National CGE Workshop 2015

Centre of Policy Studies

August 10, 2015
VU City Convention Centre
Victoria University, 300 Flinders St Melbourne

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

National CGE Workshop, 2015

Victoria University City Convention Centre
Level 12, 300 Flinders St, Melbourne
August 10, 2015

Presenters will speak for 20 minutes, with 10 minutes for questions.

8:30	Registration & coffee		
8:50	Welcome		
Session 1: CGE Applications in Asia (Chair: Janine Dixon)			
9:00	Rod Tyers	*UWA Business School*	Japan's oligopolies: modelling the potential gains from third arrow reforms
9:30	Tsue-Ing Yap	*Centre of Policy Studies, VU*	Policy Options in preparation for the post-hydrocarbon era of Brunei Darussalam
10:00	Deeptha Wijerathna	*Griffith University*	Place-Based versus Place-Neutral Policies for Promoting Regionally Balanced Economic Growth: A Sri Lankan Case using CGE based Simulation
10:30	Sang-Ho Nam	*Korea Institute for Health & Social Affairs*	Growth- and employment-oriented fiscal expenditures in South Korea
11:00	Morning Tea		
Session 2: Keynote lecture (Chair: James Giesecke)			
11:30	Professor Warwick McKibbin	*Crawford School of Public Policy, ANU*	Long-term Economic Growth Projections and Factor Shares
12:30	Lunch		
Session 3: CGE applications in Australia (Chair: Paul Gretton)			
1:30	Janine Dixon	*Centre of Policy Studies, VU*	Forecasting for labour markets with a CGE model
2:00	Peter Forsyth	*Monash University*	A review of the use of CGE models in airport evaluation
2:30	Lindsay Fairhead	*Productivity Commission*	Some aspects of labour market modelling using the VUMR model
3:00	Afternoon Tea		

Session 4: Innovations in CGE modelling (Chair: Rod Tyers)			
3:30	James Giesecke	*Centre of Policy Studies, VU*	Simulations with a financial CGE model of the Australian economy
4:00	Liangyue Cao	*Department of the Treasury*	Implementing a stylised inter-temporal dynamic CGE model in GEMPACK.
4:30	Glyn Wittwer	*Centre of Policy Studies, VU*	A decade and more of modelling regional Australia with TERM
5:00	*close*		
6:30	Informal dinner (at participants' own expense), **LUDLOW BAR & TERRACE** Building 3, 6 Riverside Quay Southbank Melbourne 03 9699 1676 http://www.ludlowbar.com.au/		

Call for Papers

Economic Papers, published by the Economics Society of Australia, provides a forum for the presentation of research and debate in applied economics and economic policy analysis. Contributions in the form of articles are sought from economists working in these areas. Articles are intended to be written in plain English and to be accessible and of interest to a broad range of economists working in business, government and in academic communities. We have published and are interested in papers applying CGE techniques to domestic or international policy issues. Papers should normally be 3,000 to 5,000 words. All contributions are refereed.

Abstracts

Japan's Oligopolies: Potential Gains from Third Arrow Reforms

Akihito ASANO
Department of Economics
Sophia University

Rod TYERS
Business School, University of Western Australia
and Research School of Economics, Australian National University

Progress has been made in economic reform under the "Abenomics" first (monetary policy) and second (taxation reform) "arrows". The third, which emphasises reforms to labour markets, company tax and competition, has been more politically difficult and slower to emerge. This paper explores the gains that are possible from the third arrow program. Economic rents and industry concentration levels are first identified from Nikkei firm specific data and used to construct an economy-wide model that represents oligopoly behaviour and its regulation explicitly. The analysis finds that modest gains in both efficiency and growth are available from increases in Japan's labour supply and reductions in company tax rates, while substantial gains are possible from active competition policy that embodies freer entry and, where necessary, pricing surveillance and price cap regulation. Central to the results is that a resurgent Japanese economy requires efficiency improvements that raise home rates of return and rebalance its large home and foreign asset portfolio toward home investment and capital growth.

Policy Options in preparation for the post-hydrocarbon era of Brunei Darussalam

Tsue Ing Yap, Philip Adams and Janine Dixon
Centre of Policy Studies, Victoria University

Brunei Darussalam, a highly hydrocarbon-dependent economy is facing the inevitable fate of depletion of her oil and gas resources. With limited success in her diversification efforts for the past decades, the future appears bleak if no urgent and effective policies are undertaken. This paper attempts to elucidate such a post-hydrocarbon scenario and a possible policy option to revive some economic growth through productivity growth, with the use of BRUGEM, a recursive dynamic computable general equilibrium (CGE) model.

Findings from the policy simulation indicate that in order to generate additional one per cent real GDP annual growth rate on top of the baseline forecast, the overall productivity has to improve by 2.4 per cent per annum. This will also lead to the improvement for real GDP per person by 0.99 per cent per annum.

This finding calls for urgent well-coordinated microeconomic reforms to take place to improve productivity from all levels. At the same time, the government must look into issues of increasing aggregate investment as the investment in hydrocarbon sector declines. The success of these reforms will much depend on the political will and unwavering commitment from the relevant parties in preparation for a smooth transition into the post-hydrocarbon era.

Place-Based versus Place-Neutral Policies for Promoting Regionally Balanced Economic Growth: A Sri Lankan Case using CGE based Simulation

Deeptha Wijerathna, Christine Smith, Athula Naranpanawa and Jayatilleke S. Bandara
Department of Accounting, Finance & Economics
Nathan Campus, Griffith University
Nathan, Queensland 4111
Australia

Reducing regional disparities while maintaining economic growth represent a major challenge for many developing countries like Sri Lanka. This study analyzes the advantages of place-based versus place-neutral polices for generating national and regional economic growth. Simulation experiments are carried out based on selected agricultural policies using a disaggregated Sri Lankan bottom-up regional Computable General Equilibrium (CGE) model developed by the author. Preliminary results suggest that place-neutral policies are better in terms of national growth; but place-based policies are better in terms of regional disparity reduction impacts. However these results may depend on the nature of the policies and the targeted industry.

Growth- and Employment-oriented Fiscal Expenditures in South Korea

Sang-Ho Nam, Research Fellow, KIHASA
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In the past several decades, fiscal policy played a key role for the evolution of the Korean economy. But, in the late 1990s, the unexpected financial crisis changed economic and social environment. Low economic growth is expected to continue and increasing desire for welfare expenditures becomes an important social issue. While experiencing unprecedented rapid aging and persistently low fertility rate, the future of the Korean economy is not that promising.

In this paper, the effect of fiscal expenditure on employment and welfare is investigated. In accordance with the change in social and economic environment, it is necessary to re-consider the role of fiscal policy. For this purpose, a version of ORANI-G computable general equilibrium (CGE) model is employed.

The four type government expenditures are analyzed: public administration and national defense, medical expenditure, educational expenditure, and social welfare expenditure. According to the results, social welfare expenditure has the largest impact in employment, public administration and national defense is the second, while medical expenditure has the smallest employment effect. This result is due to the nature of medical industry that it is more capital intensive than other industries considered.

Forecasting for labour markets with a CGE model

Janine Dixon and Tony Meagher
Centre of Policy Studies

Formal labour market forecasts produced using an economy-wide model embody modern economic theory and large amounts of relevant economic data, they are comprehensive and coherent, and they can be updated regularly at reasonable cost. Recent forecasts produced with the Vic-Uni model and additional labour market extensions take into account current and expected conditions in the Australian economy including developments in the mining and manufacturing sectors, the fall in the terms of trade and consequent depreciation of the real exchange rate, sluggish productivity growth, and increasing acquisition of tertiary qualifications. These circumstances do not bode well for workers in construction and certain manufacturing occupations. Opportunities may exist for these workers to transfer into other occupations, particularly in transport and logistics.

Economic Evaluation of Investments in Airports – Old and New Approaches

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The growth of air traffic demand has posed the question how can we best assess whether a country gains or loses from airport investments. This paper analyses different methods like Cost Benefit Analysis, Economic Impact Analysis and Computable General Equilibrium models to address the question. The paper argues that Cost Benefit Analysis, and Computable General Equilibrium address the policy issue well and that both methods are rigorous, although improvements are possible, especially in the newer aspects of evaluation. Economic Impact Analysis does not address the problem satisfactorily and it misleads policy, though it is used extensively. The emphasis here is on the use of CGE models, which have only recently been applied to airport evaluation. However, there have been some significant studies, notably that done recently for the Airport Commission in London. A CGE approach has the advantage that it can measure general equilibrium effects, such the benefits of inbound tourism, which other techniques cannot. The paper discusses a number of issues to be resolved when using CGE models to evaluate airports.

Superannuation within a financial CGE model of the Australian economy

Peter B. Dixon, James. A. Giesecke, Maureen T. Rimmer
Centre of Policy Studies, Victoria University

Australia's superannuation sector has become both a major institution in guiding the allocation of the nation's financial capital across asset classes, regions, and sectors, and a central intermediary in channelling the nation's annual savings into domestic capital formation and foreign financial asset accumulation. To put the industry's scale in context, in 2012 the sector had assets under management of approximately $1.4tn (Australia's GDP in the same year was approximately $1.5tn). Annual inflows to the system represent approximately one third of gross national savings. The sector's influence over the allocation of the nation's physical and financial assets is forecast to continue to grow. We model this important institution within an economy-wide setting by embedding explicit modelling of the sector within a model of the financial sector which is in turn linked to a dynamic multi-sectoral CGE model of the real side of the economy. We develop the financial CGE model by building on a multi-sectoral dynamic model of the real side of the Australian economy. In particular, we introduce explicit treatment of: (i) financial intermediaries and the agents with which they transact; (ii) financial instruments describing assets and liabilities; (iii) the financial flows related to these instruments; (iv) rates of return on individual assets and liabilities; and (v) links between the real and monetary sides of the economy. We explore the effects of the superannuation sector by simulating a one percentage point increase in the ratio of superannuation contributions to the economy-wide nominal wage bill.

Implementing a stylised inter-temporal dynamic CGE model in GEMPACK.

Liangyue Cao, Commonwealth Department of Treasury, Australia

A stylised inter-temporal CGE model will be described, where a representative firm chooses investment and production by maximising its lifetime market value subject to the capital stock accumulation constraint with adjustment cost of investment; and a representative household chooses its consumption and leisure by maximising the lifetime utility subject to its wealth constraint with income from supplying labour, return from holding firm's equity and foreign bonds. The model is then fully calibrated. After that, the model is implemented in GEMPACK using WINGEM. Finally, homogeneity tests are undertaken to ensure that the model displays the basic properties. Some hypothetic scenarios with temporary shocks are then simulated and the presentation will show some of the simulation results. It is found that the inter-temporal nature of the model provides very rich dynamic behaviour including transitional behaviour of economic variables such as GDP, capital stock, consumption, trade balance and leisure.

A decade and more of modelling regional Australia with TERM

Glyn Wittwer
Centre of Policy Studies, Victoria University

Mark Horridge devised the TERM approach to CGE modelling. Previous efforts at sub-national regional modelling overemphasised regional IO tables and (virtually non-existent) inter-regional trade data. The Australian version of TERM has been used in over 70 consulting projects at CoPS over the past 12 years. The variety of projects undertaken reflects the versatility of the model and the importance of disaggregating the national IO table before splitting it into regions. The mining boom and water issues are among important topics analysed using TERM.

Japan's Oligopolies:
Potential Gains from Third Arrow Reforms

CGE Workshop
CoPS, Victoria University, Melbourne, Australia
10 August 2015

Akihito Asano (Sophia University)
Rod Tyers (UWA and ANU)

1

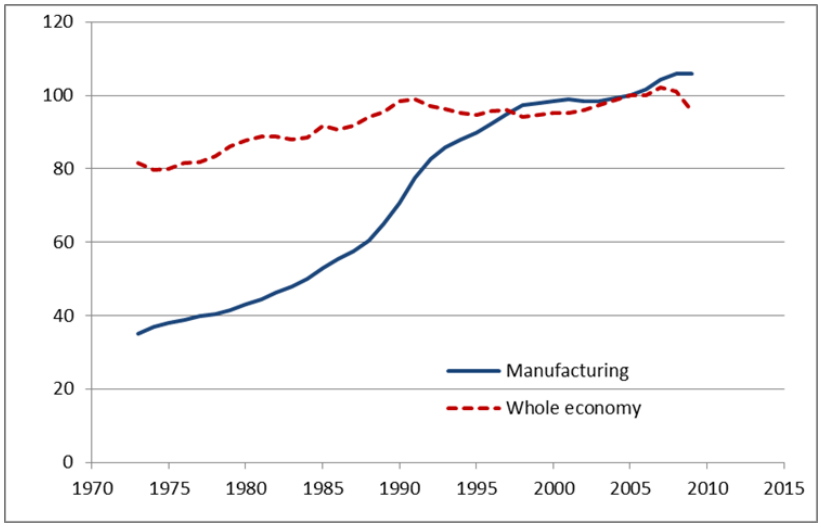
Outline

- Japan's lost decades
- Third arrow reforms
- What the data on listed firms reveals
- Modelling Japan with oligopoly
- Effects of reforms
  - Labour expansion
  - Company tax reform
  - Competition policy
  - Services productivity

2

Japan's lost decades

Total factor productivity (KLEMS)



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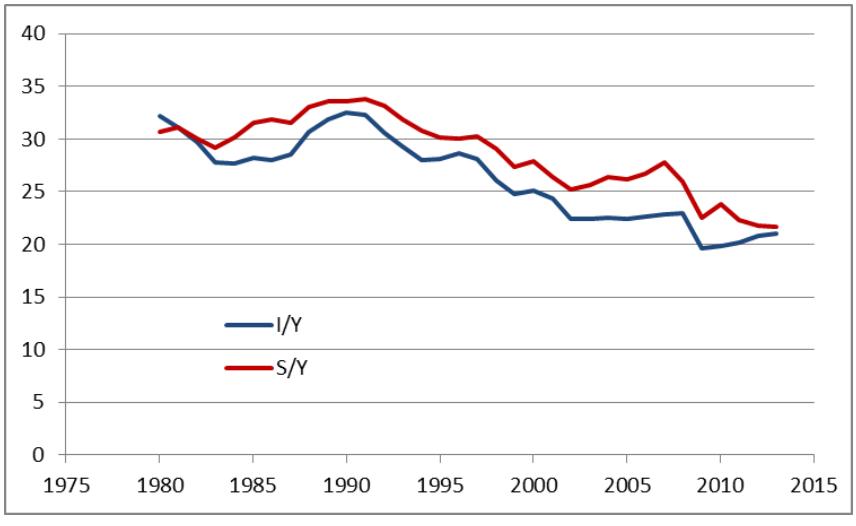
Japan's lost decades

Saving and Investment



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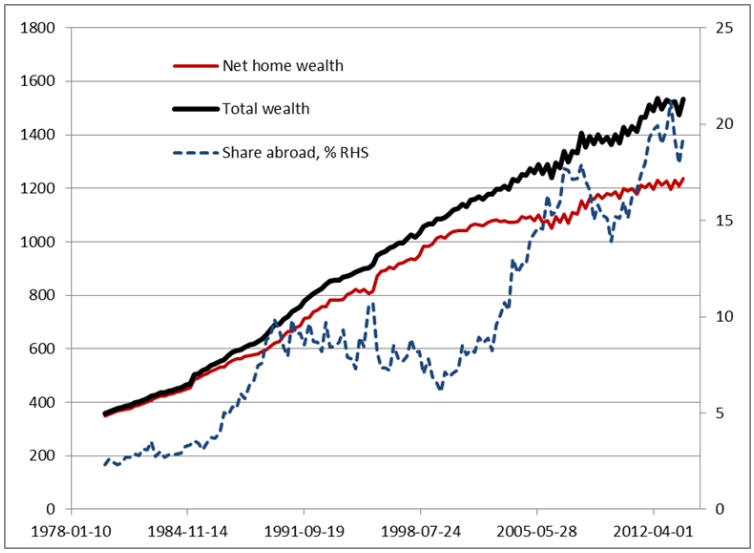
Japan's lost decades

Internationally held share of non-housing wealth



5

The Return of Abe in 2012

- **<u>Abenomics</u>**

<u>Three Arrows</u> of Abenomics

6

Three Arrow Reforms

First arrow (bold monetary policy)

- A price stability target (2% inflation) [2013 January]
- Unconventional monetary policy

Second arrow ("flexible" fiscal policy)

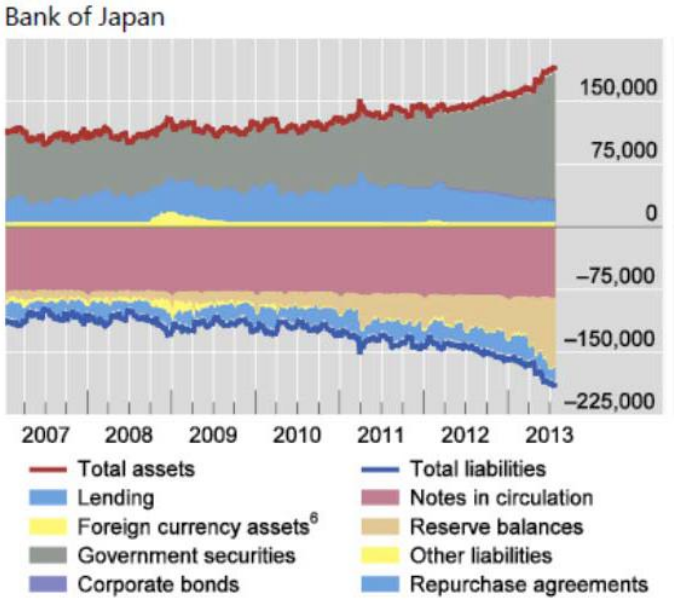
- Economic stimulus packages – temporary fiscal expansions (16 trillion Yen in 2013)
- Tax reforms to address government LR debt accumulation

Third arrow ("structural" economic reforms)

- Labour market – participation rates, immigration, flexibility
- Company tax reductions
- Robotics research
- Competition reform

7

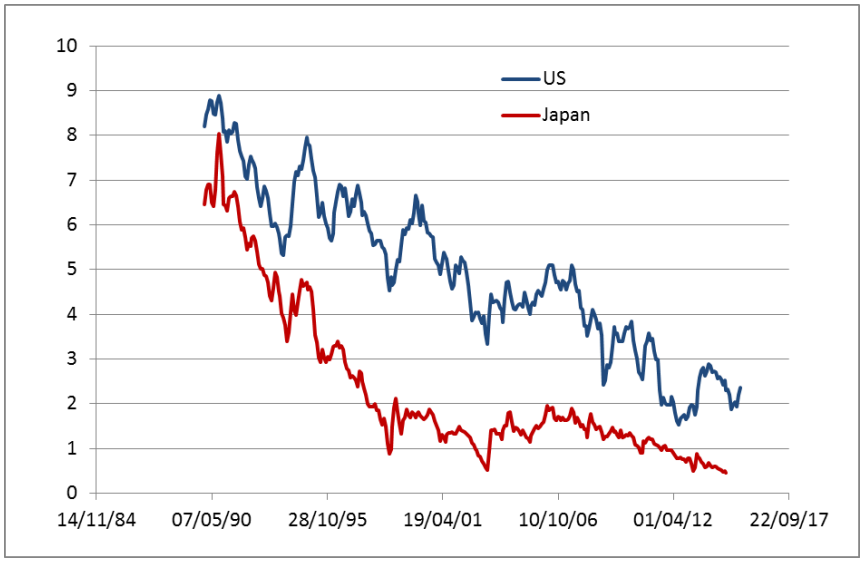
Monetary expansion



8

Bond yields

(10 year Treasury)



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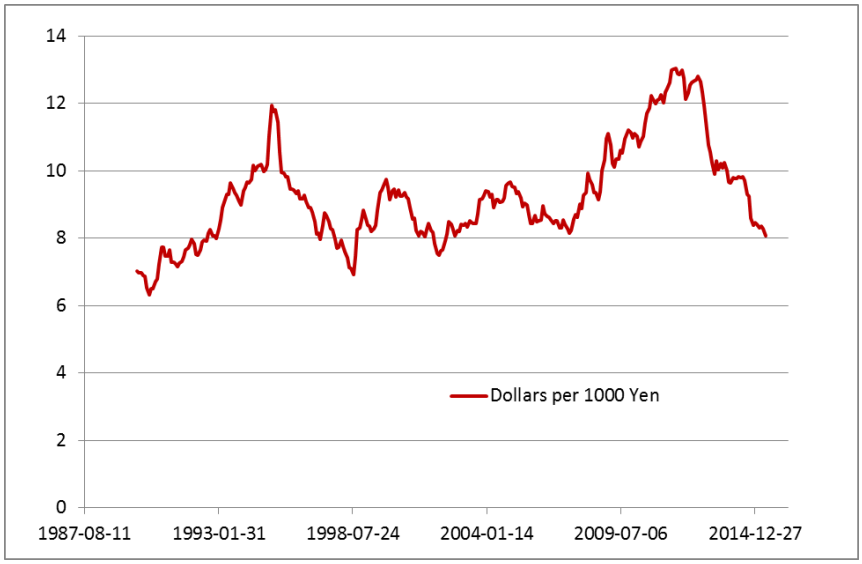
Yen depreciation since 2012



10

Data

Nikkei NEEDS *FinancialQUEST*

- 2004 – 2014 financial statements, market capitalisation
- 2776 firms organised into 20 sectors.

