l_j^f, a_{j+1}\right\}_{j=1}^{J}$ solve the household problem (16) and (19);
2. The firm chooses labor and capital inputs to solve the profit maximization problem (5);
3. The government budget constraint (15) is satisfied;
4. The markets for capital and labour clear:

$$K_t = A_t + B_t + B_{F,t} \tag{31}$$

$$L_t = LM_t + LF_t \tag{32}$$

Competitive Equilibrium: Definition (2)

5. Goods market clears:

$$Y_t = C_t + I_t + G_t + NX_t \tag{33}$$
$$NX_t = (1+n)(1+g)B_{F,t+1} - (1+r)B_{F,t}$$
$$B_{F,t} = A_t - K_t - B_t$$

Where 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:

$$BQ_t = \sum_{j=1}^{J} \int_{A\times H\times\Theta\times S^2} (1-\psi_j)(1+r_t^n)a(z,\Omega_t)\, d\Phi_t(z). \tag{34}$$

   Bequest to each surviving household aged j at time t is

$$beq_{j,t} = \left[\frac{\zeta_{j,t}}{\sum_{j=1}^{J} \zeta_{j,t}\, m_{j,t}}\right] BQ_t \tag{35}$$

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

$$beq_{j,t} = \frac{BQ_t}{\sum_{j=1}^{JR-1} m_{j,t}} \tag{36}$$

Summary: Externally Calibrated Parameters (1)

Parameter	Value	Target (2012-2018)
Demographics		
Lifespan	$J = 80$	Age 21-100
Retirement	$J_R = 45$	Age 65
Population growth	$n = 1.6\%$	Average (ABS)
Survival probabilities	ψ_m, ψ_f	Average (Aus. Life Tables, ABS)
Technology		
Labour augmenting tech. growth	$g = 1.3\%$	Average per capita 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)
Total factor productivity	$TFP = 1$	
Capital depreciation rate	$\delta = 0.0725$	
Households		
Relative risk aversion	$\sigma = \frac{1}{\gamma} = 2$	
Taste for consumption	$\nu = 0.335$	Literature**
Labour supply	n_m, n_f	Age-profiles of avg. labour hours (HILDA)
Male human capital profile	h^m	Age-profile of hourly wages for married men

Summary: Externally Calibrated Parameters (2)

Parameter	Value	Target
Permanent shocks		
Value	$\{\theta_L, \theta_H\} = \{0.745, 1.342\}$	College-HS earnings ratio of 1.8**
Measure of $\{\theta_L, \theta_H\}$ type households	$\{\pi(\theta_L), \pi(\theta_H)\} = \{0.7, 0.3\}$	College to high school ratio (2018, ABS)
Fiscal Policy		
Consumption tax	$\tau_c = 8\%$	$\tau_c \dfrac{C_0}{Y_0} = 4.5\%$; $\dfrac{C_0}{Y_0} = 56.3\%$
Company profit tax	$\tau^k = 10.625\%$	$\tau^k \left(\frac{Y-WL}{Y}\right) = 4.25\%$; $\frac{WL}{Y} = \alpha$
Gov't debt-to-GDP	$\dfrac{B}{Y} = 20\%$	Average (CEIC data)**
Gov't general purchase	$\dfrac{G}{Y} = 14\%$	Net of FTB, CCS and Age Pension (WDI and AIHW)
FTB and CCS parameters		HILDA Tax-Benefit model
Others		
Model income unit	1 unit $= 26.04 \times 24 \times 5 \times 52$	Average male hourly wage at age 21 (HILDA)

Summary: Internally Calibrated Parameters (1)

Parameter	Value	Target
Households		
Discount factor	$\beta = 0.99$	Wealth to GDP ratio**
Time cost of female labour supply	$\chi = 0.155$	Age-profile of mothers' full-time rate
Female human capital accumulation	$(\xi_1, \xi_2) = (0.0345, -0.0012)$	Married male's age-profile of hourly wages (if $^f > 0$ every period)
Female human capital depreciation	$\delta_h = 0.074$	Male-Female wage gap at age 50**
Transitory shocks, ϵ		
Persistence	$\rho = 0.98$	Literature**
Variance of shocks	$\sigma_\epsilon^2 = 0.0145$	$GINI_{j=1,m} = 0.35$
Fiscal policy		
Progressive income tax	$\lambda = 0.7237$, $\tau = 0.2$	Literature**
Maximum pension	$pen^{max} = 50\% \times Y_m$	Pension/GDP $= 3\%$

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 and ψ_j induce a stable population structure (see share of survivors).

