

Superannuation within a financial CGE (FCGE) model of the Australian economy

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A traditional CGE model

Disaggregated: many agents, regions, commodities.

Optimising behaviour governs decision making.

Agents linked by commodity flows, factor constraints, prices.

Economic outcomes determined by interactions in commodity and factor markets.

Concerned with the effects on:

industries, regions, occupations, households, environment.

of changes in:

taxes, subsidies, tariffs, preferences, technologies, foreign prices, regulations, micro-reforms, wage-setting arrangements

But no explicit recognition of financial agents or instruments.

Integrating financial agents & instruments within the CGE model

Agents (s,d):

1. Government
2. Households
3. Industries
4. Foreigners
5. Commercial banks
6. Central bank
7. Non-bank financial intermediaries
8. Superannuation funds
9. Life insurance funds
10. Reproducible housing
11. Non-reproducible housing

Financial instruments (f)

1. Bonds
2. Cash
3. Deposits and loans
4. Equity
5. Gold & special drawing rights

A (s,f,d)

Value of financial instrument (f), issued as a liability by agent (s), and held as an asset by agent (d)

Financial assets & liabilities by agent (Australia 2010, \$b.) (ABS 5232.0)

$$\Sigma_f A(s,f,d)$$

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
Government	86	19	188	0	282	24	28	24	12	0	0
Households	0	0	0	0	0	0	0	0	0	0	0
Industries	522	0	739	82	438	0	186	223	18	0	0
NBFI	217	5	153	40	120	75	0	190	158	0	0
Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Financial assets & liabilities by agent (Australia 2010, \$b.) (ABS 5232.0)

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Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH
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Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Instrument:	\$b.	%
Bonds	0	0.0%
Cash	0	0.0%
Deposits	4	0.3%
Equity	1,166	99.7%
Total	1,170	100%

Financial assets & liabilities by agent (Australia 2010, \$b.) (ABS 5232.0)

$$\Sigma_f A(s,f,d)$$

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH
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NBFI	217	5	153	40	120	75	0	190	158	0	0
Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
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Financial assets & liabilities by agent (Australia 2010, \$b.)

$$\sum_f A(s,f,d)$$

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
Government	86	19	188	0	282	24	28	24	12	0	0
Households	0	0	0	0	0	0	0	0	0	0	0
Industries	522	0	739	82	438	0	186	223	18	0	0
NBFI	217	5	153	40	120	75	0	190	158	0	0
Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Instrument:	\$b.	%
Bonds	27	9.5%
Cash	0	0.0%
Deposits & loans	186	64.6%
Equity	74	25.8%
Total	288	100%

Instrument:	\$b.	%
Bonds	45	21.8%
Cash	1	0.3%
Deposits & loans	3	1.3%
Equity	157	76.6%
Total	205	100%

Instrument:	\$b.	%
Bonds	5	2.2%
Cash	0	0.0%
Deposits & loans	0	0.2%
Equity	217	97.6%
Total	223	100%

Optimising behaviour: asset agents

$$\Sigma_f A(s,f,d)$$

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
Government	86	19	188	0	282	24	28	24	12	0	0
Households	0	0	0	0	0	0	0	0	0	0	0
Industries	522	0	739	82	438	0	186	223	18	0	0
NBFI	217	5	153	40	120	75	0	190	158	0	0
Super	0	0	1	1	1170	0	1	0	0	0	0
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NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Asset agent d (e.g. households) makes choices across asset instrument f issued by liability agent s to maximise benefits subject to availability of funds

Optimising behaviour: liability agents

$$\Sigma_f A(s,f,d)$$

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
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Households	0	0	0	0	0	0	0	0	0	0	0
Industries	522	0	739	82	438	0	186	223	18	0	0
NBFI	217	5	153	40	120	75	0	190	158	0	0
Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Liability agent s (e.g. industries) makes choices across financing instrument f issued to asset agent d to minimise costs subject to satisfying funding requirements

Equilibration via rates of return, equity valuations & exchange rate

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
Government	86	19	188	0	282	24	28	24	12	0	0
Households	0	0	0	0	0	0	0	0	0	0	0
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Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

- Every cell carries a rate of return: $R(s,f,d)$ (expressed as a power: $1 + ror$)
- These are jointly determined to reconcile the behaviour of asset agents and liability agents.
- Policy rates exogenous: Cash, Central Bank deposits/loans.

