



Pensions, Saving and Housing:  
*A life-cycle framework with policy simulations*

by

John Creedy<sup>a,b</sup>, Norman Gemmell<sup>a</sup>  
and Grant Scobie<sup>b</sup>

CEPAR Workshop, UNSW, Sydney  
*November 17-18, 2014*

<sup>a</sup> Victoria Business School, Victoria University of Wellington

<sup>b</sup> New Zealand Treasury



Chair in Public Finance  
Victoria Business School

# Outline

---

- Motivation
- Summary of model structure
- Model solutions:
  - Consumption, saving, pensions, housing
- Policy simulations
  - Tax rates, pension levels, borrowing constraint; pop ageing
- Conclusions

# Motivation

---

- New Zealand Context:
    - Are NZ households' (retirement) savings/assets/liabilities biased towards housing?
    - Are NZ households' savings rates especially low? If so, why?
    - What roles do retirement planning & policy play in these household choices?
  - Can a model help?
    - To identify how households' *retirement* savings decisions in financial and housing assets are related to:
      - (a) optimising behaviour over the lifecycle
      - (b) state pension policy and tax settings?
  - Specific NZ policy questions:
    - Should NZ Superannuation (PAYGO) be reformed to deal with ageing consequences?
    - Should NZ shift pension balance towards greater use of SAYGO options?
    - Should SAYGO be compulsory?
- ⇒ A two-period (work/retirement) OLG model of an optimising household allocating consumption (a) across periods and (b) between housing/non-housing in retirement

# The core of the model

---

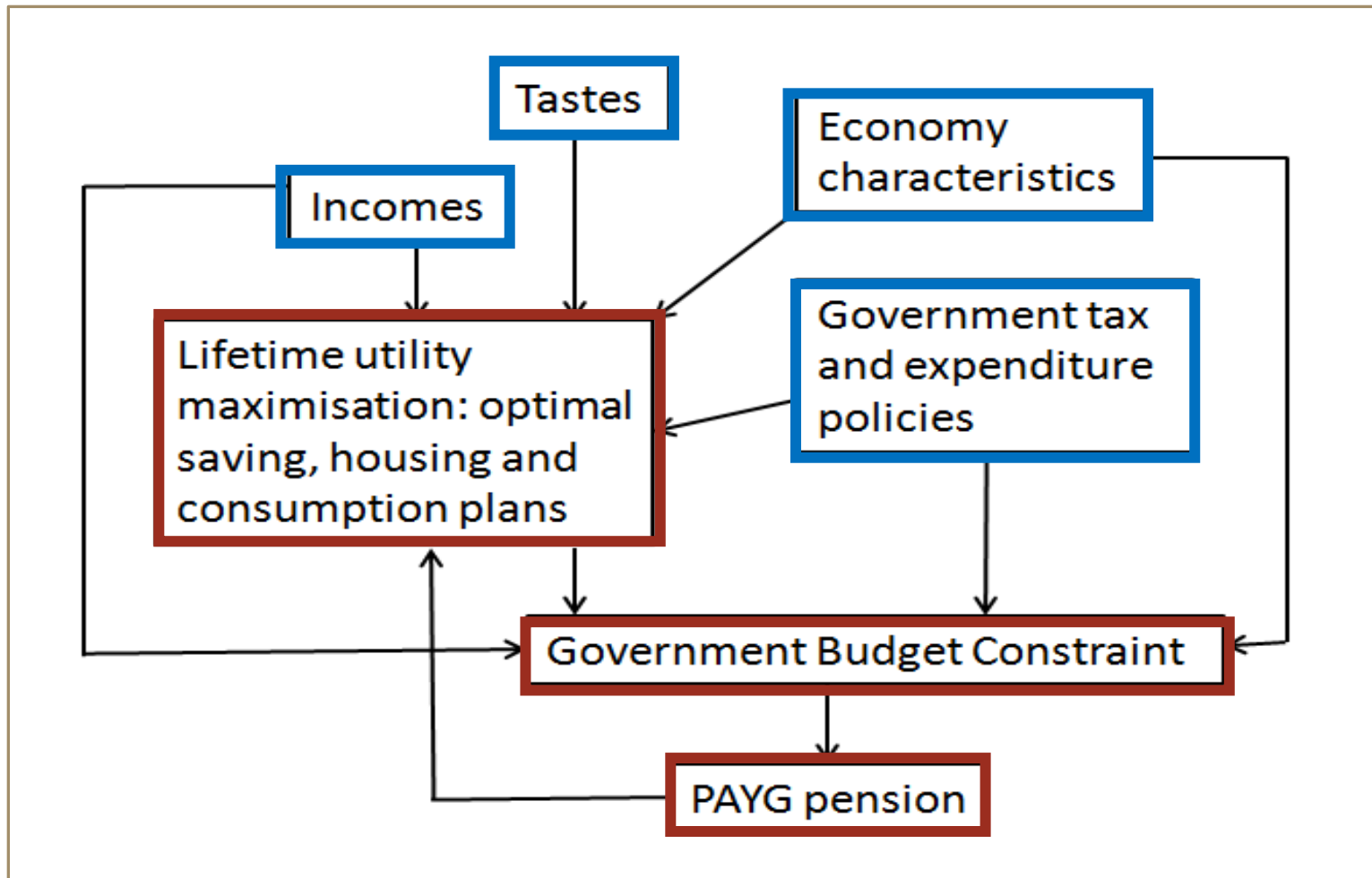
- Representative agent: overlapping generations
- 2 period lifetime framework: ‘working’ (w) & ‘retirement’ (p)
- Workers:  $N_w$ ; pensioners:  $N_p$
- Income:  $y_1$  &  $y_2$  (*exogenous*); public (PAYG), and compulsory SAYG, pensions
- Individuals maximise utility from consumption in periods 1 and 2 ( $c_1$  &  $c_2$ ) and ‘retirement’ housing consumption in period 2 ( $c_H$ ).