	Sector name	number of firms
1	Agriculture	10
2	Fishing	6
3	Mining, Minerals	24
4	Energy	12
5	Processed agricultural products	102
6	Electronic equipment	69
7	Transport equipment	81
8	Chemical, Rubber	248
9	Textiles, Clothing	48
10	Metal	146
11	Other manufacture	496
12	Electricity	12
13	Gas	10
14	Communications	23
15	Financial	215
16	Transport	114
17	Construction	140
18	Business services	82
19	Recreation	504
20	Other services	434
		2776

11

Pure profits and corporate saving

Pure (economic) profits

Market capitalisation, K
Net firm debt, d
Earnings after depreciation but including tax and interest, E
Gross rate of return, $r=E/(K_{t-1}+d_{t-1})$
Gross firm debt, D
Interest expenses, I
Market rate of return facing firm, $r_M=I/D$
Pure profit,* $\pi=(K_{t-1}+d_{t-1})(r-r_M)$

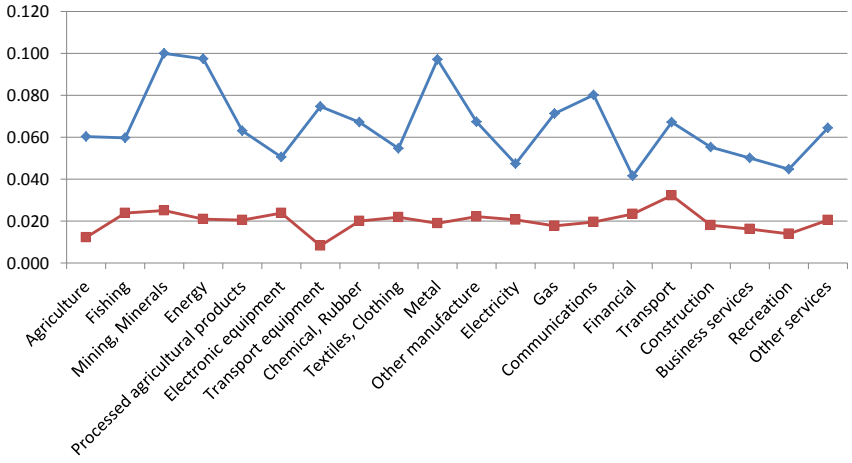
Corporate saving (retained earnings)

Earnings after depreciation but including tax and interest, E
Interest expenses, I
Dividend payments, H
Company tax payments, T
Corporate saving, $S_C=E-(T+I+H)$

*Part of the $(r-r_M)$ gap is a risk-driven equity premium, though our estimates of this are small given observed variability 2004-2014.

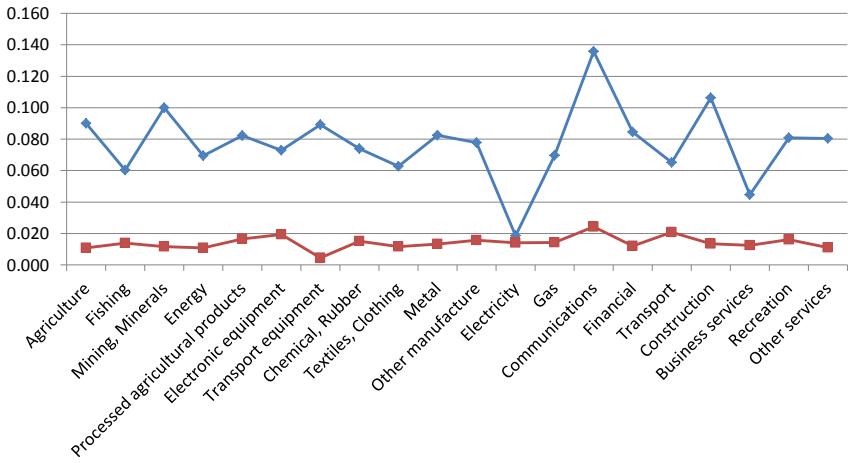
12

Rate of return and borrowing rate in 2007



13

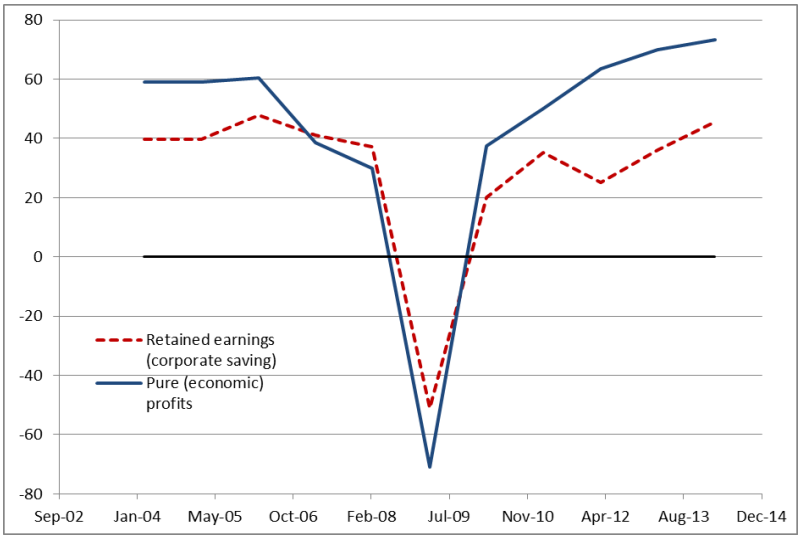
Rate of return and borrowing rate in 2014



14

Pure profit, Corporate saving

% Capital income after depreciation

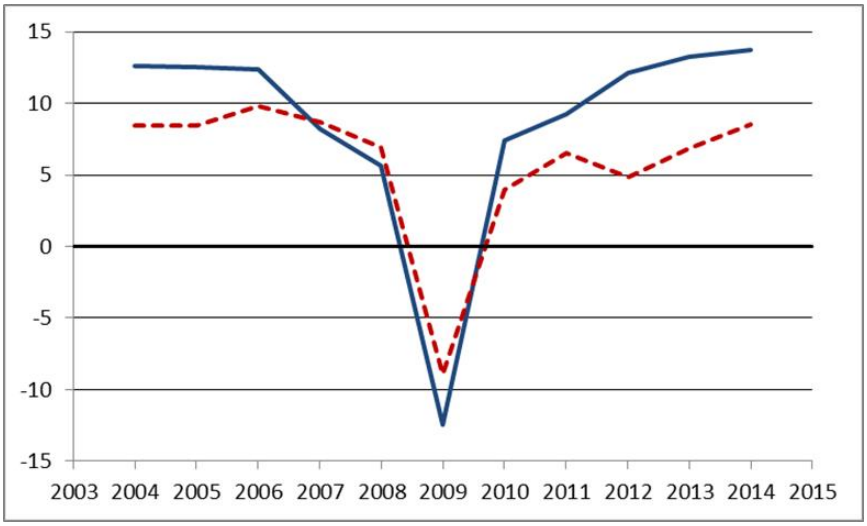


This applies to the sample of listed firms studied.

15

Pure profit, Corporate saving

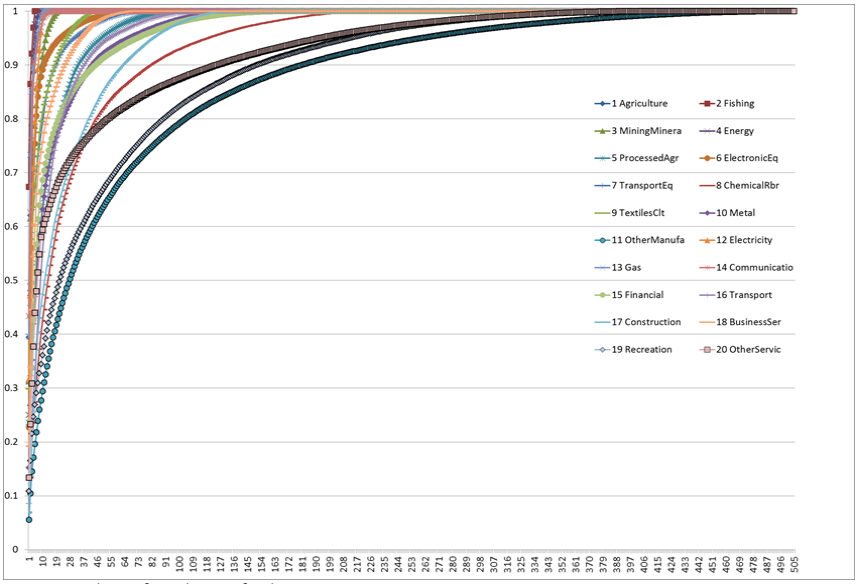
% GDP



This assumes that pure profit and retained earnings shares from our sample apply across all firms.

16

Market concentration



Cumulative firm shares of industry gross revenue.

Source: Nikkei NEEDS *FinancialQUEST* data on listed firms.

Market concentration

Despite the large size of Japan's economy, most industries are dominated by relatively few firms

- The collectives "other manufacturing" and "recreation" have two thirds of the revenue earned by 58 and 50 firms
- All other industries have 2/3 revenue captured by less than 25 firms

In some key sectors the concentration is very high; 2/3 revenue is earned by six firms or less in

- "energy", "electronics", "transport equipment", "textiles", "electricity", "gas" and "telecommunication"

18

The modelling

- 20 sector CGE model of the Japanese economy, with oligopoly behaviour on prices with differentiated varieties
- Each firm carries a recurrent fixed *L* and *K* costs
- Taxes are levied separately on *L* and *K* income, *C*, *M* and *X*
- The capital account is open, driven by endogenous *S* and *I*
- Home assets differentiated from foreign with financial flows motivated fairly elastic to departures from interest parity
- Fixed household and industry-specific corporate saving rates

Closure alternatives

Short run

Capital use fixed by industry so r_i endogenous

Fiscal policy $S_G=T-(G_X+G_T)$, G_T/P_C constant so G_X changes

Real production wage fixed, production *L* endogenous

Oligopoly - fixed *n,* endogenous π

Long run

Capital internationally and sectorally mobile at a r_W

Fiscal policy $S_G=T-(G_X+G_T)$, G_T/P_C constant so G_X changes

Employment of all primary factors fixed

Oligopoly - fixed *n,* endogenous π

Free entry, exit - *n* endogenous, π exogenous

Modelling Experiments

Expanding production and professional labour
- A rise in both by 5%

Lowering corporate tax rates
- Reduction in the power of industry-specific capital income taxes by 5%
- Fiscal balance so power of consumption tax rises

Tighter pricing surveillance to prevent collusion
- Conjectural variations parameters down 20%

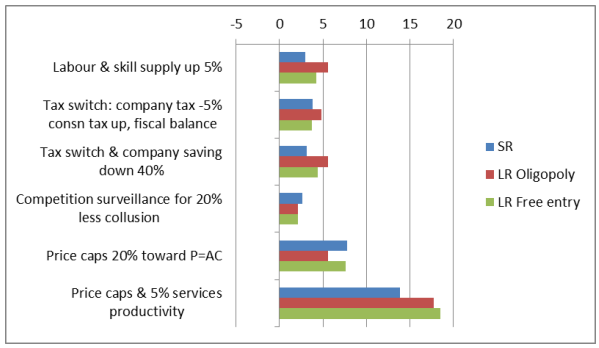
Tighter price-cap oligopoly regulation
- Reducing output prices toward *P=AC* by 20%

Reduced oligopoly margins with services productivity
- Adding 2% services productivity in SR and 5% in LR

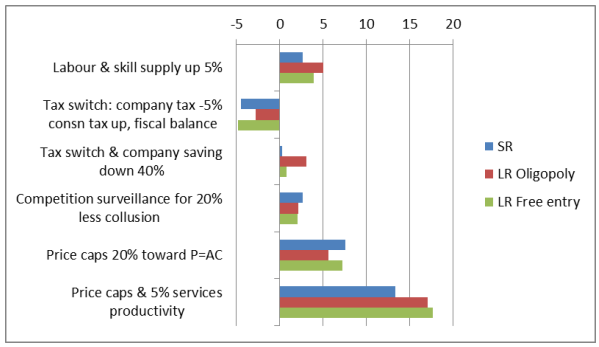
21

Real effects

GDP/P_Y



GNP/P_C



22

Modelling Results

Expanding production and professional labour
- Scale gains raise efficiency, attract *I*, *K*
- No significant real wage loss

Tax switch τ_K *(-5%)* to τ_C *(8%)*
- Reduced capital tax rate attracts *I*, *K*
- But *GNP/Pc* falls due to higher τ_C

Tax switch, reduced s_C *(-40%)*
- Reduced capital tax rate attracts *I*, *K*
- Reduced S_C raises *C*, *T* so τ_C rises less *(2%)*
- Rentiers gain (after tax) but least

23

Modelling Results

Tighter price surveillance
- More competitive pricing
- Efficiency gain attracts *I*, *K*
- Overall gains, rentiers gain least

Tighter price-cap oligopoly regulation, 20% toward *P=AC*
- Reduced mark-ups give major efficiency gain and expansion
- Rentiers gain least

Reduced oligopoly margins & 5% services productivity
- Significant rise in efficiency
- Very large expansions
- Elasticities of
  - GDP to service productivity, 2
  - Real wage to service productivity, 3

24

Conclusions

Labour supply is expansionary without impairing real production and professional wages

Company to consumption tax switch is expansionary and, combined with reduced corporate saving, is Pareto improving

Competition policy and regulation reforms yield large gains, though rentiers gain least

Overall performance is very sensitive to services productivity

There is potential for a major 3rd Arrow driven recovery

25

Annexures

26

Japan's lost decades

1990s and 2000s

Stagnation (average real GDP growth per year = 0.7%)

Deflation (average GDP deflator = -0.7%)

Unemployment rate rose 2.1% to 5.1% (peaking at 5.36% in 2002)

Gross government debt expands to 200% GDP

15 different prime ministers

27

Third arrow reforms in more detail

Labour:

- Enhancing women's participation and advancement
- Sourcing high-skilled human resources from overseas
- Enable flexible working practices
- Stimulate innovation in the "robotics revolution"

Private sector structural reform:

- Lower corporate tax, venture business promotion
- Electricity: nationwide grid, liberalising retail, legal separation between generators and distributors
- Agricultural policy: rice production regulation, dairy distribution
- Health: investments in improved services

28

Three Arrow Reforms Thus Far

Major depreciation of the Yen

Growth rate

- Real GDP growth rate in FY2013 = 2.3%
- Slowed down again in 2014 [GST increased from 5% to 8% in April 2014]

Labour market

- Number of employees has been increasing
- Unemployment rate has fallen [3.5% in Dec 2014]

Consumer price

- CPI growth in 2014 = 2.7%

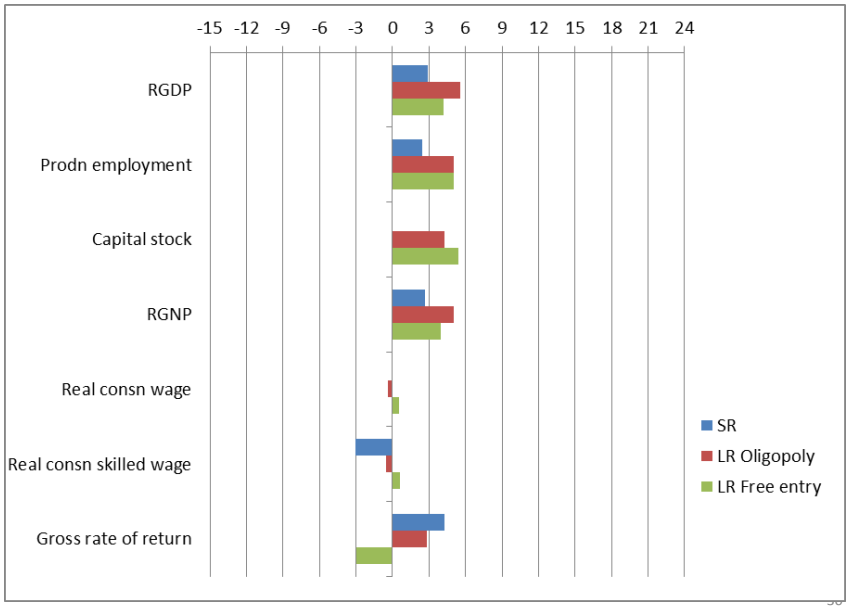
Stock price

- Stock prices have been on the rise [around 70% rise in Nikkei225 since the end of 2012]

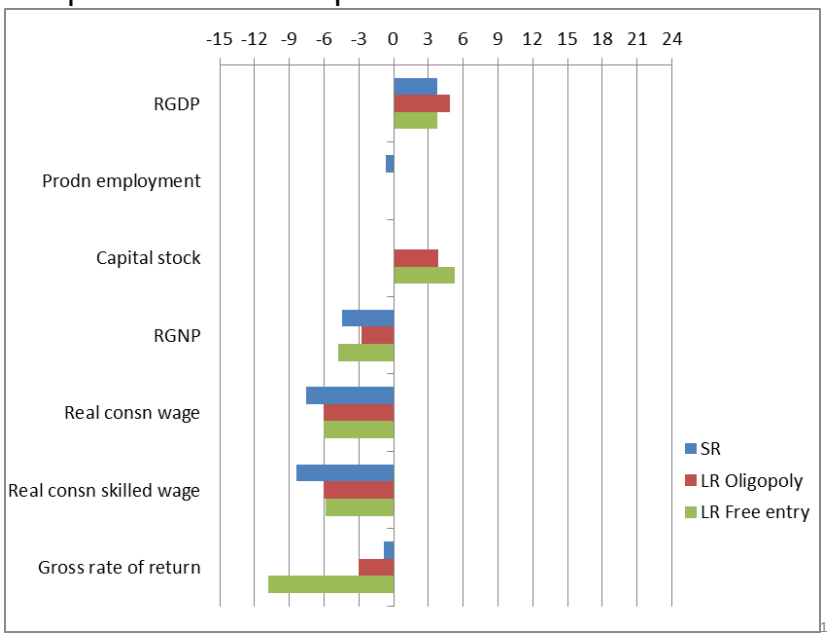
Landslide snap election victory in December 2014

29

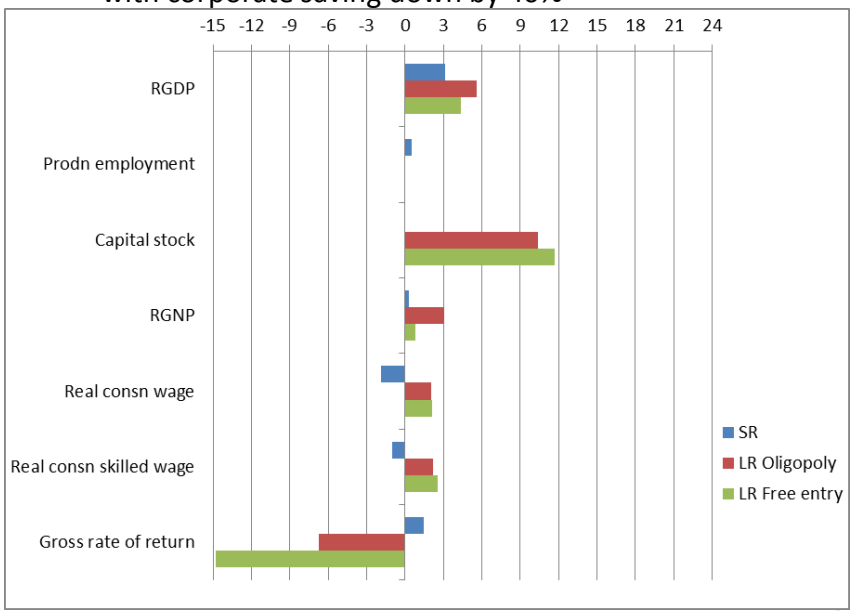
Expanding production and professional labour 5%