Linking the financial sector & the real economy: asset acquisition

Zero
pure
profit
condition

Indexed to
public
consumption

Zero
Linked to pure
nominal profit
GDP condition

Zero
pure
profit
condition

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	0	0
Central Bank	10	0	0	29	21	21	1	0	0	0	0
Foreigners	272	44	0	61	91	383	102	205	12	0	0
Government	86	19	188	0	282	24	28	24	12	0	0
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Super	0	0	1	1	1170	0	1	0	0	0	0
Life insurance	2	0	9	0	63	0	3	161	0	0	0
NRH	633	0	19	21	1265	2	152	7	0	0	0
RH	518	0	62	17	316	2	124	6	0	0	0

Exog

CAD + Aust
acquisition of
foreign assets

Linked to
household
savings

Linked to
liability
accumulation

Exog

Exog

Linking the financial sector & the real economy: liability acquisition

Asset agent (d) \ Liability agent (s)		Asset agent (d)											
		Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life	NRH		RH
Asset acq.	Banks	0	13	793	111	680	352	166	288	29	0	0	
Row sum	Central Bank	10	0	0	29	21	21	1	0	0	0	0	Walras' law
	Foreigners	272	44	0	61	91	383	102	205	12	0	0	
Exog.	Government	86	19	188	0	282	24	28	24	12	0	0	PSBR
	Households	0	0	0	0	0	0	0	0	0	0	0	
Asset acq.	Industries	522	0	739	82	438	0	186	223	18	0	0	Investment
	NBFI	217	5	153	40	120	75	0	190	158	0	0	
Asset acq.	Super	0	0	1	1	1170	0	1	0	0	0	0	Wage bill
Asset acq.	Life insurance	2	0	9	0	63	0	3	161	0	0	0	
	NRH	633	0	19	21	1265	2	152	7	0	0	0	Exog.
Investment	RH	518	0	62	17	316	2	124	6	0	0	0	

Behaviour of domestic asset agents

Domestic optimising asset agents:

In year t , domestic optimising agent d :

Chooses $AT1_{s,f,d}$ for all s,f ,

To max $U[AT1_{s,f,d} \times R_{s,f,d}, \text{ for all } s, f]$

Subject to: $\sum_{s,f} AT1_{s,f,d} = \sum_{s,f} [AT_{s,f,d} \times V_{s,f,d} + FLOW_{s,f,d}]$

Agent d 's total end-of-year financial assets

End of year asset values weighted by ROR

Valuation effects

New flows

Behaviour of domestic asset agents

Domestic optimising asset agents:

Solution to above problem, in % change form is:

Average rate of return received by agent (d)

$$at1_{s,f,d} = portfolio_d + \phi \left[r_{s,f,d} - r_d^{(Ave)} \right]$$

End-of-year holdings

$$r_d^{(Ave)} = \sum_s \sum_f \left(\frac{AT1_{s,f,d}}{\sum_k \sum_j AT1_{k,j,d}} \right) r_{s,f,d}$$

Share of instrument (f) issued by liability agent (s) in asset agent (d)'s total portfolio

Behaviour of foreign asset agents

Foreign asset agents:

Optimisation problem:

Choose $AT1_{s,f,Fgn}$ for all s, f , & assets in all other countries

To max $U[E1 \times AT1_{s,f,Fgn} \times R_{s,f,Fgn}$,
for all s, f & assets in all other countries]

Subject to:

$S_{Fgn} =$
 $\sum_{s,f} E1 \times FLOW_{s,f,Fgn}$ + *new assets in other countries*

$\sum_{s,f} AT1_{s,f,Fgn} =$
 $\sum_{s,f} [AT_{s,f,Fgn} \times V_{s,f,Fgn} + FLOW_{s,f,Fgn}]$

Behaviour of foreign asset agents

Solution to above problem, in % change form is:

$$e1 + at1_{s,f,Foreign} = portfolio_{Foreign}^{(FC)} + \phi \left[r_{s,f,Foreign} - r_{Foreign}^{(Ave)} \right]$$

When combined with relevant definitional equations & CAD condition, we have the exchange rate determined.