$$\log U = \alpha' \log(c_1) + \beta' \log(c_2) + \gamma' \log(c_H) \qquad \alpha' + \beta' + \gamma' = 1$$

- Subject to a budget constraint: borrowing only for house purchase
- Consumption and housing expenditure from:  
Market income (after tax) + NZS + SAYG + interest on financial saving (after-tax) + appreciation of the housing asset (after mortgage repayment?)
- Exogenous market income  $\Rightarrow$  focuses on effects of consumption *smoothing* and *allocation in retirement* (housing/non-housing) w.r.t. policy settings.

# Overview of model structure

---



— exogenous/predetermined

— endogenous

# The model: housing & saving

---

- **‘Retirement housing’ consumption** in period 2:  $c_H$  (*imputed* rental income)
- Motivates housing asset accumulation in period 1 via saving in ‘housing equity’,  $s_H$
- Housing consumption in period 1 included in  $c_1$
- $c_2$  and  $c_H$  are not fungible in period 2  $\Rightarrow$  funded by 2 separate “pots” ( $s_f$  and  $s_H$ )
- **Saving:**
  - $s_f$  (period 1) buys a private retirement fund; at rate of return,  $r$ , for consumption,  $c_2$
  - $s_H$  buys housing equity, at rate of return,  $\pi$ , for consumption,  $c_H$
- **House value** =  $V_{H,1} = s_H + b$  (obtain  $p_H$  for assumed elasticity of supply)
- **Mortgage borrowing**,  $b$ , in period 1 repaid with interest at start of period 2
- Borrowing constrained by loan-to-value ratio (LVR),  $\xi$  :  $b = \frac{\xi}{1 - \xi} s_H$

*Note:* ‘saving’ = ‘workers’ saving during period 1 (retirees dis-save)

# The model: the government budget

- Taxes:
  - Income tax (on all income) at rate,  $\tau$
  - GST at rate,  $v$
  - Compulsory SAYG contribution (tax) rate  $\delta$ ; return taxed at (reduced) rate  $\tau'$
  - No tax on return to housing,  $\pi$  (capital gain?)
- Government spending:
  - Pensions, P (NZ Superannuation): non-means-tested
  - Non-pension spending, G [n.b. does not affect  $U$ ]
- Balanced budget in each period
  - Depends on numbers of workers and pensioners in each *generation*