Corporate to consumption tax switch

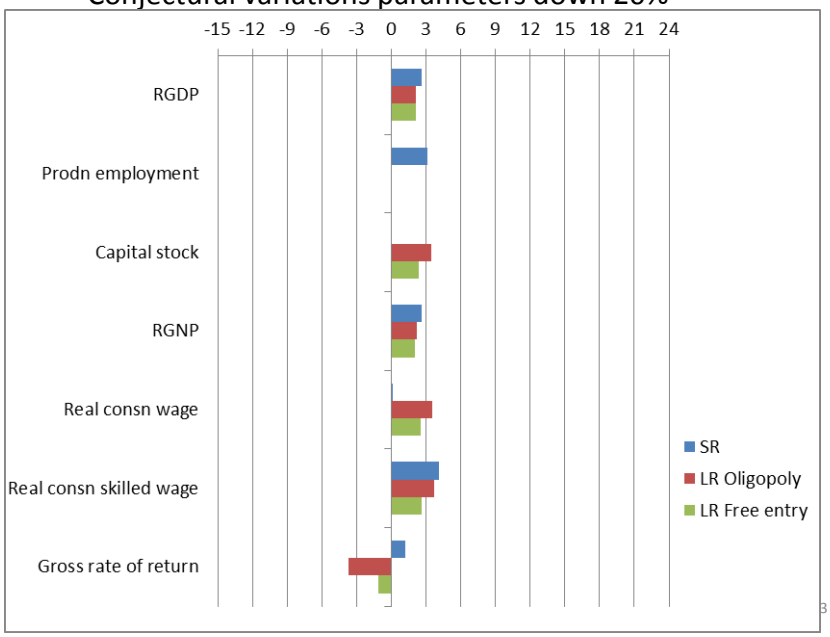


Corporate to consumption tax switch
with corporate saving down by 40%



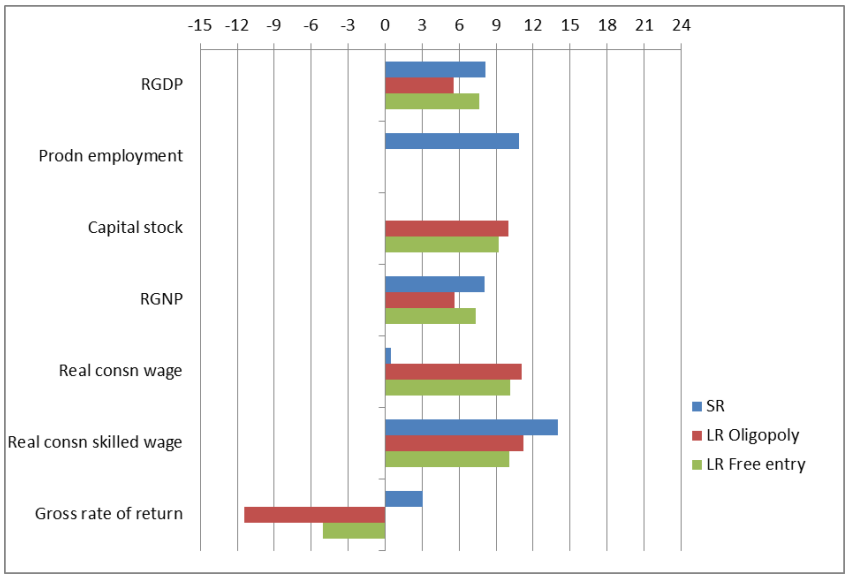
Tighter pricing surveillance to prevent collusion

Conjectural variations parameters down 20%



Tighter price-cap oligopoly regulation

Reducing output prices toward *P=AC* by 20%



34

Reduced oligopoly margins with services productivity

Adding 2% services productivity in SR and 5% in LR

Simulation results

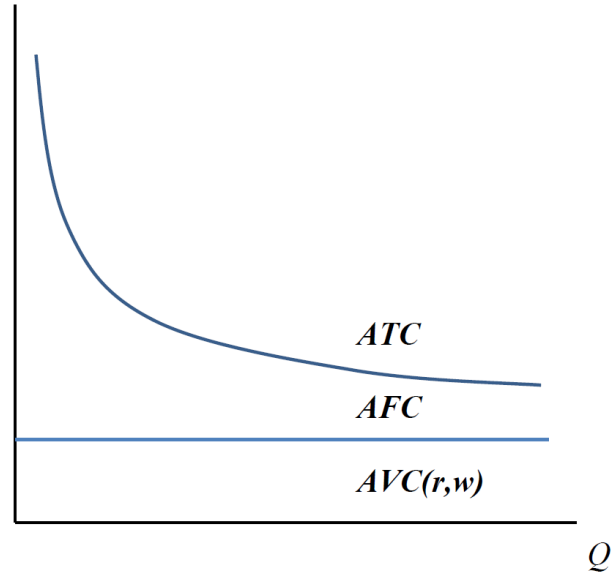
Labour market reforms

% change relative to baseline due to: 5% increase in prodn and professional labour	Oligopoly Short run	Oligopoly Long run	Free entry and exit
Real output, GDP/P_Y	2.9	5.6	4.2
Real income, GNP/P_C	2.7	5.1	4.0
Real production wage, W/P_C	0.00	-0.39	0.53
Real skilled wage, W_S/P_C	-3.1	-0.51	0.59
Gross rate of return on K, r_C	4.3	2.8	-3.0
Real exchange rate, e_R	0.19	-0.98	-0.73
Number of firms, n	0.00	0.00	14.7
Average scale (relative to MES), s	3.2	5.2	-6.3

Summary of paper Table 7.

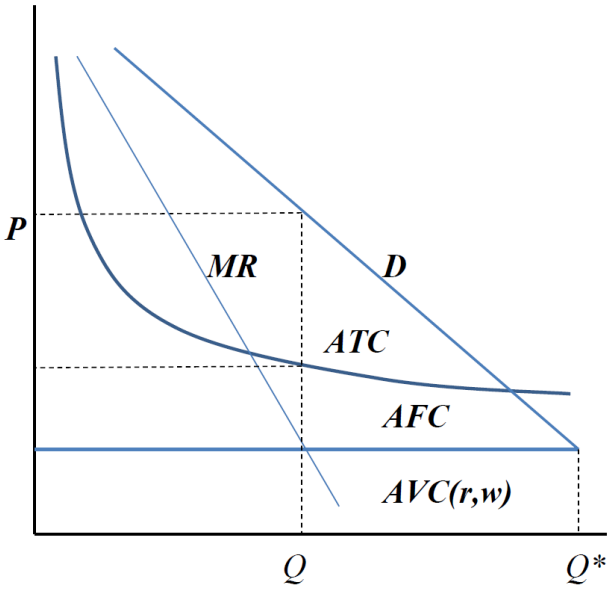
36

Oligopoly with Differentiated Products



37

Oligopoly with Differentiated Products

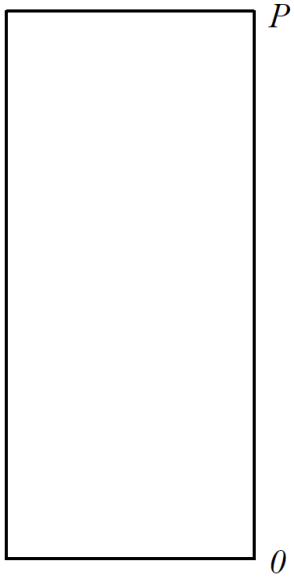


38

Model database – oligopoly calibration

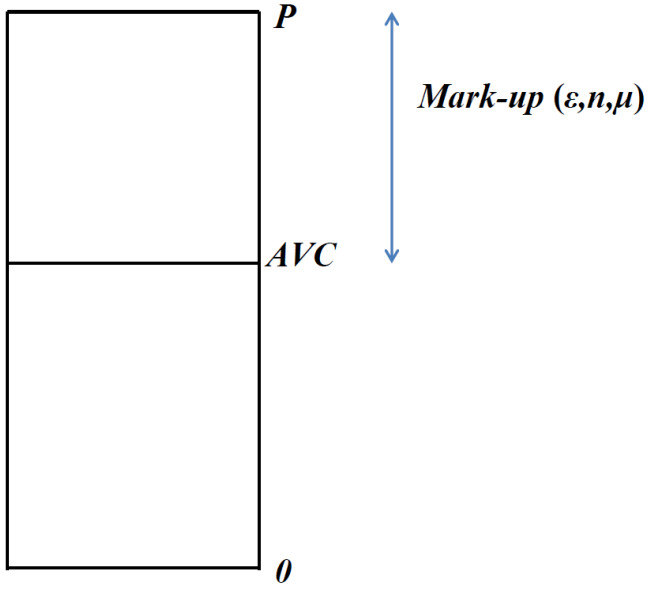
- National and government accounts, balance of payments and inter-industry flows: GTAP VII (2007)
- Flows and parameters associated with imperfect competition:
  - pure profits: Nikkei database on listed firms
  - "effective" firm numbers, conjectural variations: judgements based on Nikkei database
  - varietal elasticities of substitution: literature and calibration
  - fixed cost shares of revenue: literature and calibration
- Calibration steps:
  - initial elasticities + effective firm numbers + conjectural variations → mark-ups
  - mark-up margin less pure profit → fixed cost
  - check fixed cost shares against data and judgement
  - revise elasticities as necessary

Calibration of Elasticities



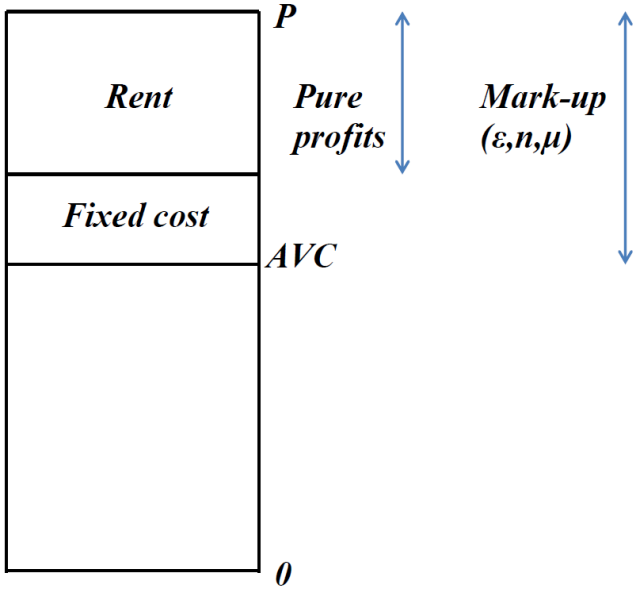
40

Calibration of Elasticities



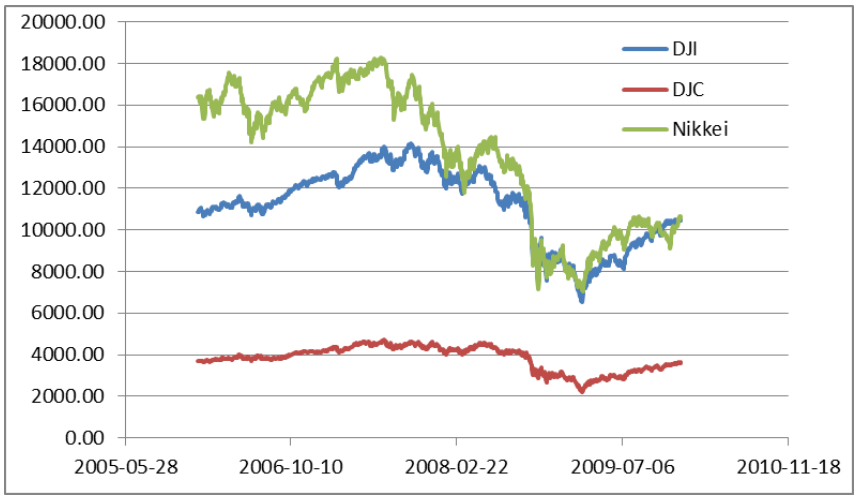
41

Calibration of Elasticities



42

Japan's assets worst hit by GFC



43

Policy options in preparation for the post-hydrocarbon era of Brunei Darussalam

Tsue Ing Yap (Irene)
Centre of Policy Studies

Centre of Policy Studies

National CGE Workshop 2015
10 August 2015, Melbourne

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Outline of Presentation

- Introduction
- Modelling approach
  - BRUGEM model
- Simulations and results
  - Scenario 1 – no action
  - Scenario 2 – some actions
  - Policy scenario
- Conclusions

Introduction

- Oil and gas → 59% of GDP, 81% of exports, 89% of government revenues in 2014.
- Small population of 411,900 → 1.4% population growth → high B$52,614 GDP per capita in 2014.
- -2.3% real GDP growth rate in 2014 → -3.7% real GDP per capita growth rate

Note: Exchange rate AUD1.00=B$1.00 as of 30 July 2015 (http://www.xe.com)

Hydrocarbons are finite…

BP Statistical Review of World Energy 2015 forecast:

- **oil** will last another **23.8 years**.
- **gas** will last another **23.3 years**.

…ceteris paribus…"depleted" by 2038

=> Slow and limited success in economic diversification

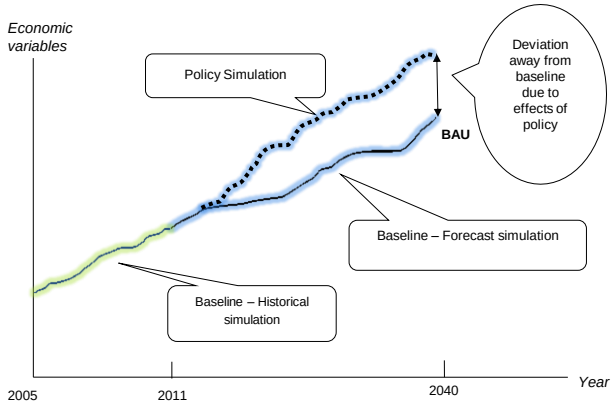
Modelling Approach

- BRUGEM, a large recursive dynamic CGE model for Brunei economy based on ORANIG-RD.
- 74 industries, 74 commodities, 3 primary factors, 5 economic agents, 7 margins services and 2 sources of supply.
- Solved sequentially on year-to-year basis using Euler 100-steps* solution method in GEMPACK.
- Optimising behaviour of agents, zero pure profit and market clearing conditions.

Updated IOT needed

- The published IOT 2005 is updated to 2011 using historical simulation.
- A new infant industry created – MethanolPChm (methanol & petrochemicals)
- Stimulate its growth in baseline forecast as part of downstream diversification

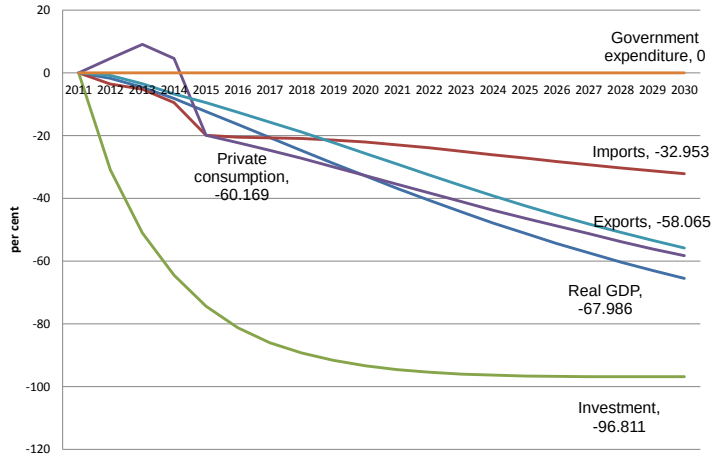
The simulations



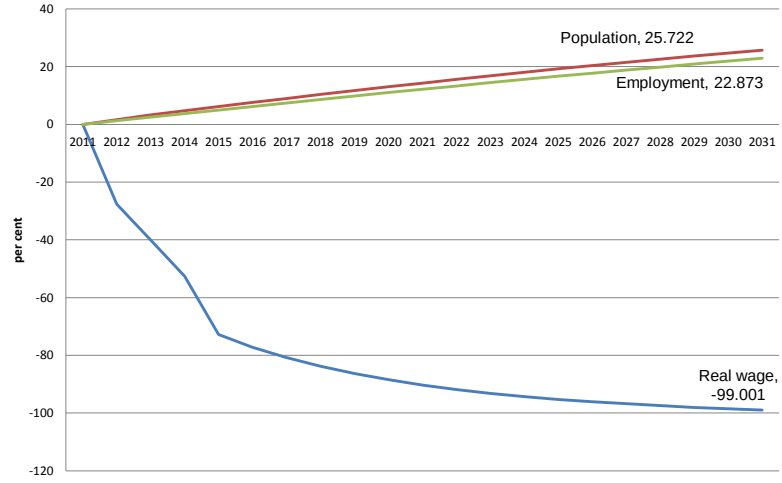
Scenario 1

- No diversification efforts taken
- Oil and gas sectors given negative shocks from 2012 till 2040
  - Proxy for resources – x1lnd(OILGAS)
  - Investment decline – x2tot(OILGAS)

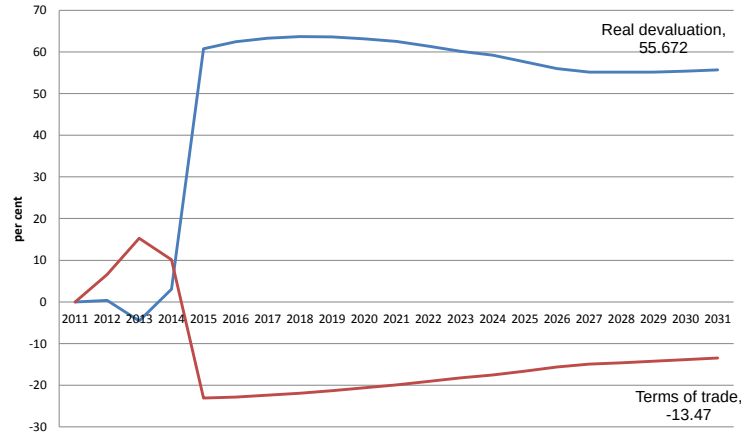
Scenario 1 – no action



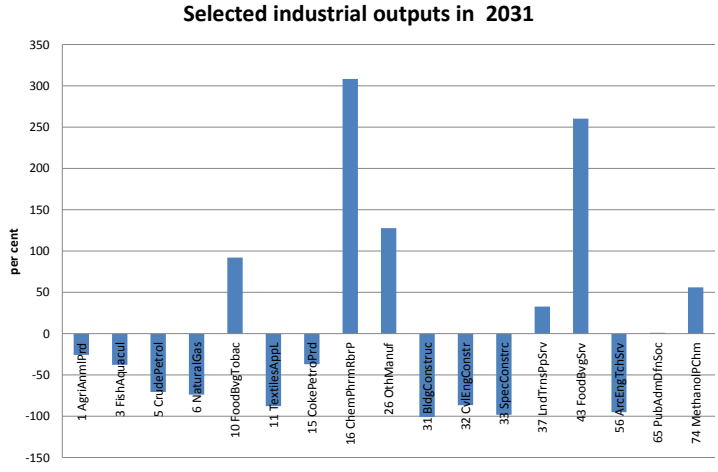
Scenario 1 – no action



Scenario 1 – no action



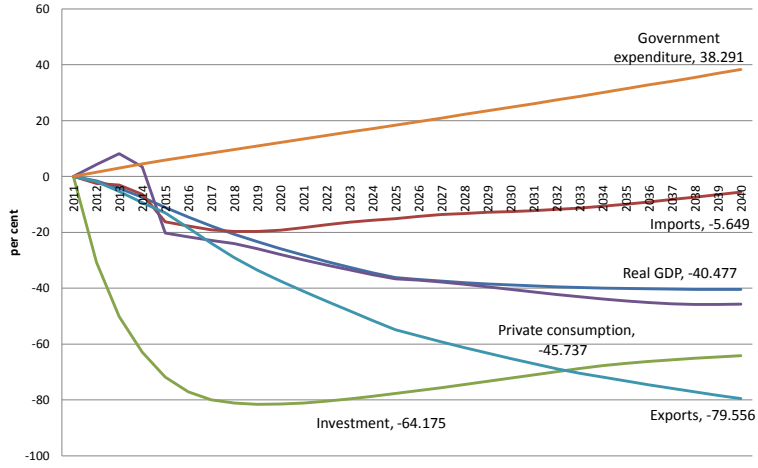
Scenario 1 – no action



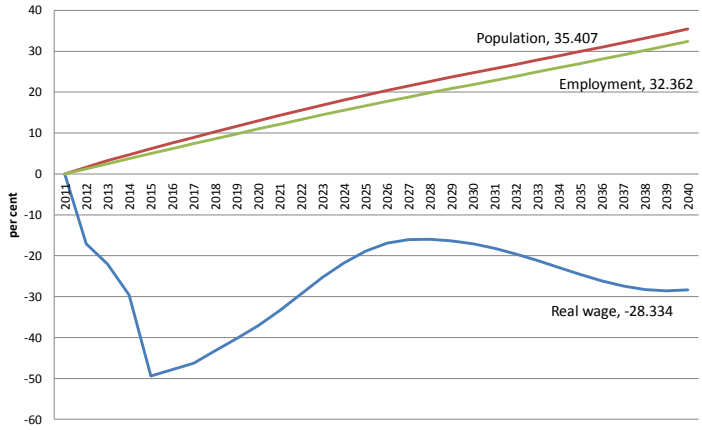
Scenario 2

- Some diversification efforts
- Oil and gas sectors given negative shocks from 2012 till 2040 (smaller shock from 2026-2040)
- Eight selected industries stimulated : MethanolPChm, CokePetroPrd, ChemPhrmRbrP, BldgConstruc, CvlEngConstr, SpecConstr, ArcEngTchSrv and PubAdmDfnSoc
- To replace half of lost hydrocarbons output
- Decline of TextilesAppL sector