Behaviour of foreign asset agents

$$(1) \quad e1 + at1_{s,f,Foreign} = \text{portfolio}_{Foreign}^{(FC)} + \phi \left[r_{s,f,Foreign} - r_{Foreign}^{(Ave)} \right]$$

$$(2) \quad \sum_s \sum_f 100 \cdot \Delta flow_{s,f,Foreign} = AT1_{s,f,foreign} \cdot at1_{s,f,foreign} - [VAL_{s,f,d} \cdot AT_{s,f,d}] \cdot (val_{s,f,d} + at_{s,f,d})$$

$$(3) \quad \Delta assets_{Foreign}^{(New)} = \sum_s \sum_f \Delta flow_{s,f,Foreign}$$

$$(4) \quad \Delta assets_{Foreign}^{(New)} - \sum_f \sum_d \Delta flow_{Foreign,f,d} = \Delta CAD$$

Budgets available for net acquisition of assets, e.g.

Households:

$$S_{Hhld} = Disp\ Income - Con + \sum_{f,d} FLOW_{Hhld,f,d}$$

Foreigners:

$$S_{Fgn} = CAD + \sum_{f,d} FLOW_{Fgn,f,d}$$

Superannuation:

$$S_{Super} = L_{Super} = \alpha \times WAGEBILL$$

Behaviour of liability agent s

Liability accumulation:

$$(1) \quad AT1_{s,f,d} = AT_{s,f,d} \times V_{s,f,d} + FLOW_{s,f,d} \quad \text{for all } s, f, d$$

Optimisation problem:

Choose: $AT1_{s,f,d}$ for all f and d

to min: $Z = CET[AT1_{s,f,d} \times R_{s,f,d}, \text{over } f \text{ \& } d]$

s.t. (1) and $\sum_{f,d} FLOW_{s,f,d} = L_s$

E.g. Investment, PSBR

Behaviour of liability agent s

Solution to above problem, in % change form is:

$$at1_{s,f,d} = liability_{s,f,d} - \tau \left[r_{s,f,d} - wacc_s \right]$$

$$wacc_s = \sum_f \sum_d \left(\frac{AT1_{s,f,d}}{\sum_j \sum_t AT1_{s,j,t}} \right) r_{s,f,d}$$

How to determine $R(\text{Inds}, \text{Equity}, d)$

$$(1) R_{\text{Inds}, \text{Equity}}^{(\text{Act})} - 1 = \frac{P_K \cdot K + (P_I / 100) \cdot K - \sum_{f \neq \text{Equity}} \sum_d \text{ATO}_{\text{Inds}, f, d} \cdot V_{\text{Inds}, f, d} \cdot (R_{\text{Inds}, f, d} - 1)}{\sum_d \text{ATO}_{\text{Inds}, \text{Equity}, d} \cdot V_{\text{Inds}, \text{Equity}, d}}$$

ROR on equity = [capital rental + capital appreciation – non equity claims on capital rental] / value of equity

$$(2) P_I \cdot K + \sum_s \sum_f \text{ATO}_{s, f, \text{Inds}} \cdot V_{s, f, \text{Inds}} = \sum_f \sum_d \text{ATO}_{\text{Inds}, f, d} \cdot V_{\text{Inds}, f, d}$$