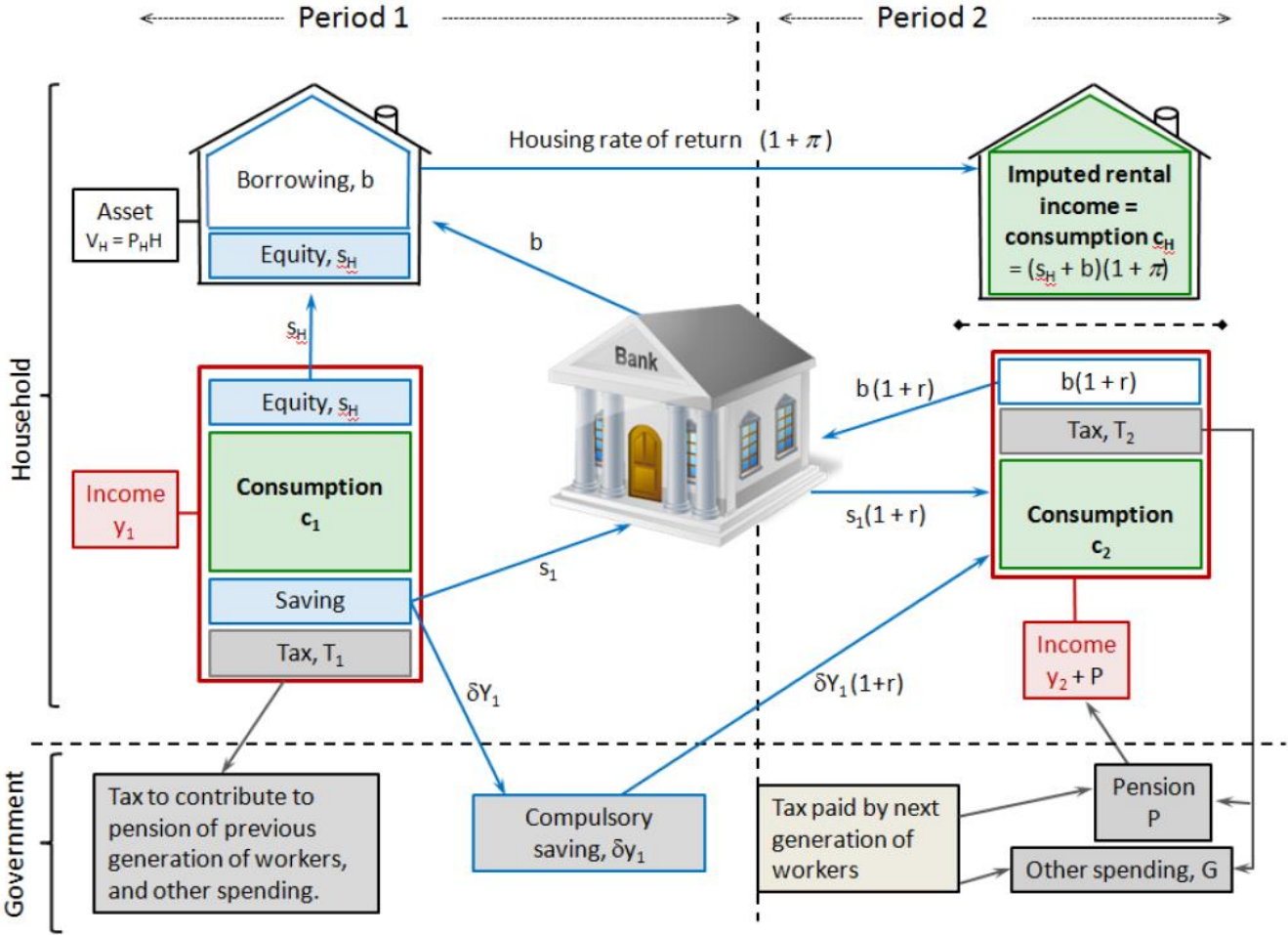
# The government budget constraint

---

$$\begin{aligned}
 N_p P + (N_p + N_w) G &= \tau \sum_{i=1}^{N_w} y_{w,1,i} + \tau \sum_{i=1}^{N_p} y_{p,2,i} && \text{Income Tax} \\
 \text{Total Govt Expenditure} &&& \\
 &+ \tau r \sum_{i=1}^{N_p} (y_{p,1,i} (1 - \tau - \delta) - c_{p,1,i} (1 + v) - s_{p,H,i}) && \text{Tax on interest from financial savings} \\
 &+ v \left( \sum_{i=1}^{N_w} c_{w,1,i} + \sum_{i=1}^{N_p} c_{p,2,i} \right) && \text{GST} \\
 &+ r \delta \tau' \sum_{i=1}^{N_p} y_{p,1,i} && \text{Tax on earnings of compulsory savings}
 \end{aligned}$$