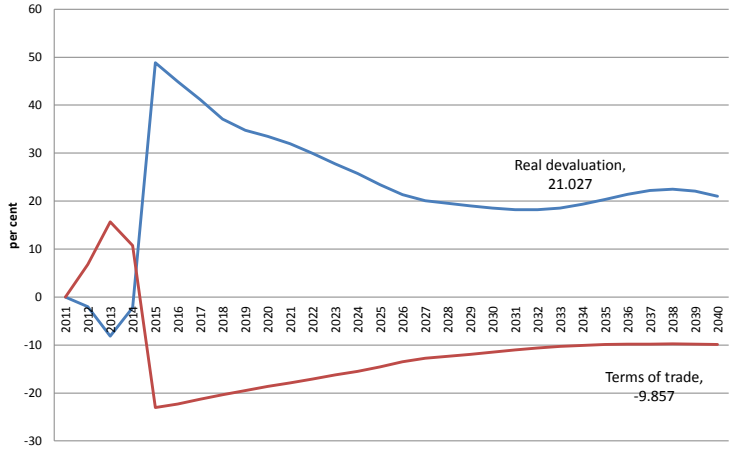
Scenario 2 – some actions



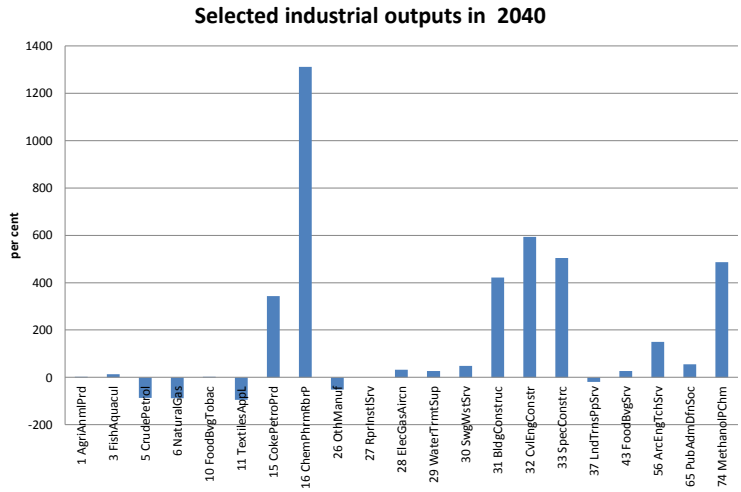
Scenario 2 – some actions



Scenario 2 – some actions



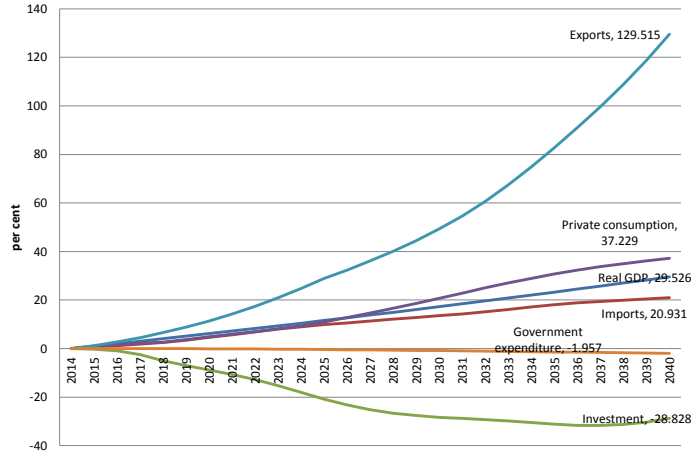
Scenario 2 – some actions



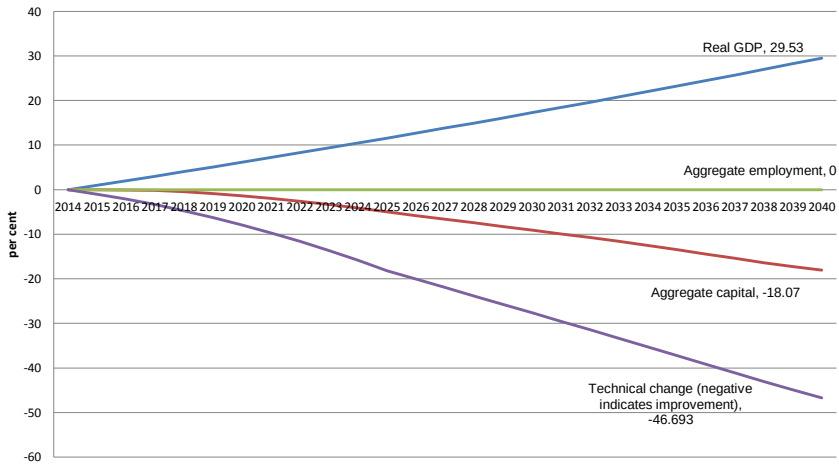
Policy scenario

- A calibrated all-factor augmenting productivity shock to create additional 1% real GDP growth p.a. from 2015 onwards.
- Same closure as baseline forecast except:
  - (1) Swap x0gdpexp = a1primgen
  - (2) Aggregate employment is tied down

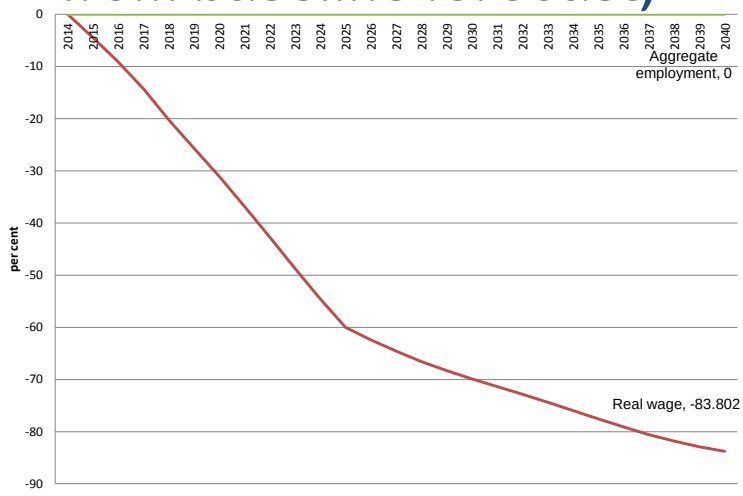
Policy scenario (% deviation from baseline forecast)



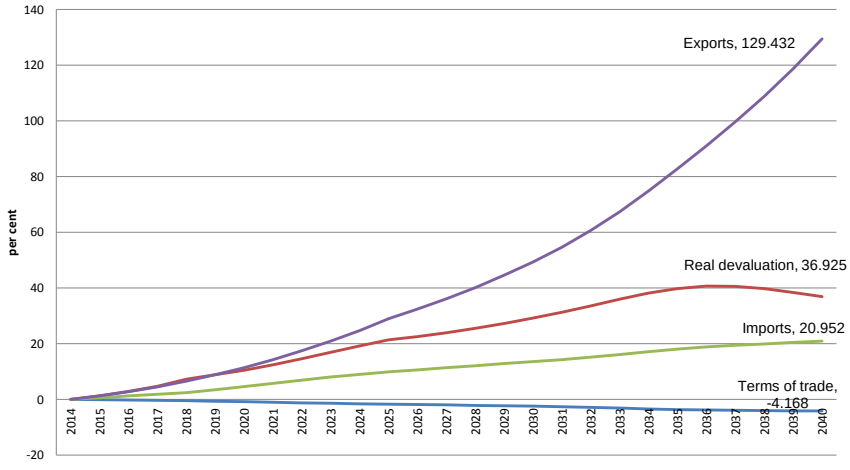
Real GDP and factor inputs (% deviation from baseline forecast)



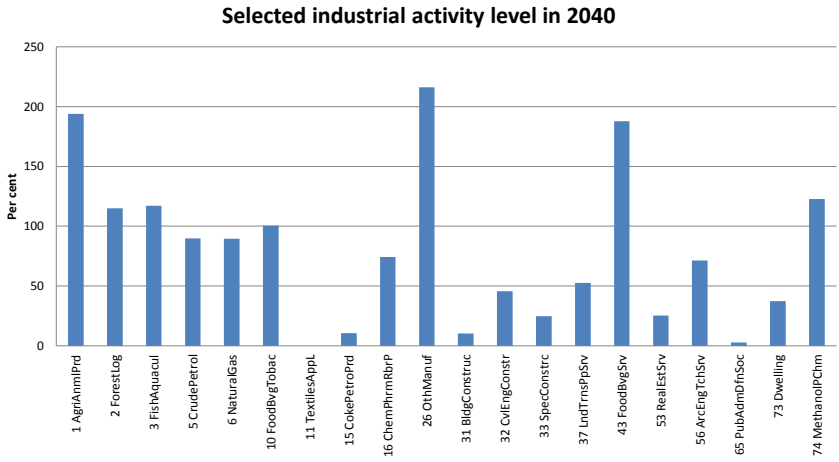
Policy scenario (% deviation from baseline forecast)



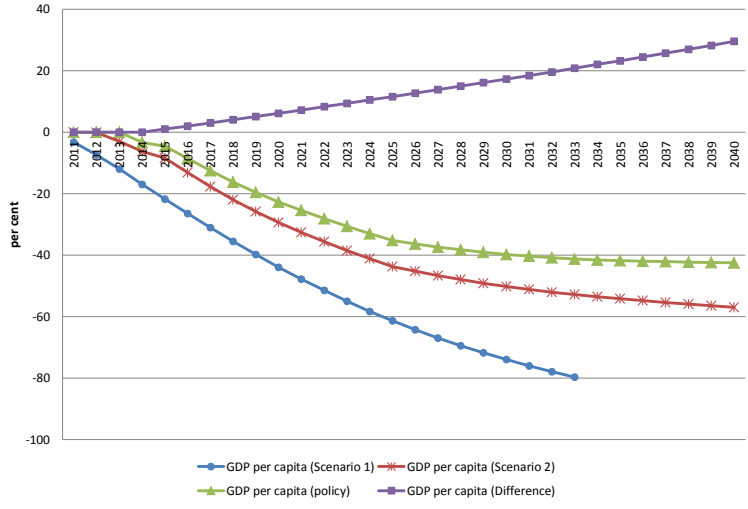
Policy scenario (% deviation from baseline forecast)



Policy scenario (% deviation from baseline forecast)



GDP per capita (% deviation from baseline forecast)



Conclusions

- Decline in real wage → fall in living standards
- Aggregate investment falls in long run.
- Productivity growth of 2.4% p.a. → additional 1% real GDP growth p.a.
- Real GDP per capita improves by 0.99% p.a. with productivity shock.
- Is current strategy of diversifying into downstream industries sustainable?
- No obvious industries which contribute significantly to the lost outputs.

Policy implications

- Need alternative industries to replace declining oil and gas sectors.
- Timing of large projects.
- Urgent actions to improve productivity via microeconomic reforms.
- Need to create environment conducive for more inward investment.

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Thank you

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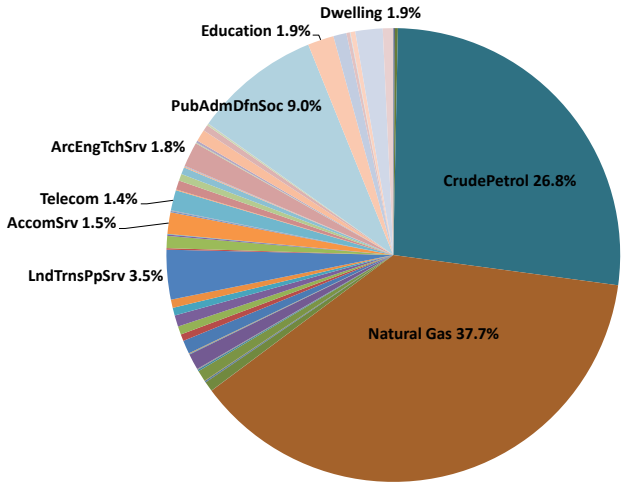
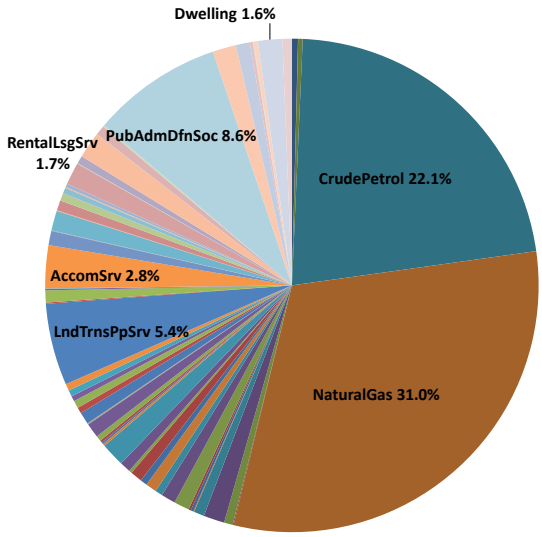
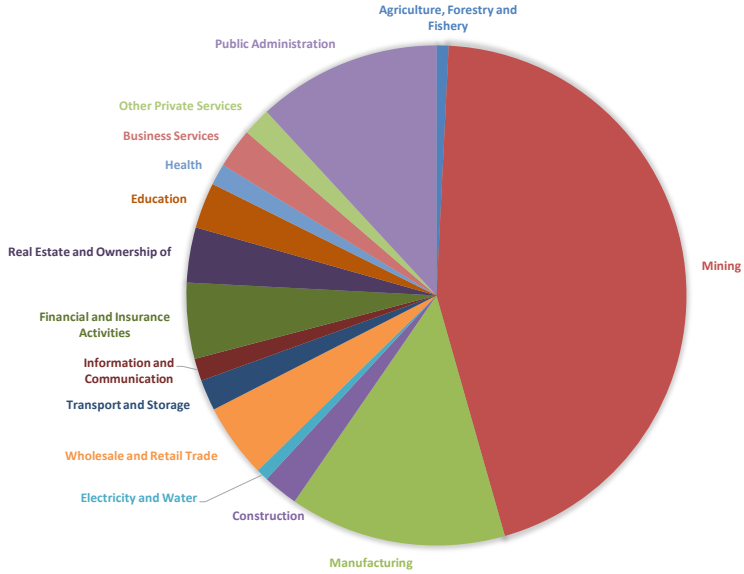
Industrial outputs



Sale share of commodities to all demanders



GDP by economic activities in 2014



Place-Based versus Place-Neutral Policies for Promoting Regionally Balanced Economic Growth:

A Sri Lankan Case using CGE based Simulations

by

Deeptha Wijerathna

Christine Smith, Athula Naranpanawa and Jayatilleke S. Bandara

The presentation prepared for the

CGE workshop 2015, The Centre of Policy Studies, Victoria University, Melbourne
10 August 2015

Previous version of the paper was presented at
1. The PhD conference of Economics and Business 2014 (Monash University, Melbourne),
***2. The Winter Conference of the Regional Studies* Association 2014 (London Bloomsbury, UK)**
3. The "BROWN BAG" SEMINAR OF THE ECONOMICS AND POLICY ANALYSIS PROGRAM, GRIFFITH BUSINESS SCHOOL (BRISBANE)
4. Australian Conference of Economists (ACE 2015), *Economic Challenges Today: Answers from theory and Practice* ***(QUT-Brisbane)***

Introduction

- **Development thinking has evolved over time**
- **The role of space in economic growth/ development have become increasingly emphasized**
- **Regionally balanced economic growth is suggested to be a cure for the problems of**
  1. **slow economic growth rate**
  2. **regional economic disparities**

3

Introduction

- **What kind of policies can create balanced growth?**

  Place based? Place neutral? Or a mixture of each?

- **There is only very limited empirical evidence**

- **Lack of proven and practical economic tool for undertaking a comparative analysis is another gap**

4

Research Question

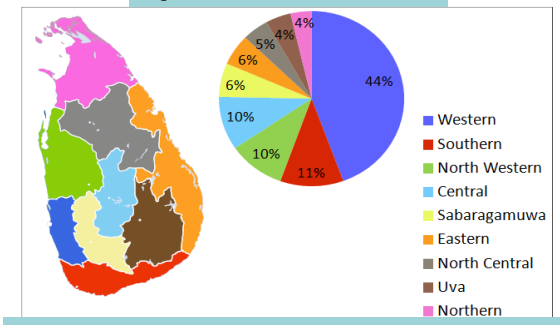
Can a Multi-Regional CGE model based quantitative method be used for analysing the relative merits of alternative policies **(place-based and place-neutral) aimed at achieving** regionally balanced economic growth **in a developing country context?**

5

Why Sri Lanka?

- **Sri Lanka has considerable level of regional disparity at the moment**

Regional share in National GDP 2011



Source: Authors Calculation based on Central Bank of Sri Lanka 2013

* A paper based on detailed regional disparity analysis "Regional Disparities in Sri Lanka: An Empirical Analysis", is forthcoming in Asia-Pacific Development Journal, Vol 21, No2

6

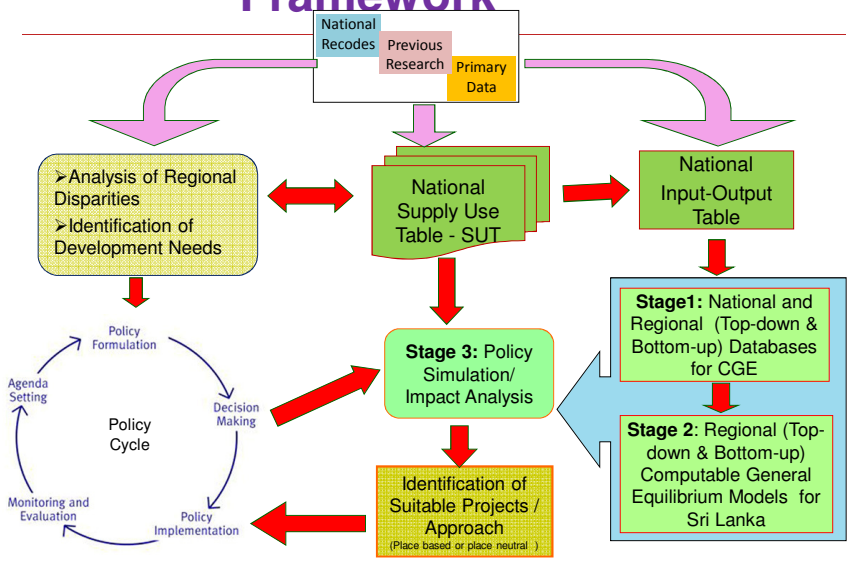
Why Sri Lanka?