Calibration: Demographics (2)

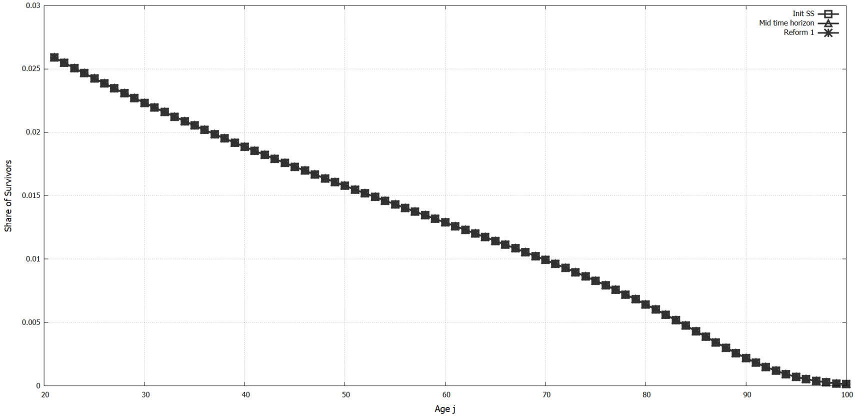


Figure: Share of survivors over life cycle

Calibration: Endowment (Deterministic) (1)

- Male and female labour hours, n^m and n^f, match the normalized average hours of married male and female workers, respectively, over their working age.
- Labour efficiency (human capital) for male, h^m, follows the age profile of married male's hourly wage.
- Low vs. High education (deterministic productivity realized at birth):
  - $\{\theta_L, \theta_H\} = \{0.745, 1.342\}$: college wage premium of 1.8 relative to high school;
  - $\{\pi(\theta_L), \pi(\theta_H)\} = \{0.7, 0.3\}$: fraction of college and high school graduates (ABS).

Labour hours (if employed), HILDA 2012-2018

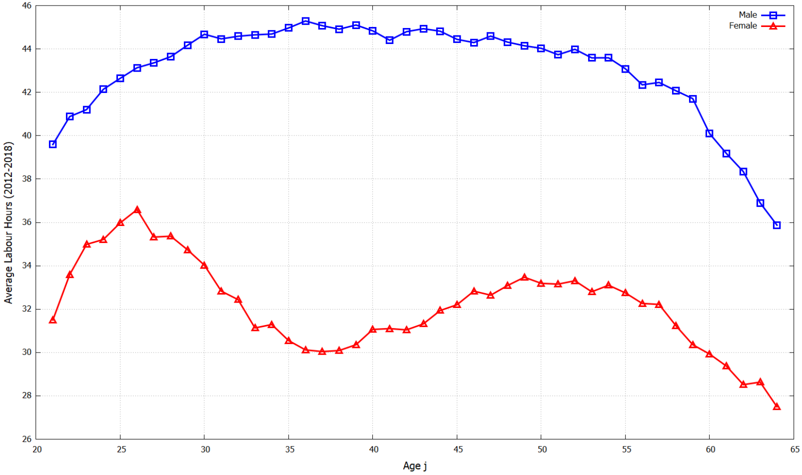


Figure: Age profile of married male's and married female's labour hours

Labour efficiency (human capital), HILDA 2012-2018

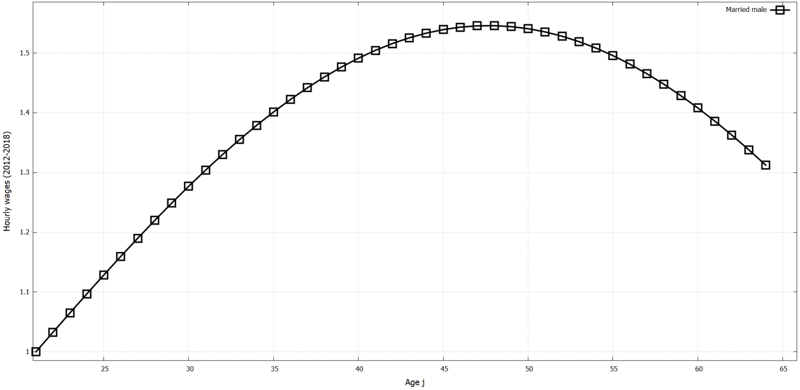


Figure: Age profile of married male's hourly wages

Calibration: Endowment (Deterministic, Female)

We calibrate the female human capital accumulation rate, $\{\xi_1, \xi_2\} = \{0.03452, -0.00123\}$, so that h^f mimics h^m:

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

Calibration: Endowment (Deterministic, Children)

Children:

1. Assign *first and second child births* to
   - type θ_H households aged $\{28, 32\}$ (See AIHW report);
   - type θ_L households aged $\{21, 25\} **$
2. Child care service fee is \$12.5/*hour* or 48% of age 21 married male hourly wage.
3. Based on approximates** from child care service and school fees, parents pay
   - 100% of the fee for child aged 0-2;
   - 80% for child aged 3-5;
   - 60% for child aged 6-11;
   - 40% for child aged 12-17.