Value of physical assets + financial assets = value of liabilities

Linking WACC & capital formation

$$(1) \quad EROR_i = F(KGR) \cdot ROR$$

↑
Expected rate
of return

↙
Negative
function of KGR

←
Previous year's
rate of return

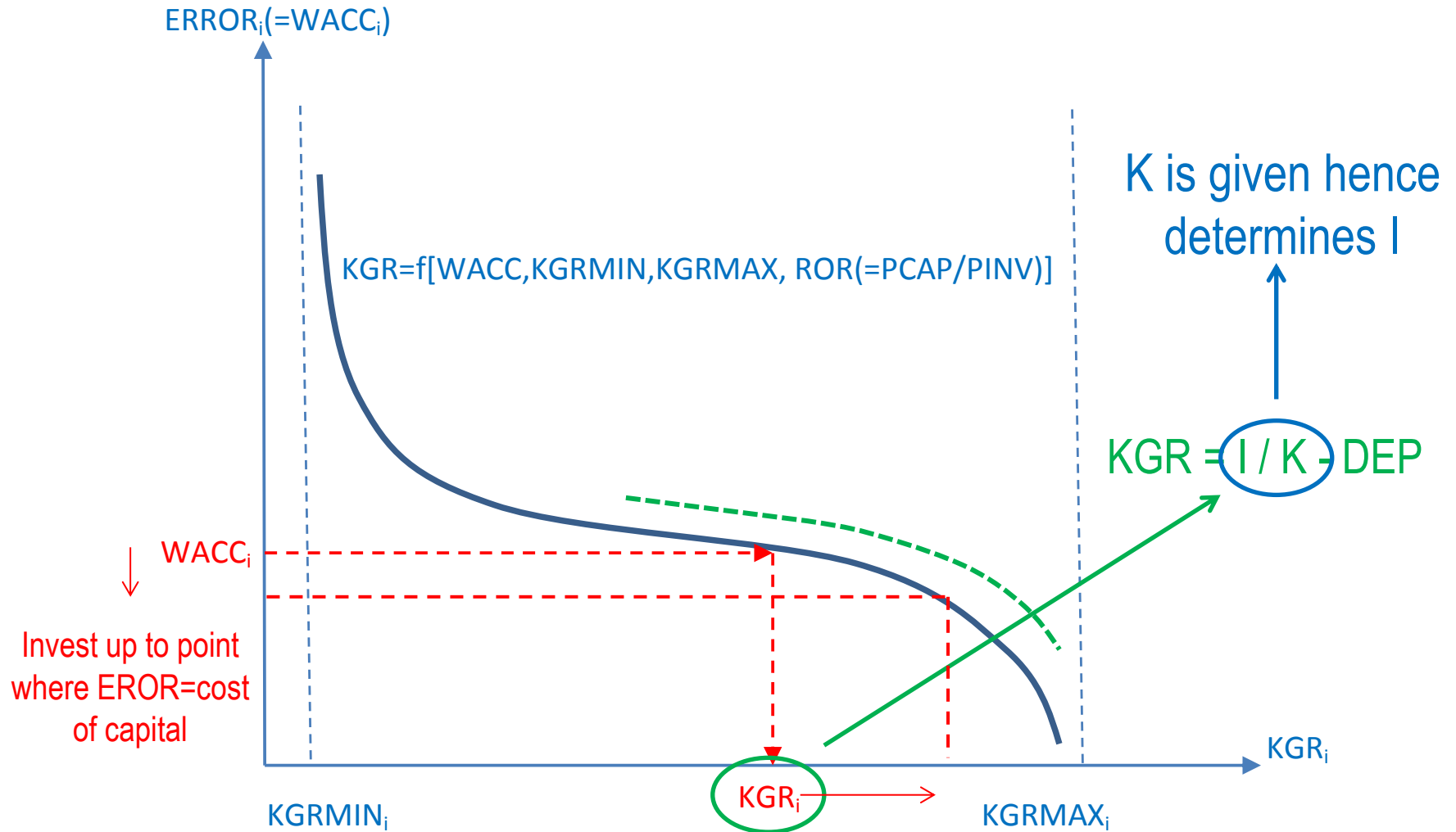
↙
Previous year's
capital growth rate

$$(2) \quad F(KGR) = 1 \text{ if } KGR = KGR_Base$$

$$(3) \quad EROR = WACC$$

↗
Weighted average
cost of capital

Linking WACC & capital formation



Simulation: a rise in the super rate

Short-run closure:

- Closure of financial intermediation as described above.
- Labour market: nominal wage is sticky, employment adjusts. Wage as a cost to firms does not rise (an announced policy).
- Physical capital market: capital stocks are given, rates of return adjust.
- Nominal private consumption linked to nominal disposable income via exogenous savings rate.
- Real public consumption spending is exogenous.
- Public borrowing requirement exog via endo direct tax.
- Gross fixed capital formation endogenous.