# Schematic summary of the model



# Model endogenous/exogenous variables

---

## Endogenous:

- Consumption (Utility)  $c_1, c_2, c_H, (U)$
- Savings (financial & housing)  $s_f (=s_1), s_H$
- PV of lifetime Wealth  $W$
- The compulsory SAYG pension  $P'$
- Government non-PAYG spending  $G$
- Mortgage borrowing  $b$
- The value (price) of housing  $V_H (p_H)$
- $U$  parameters  $\alpha', \beta', \gamma'$

## Exogenous/policy variables:

- Income  $y_1, y_2$
- Rates of return on saving & LVR  $r, \pi, \xi$
- Nos. of workers, pensioners  $N_w, N_p$
- Tax rates (SAYG contribution rate)  $\tau, \tau', \nu (\delta)$
- PAYG pension (=NZS)  $P$
- $U$  parameters  $\alpha = 1, \beta = 1/(1 + \rho), \gamma, \rho$

# Solutions for optimal consumption

---

No subsidized compulsory SAYG pension:

Consumption

$$c_1 = \frac{\alpha'W}{1+v}$$

$$c_2 = \frac{\beta'W \{1+r(1-\tau)\}}{1+v}$$

$$c_H = \gamma' (1+\pi) W$$

Net wealth,  $W$

$$\begin{aligned} W &= y_1 (1-\tau) + \frac{P + y_2 (1-\tau)}{1+r(1-\tau)} \\ &= c_1 (1+v) + \frac{c_2 (1+v)}{1+r(1-\tau)} + \frac{c_H}{1+\pi} \end{aligned}$$

Minor changes to  $W$  with subsidised compulsory SAYG pension ( $P'$ ) ...

$$P' = \delta y_1 \{1+r(1-\tau')\}$$

$$W^* = y_1 (1-\tau^*) + \frac{P + y_2 (1-\tau)}{1+r(1-\tau)}$$

$\delta$  = contribution rate

$$\tau^* = \tau - \frac{\delta r (\tau - \tau')}{1+r(1-\tau)}$$



# Implied optimal savings

---

Savings for housing

$$s_H = \gamma' \left( y_1 (1 - \tau) + \frac{P + y_2 (1 - \tau)}{1 + r (1 - \tau)} \right) \quad \text{or } s_H = \gamma' W$$

Financial savings,  $s_f (= s_1)$

$$s_1 = y_1 (1 - \tau) - (\alpha' + \gamma') \left( y_1 (1 - \tau) + \frac{P + y_2 (1 - \tau)}{1 + r (1 - \tau)} \right)$$
$$\text{or } s_1 = y_1 (1 - \tau) - c_1 (1 + \nu) - s_H$$

⇒ Research questions:

- Response of saving, retirement housing expenditures and welfare to policy settings, ageing etc?
- Trade-offs between (tax-funded) public pension and (contribution-funded) compulsory private pension?

# Policy simulations

---

- **Group A: Tax and expenditure policies**

- A.1 Tax on labour income (increase)
- A.2 Tax on consumption (GST) (increase)
- A.3 Public universal pension (NZS) (decrease)

= +5% change in public non-pension expenditure, G

- **Group B: Other policy changes**

- B.1 Loan : value ratio (borrowing constraint)
- B.2 Contribution rate to a compulsory pension
- B.3 Tax rate on compulsory pension earnings
- B.4 Interest rate
- B.5 Removal of tax on interest income

10% reduction

10% increase

*Removal*

‘residual’ GBC variable

---

- **Group C: Economy-wide and demographic changes**

- C.1 Market income in period 1
- C.2 Ratio of workers : pensioners
- C.3 Preference for housing,  $\gamma$

10% reduction (ageing)