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: $\rho = 0.98$ taken from literature;
- 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 GINI $= 0.3766$ for wage distribution of work-age male population (not targeted).

Lorenz Curve (male wages at aged 21 and 22)

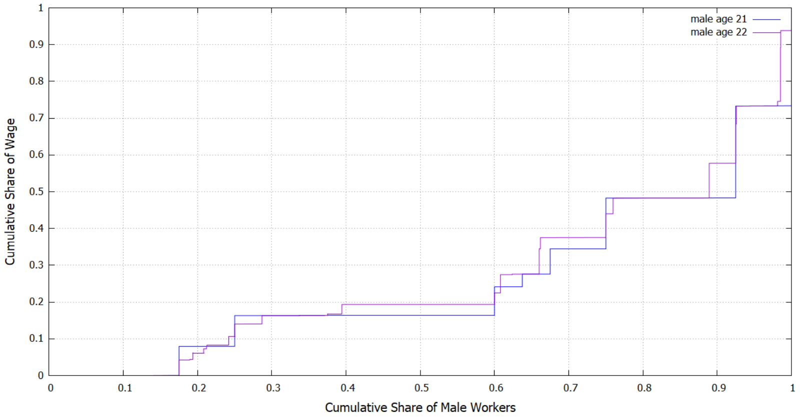


Figure: Lorenz curves of the distributions of married male wages at age 21 and 22

Lorenz Curve (male wages at working age)

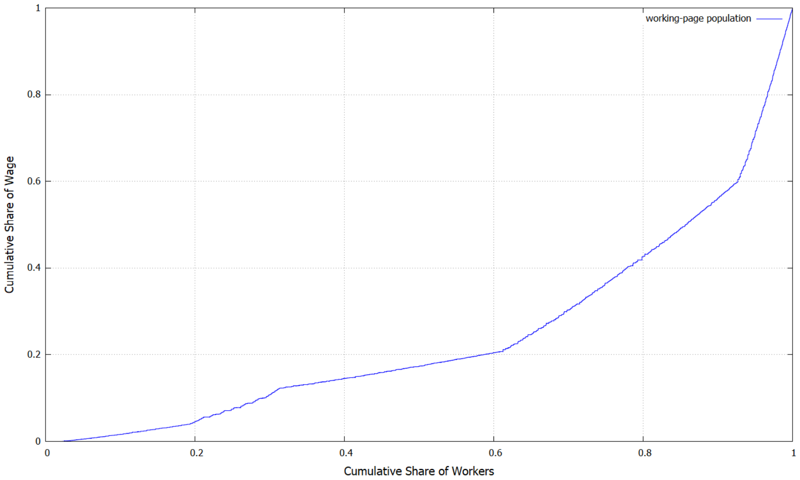


Figure: Lorenz curve of the wage distribution of the working-age male population (accounting for human capital, education and transitory shocks over the life cycle)

Calibration: Fiscal Policy

- Income tax:
  - If proportional tax: τ^w balances the budget
  - If progressive income tax:

$$\begin{cases} \lambda & \text{endogenous (budget balancing variable);} \\ \tau = 0.2 & \text{total tax revenue to GDP ratio} = 25\% \end{cases}$$

- Means-tested pension:

$$p^{max} = 0.35 \times \text{ Average Annual Male Income}$$

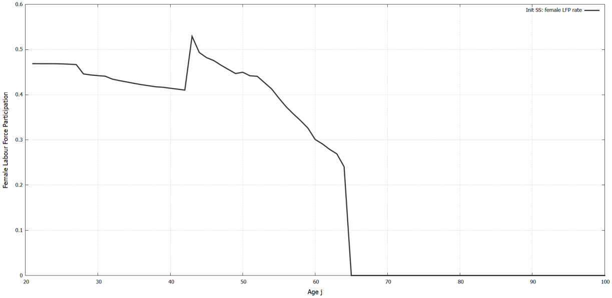
to match the pension-to-GDP ratio of 3.2%.