Shock is a 1%-point increase in the ratio of superannuation contributions to the nominal wage bill.

We investigate financial, macro-economic and industrial effects.

Change in financial flows (\$m.)

Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	Life insurance	NRH	RH	Total
Banks	0	8	2,450	65	847	384	774	1,911	146	0	0	6,584
Central Bank	26	0	1	-20	-3	-6	1	0	0	0	0	0
Foreigners	910	15	0	-59	-11	-108	608	1,909	98	0	0	3,363
Government	59	-23	202	0	-394	-31	76	79	50	0	0	18
Households	0	0	0	0	0	0	0	0	0	0	0	0
Industries	1,698	0	19	-27	-2,201	0	549	1,434	62	0	0	1,534
NBFI	596	0	460	27	118	66	0	1,247	813	0	0	3,327
Super	0	0	10	1	7,704	2	7	0	0	0	0	7,725
Life insurance	4	0	29	0	64	0	12	1,062	0	0	0	1,171
NRH	1,798	0	61	19	-2,645	3	718	45	1	0	0	0
RH	1,493	0	0	12	-1,851	2	582	38	0	0	0	277
Total	6,584	0	3,232	18	1,629	312	3,327	7,725	1,171	0	0	

Expressed as increase in equity interest issued to households

1% of national wage bill is \$7.4 b.

Change in financial flows (\$m.)

Household is an asset optimiser

Asset agent (d) \ Liability agent (s)	Household is an asset optimiser										
	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super insurance	NRH	RH	Total
	% change in returns offered by:										
Banks	0	8	2,450	65	847	38	1. Banks	0.01	0	0	6,584
Central Bank	26	0	1	-20	-3	-2	2. Reserve Bank	0.00	0	0	0
Foreigners	910	15	0	-59	-11	-10	3. Foreigners	0.00	0	0	3,363
Government	59	-23	202	0	-394	-3	4. Government	-0.09	0	0	18
Households	0	0	0	0	0	5	5. Households	0.00	0	0	0
Industries	1,698	0	19	-27	-2,201	6	6. Industries	0.01	0	0	1,534
NBFI	596	0	460	27	118	7	7. Non-bank financial inst.	-0.03	0	0	3,327
Super	0	0	10	0	7,704	8	8. Superannuation	0.29	0	0	7,725
Life insurance	4	0	29	0	64	9	9. Life insurance	-0.07	0	0	1,171
NRH	1,798	0	61	0	-2,645	10	10. Non-reproducible housing	0.05	0	0	0
RH	1,493	0	0	12	-1,851	11	11. Reproducible housing	0.01	0	0	277
Total	6,584	0	3,232	18	1,629	312	3,327	7,725	1,171	0	0

Household savings rises because nominal GDP rises

Superannuation return rises relative to other returns. Requires subsidy.

Change in financial flows (\$m.)



Asset agent (d) \ Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	NRH	RH	Total
Banks	0	8	2,450	65	847	384	774	1,911	146	0	0	6,584
Central Bank	26	0	1	-20	-3	-6	1	0	0	0	0	0
Foreigners	910	15	0	-59	-11	-108	608	1,909	98	0	0	3,363
Government	59	-23	202	0	-394	-31	76	79	50	0	0	18
Households	0	0	0	0	0	0	0	0	0	0	0	0
Industries	1,698	0	19	-27	-2,201	0	549	1,434	62	0	0	1,534
NBFI	596	0	460	27	118	66	0	1,247	813	0	0	3,327
Super	0	0	10	1	7,704	2	7	0	0	0	0	7,725
Life insurance	4	0	29	0	64	0	12	1,062	0	0	0	1,171
NRH	1,798	0	61	19	-2,645	3	718	45	1	0	0	0
RH	1,493	0	0	12	-1,851	2	582	38	0	0	0	277
Total	6,584	0	3,232	18	1,629	312	3,327	7,725	1,171	0	0	

Increase in \$A value of holdings of domestic assets by foreigners requires nominal depreciation

+3,363 – 3,232 = \$130 m.
movement towards current account surplus (GE effect: first guess is \$ 0 m.)