- **The country has recently come out of a nearly three decade long civil conflict**

- **The country is currently motivated towards achieving a more regionally balanced economic growth pattern**

The Research Framework

7

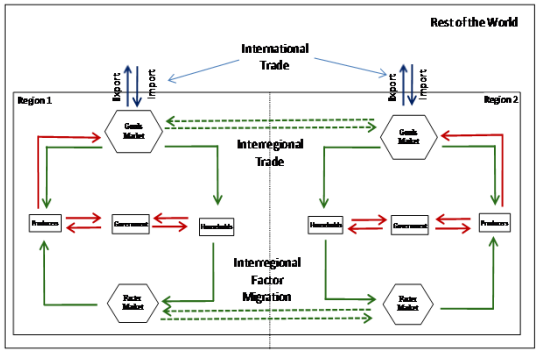


Methodology

8

The Model (SLBRC-GEM)

- The model is based on the theoretical structure of Australian TERM model
- Nine Provinces of the country are treated as independent sub-economies



Methodology

9

The Calibration

- Calibrate ORANI model with SL I-O table (64 sectors, 2006)
- Revise few sectors and created 65 sectors
  - 'Milling' sector divided into paddy and other milling
  - Two sectors 'other Food' and 'Beverages' firstly combined and then spited into two sectors as 'Tea' and 'Other food & beverages'
- Updated for year 2011 with adjuster program
  - Growth rate of all 65 sectors were used
  - Fertilizer subsidy was adjusted
- Calibrated the TERM model
  - Updated SL database (65 sectors) for 2011
  - Regional shares for 2011 – based data from CBSL
  - Parameters – Mostly based on GTAP

Note: Number of Tablo code files available in COPS web site was used with some modifications

Methodology

10

Amendments (To Standard TERM)

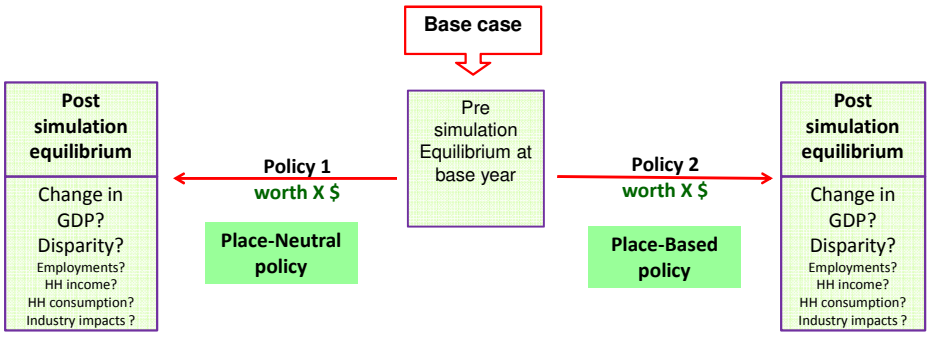
- Intermediate substitution – Allowed only for agriculture
- Intermediate substitution elasticity parameter "Int_Sigma" is introduced to the database
  - Paddy – 0.15
  - Other crops - 0.1
  - Other agriculture – 0.05
  - Other - 0

Methodology: Policy Simulation

11

Experimental Design

- **Objective - compare the economy-wide growth and disparity reduction impact of two selected policies of place-neutral and place-based nature**
- **A CGE model for hypothesis testing ?**



Policies related to same industry ?

Methodology: Policy Simulation

12

Two example policies

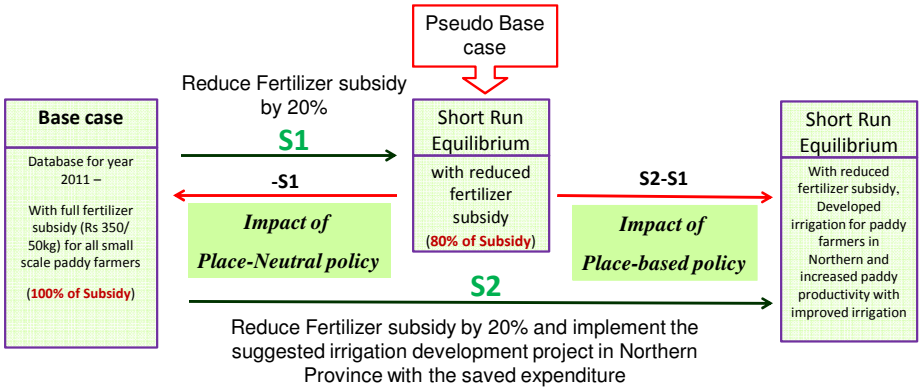
1. **Ongoing national fertilizer subsidy scheme for all Sri Lankan small scale paddy farmers – The impact of 20% of the current level of subsidy is considered**
2. **Suggested irrigation infrastructure development in Northern Province of Sri Lanka** (aimed at enhancing productivity of paddy lands in this region)

Methodology: Policy Simulation

13

Experiment

- **Two stage simulation**



Methodology: Policy Simulation

14

Robustness Checks

- **Sensitivity of the outcome to region was checked by changing the target region to Eastern**
- **Sensitivity of the results to the industry is checked by changing the place based project to a construction of new fisheries harbor**
- **Sensitivity of the results to values of parameters were checked with systematic Sensitivity Analysis**

Methodology: Policy Simulation

15

Shocks

	SR	LR
S1: Fertilizer subsidy (20%)	Fertilizer subsidy: 20% reduce Land Productivity al: 3.4 % reduce	Fertilizer subsidy: 20% reduce Land Productivity all: 3.4 % reduce
S2: Irrigation development in Northern	Fertilizer subsidy: 20% reduce Land Productivity all: 3.4 % reduce Govt. demand for construction in Northern - increased by X, X= 20% of subsidy	Fertilizer subsidy: 20% reduce Land productivity all: 3.4 % reduce Paddy land productivity Northern: 5 % increase
S2.2: Irrigation development in Eastern	Fertilizer subsidy: 20% reduce Land Productivity all: 3.4 % reduce Govt. demand for construction in Eastern- increased by X, X=20% of subsidy	Fertilizer subsidy: 20% reduce Land productivity all: 3.4 % reduce Paddy land productivity Eastern: 5 % increase
S2.3: Fisheries habour development in Northern	Fertilizer subsidy: 20% reduce Land Productivity all: 3.4 % reduce Govt. demand for construction in Northern - increased by X, X=20% of subsidy	Fertilizer subsidy: 20% reduce Land productivity al: 3.4 % reduce Out put of fisheries sector in Northern: 40 % increase

NB. 1. We assumed that fertilizer subsidy is not re-established within our long run period.

2. Values of the shocks were calculated based on Wijetunga et al., 2008, Hussain et al., 2007 and proposed costs & benefits of the projects by planning ministry of Sri Lanka

Methodology: Policy Simulation

16

Shocks – (considered in policy interpretation)

	SR	LR
-S1: Fertilizer subsidy (20%)	Fertilizer subsidy: 20% increase Land Productivity all: 3.4 % increase	Fertilizer subsidy: 20% Increase Land Productivity all: 3.4 % increase
S2-S1: Irrigation development in Northern	~~Fertilizer subsidy - 20% reduce~~ ~~Land Productivity all -3.4 % reduce~~ Govt. demand for construction in Northern - increased by X, X=20% of subsidy	~~Fertilizer subsidy - 20% reduce~~ ~~Land productivity all - 3.4 % reduce~~ Paddy land productivity Northern: 5 % increase
S2.2-S1: Irrigation development in Eastern	~~Fertilizer subsidy - 20% reduce~~ ~~Land Productivity all -3.4 % reduce~~ Govt. demand for construction in Eastern- increased by X, X=20% of subsidy	~~Fertilizer subsidy - 20% reduce~~ ~~Land productivity all -3.4 % reduce~~ Paddy land productivity Eastern: 5 % increase
S2.3-S1: Fisheries habour development in Northern	~~Fertilizer subsidy - 20% reduce~~ ~~Land Productivity all -3.4 % reduce~~ Govt. demand for construction in Northern - increased by X, X=20% of subsidy	~~Fertilizer subsidy - 20% reduce~~ ~~Land productivity all -3.4 % reduce~~ Out put of fisheries sector in Northern: 40 % increase

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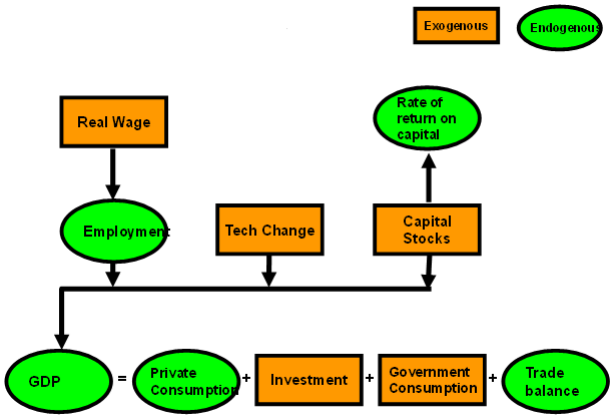
Methodology: Policy Simulation

17

Closure – Short Run

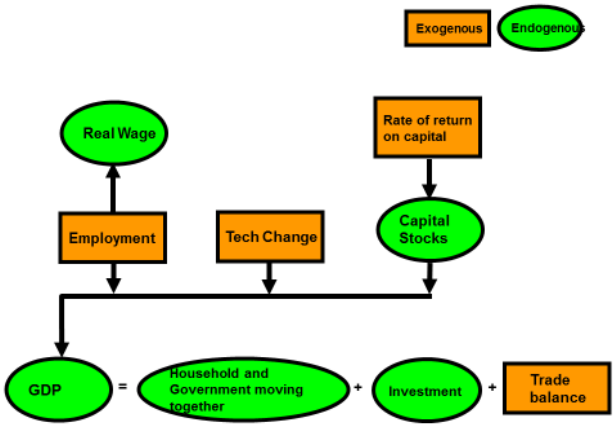


- At Macro level, **Capital, Investments, Government expenditure, Real wages and Production technology** are exogenous

Methodology: Policy Simulation

18

Closure – Long Run



- At Macro level, **Trade Balance, Employments, Rate of Return to Capital and Production technology** are exogenous

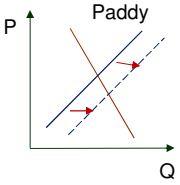
19

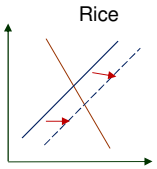
Potential impacts (**SR**) – Fertilizer Subsidy increase in all regions

Paddy=F(land, labour, capital, fertilizer, other)

y= land + labour + capital + fertilizer+ chemicals + other - subsidy

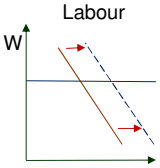
Cost ↓
Land productivity ↑
Supply ↑
Price ↓





Cost ↓
Supply ↑
Price ↓

Real wages fixed
Employments ↑



•Employment ↑
•HH income ↑
•Price of consumption ↓
•Employment ↑
•HH consumption ↑

Regional impacts
Direct- based on paddy industry shares
Indirect- based on supporting industry shares

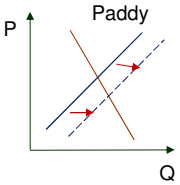
20

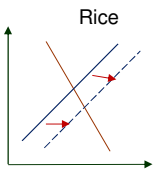
Potential impacts (**LR**) – Fertilizer Subsidy increase in all regions

Paddy=F(land, labour, capital, fertilizer, other)

y= land + labour + capital + fertilizer+ chemicals + other - subsidy

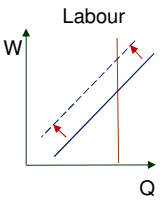
Cost ↓
Land productivity ↑
Supply ↑
Price ↓





Cost ↓
Supply ↑
Price ↓

Employments fixed
wages ↑



•Employment ↑
•HH income ↑
•Price of consumption ↓
•Employment ↑
•HH consumption ↑

Regional impacts
Direct- based on paddy industry shares
Indirect- based on supporting industry shares

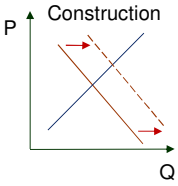
21

Potential impacts (**SR**) — Irrigation Development in Northern

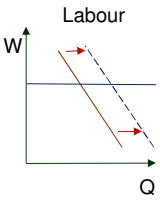
construction=F(labour, capital, other)

y= labour + capital + other

Demand ↑
Price ↑



Real wages fixed
Employments ↑



- Employment ↑
- HH income ↑
- Price of consumption ↓
- Employment ↑
- HH consumption ↑

Regional impacts

Direct- Northern Province

Indirect- based on supporting industry shares and competing industries

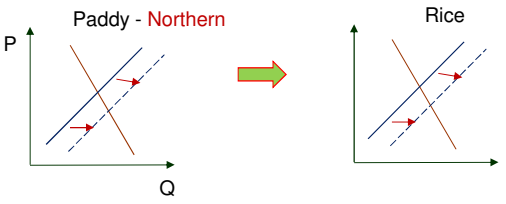
22

Potential impacts (**LR**) — Fertilizer Subsidy increase in all regions

Paddy=F(land, labour, capital, fertilizer, other)

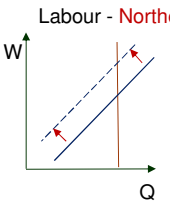
y= land + labour + capital + fertilizer+ chemicals + other + subsidy

Cost ↓
Land productivity ↑
Supply ↑
Price ↓



Cost ↓
Supply ↑
Price ↓

Employments fixed
wages ↑



- Employment ↑
- HH income ↑
- Price of consumption ↓
- Employment ↑
- HH consumption ↑

Regional impacts

Direct- based on paddy industry shares

Indirect- based on supporting industry shares

Methodology

23

Structure of Economy – at base level

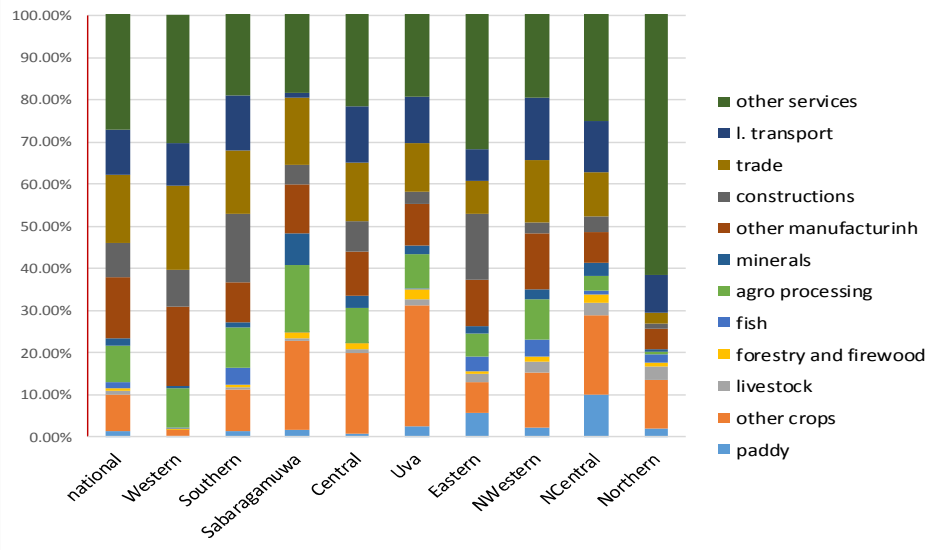
	Sector	share	Cumulative
1	Trade and Repair Work	16.32%	16.32%
2	Land Transport	10.56%	26.88%
3	Construction Service	8.24%	35.12%
4	Financial Intermediation	8.21%	43.33%
5	Public Administration and Defence	7.43%	50.76%
6	Real Estate Activities	3.57%	54.33%
7	Wearing apparel, except fur	3.19%	57.52%
8	Meat and processed Fish, Fruit & Veg.	2.80%	60.32%
9	Other Vegetables	2.66%	62.98%
10	Other food products Beverages	2.49%	65.47%
11	Electricity	2.48%	67.95%
12	Education	2.14%	70.09%
13	Refined Petroleum Products	2.09%	72.18%
14	Mining and Quarrying	1.71%	73.89%
15	Paddy	1.42%	75.31%
16	Fish (Inland and Marine)	1.34%	76.65%
17	Tea Leaves	1.27%	77.92%
18	Other Services	1.24%	79.16%
19	Live Animal (for meat and draft)	1.12%	80.28%
20	Electrical Machinery and Apparatus	1.12%	81.40%
21	Coconut	1.10%	82.50%
22	Post and Telecommunications	1.07%	83.57%

	Sector	share	Cumulative
23	Other Transportable Goods	1.06%	84.63%
24	Other Chemical Products	1.02%	85.65%
25	Tobacco Products	0.94%	86.59%
26	Dairy Products	0.92%	87.51%
27	Non-metallic Mineral Products n.e.c.	0.91%	88.42%
28	Other Agriculture and Hunting	0.88%	89.30%
29	Tea	0.78%	90.08%
30	Supporting and Auxiliary Transport	0.78%	90.86%
31	Processes Rice	0.74%	91.60%
32	Health and Social Services	0.71%	92.31%
33	Water Transport	0.70%	93.01%
34	Air Transport	0.68%	93.69%
35	Insurance and Pension Funding	0.68%	94.37%
36	Rubber (natural)	0.66%	95.03%
37	Other Cereals	0.58%	95.61%
38	Hotels and Restaurants	0.54%	96.15%
39	Firewood (in logs and billets)	0.54%	96.69%
40	Basic Chemicals	0.46%	97.15%
41	Knitted and Crocheted Fabrics	0.36%	97.51%
42	Rubber Products	0.35%	97.86%
43	Other Beverages and Spice	0.35%	98.21%
44	Plastics Products	0.26%	98.47%

Methodology: Policy Simulation

24

Structure of economy – at base level



Results:

25

National Macro Impacts

	Short Run				Long Run			
	Place Neutral	Place based			Place Neutral	Place based		
	Fert sub	North Irri.	East Irri.	No. F.Hab	Fert sub	North Irri.	East Irri.	No. F.Hab
Real GDP	0.139	0.051	0.051	0.051	0.054	0.007	0.010	0.097
Ag. Emp.	0.221	0.101	0.100	0.101	Exogenous			
Real Wage	Exogenous				0.216	0.019	0.030	0.141
Ag. Capital	Exogenous				0.110	0.011	0.015	0.058
Ag. HH Con	0.225	0.101	0.086	0.101	0.097	-0.048	-0.045	0.042
Ag. Invest.	Exogenous				0.108	0.015	0.021	0.130
Ag. Govt.	Exogenous	0.500	0.503	0.500	Exogenous			
R. exports	0.083	-0.182	-0.153	-0.182	-0.008	-0.001	-0.001	0.103
R. Imports	0.102	0.123	0.120	0.123	0.037	0.005	0.008	0.077
CPI	-0.021	0.089	0.073	0.089	-0.063	-0.006	-0.009	-0.034
GDPPI	-0.049	0.104	0.090	0.104	-0.043	-0.004	-0.006	-0.020
Export PI	-0.019	0.039	0.033	0.039	-0.007	0.000	-0.001	-0.072

Results:

26

BOTE – Decomposition: National GDP (Income)

(With our place neutral and place based policy 1)

$$Y = a + SK * K + SL * L + SN * N$$

GDP Mkt price = GDP factor cost + taxes

Where,
y – GDP factor cost, K - capital, L – Labour,
N – Land, a - technical change
SK, SL and SN are shares of GDP in base case from capital, labour and land respectively

in the model – GDP income

$$y = Sk * k + SL * L + SN * N + a + tax$$

from the database, SK=0.35, SL=0.50, SN=0.04, share of tax =0.11

In short run, K=N=0

With fertilizer subsidy increase, L=0.221, a=0.026, tax =.093

$$y=SL * L + a + tax = 0.221*0.50+0.026+0.093 = 0.139$$

With Irrigation Development in Northern, L=0.101, a= 0, tax =0.001

$$y=SL * L + a + tax =0.101*0.50+0+0.001 = 0.051$$

Results

27

BOTE – Decomposition: National GDP (Expenditure)

(With our place neutral and place based policy 1)

$$Y = C + I + G + In + (X - M)$$

		(C) Household Consumption	(I) Investments	(G) Government consumption	(In) Stocks	(X) Exports	(M) Imports	(Y) GDP
	Share in Base case (1)	0.648	0.258	0.167	0.014	0.285	-0.372	1.000
With Place Neutral Policy	% change with simulation (2)	0.224	0.000	0.000	0.591	0.082	0.101	0.139
	contribution to % change in GDP (1) X (2)	**0.145**	**0.000**	**0.000**	**0.008**	**0.023**	**-0.038**	**0.139**
With Place Neutral Policy	% change with simulation (3)	0.101	0.000	0.500	-5.806	0.102	0.123	0.051
	contribution to % change in GDP (1) X (3)	**0.066**	**0.000**	**0.084**	**-0.081**	**0.029**	**-0.046**	**0.051**

Results

28

BOTE: National and Regional GDP

(With our place neutral)

$$y = \sum_{1}^{r} S_r * y_r$$

Where, y –national GDP
Yr – regional GDP
Sr – Region r's share in national GDP in base case

	Western	Southern	Sabara-gamuwa	Central	Uva	Eastern	North Western	North Central	
(S_r) **share in national GDP**	0.453	0.106	0.059	0.098	0.046	0.060	0.093	0.050	1.000
(y_r) **% change**	0.081	0.136	0.150	0.131	0.194	0.209	0.189	0.425	
$(S_r y_r)$ **Contribution to % change in national GDP**	0.037	0.014	0.009	0.013	0.009	0.013	0.018	0.021	**0.139**

Results

29

BOTE – Decomposition: Regional GDP (Income)

(With our place neutral policy)

y= SK * K +SL * L +SN * N + a + tax

NB: All values indicate the % contribution of the variable to change in national GDP

