



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

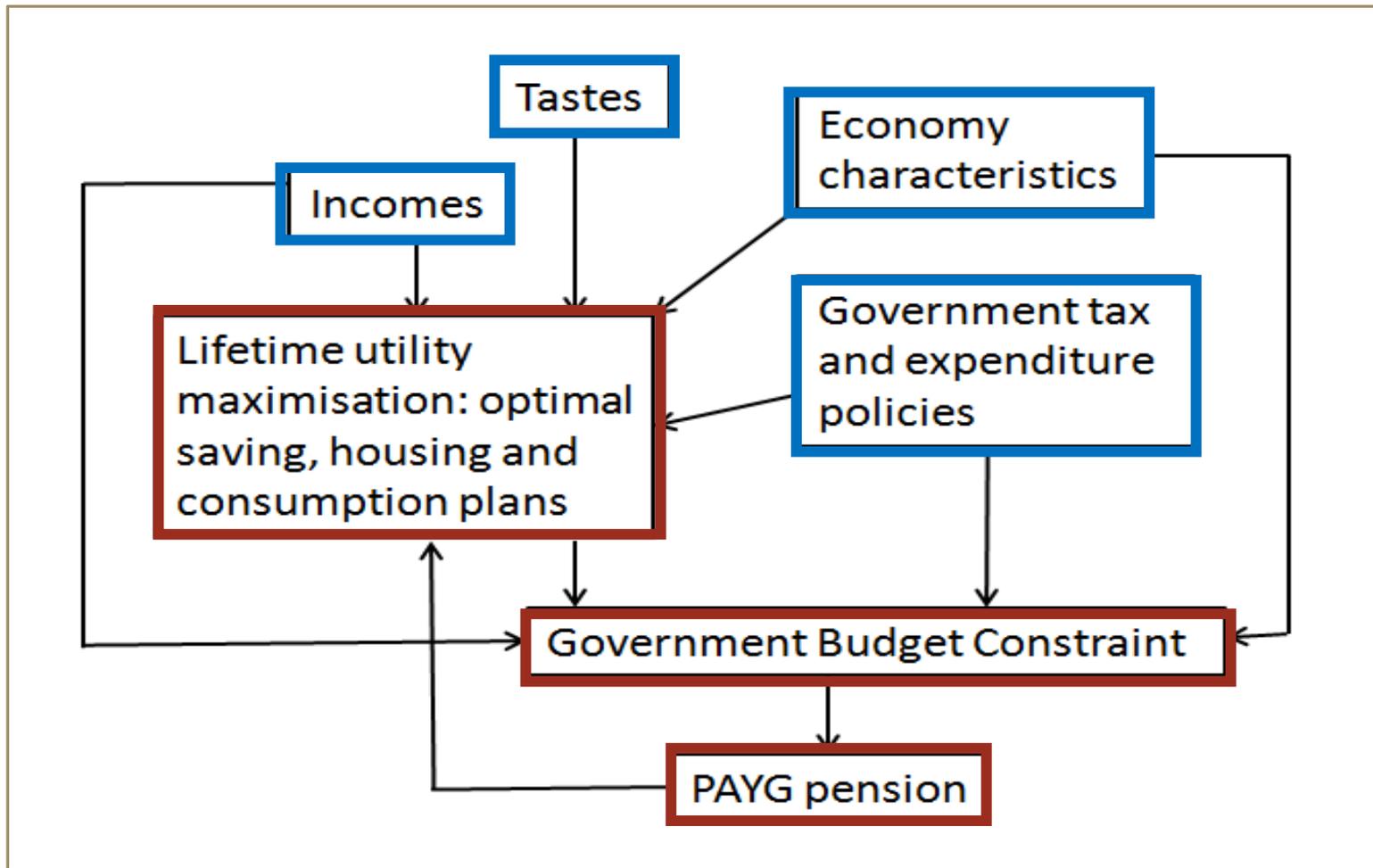
# The core of the model

---

- 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

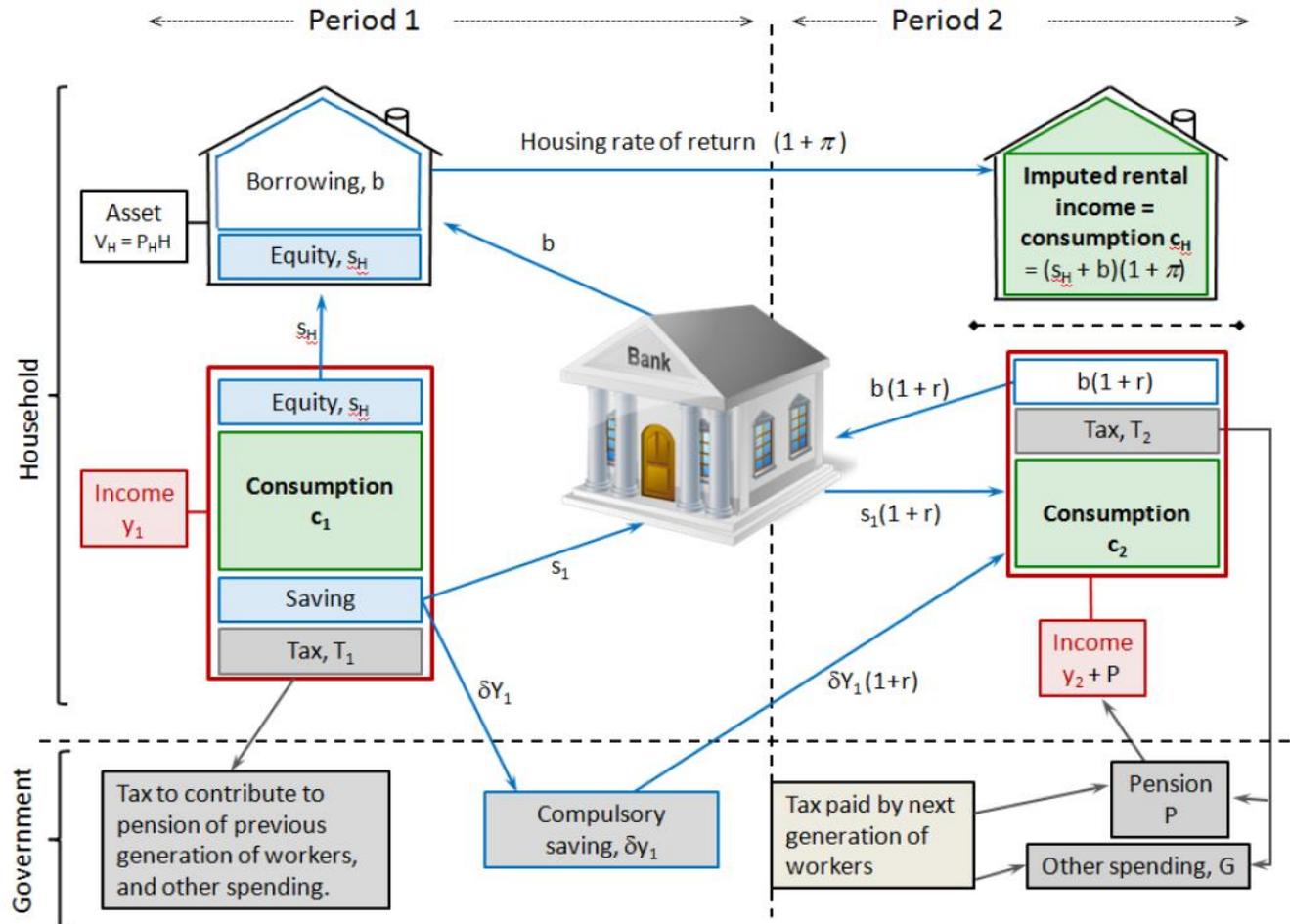
- Taxes:
  - Income tax (on all income) at rate,  $\tau$
  - GST at rate,  $v$
  - Compulsory SAYG contribution (tax) rate  $\delta$ ; return taxed at (reduced) rate  $\tau'$
  - No tax on return to housing,  $\pi$  (capital gain?)
- Government spending:
  - Pensions, P (NZ Superannuation): non-means-tested
  - 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:

<u>Consumption</u>	<u>Net wealth, <math>W</math></u>
$c_1 = \frac{\alpha'W}{1+v}$	$W = y_1 (1 - \tau) + \frac{P + y_2 (1 - \tau)}{1 + r (1 - \tau)}$ $= c_1 (1 + v) + \frac{c_2 (1 + v)}{1 + r (1 - \tau)} + \frac{c_H}{1 + \pi}$
$c_2 = \frac{\beta'W \{1 + r (1 - \tau)\}}{1 + v}$	
$c_H = \gamma' (1 + \pi) W$	

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

$P' = \delta y_1 \{1 + r (1 - \tau')\}$	$\delta = \text{contribution rate}$ $\tau^* = \tau - \frac{\delta r (\tau - \tau')}{1 + r (1 - \tau)}$
$W^* = y_1 (1 - \tau^*) + \frac{P + y_2 (1 - \tau)}{1 + r (1 - \tau)}$	

# 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	saving	saving	saving	housing	borrowing	Period 1	Period 2	housing	pension	wealth	utility	Exp
			(for constant $\Delta G$ )	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	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	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>