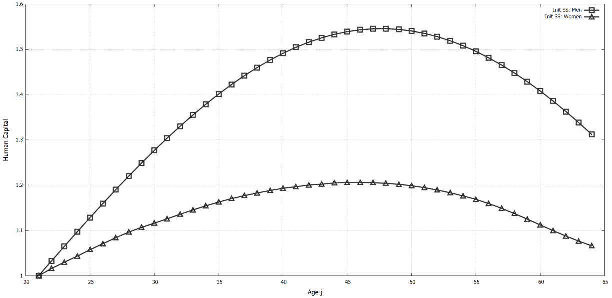
- FTB and Child Care Subsidy parameters are exogenous (from HILDA 2018).

Key Macro Variables: Model vs. Data

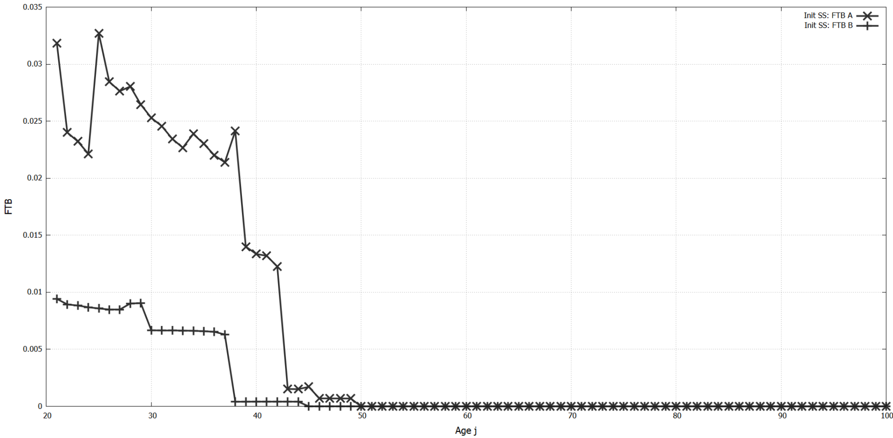
Moments	Benchmark Model	Data	Source
Targeted			
Capital, K/Y	3.18	3 - 3.3	ABS (2012-2018)
Investment, I/Y	32%	24% - 28%	ABS (2012-2018)
Consumption tax, T^c/Y	4.25%	4.5%	APH Budget Review
Company tax, T^K/Y	4.25%	4.25%	APH Budget Review
Age Pension, P/Y	2.59%	3%	ABS (2012-2018)
Non-targeted			
Consumption, C/Y	53%	54% - 58%	ABS (2012-2018)
Gross foreign debt, B_F/Y	63.93%	80% - 110%	ABS (2012-2018)
Mother's LFP (full-time)	34%	38%	HILDA (only married)
Tax Revenue to output	19.74%	25%	ABS (2012-2018)
Income tax, T^I/Y	11.24%	11%	APH Budget Review
Child related transfers (FTB + CCS)	2.35%	2%	ABS (2012-2018)

Benchmark: Female LFP and human capital





Benchmark: FTB A and FTB B

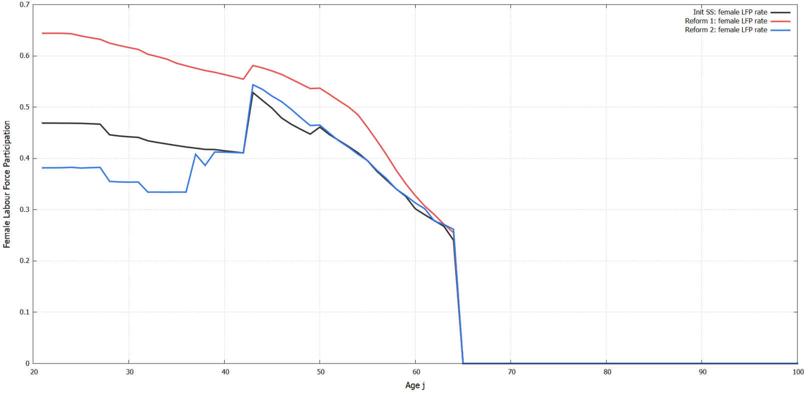


Results: Benchmark vs. Experiments**

	Benchmark	1: **No FTB**	2: **No CCS**	3: **No FTB, No CCS**
Capital (K)	4.03	+2.98%	-1.99%	-0.99%
female LFP	0.34	+32.35%	-14.71%	-5.88%
Output (Y)	1.27	+3.15%	-2.36%	-1.57%
Consumption (C)	0.67	+2.99%	-1.49%	-1.49%
Savings (S)	0.1154	+5.29%	-0.52%	+0.86%
Investment (I)	0.41	+2.44%	-2.44%	0
τ^w	17.75%	-6.59%	-9.2%	-22.59%
Tax Revenue	0.25	-4%	-6.8%	-12%
FTB	0.0145		+16.55%	
CCS	0.015	+33.33%		
Pension	0.033	-6.06%	-6.06%	-6.06%
HEV (newborn)	0	-1.05%	-0.37%	-1.5%