	(SN * N) Land	(SL * L) Labour	(SK * K) Capital	(a) Ind	(tax) PRODTAX	(tax) ComTax	(y) Total GDP
Western	0	0.033	0	0.001	0	0.003	0.036
Southern	0	0.011	0	0.003	-0.001	0.001	0.014
Sabaragamuwa	0	0.007	0	0.001	0	0.001	0.009
Central	0	0.011	0	0.001	0	0.001	0.013
Uva	0	0.007	0	0.002	0	0.001	0.009
Eastern	0	0.009	0	0.004	-0.001	0.001	0.012
NorthWestern	0	0.013	0	0.004	-0.001	0.001	0.017
NorthCentral	0	0.014	0	0.007	-0.002	0.001	0.021
Northern	0	0.005	0	0.002	-0.001	0	0.007
Total	0	0.11	0	0.026	-0.007	0.01	0.139

Results

30

BOTE – Decomposition: Regional GDP (Expenditure)

(With our place neutral policy)

Yr = Cr + Ir + Gr + Inr + (X – M)r + (RX-RM)r + net Mar

NB: All values indicate the % contribution of the variable to change in national GDP

	HOU	INV	GOV	STOCKS	EXP	IMPORTS	REXPORTS	RIMPORTS	NETMAR	Total
Western	0.150	-0.024	0.000	0.177	0.081	0.102	0.161	0.197	0.055	0.080
Southern	0.201	-0.015	0.000	0.544	0.000	0.000	0.115	0.110	0.197	0.135
Sabaragamuwa	0.240	0.009	0.000	0.522	0.000	0.000	0.139	0.154	0.053	0.149
Central	0.216	0.016	0.000	0.385	0.000	0.000	0.134	0.133	0.059	0.131
Uva	0.302	0.042	0.000	0.707	0.000	0.000	0.168	0.180	-0.009	0.193
Eastern	0.262	0.003	0.000	1.068	1.003	-0.350	0.267	0.130	-0.027	0.209
NorthWestern	0.285	0.020	0.000	0.764	0.000	0.000	0.146	0.159	0.103	0.188
NorthCentral	0.559	0.106	0.000	1.299	0.000	0.000	0.497	0.376	-1.092	0.425
Northern	0.262	0.017	0.000	0.810	0.000	0.000	0.215	0.131	0.118	0.195
Total	0.224	0.000	0.000	0.607	0.082	0.102	0.171	0.171	0.000	0.139

Results

31

BOTE – Decomposition: Industry contribution to GDP

(With our place neutral policy)

NB: All values indicate the % contribution of the variable to change in national GDP

	TempCoeff	Western	Southern	Sabara-gamuwa	Central	Uva	Eastern	North Western	North Central	Northern	Total	Cumulative
	Total	0.033	0.013	0.008	0.012	0.008	0.012	0.016	0.020	0.007	0.129	
1	paddy	0.001	0.003	0.001	0.001	0.002	0.004	0.004	0.007	0.002	0.024	18%
2	trade	0.005	0.002	0.002	0.002	0.001	0.001	0.003	0.002	0.000	0.019	33%
3	finance	0.009	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.015	45%
4	r_mil	0.001	0.002	0.001	0.001	0.001	0.002	0.002	0.004	0.001	0.015	57%
5	L_trans	0.003	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.001	0.012	66%
6	r_est	0.007	0.001	0.000	0.001	0.000	0.000	0.001	0.001	0.000	0.011	75%
7	f_be_nec	0.003	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.009	82%
8	constr	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.004	85%
9	r_petro	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	87%
10	electicity	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.003	89%
11	vege	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	91%
12	pro_f_v	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	93%
13	tea_lvs	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	94%
14	tea	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	94%
15	tobac	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	95%
16	apparel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	96%
17	coco	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	96%
18	insura	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	96%
19	postal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	97%
20	serv_nec	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	97%

Results

32

BOTE – Decomposition: Industry contribution to GDP

(With our place based policy 1: irrigation development in Northern)

NB: All values indicate the % contribution of the variable to change in national GDP

	TempCoeff	Western	Southern	Sabara-gamuwa	Central	Uva	Eastern	North Western	North Central	Northern	Total	Cumulative
	Total	-0.0012	0.0008	0.0002	0.0016	0.0007	0.0012	0.0013	0.0019	0.0441	0.0504	
1	constr	-0.0006	-0.00003	0.0000	-0.0001	0.0000	0.0004	-0.0001	0.0001	0.0350	0.0347	49%
2	finance	0.0030	0.0003	0.0002	0.0004	0.0002	0.0003	0.0004	0.0004	0.0021	0.0073	60%
3	r_est	0.0034	0.0003	0.0002	0.0003	0.0001	0.0002	0.0003	0.0003	0.0011	0.0063	69%
4	trade	-0.0017	0.0005	0.0002	0.0005	0.0002	0.0003	0.0010	0.0007	0.0025	0.0041	74%
5	L_trans	0.0005	0.0002	0.0001	0.0003	0.0001	0.0001	0.0002	0.0003	0.0023	0.0041	80%
6	electicity	0.0003	0.0001	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0001	0.0010	82%
7	vege	0.0000	0.0001	0.0000	0.0002	0.0002	0.0000	0.0001	0.0001	0.0003	0.0009	83%
8	f_be_nec	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0003	0.0006	84%
9	tobac	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0005	84%
10	r_petro	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	85%
11	wood	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	85%
12	f_wood	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	85%
13	educa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	85%
14	gla_pro	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	85%
15	coco	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	86%
16	water	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	86%
17	health	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	86%
18	insura	-0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	86%
19	potato	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	86%
20	paddy	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	86%

Results

33

Impact of selected policies on regional disparity

- **Regional disparity at base case and post simulation situations**
- **indicator MD_W is used in analyzing regional disparity in base and post simulation situations**

$$MD_w = \left(\sum_{i=1}^{n} (|Y_i - \bar{Y}|) \frac{P_i}{P} \right) / \bar{Y}$$

Further details

1. "Regional Disparities in Sri Lanka: An Empirical Analysis", **Asia-Pacific Development Journal, Vol 21, No2** http://www.unescap.org/sites/default/files/5-Part4-Wijerathana.pdf

where Y_i is the per capita GPDP of i^{th} province, is per capita GPDP of the country, P_i is population of i^{th} province, N is the number of provinces and P is population of the country

In our base year MD_W = 0. 0.33842

At Post Simulation

- **with uniform fertilizer subsidy, MD_W =** 0.33789
- **with a Irrigation Project in North, MD_W =** 0.33785

Results

34

Impact of selected policies on regional disparity

Policy	In Short Run		In Long Run	
	value	% change	value	% change
	0.33842		0.33842	
Place-neutral Policy - Uniform fertilizer subsidy (as at 2011)	0.33789	-0.157	0.33744	-0.290
Place-based Policy - Region 1 **Irrigation project in North** (reduced subsidy in all regions)	0.33785	-0.168	0.33833	-0.028
Place-based Policy - Region 2 **Irrigation project in East** (reduced subsidy in all regions)	0.33787	-0.164	0.33827	-0.044
Place-based Policy - Region 1 **Fisheries Habour project in North** (reduced subsidy in all regions)	0.33785	-0.168	0.33749	-0.274

- **Regional disparity reduction impact of *place-based* policy is comparatively higher in short run but not in long run**

Results

35

Summary - Impact of selected policies (Preliminary Results)

Policy	In Short Run		In Long Run	
	National GDP	Regional Disparity Index	National GDP	Regional Disparity Index
Place-neutral Policy - Uniform fertilizer subsidy (as at 2011)	**0.140**	-0.157	**0.054**	**-0.290**
Place-based Policy - Region 1 **Irrigation project in North** (reduced subsidy in all regions)	0.051	**-0.168**	0.007	-0.028
Place-based Policy - Region 2 **Irrigation project in East** (reduced subsidy in all regions)	0.051	**-0.164**	0.010	-0.044
Place-based Policy - Region 1 **Fisheries Habour project in North** (reduced subsidy in all regions)	0.051	**-0.168**	0.097	-0.274

Note: **we assumed that Fertilizer subsidy was not reestablished during our long run simulation period. The money saved by the government was kept as a budget surplus**

Conclusions

36

- **Our experiment suggest that in short run place neutral policies is better in terms of National growth while place based policies are better in terms of reducing Regional disparity, In long run place neutral policy is better both in growth and disparity reduction, however this may vary with the industry and policy considered**
- **Our simulations highlight the usefulness of the model in analyzing the economy-wide effects of both Place-based and Place-neutral policy scenarios**
- **The simulation of the Sri Lankan policies supports the argument that no policy can be purely Place-based or place-neutral in terms of impact**

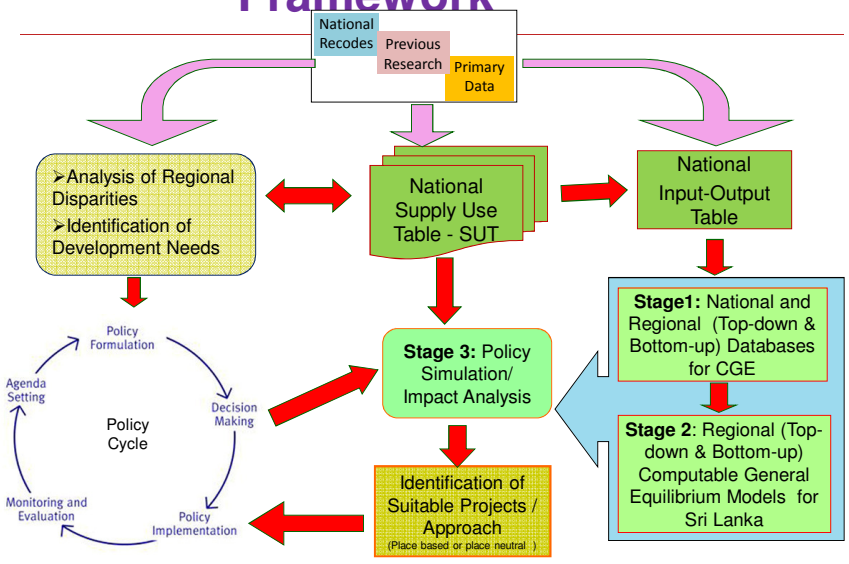
37

Conclusions

- Simulations using our bottom-up model can assist in identifying the order of magnitude and spatial pattern of regional impact of policies
- Output from a multi-regional CGE model can effectively linked with convergence analysis in identifying the impact of suggested policies on regional disparity
- Bottom up regional CGE modeling approach can usefully be employed in identifying relevant policies for regionally balanced economic growth

38

The Research Framework



39

Thank You

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Your comments and questions are welcome

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Introduction

Place-based Verses Place-neutral Policies

Development policies designed without explicit consideration to space is called as "place-neutral" or spatially blind policies and those policies are targeted in generating efficiency, guaranteeing equal opportunities and improving the lives of individuals wherever they live or work. While some development practitioners and reports, including World Development Report 2009, support this approach some others authors, such as Barca (2009); Barca et al. (2012), highlight the importance of spatially targeted or "place-based" development policies.

Growth- and Employment-oriented Fiscal Expenditures in South Korea

10 August 2015

Sang-Ho Nam
KIHASA

I. Introduction

- S. Korea is experiencing low fertility and rapid aging
- Persistent increase in social welfare expenditures
- Need to promote growth and expand employment
- CGE model is a useful tool to analyze the effects of government ex penditures on economic growth and employment
  - ✓Useful in determining the composition of public expenditures

I. Introduction (2)

- standard ORANI-G model is employed to analyze the effects of go vernment expenditures
  - ✓ a version of CGE model with Social Accounting Matrix is selected (M . Horridge and E. Corong 2012)
- '2009' is the most recent available data for South Korea (as of August 2014)
  - ✓ Input-Output and National Income Statistics follow UN's SNA 1993
  - ✓ for the year 2010, detailed investment data by sector were not availa ble

I. Introduction (3)

- The aim of this paper are:
  - ✓ Apply a CGE model for the analysis of growth and employment effect s of government expenditure
  - ✓ Perform pre-eminent analysis of government expenditures
  - ✓ Propose policy recommendations for the growth and employment

II. Model and Database

- Standard ORANI model with 2009 SAM in South Korea
- Production structure, Intermediate inputs, Investment demands, and households demand follows prototype ORANI-G model
- All the standard Neo-classical assumptions are employed:
  - ✓profit maximization,
  - ✓utility maximization, etc.

II. Model and Database (2)

- 2009 Input-Output Table and the National Accounts data compiled by the Bank of Korea was employed as a base data for the CGE model
  - ✓Tax table is obtained by combining producers price and basic price tables of Input-Output tables
- Other information used
  - ✓Household Income Dynamics Survey (Statistics Korea)

II. Model and Database (3)

- Base Data for CGE model in 2009
  - ✓Link Excel sheet for macro SAM here [link]

II. Model and Database (4)

- Columns of SAM represents expenditures, whereas rows represent s receipts
- Row sum must be equal to column sum (i.e., receipts = expenditu res) due to double book-keeping
- Account names for 2009 SAM:
  - ✓1 Firm, 2 DomCom, 3 ImpCom, 4 Labor, 5 Capital, 6 ProdTax, 7 Com Tax, 8 Tariff, 9 DirTax, 10 Households 11 Enterprises, 12 GovCurrent , 13 GovInvest, 14 PrvInvest, 15 Stocks, 16 ROW

II. Model and Database (5)

- Originally, there are 28 activities (commodities), but
  - ✓26th industry (Education and Health) is divided into Education sector , Health sector, and Social security sector
- Thus the total number of industries become 30!
  - ✓C1 Agric, C2 Coal, Oil, Gas, and Mining, C3 Food and Beverages, C4 T extiles and Leather, (so on) C24 Real Estate Services, C25 Public Ad ministration and National Defense, C26 Education, C27 Health, C28 Social Security, C29, Other Social services, C30 NEC
- Social Security occupies 6.08% in total production, and 12.8% in e mployment

III. Scenarios

- Investigate the growth and employment effects of government con sumption expenditures of 1 Trillion Won
  - ✓ standard short-run closures of ORANI model
- Type of expenditures are: public administration & national defense, education, health, and social security)
  - ✓Scenario 1: Expend. of 1 Trillion Won on Pub. Admin.
  - ✓Scenario 2: Expend. of 1 Trillion Won on Education
  - ✓Scenario 3: Expend. of 1 Trillion Won on Health
  - ✓Scenario 4: Expend. of 1 Trillion Won on Social Security

III. Scenarios (2)

- Gov't Consumption Expenditures in 2009

Sector	Name	Consumption (Trillion)	Share of 1 Trillion (%)
25	Pub Admin & Nat Defense	91.5	1.1%
26	Education	37.0	2.7%
27	Health	33.8	3.0%
28	Social Security	2.4	42.5%
Total		170.3	

IV. Simulation Results

real variables	Pub. Admin	Education	Health	Social Sec.
Real GDP	0.0632	0.0285	0.0155	0.0259
import(cif)	0.0017	-0.0025	0.0003	-0.0051
private consumption	-0.0781	-0.0383	-0.0853	-0.0725
Gov. curr. expenditure	0.4058	0.3381	0.3378	0.3225
gdp deflator	0.0066	-0.0006	-0.0124	-0.0167
(Nominal wage | CPI)	-0.0154	-0.0012	-0.0141	-0.0153
Gov. balance	0.0066	-0.0006	-0.0124	-0.0167
Bud Surp/GDP	-0.0007	-0.0003	0.0000	-0.0001
employment	0.1438	0.0670	0.0392	0.0620

VI. Simulation Results (2)

- Increase in Gov. consumption Expenditure makes GDP and emplo yment to increase.
- Real GDP and employment effects are largest in Public Admin., du e to the increase in private consumption
- Real GDP and employment effects are lowest in 'Health'
  - ✓This is due to the fact that 'Health' sector is more capital intensive
- Social security expenditure has the largest income redistribution e ffect (while 'Public Admin' is the worst!)

VI. Simulation Results (3)

Gov. expend. multipliers

Expenditure On	% Change In Gini	GDP multiplier	Employment multiplier
Social Security	-0.1606	0.5786	0.0186
Health	-0.1432	0.3475	0.0116
Education	-0.0221	0.6039	0.0191
Public Admin.	0.0208	0.6391	0.0199

VI. Simulation Results (4)

Policy priority

priority	Income distribution	Growth & employment
I	Social security	Publicadmin.
II	Health	Education
III	Education	Socialsecurity
IV	Publicadmin.	Health

VII. Conclusion

- Analyzed the output and employment effects of gov. consumption expenditure with 2009 SAM for the S. Korea
- Public Administration & National Defense has the biggest real GDP increase.
  ✓Education is the second largest.
- Social Security expenditure is the most efficient in income re-distribution, and Health is the second.

VII. Conclusion (2)

- For the pre-eminent policy analysis, CGE modeling is a useful tool
- Policy makers should carefully design the policy options for the ex pansion of social expenditure
- Financing methods are also important determinants for the real a ctivity in the economy
- Need to use dynamic CGE model for longer-term analysis

Long Term Economic Growth Projections and Factor Shares

Warwick J. McKibbin
Centre for Applied Macroeconomic Analysis,
Crawford School of Public Policy, ANU
& The Brookings Institution

Presentation to the National CGE Modeling Conference, Victoria University, 10 August 2015

Extension of:

Long term Projections of the World Economy – A Review

Alison Stegman
Warwick McKibbin
CAMA Working Paper 14/2013

Overview

- Methodologies for projecting Global Economic Growth
- Brief Survey of Major Global Models that produce Longer Term Projections
- The G-Cubed Model
- Projections From a Range of Models
- Some Implications for Future Factor Shares
- Summary and Conclusion

Key Points

- Extremely difficult to predict the next 50 years
- History contains many lessons for evaluating future scenarios
- Framework needs to be transparent so that key assumptions and sensitivities can be understood
- Relative prices and sectoral disaggregation are useful for capturing the changing composition of production and consumption

Key Points

- Changes in future Factor Shares depend critically on a range of assumptions but in particular on;
  - The elasticity of substitution between capital and labor which differs across sectors
  - The sectoral sources of economic growth

How to project the World in 2050?

- Many non model based studies project individual countries as islands
- But
  - global exports need to equal imports
  - global investment needs to be funded by global savings
- Models do this in a more consistent fashion

The Models

Table A1 Model Base Studies Surveyed

Projections	Reference
SRES-MESSAGE	IPCC (2000)
USDA	U.S. Department of Agriculture Economic Research Service projection, updated in 2011.
EIA	U.S. Energy Information Administration, International Energy Outlook 2011, released in September 2011, Table A3, A4, A11.
CEPII	Fouré, J. Bénassy-Quéré, A. and Fontagné, L. (2010)
GS2011	GS2011: Wilson, D., Trivedi, K., Carlson, S. and Ursúa, J. (2011) GS2003: Wilson, D. and Purushothaman, R. (2003)
OECD ENV-L	Chateau, J., C. Rebolledo and R. Dellink (2011),
PWC*	PWC2006: Hawksworth, J. (2006) PWC2008: PricewaterhouseCoopers (PWC) (2008) PWC2011: Hawksworth, J. and Tiwari, A. (2011)
K2008	Klinov, V.G. (2008)
DM2010	Duval, R. and de la Maisonneuve, C. (2010)
JCER	Long term forecast team, Economic Research Department, Japan Center for Economic Research (2007)
G-CUBED	McKibbin W. Morris, A. And Wilcoxen, P (2011)

Methodologies and Issues

Theoretical Issues in Forecasting Global Economic Growth

- Sources of output growth
  - Increases in the supply capital, labor, energy, materials
  - Increase in the quality of these inputs
  - Improvements in the way the inputs are used (technical change)
  - Improvements in the way inputs are allocated across the economy
  - Improvements in the way inputs are allocated across the world

10

Theoretical Issues in Forecasting Global Growth

- Convergence
  - What converges?
    - Incomes per capita
    - GDP per capita
    - Aggregate level or rate of technical progress
    - Sectoral level or rates of technical progress
  - The empirical literature examines conditional versus unconditional convergence of income per capita and to a lesser extent output per worker (productivity)
  - Little empirical evidence of unconditional convergence across large numbers of countries

11

Model Methodologies

- Generally, the GDP projections are based on an aggregate Cobb-Douglas production function for output. The standard specification with constant returns to scale and Hicks-neutral technology is
- (1) $$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{1-\alpha}$$
- where *Y* is output, *K* is (physical) capital, *L* is labor, *A* is the technological progress variable, α is the output elasticity of capital (generally assumed to be 1/3), *i* is the country subscript and *t* is a time subscript.

- Some models add human capital (GS2011, DM2010, OECD Env-L

$$Y_{it} = K_{it}^{\alpha}(A_{it}H_{it})^{1-\alpha} = K_{it}^{\alpha}(A_{it}h_{it}L_{it})^{1-\alpha}$$

Sectoral hetrogeneity

- Some models model energy (CEPII)

$$Y_{it} = [(A_{it}K_{it}^{\alpha}L_{it}^{1-\alpha})^{\rho} + (B_{it}E_{it})^{\rho}]^{1/\rho}$$

Sectoral Hetrogeneity

- Some models model production functions at the sectoral level and aggregate up.