# Model Calibration: benchmark values

Table 1: Benchmark Values

| Representative Individual                | Symbol                 | Benchmark     |
|--|------------------------|---------------|
| <i>Taste parameters</i>                  |                        |               |
| Exponent on consumption in first period  | $\alpha$ ( $\alpha'$ ) | 1.0 (0.612)   |
| Exponent on consumption in second period | $\beta$ ( $\beta'$ )   | 0.385 (0.235) |
| Exponent on housing consumption          | $\gamma$ ( $\gamma'$ ) | 0.25 (0.153)  |
| <i>Incomes</i>                           |                        |               |
| Income in first period of life cycle     | $y_1$                  | 1000          |
| Income in second period of life cycle    | $y_2$                  | 50            |
| <b>Economy characteristics</b>           |                        |               |
| Real rate of interest                    | $r$                    | 1.1           |
| Real growth rate of incomes              | $g$                    | 0.8           |
| Rate of appreciation of housing          | $\pi$                  | 1.4           |
| Elasticity of supply of housing          | $\varepsilon_s$        | 0.5           |
| Ratio of number of workers to pensioners | $N_w/N_p$              | 2.5           |
| <b>Government policy</b>                 |                        |               |
| <i>Tax policy</i>                        |                        |               |
| Income tax rate                          | $\tau$                 | 0.25          |
| Tax rate applied to SAYG income          | $\tau'$                | 0.20          |
| GST rate                                 | $v$                    | 0.15          |
| <i>Expenditure policy</i>                |                        |               |
| PAYG pension                             | $P$                    | 255           |
| Rate of adjustment to PAYG pension       | $g'$                   | 0.8           |
| <i>Other policies</i>                    |                        |               |
| SAYG Contribution rate                   | $\delta$               | 0.035         |
| Mortgage loan to value ratio             | $\xi$                  | 0.5           |

Period 1  $\approx$  30 years ;

Period 2  $\approx$  15 years

$r$  (annual)  $\approx$  2.5%

$\pi$  (annual)  $\approx$  3.0%

LVR = period 1 average

# Simulation results

Benchmark (% of  $y_1$ ):  
 $S_f = 8.8$  ;  $S_H = 6.9$  ;  $S = 15.7$  ;  $V_H = 13.9$

Table 3: Summary of Policy Effects

| Policy Change  | Percentage point change in: |                |                   | Percentage change in: |                  |
|--|-----------------------------|----------------|-------------------|-----------------------|------------------|
|  | Financial saving            | Housing saving | Total saving rate | Stock of Housing      | Price of Housing |
| <i>A. Tax and Expenditure Policies: producing an increase in <math>G</math> of 5%</i>    |                             |                |                   |                       |                  |
| Tax on labour income ( <i>increase</i> <sup>+</sup> )                                    | -0.57                       | -0.11          | -0.68             | -0.54                 | -1.07            |
| Tax on consumption ( <i>increase</i> <sup>⚡</sup> )                                      | 0                           | 0              | 0                 | 0                     | 0                |
| Public PAYG pension ( <i>decrease</i> <sup>*</sup> )                                     | 2.95                        | -0.33          | 2.62              | -1.62                 | -3.13            |
| <i>B. Other Policy Changes: 10% increases, except for removal of interest income tax</i> |                             |                |                   |                       |                  |
| Loan: value ratio ( <i>decrease</i> )  | -0.70                       | 0.70           | 0                 | 0                     | 0                |
| Contrib rate to private pension  | -0.36                       | 0.00           | -0.36             | 0.00                  | 0.01             |
| Tax on private pension earnings  | 0.03                        | 0.00           | 0.03              | -0.02                 | -0.03            |
| Interest rate  | 0.47                        | -0.05          | 0.42              | -0.25                 | -0.50            |
| Remove interest income tax   | 1.52                        | -0.17          | 1.35              | 0                     | -2.42            |
| <i>C. Economy-wide and demographic changes</i>   |                             |                |                   |                       |                  |
| Period 1 income: 10% increase  | 1.00                        | -0.11          | 0.89              | 2.60                  | 5.49             |
| Ratio $N_W/N_P$ : 10% reduction  | 0                           | 0              | 0                 | 0                     | 0                |
| Housing pref: 10% increase in $\gamma$   | 0.26                        | 0.58           | 0.84              | 2.63                  | 5.56             |