**The experiments are conducted within a model economy without single parents and childless singles and couples.

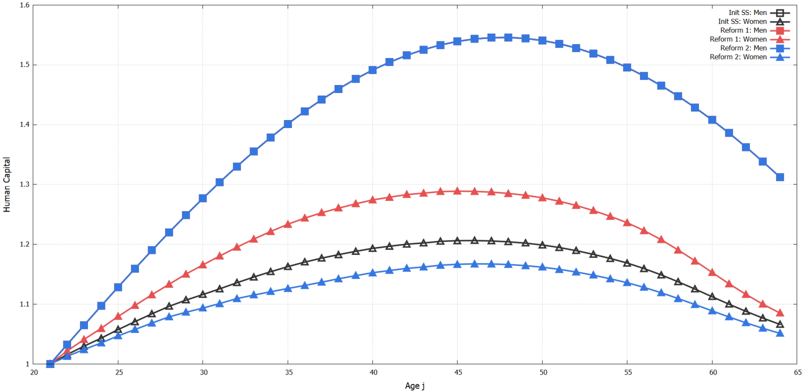
Effects on LFP of mothers



Red line: Reform 1 (Remove FTB, Keep CCS)

Blue line: Reform 2 (Removing FTB and CCS).

Effects on human capital of mothers



Red line: Reform 1 (Remove FTB, Keep CCS)

Blue line: Reform 2 (Removing FTB and CCS).

Conclusion

1. A unified framework incorporating the FTB and CCS into a large scale GE heterogeneous-agent OLG with family structure;
2. Lessons from a unique setting in Australia:
   - FTB part A and part B: *(i) means-tested*, *(ii) conditional on number and age of children*, but *(iii) NOT conditional on work*;
   - Child Care Subsidy: *(i) means-tested*, *(ii) conditional on work*.
3. A possible explanation on the findings by Herault and Kalb (2020) as to why tax and transfer policies contribute little to the increase in female LFP.[1]

[1] They explain the rise in female LFP rate (1990–2017 Australia) using a decomposition approach (4 explanatory factors: *wage, tax and transfer, preference, demographic composition changes*).

Future work

Future work

1. Add new household types;
2. Endogenous intensive margin of labour supply;
3. Richer income process (See De Nardi et al. (2020));
4. And more!

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 (3).
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)

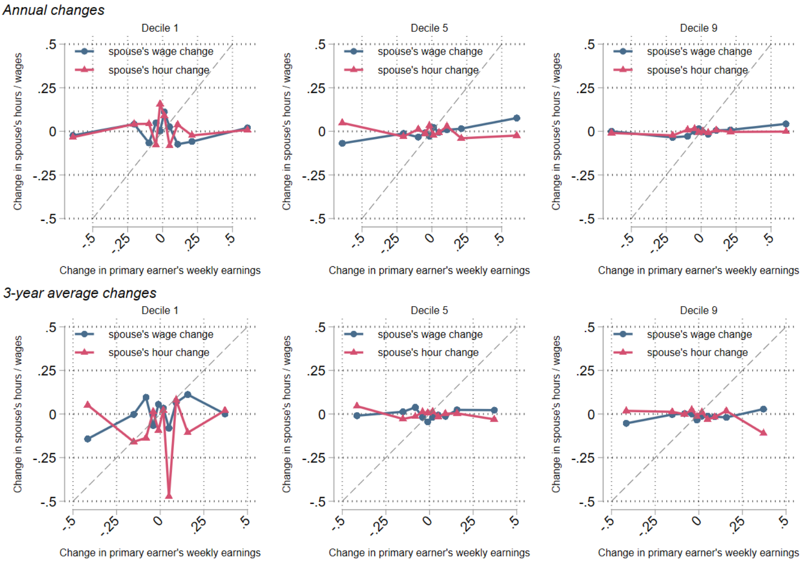
7. Given the updated variables, compute the goods market convergence criterion for a small open economy:

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

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

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

Spousal responses to shocks



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