Input assumptions

- Labor
  - Population growth
  - Labor supply
  - Labor force participation – by sex
  - Detailed demographic adjustment by cohort
  - Human capital and education

Input assumptions

- Productivity Growth
  - Aggregate
    - Exogenous
    - Catchup model
  - Sectoral
    - Exogenous
    - Catchup model

Input assumptions

- Capital Accumulation
  - Based on available savings
    - Nationally or globally
  - Based on a simple accelerator model
  - Based on intertemporal optimization

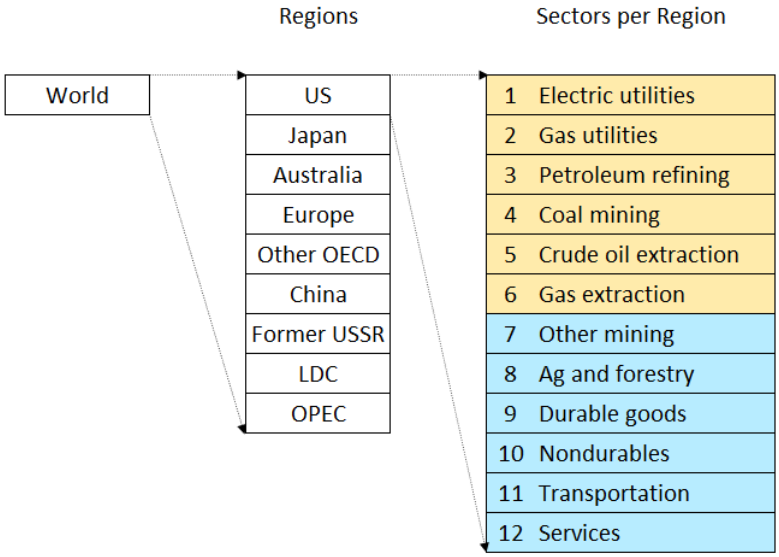
G-Cubed Model

Many versions with different sectoral and country coverage

G-Cubed Model

- Developed by McKibbin and Wilcoxen since 1991
- Documented in *Handbook of CGE Modeling*, Chapter 17, North Holland
- Used for policy analysis and scenario planning by governments, international agencies, corporations, banks, and academic researchers.

The G-Cubed model



Simulations with the Intertemporal General Equilibrium Global Model

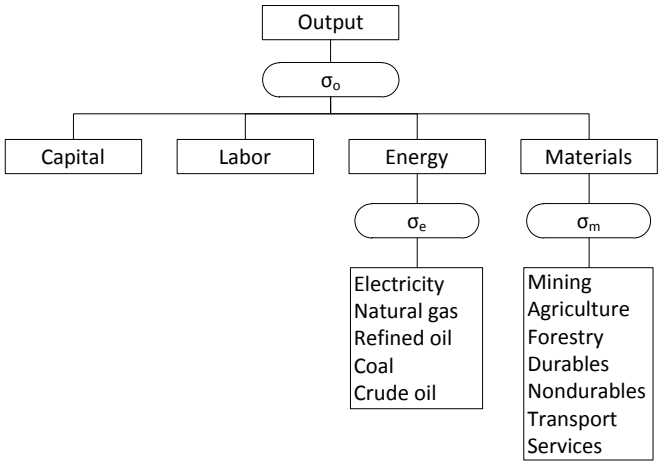
- Hybrid of macro models (dynamic stochastic general equilibrium model) and computable general equilibrium models
- Allow for inter-industry input-output linkages, capital movements, and consumption and investment dynamics.
- Annual frequency with detailed macroeconomic and sectoral dynamics
- Extensive econometric estimation of key consumption and production substitution elasticities

22

Main Features of the G-Cubed Model

- Firms produce output using capital, labor, energy and material inputs and maximize share market value subject to costs of adjusting physical capital.
- Households maximize expected utility subject to a wealth constraint and liquidity constraints.
- A mix of rational and non rational expectations.
- Short run unemployment possible due to wage stickiness based on labor institutions.
- Financial markets for bonds, equity, foreign exchange.
- International trade in goods, services and financial assets.

Firm Model



Process of Generating Future Projections

- Given initial capital stocks in each sector, the overall output growth rate of an economy depends;
  - the growth in LATC (from convergence model),
  - labor force (exogenous in the long run);
  - the accumulation of capital (endogenous)
  - the use of materials input by type (endogenous)
  - the use of energy inputs by type (endogenous)

25

An Aside on carbon emissions

- The projection of carbon emissions will depend on the growth of the demand for carbon intensive inputs (oil, natural gas, coal).
- There is no reason for a fixed relationship between growth in the economy and growth in carbon emissions
- The outcomes depend on the trend inputs and the structural change in the economy induced on the supply side and demand side of all economies.

26

Results for All Models 2010 to 2050

Figure 1: Survey Projections of Real GDP per Capita Growth for the US and China

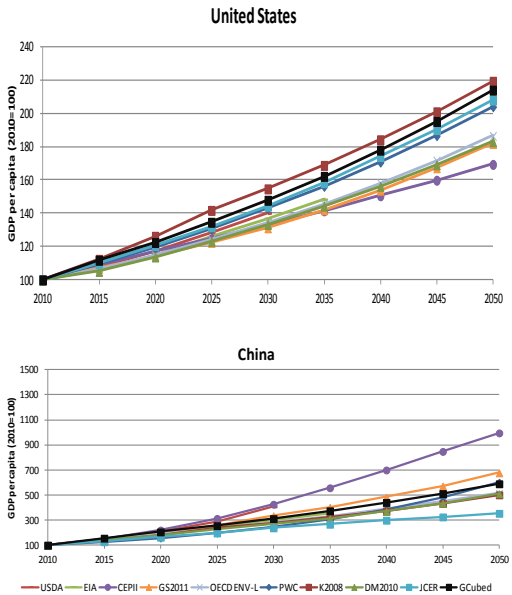


Figure 5: Total Growth Projections of GDP per Capita for Regions

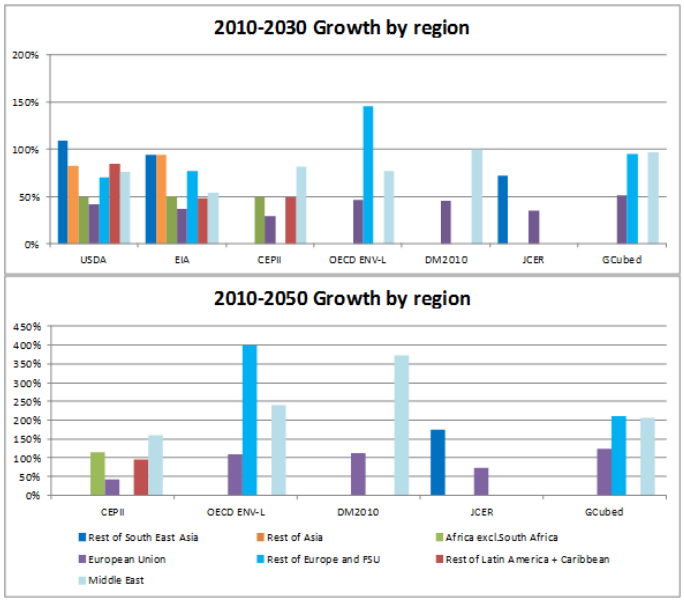
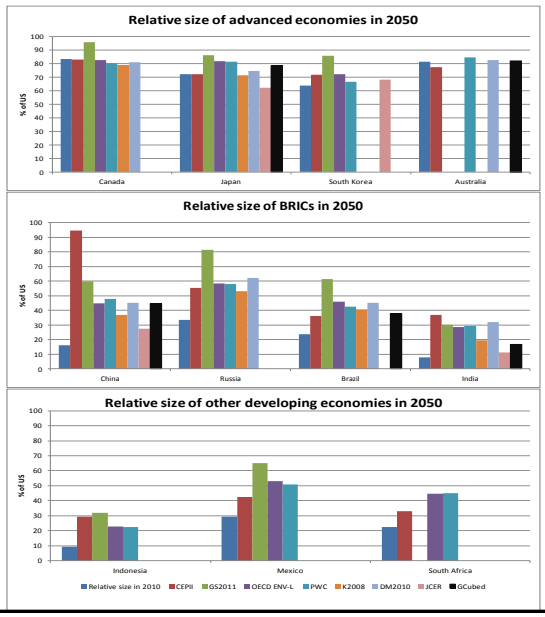


Figure 6: Projections of GDP per Capita Levels Relative to the United States



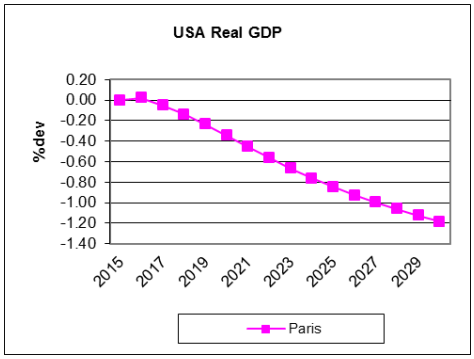
Implications for Factor Shares

(Picketty)

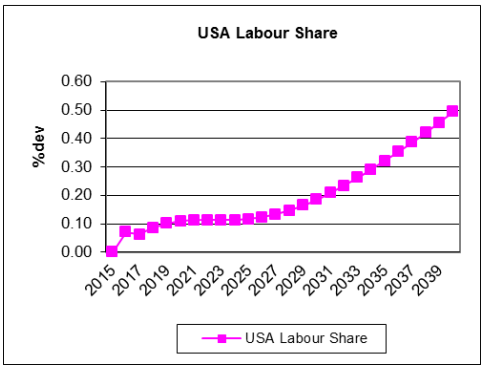
scenarios

- What if LATC is expected to fall by 0.1% per year in the US over coming decades?
- (very preliminary)

Fall of 0.1% per year in LATC



Fall of 0.1% per year in LATC



Role of substitution elasticity

- If factor are paid their marginal product and markets are competitive then
- If σ=1 factor shares are constant
- If σ>1 capital share rise as K/Y rises
  - Labor share falls as K/Y rises
- If σ<1 capital share falls as K/Y rises
  - Labor share rise as K/Y rises

Estimated KLEM Elasticities

01 electric utilities	0.2
02 gas utilities	0.8096
03 petroleum refining	0.5426
04 coal mining	1.703
05 crude oil extraction	0.4934
06 gas extraction	0.4934
07 mining	0.5
08 agriculture, forestry, fishing & hunting	1.283
09 durable manufacturing	0.4104
10 non-durable manufacturing	1.0044
11 transportation	0.5368
12 services	0.2556

Implication

- If share of sectors with $\sigma>1$ is large then uniform slowdown with tend to lower labor's income share economy wide
  - Agriculture with $\sigma>1$; most $\sigma<1$
- If share of sectors with $\sigma>1$ is small then a large fall in productivity growth in those sectors is required to get falling labor share across the economy

Note

- Consistent with Matthew Rognlie (2015) results

Conclusion

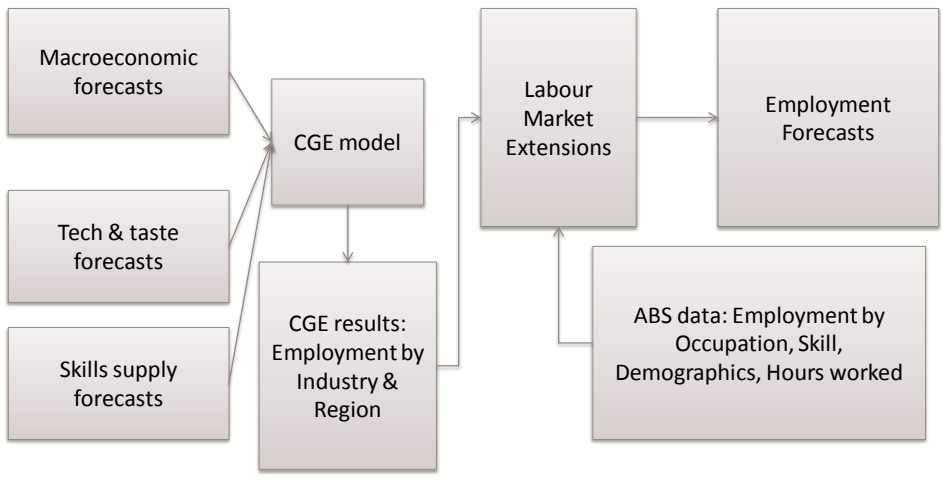
- Long term growth projections are difficult
- Results are very sensitive to assumptions
- Given estimated elasticities of substitution for most sectors are less that unity it is likely that a slowdown in growth would raise the labour share of income unless agriculture is a dominant part of the economy

WWW.GCUBED.COM

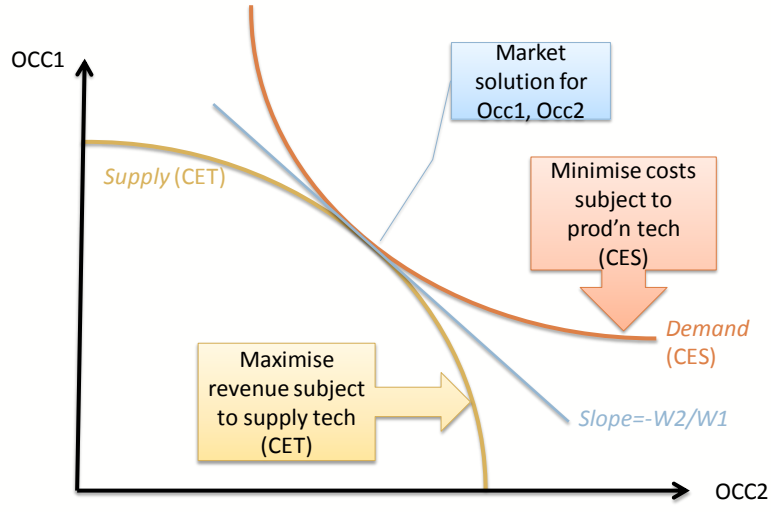
Labour market forecasting in a CGE model

National CGE Workshop
CoPS, Victoria University
August 10, 2015
Janine Dixon and Tony Meagher
janine.dixon@vu.edu.au

VU Employment forecasts



Market for occupations



Labour market modelling in VU-Nat

(1) Demand: familiar CES

$$l\_s_{io} = l\_os_i - \theta\left(w\_s_{io} - \sum_{k\in OCC} SI_{ik} w\_s_{ik}\right)$$

(2) Supply: CET* – requires OCC x SKILL wage bill

$$l_{os} = \frac{\tau}{\tau+1} b_s + \tau\left(w_{os} - \sum_{j\epsilon OCC} S_{js} w_{js}\right)$$

** Alternatively we can use CRESH (Giesecke et al 2014)*

Modelling (2)

(3) Market Clearing (wage bills)

$$\sum_{i \in IND} VLAB_{io}(l\_s_{io} + w\_s_{io}) = \sum_{s \in SKILL} VSKL_{os}(l_{os} + w_{os})$$

(4, 5) Wage setting (labour units)

$w_{os} = fw\_s_o$

$w\_s_{io} = fw\_s_o$

Modelling (3)

(6) Convert labour units to persons

$pers_{os} + hpp = l_{os}$

(7) Market clearing (persons)

$$\sum_{s \in SKILL} PERS_{os} pers_{os} = \sum_{i \in IND} PERS\_S_{io} pers\_s_{io}$$

(8) Determine persons by industry

$pers\_s_{io} = l\_s_{io} + f\_pers_o$

Modelling (3a) – an aside

Why do we need f_pers$_o$?

$$pers\_s_{io} = l\_s_{io} + \left\{ \sum_{s=1}^{SKL} \frac{PERS_{ios}}{PERS\_S_{io}} w_{os} - \sum_{s=1}^{SKL} \left(\frac{PERS_{ios}}{PERS\_S_{io}} - \frac{VLAB_{ios}}{VLAB_{io}} \right) l_{ios} \right\}$$

NOT uniform across skills

The whole term in {} is *f_pers$_o$*

This term: **Positive** for low-wage skills, **negative** for high-wage skills

Modelling (4)

(9) Aggregate by skills

$$\left(\sum_{o \in OCC} PERS_{os} \right) pers\_o_s = \sum_{o \in OCC} PERS_{os} pers_{os}$$

(10) Aggregate

$$\left(\sum_{o \in OCC} \sum_{s \in SKILL} PERS_{os} \right) pers\_os = \sum_{s \in SKILL} \sum_{o \in OCC} PERS_{os} pers_{os}$$

Modelling (5)

(11) Enables shock to skill composition, holding total persons exo.

$$skillrat_s = pers\_o_s - pers_{os} + fskill$$

Model equations: summary

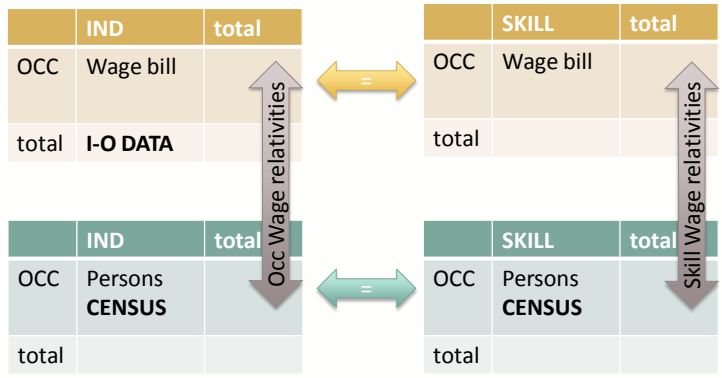
Eq'n	Short description	Size	Endo
(1)	CES demand	IND*OCC	l_s(i,o)
(2)	CET supply	OCC*SKILL	l(o,s)
(3)	Market clearing (wage bill)	OCC	fw_s(o)
(4)	wage setting	OCC*SKILL	w(o,s)
(5)	wage setting	IND*OCC	w_s(i,o)
(6)	labour units to persons	OCC*SKILL	pers(o,s)
(7)	Market clearing (persons)	OCC	f_pers(o)
(8)	persons by industry	IND*OCC	pers_s(i,o)
(9)	aggregate persons	SKILL	b(s)
(10)	aggregate persons	1	fskill
(11)	ratio	SKILL	pers_o(s)

Exo
pers_os
skillrat(s)
l_os(i)
hpp

Data requirements

Wage bills: IND * OCC and OCC * SKILL

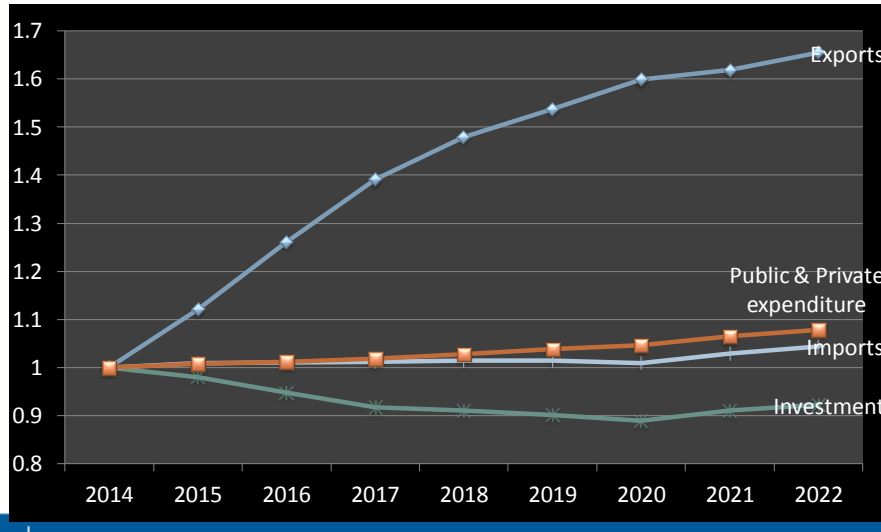
Head counts: IND * OCC and OCC * SKILL



Insights from 2014 VUEF

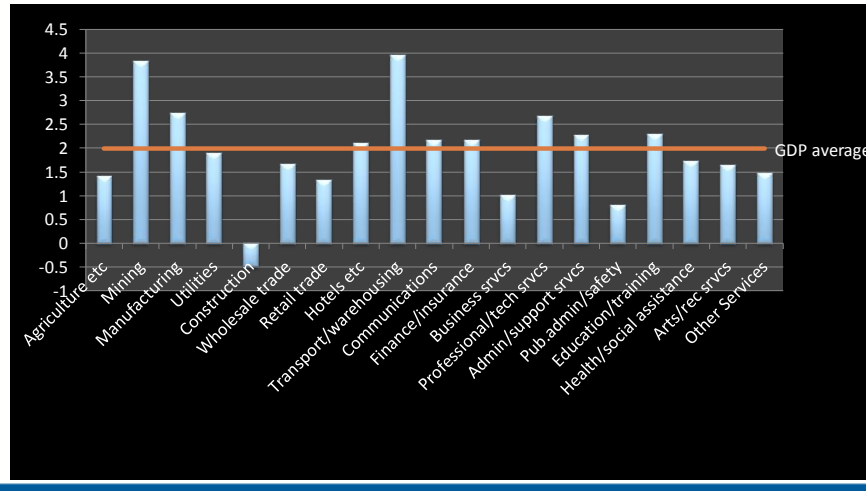
- Macro overview
- Industries
- Regions
- Occupations