Moving from financial flows to the real economy

- *Ceteris paribus*, the shift in savings to the superannuation sector represents an autonomous increase in domestic holdings of foreign assets of approximately \$A 1.9 b. . . . But . . .
- Δ foreign liabilities – Δ foreign assets = Δ CAD
- With Δ CAD = 0 as a first approximation, we require foreign liabilities to rise by \$A 1.9 b.
- *Ceteris paribus*, foreigners hold a fixed share of their portfolio, expressed in \$FC, in Australian assets.
- To induce them to hold \$A 1.9 b. more domestic assets, the nominal exchange rate ($\$FC / \A) must depreciate.

Short-run macro results

Table 1: Macroeconomic results

1. Nominal exchange rate (\$Foreign/\$A)	▼ -0.35
2. Import price deflator	▲ 0.35
3. GDP deflator	▲ 0.27
4. Nominal wage	— 0.00
5. Employment	▲ 0.25
6. Capital stock	— 0.00
7. Real GDP	▲ 0.15
8. Real investment	▲ 0.26
9. Real private consumption	▲ 0.15
10. Real public consumption	— 0.00
11. Import volumes	▲ 0.16
12. Export volumes	▲ 0.17
13. Real exchange rate appreciation	▼ -0.08
14. Terms of trade	▼ -0.04

Concluding comments – model developments

- **Next steps – model development:**
 - Move from comparative statics to dynamics.
 - Tie-down balance sheets of Banks, and NBFIs.
 - Embed explicit central bank policy rules.
 - Link real activities of financial intermediaries to financial intermediation activities.

Concluding comments – applications

Next steps – project applications:

- Theme 1. The VU-Super model and superannuation's impact on real national wealth.

- Theme 2. Superannuation and macroeconomic growth and stability.

- Theme 3. Superannuation and the allocative efficiency of capital supply.

Concluding comments - VU-S model & tracking real national wealth

- Tracking long-run real national wealth under alternative superannuation policy and economic development assumptions.
- Baseline: Forecast for the Australian economy with current policy mandated levels of superannuation contributions in place.
- Counterfactual: Forecast for the Australian economy without mandated superannuation contribution rates.

Concluding comments - Macro growth and stability

Explore how the super system affects macroeconomic stability. Eg:

- Stability & growth may be supported by compulsory minimum savings rate.
- Domestic bias in equity allocation may damp swings in capital supply to domestic industries.
- Costly intermediation may reduce capital formation.
- International diversification may reduce sensitivity of C to local conditions, while increasing sensitivity to foreign conditions.
- Baseline: 2 baselines, one with, one without, compulsory super.
- Counterfactual: unanticipated adverse shocks.
- Compare counterfactual against two baselines: reveals super's impact on stability & resilience.

Concluding comments - Allocative efficiency of capital supply

- VU-S models economic activity in just over 100 industries.
- Changes in superannuation policy will have implications for the cost of capital to these industries.
- VU-S can be used to examine the economic consequences of these cost of capital effects.
- Can be undertaken under alternative forecast assumptions regarding growth, technical change, foreign prices, taste changes, immigration policy, etc.

Concluding comments – future potential applications

- How will changes in compulsory contributions to superannuation affect the balance sheets of other financial institutions?
- How do the operations of the super sector interact with other matters of current policy interest related to financial stability such as: (i) prudential regulations such as changes in capital adequacy ratios imposed on banks; (ii) the monetary transmission mechanism and operational principles such as the Taylor rule; (iii) the connection between rules of thumb adopted by banks (such as loan-to-valuation ratios) and asset price bubbles.

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