<sup>+</sup> = 1.6%pt increase in  $\tau$  ; <sup>⚡</sup> = 3.2%pt increase in  $v$  ; <sup>\*</sup> = 31% decrease in NZS

# Comparing policy impacts

Can compare policy effects on saving, utility etc. by considering effects of:

- \$1 increase in PAYG or SAYG
- and
- Unchanged non-PAYG spending, G (revenue-neutral)

Benchmark (% of  $y_1$ ):

$$S_f = 8.8 ; S_H = 6.9 ; S = 15.7 ; \\ V_H = 13.9$$

2.5 to 2.25

*\$ effect assoc. with \$1 increase in PAYG or SAYG and revenue-neutrality*

|   | PAYG | SAYG  | Financial Saving | Housing saving | Total saving | Utility       | Change in G |
|---|------|-------|------------------|----------------|--------------|---------------|-------------|
| Benchmark   | 255  | 65.80 | 87.79            | 69.69          | 157.48       | 19.52         |             |
| Policy change                                     |      |       |                  |                |              |               |             |
| <b>PAYG (\$1 increase)</b>                        |      |       | <b>-0.38</b>     | <b>0.04</b>    | <b>-0.34</b> | <b>0.019</b>  |             |
| <u>Funded by</u>                                  |      |       |                  |                |              |               |             |
| Tax on labour income (increase)                   |      |       | -0.07            | -0.01          | -0.09        | -0.007        |             |
| Net effect:                                       |      |       | <b>-0.45</b>     | <b>0.03</b>    | <b>-0.42</b> | <b>0.011</b>  | 0           |
| Tax on consumption (increase)                     |      |       | 0.00             | 0.00           | 0.00         | -0.009        |             |
| Net effect:                                       |      |       | <b>-0.38</b>     | <b>0.04</b>    | <b>-0.34</b> | <b>0.009</b>  | 0           |
| <b>SAYG contrib. rate (increase)</b>              |      |       | <b>-0.54</b>     | <b>0.00</b>    | <b>-0.54</b> | <b>0.001</b>  |             |
| <b>SAYG fund tax rate (t') decrease</b>           |      |       | -0.38            | 0.04           | -0.34        | 0.019         |             |
| <u>Funded by</u>                                  |      |       |                  |                |              |               |             |
| Tax on labour income (increase)                   |      |       | -0.07            | -0.01          | -0.08        | -0.007        |             |
| Net effect:                                       |      |       | <b>-0.44</b>     | <b>0.03</b>    | <b>-0.42</b> | <b>0.012</b>  | 0           |
| <b>Tax on interest income (SAYG increase \$1)</b> |      |       | 1.97             | -0.22          | 1.71         | 0.039         | -0.84       |
| <u>Funded by</u>                                  |      |       |                  |                |              |               |             |
| Tax on labour income (increase)                   |      |       | -0.24            | -0.05          | -0.29        | -0.01         | 0.84        |
| Net effect:                                       |      |       | <b>1.73</b>      | <b>-0.27</b>   | <b>1.42</b>  | <b>0.03</b>   | 0           |
| <b>Population ageing</b>                          |      |       |                  |                |              |               |             |
| <b>Nw/Np (decrease » 8 yrs of ageing)</b>         |      |       | 0.00             | 0.00           | 0.00         | 0.00          | -14.57      |
| <u>Funded by</u>                                  |      |       |                  |                |              |               |             |
| Tax on labour income (increase)                   |      |       | -4.21            | -0.83          | -5.04        | -0.430        | 14.57       |
| Net effect:                                       |      |       | <b>-4.21</b>     | <b>-0.83</b>   | <b>-5.04</b> | <b>-0.430</b> | 0           |
| Tax on consumption (increase)                     |      |       | 0.00             | 0.00           | 0.00         | -0.54         | 14.57       |
| Net effect:                                       |      |       | <b>0.00</b>      | <b>0.00</b>    | <b>0.00</b>  | <b>-0.54</b>  | 0           |



# Simulation results: endogenous labour income

Percentage Changes in Endogenous Variables following Rev-neutral Changes in Tax and Expenditure Policies

| Exogenous Y1                                   |       | Benchmark | Change in policy           | Total  | Financial | Housing | Value of | Mortgage  | Cons     | Cons     | Cons    | SAYG    | Total  | Total   | Other |
|--|-------|-----------|----------------------------|--------|-----------|---------|----------|-----------|----------|----------|---------|---------|--------|---------|-------|
| Policy Change                                  | value | variable  | (for constant $\Delta G$ ) | saving | saving    | saving  | housing  | borrowing | Period 1 | Period 2 | housing | pension | wealth | utility | Exp   |
|  |       |           |                            | s      | s_1       | s_H     | V_H      | b         | c1       | c2       | cH      | P'      | W      | U       | G     |
| <b>A. Tax and Expenditure Policies</b>         |       |           |                            |        |           |         |          |           |          |          |         |         |        |         |       |
| Tax on labour income                           | tau   | 0.25      | 0.016                      | -4.3%  | -6.4%     | -1.6%   | -1.6%    | -1.6%     | -1.6%    | -2.5%    | -1.6%   | -0.9%   | -1.6%  | -3.0%   | 5.0%  |
| Tax on consumption (GST)                       | v     | 0.15      | 0.032                      | 0%     | 0%        | 0%      | 0%       | 0%        | -3%      | -3%      | 0%      | 0%      | 0%     | -3.7%   | 5.0%  |
| Public universal pension (NZS) P               | 255   | -78.19    |                            | 16.6%  | 33.6%     | -4.7%   | -4.7%    | -4.7%     | -4.7%    | -4.7%    | -4.7%   | 0.0%    | -4.7%  | -7.6%   | 5.0%  |
| <b>Endogenous Y1 (to tax &amp; NZS change)</b> |       |           |                            |        |           |         |          |           |          |          |         |         |        |         |       |
| Tax on labour income                           | tau   | 0.25      | 0.02                       | -5.9%  | -8.8%     | -2.4%   | -2.4%    | -2.4%     | -2.4%    | -3.4%    | -2.4%   | -1.7%   | -2.4%  | -4.2%   | 5.0%  |
| Tax on consumption (GST)                       | v     | 0.15      | 0.03                       | -1.7%  | -2.4%     | -0.9%   | -0.9%    | -0.9%     | -3.6%    | -3.6%    | -0.9%   | -1.1%   | -0.9%  | -5.1%   | 5.0%  |
| Public universal pension (NZS) P               | 255   | -69.30    |                            | 15.9%  | 31.3%     | -3.6%   | -3.6%    | -3.6%     | -3.6%    | -3.6%    | -3.6%   | 0.7%    | -3.6%  | -5.8%   | 5.0%  |

### Assumed responses:

Tax on labour income: elasticity  $y_1$  w.r.t.  $\tau = -0.1$   
 Tax on consumption: elasticity  $y_1$  w.r.t.  $v = -0.05$   
 Increase in NZS (=PAYG):  $dy_1/d(\text{PAYG}) = -0.1$

# Key messages

---

## The Model:

- Captures interrelated decisions about housing, saving, retirement and consumption
- Provide a framework to keep track of all the interactions:
- Treating housing as a ‘retirement good’, & integrating saving, borrowing and pensions is relatively novel
- Govt. budget ensures suitable funding options considered simultaneously
- Simulations provide some quantitative estimates of the possible long-run responses to policy changes

# Key messages

---

- Changes in pensions (PAYG or SAYG) with associated funding options have substantial savings response ( $\approx$  40-50 cents per \$1 of pension) ... *but* small responses as fractions of income
- Changing interest income taxation (to fund change in pensions) has largest, *positive* impact on saving
- Housing savings,  $s_H$ , responses more modest; usually in opposite direction to  $s_f$  (If retirement housing and pensions are largely separate savings 'pots', then expect little substitution between  $s_H$  and  $s_f$  when PAYG or SAYG change)
- Projected ageing has substantial *negative* savings impact, with tax-funding of pensions (not with GST).
- How to endogenise income responses to policy changes in this framework?



# Thank you



Chair in Public Finance  
Victoria Business School

For more information on the Chair in Public Finance see:

<http://www.victoria.ac.nz/cpf>