Macro overview



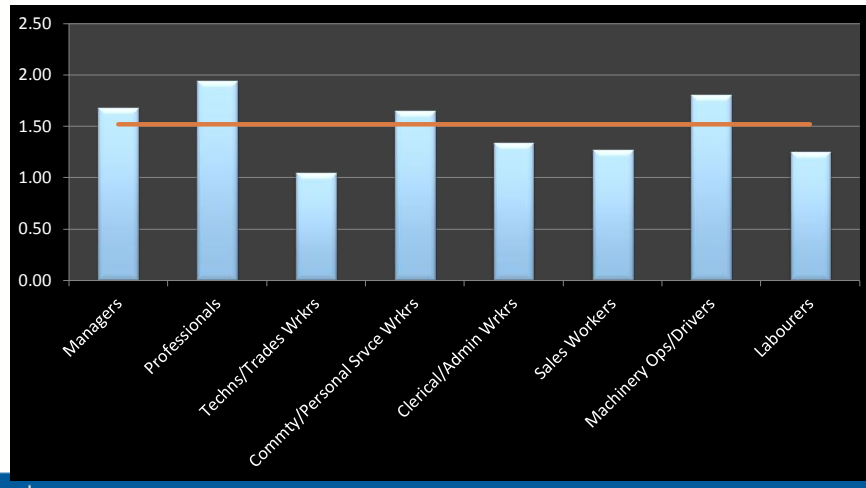
Industry outlook

Average annual growth rate of output, 2014-2022



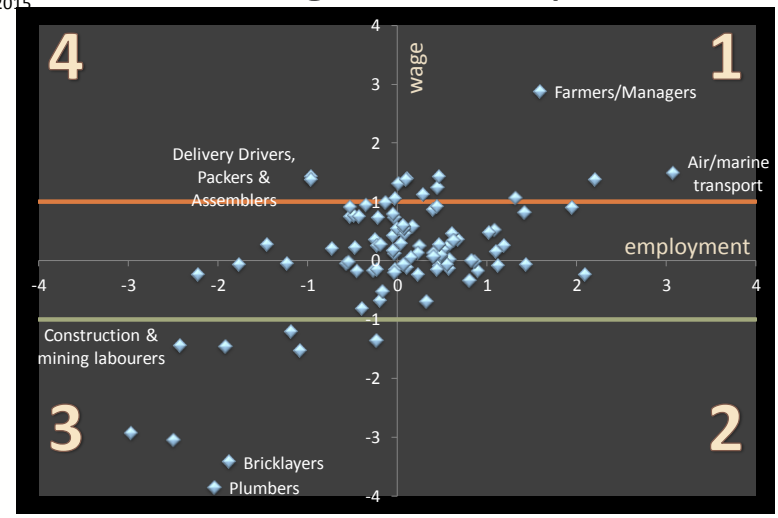
Average annual growth rate of employment, 2014-2022

Occupations

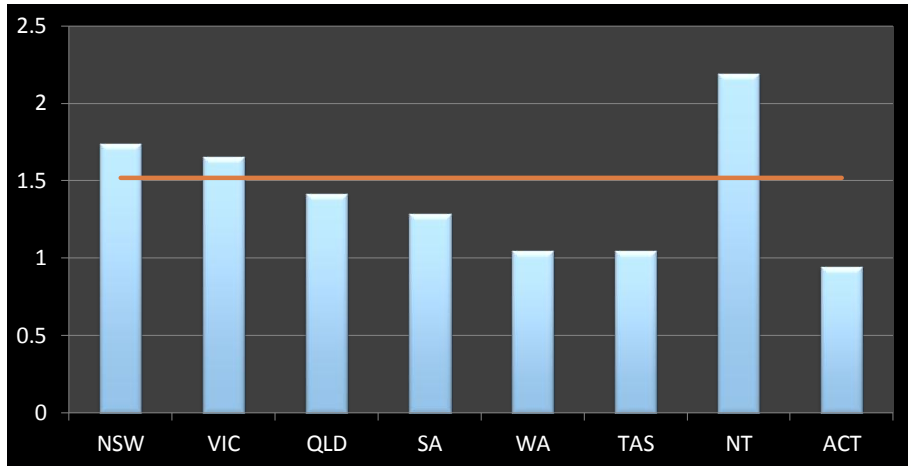


% growth by ANZSCO 3-digit occupation, distance from average, 2015

Shortage and surplus



Regions



Labour market project: future

- Age/gender dimension in skills
- Endogenous skill acquisition (rate of return theory)
- Detailed tech and taste change
- Nesting with capital/automation
- Skill shortages

Economic Evaluation of Investments in Airports – Old and New Approaches

Peter Forsyth, Monash University and Southern Cross University
Hans-Martin Niemeier, Bremen UAS, and
Eric Njoya, Huddersfield University

National CGE Workshop
10 August 2015

The Issue…

How can we best assess whether a country gains or loses from having a new airport or a new runway ?

The growing role of CGE models

Agenda

Background

Traditional Technique- CBA

Newer Technique- CGE

Conclusions

Background

Types of Assessment Problems

- Does the country gain from investing in a new airport?
- A new runway for or terminal for an existing airport?
- Or, from subsidies to an airport?
- Or implementing a curfew at an airport?

The Three Techniques

- There has been a considerable use of three techniques of assessment-

1. Cost Benefit Analysis (CBA)
2. Economic Impact Analysis (EIA)
3. Computable General Equilibrium (CGE) models

- All have been used in assessing Airports

Key Evaluation Question

- CBA long established, CGE new and evolving
- EIA used over last 30 or so years, CGE since about 2000
- Key issue: will the economy be better off as a result of making the airport investment?
- CBA answers this
- CGE can answer
- EIA, which is used a lot, cannot – will not be discussed further

Analysing the Techniques- CBA

Airports-CBA

- UK Commission of the Third London Airport (Roskill), 1970
- Second Sydney Airport 1970s
- Several Bureau of Transport Economics studies
- A number of studies of large and small airports
- Recent Dept for Transport study for London (2003)
- Boris's airport for London

Old Issues with CBA

- Noise and local externalities
- Distribution (difficult to handle)
- Value of time (very important parameter)
- Airport pricing and congestion
- Unemployment (usually assume full employment or an arbitrary shadow wage)
- Land and accessibility

New Issues

- Measuring tourism benefits
- Wider economic benefits (WEBs) of air transport
- Benefits of connectivity- and aspect of WEBs
- Climate change externalities

Is CBA Sufficient?

- CBA does have limitations:
- Too partial equilibrium: obvious when measuring indirect effects, shadow pricing (theory says you should use a GE approach)
- Handling global emissions, such as greenhouse gas emissions
- Distributional effects- not sufficient to only measure immediate incidence
- Handling widely spread small effects, such as tourism benefits
- Employment effects: a problem with CGE but can go further than CBA

Analysing the techniques- CGE

Can Results from CBA and CGE be Compared?

- Many think not (esp. in Australia)
  - Output of a CBA is a measure of net benefit, or welfare
  - Outputs of a CGE model are measures of impact on the economy on variables such as GDP, Consumption, Employment etc
- I.e., “CGE models do not measure welfare, and results cannot be compared”
- To evaluate whether a country gains or loses from a change, a welfare measure is essential
- Sometimes people claim that measures such as GDP, or Consumption are a “rough measure of welfare”
- They aren't

CGE Models and Welfare

- CGE models can measure welfare
- They have demand systems, and can measure consumers surplus, producers surplus, tax changes etc
- A straightforward matter to include a welfare measure in the outputs of a CGE model (many models do)
- Can produce results in exactly the same metrics as CBA
- -in addition to a range of other useful results

Using CGE models to Evaluate Projects in Europe

- Quite common in Europe
- Esp. in transport
- Models used do have a welfare measure
- See Broecker and Mercenier, 2011, for a review- (no Australian studies mentioned-why?)
- B and M argue that CGE supersedes CBA for evaluation
- No need to assume perfect competition, that distribution does not matter, that there are no externalities etc.

Airports-CGE

- Assessment of Melbourne curfew (2003), Madden 2004
- Japan study – Haneda expansion (2005)
- New runway for Brisbane (2007)
- Australian Regional Airports (2007)
- Subsidies to regional airports (Forsyth, 2007)
- New Sydney study (2012)
- Airports Commission UK (2013/2015)

Airports	ype of tudy	elfare Measure	E ternalities	ourism	Unemployme nt	evel of Disaggreg.	omments
Mel ourne 00 Madden 00	Impact of Curfew	no	no	implicit	flexible labour market	36	
ris ane 00	New Runway	no	no	implicit	flexible labour market	?	limited detail
ydney 01	Additional Airport	no	no	Not used for explicit evaluation	flexible labour market	58	
okyo aneda 005	New Runway	yes	no	implicit	fixed	?	spatial model
ondon 01 015	Multiple Investments a several airports	Yes?	no	No Tourism	Variable	23	spatial model
Airports in Australian Regions 01	Study of Benefits and Impacts of Subsidies	Yes	No	Tourism model	Fixed and Variable	50+	
Regional Airport u sidies 00	Evaluation of subsidies	yes	No	Explicit Tourism	Fixed and variable	50+	

Where CGE can Improve Evaluation of Airport Investments

- Welfare measurements - not difficult, but many examples do not have them
- Capturing general equilibrium effects - a key advantage of CGE
- Externalities and non market goods- CGE can handle global externalities well (eg greenhouse emissions)
- Tourism benefits- CGE models can measure these- partial CBA cannot
- Exploring employment effects- you don't have to assume full employment
- Analysing distribution
- Measuring wider economic benefits (WEBs)
- Validation- a useful check

Second Sydney Airport

- Two separate studies- a CBA, and a CGE- used to answer separate questions
- CBA- estimate *net benefits* of different sites
- CGE- estimate when the airport is worthwhile
- A missed opportunity---
- CGE results could have been used to estimate the benefits of inbound tourism in the CBA
- Instead, it was assumed that benefits were 25% of tourism expenditures (CGE estimates suggest 5-15% of expenditures- Aust, UK)
- And tourism benefits are about 40% of measured benefits in Sydney
- The *when* question was answered by a CGE study without any welfare measure

London Study 2015

- Published in July
- Additional runways for Heathrow or Gatwick airport
- Heathrow selected
- Data from a CBA plus other sources

Key Aspects

- Welfare –Some discussion, but GDP used as the “welfare” measure
- General Equilibrium – estimated
- Tourism benefits- not counted; tourists regarded as residents
- Distribution- not measured
- Externalities- not measured, though CBA includes
- Employment- variable, but not analysed (makes the use of GDP questionable)
- Wider Economic Benefits (WEBs)- a BIG part of the impacts; measured using an econometric measure of how additional air travel increases productivity and inserted into the model

Conclusions

Conclusions and Further Work

- Limited number of examples of using CGE to evaluate airport investments, but becoming more accepted
- A CGE approach addresses a number of limitations of CBA
- Several studies have used quite small models
- To assess whether the investment leads to an economy which is better off, really need to have a welfare measure
- Full potential of CGE often not made use of (e.g., exploring employment effects, emissions estimates etc.)
- Measurement of WEBs is in its infancy- but this form of benefit is very large
- So far, no airport study has been very “spatial”
- E.g., could measure the value of time more accurately

Thank You!

National CGE Workshop, Centre of Policy Studies

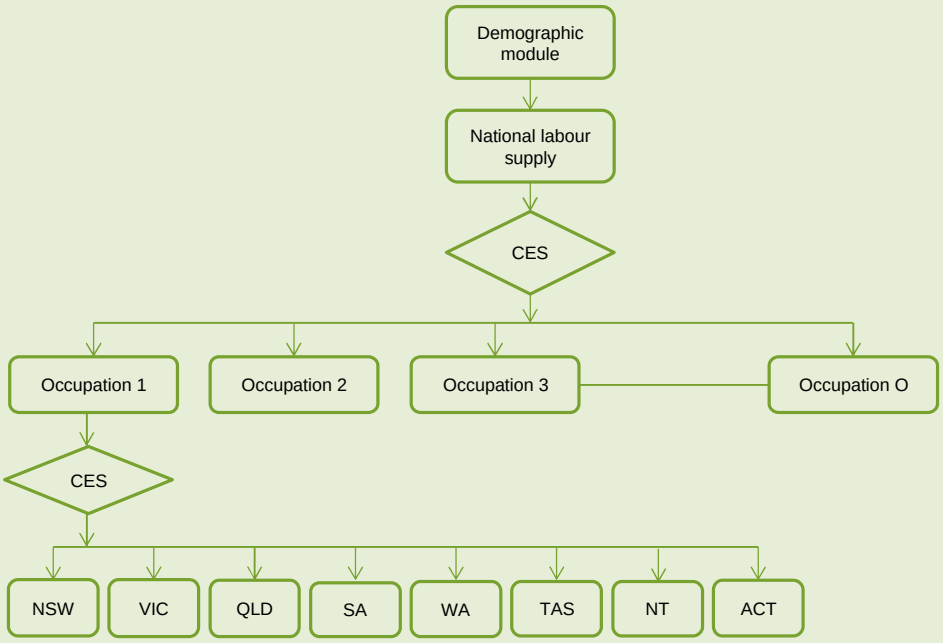
An aspect of modelling the labour market in the VUMR model

10 August 2015

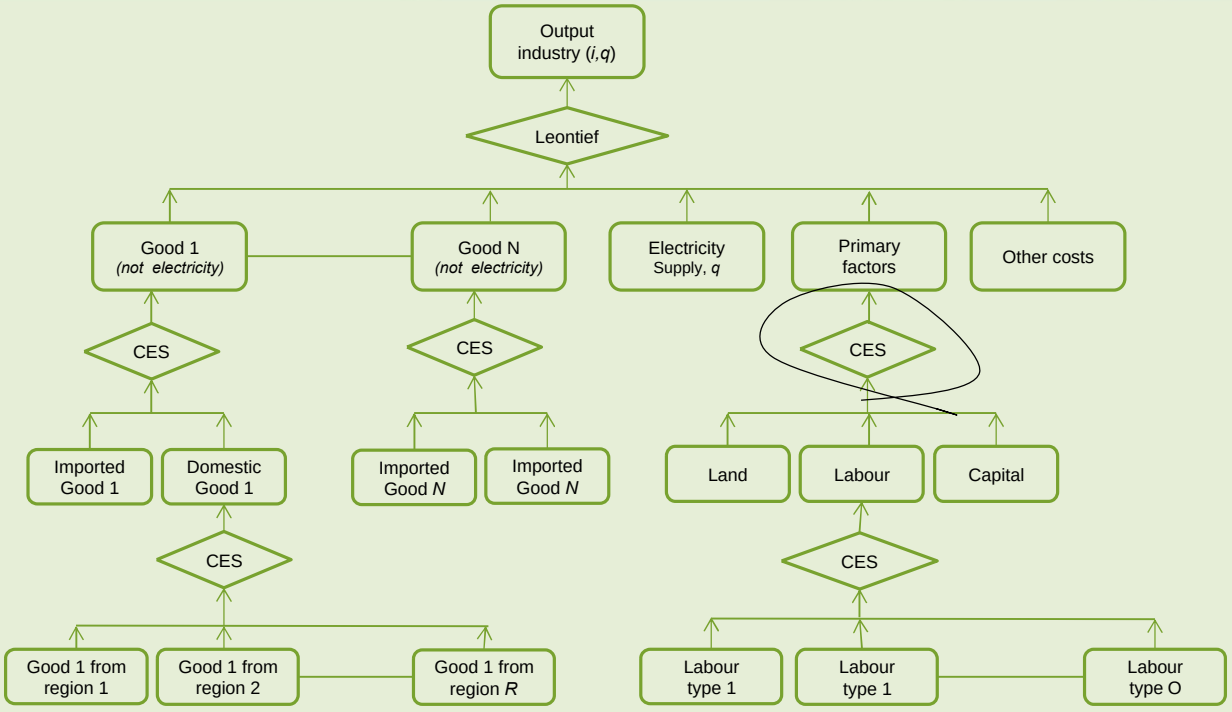
Some aspects to consider when modelling a labour market scenario in VUMR

- What is the footprint of directly affected workers?
- How to incorporate directly affected workers into the model's labour supply and labour demand nests?
- What are the key labour market parameter values?
  - How do they compare with the Australian literature?

Supply of labour across occupations & regions in VUMR varies with changes in competitiveness



Labour demand by occupation in VUMR varies with industry activity and competitiveness



What are the key labour market parameter values in VUMR?

	VUMR default	MONASH (Dixon et al 2010)
Labour demand		
Award/non-award substitution	n/a	2
Occupational substitution	0.35	0.35
Labour/capital substitution	0.5	0.15
Labour supply		
Award/non-award transformation	n/a	"high"
Move between industries	implicit	moderate
Occupational transformation	0.1	"little"
Interstate migration	1	n/a
Labour market adjustment: move out of unemployment	Returns to baseline after 5-7 years	"weak"

Focusing on the labour/capital substitution parameter in VUMR

- VUMR assumes a CES production function with CRS
  $Y=A[a_L L^p + a_K K^p]^{1/p}$ [in simplified form]

- Labour demand is given by firms minimising costs s.t. the production function
  $L=Ya_L^{1/(1-p)}[W/P_{ave}]^{-1/(1-p)}$
  - in log terms: $\ln L = \sigma.a + \ln Y - \sigma.\ln[W - P_{ave}]$
  - in percentage change terms: $l = y - \sigma(w - p_{ave})$
- Labour-capital substitution elasticity, $\sigma = 1/(1-p)$
- How does the default parameter value of 0.5 in VUMR compare with the empirical literature?

Estimates in the Australian literature on employment

	One year or less	*More than one year*
Employment measured in persons		
Daly et al (1998)	-2 to -5 (youth)	
Dungey & Pitchford (1998)		-0.4
Downes & Bernie (1999)	-0.3 to -0.4	-0.82
Lewis & MacDonald (2002)		-0.8
Dixon, Freebairn & Lim (2004)	-0.11	-0.32
Yuen & Mowbray (2009)	-0.2	-0.49
Hutchings & Kouparitsas (2012)		-0.40
Employment measured in hours worked		
Debelle & Vickery (1998)	-0.21 (1978-97)	-0.4 (1978-97)
	-0.51 (1969-97)	-0.68 (1969-97)
Lewis & MacDonald (2002)		-0.9

But, what does the Australian empirical literature actually measure?

- Most studies estimate error correction models of the form

$$\ln L_t = \alpha + \alpha_0[\ln L_{t-1} - \alpha_1 \ln(W/P)_t + \alpha_2 \ln Y_t + \alpha_3 t\,] + u_t$$

employment | real wage | output | time trend | error term

- Based on a CES production function with CRS $Y=A[a_L L^p + a_K K^p]^{1/p}$
- Derived from the marginal productivity condition $dL/dY = W/P$
- This implies α_1 is labour-capital substitution elasticity
  - and $\alpha_1 = 1/(1-p) = \sigma$?

The VUMR labour-capital substitution elasticity is consistent with the empirical estimates

	Persons	*Hours*
All employment	0.3 to 0.6	0.4 to 0.7
All employment excluding public sector	0.8	
Range in empirical literature	0.3 to 0.8	0.4 to 0.7
Default VUMR		**0.5**

What does this imply for total employment responsiveness wrt average wages in VUMR?

	Scenario	*Method*	*Year 1*	*Year 3*	*Year 10*
Default VUMR	**Average wage change**	**VUMR**	**-0.8**	**-1.1**	**-1.6**
How does this compare with other studies?					
Lewis & MacDonald (2002)	Assumed 1:1 relationship between output and employment	ECM estimate	-0.8		
Downes & Bernie (1999)	Permanent reduction in NAIRU	TRYM	-1	-2.2	-4.8
Dixon & Rimmer (2000)	Award wage change	MONASH	-0.4	-0.5	-0.8
Dixon, Madden & Rimmer (2010)	Award wage change	MONASH	-0.5	-0.6	-1.2

Wrap up

- The default labour-capital substitution parameter in VUMR is 0.5
- The labour-capital substitution parameter in the Australian empirical literature ranges from 0.3 to 0.7
- This suggests that the default parameter value in VUMR is broadly consistent with the Australian literature

Superannuation within a financial CGE model of the Australian economy

Peter Dixon, James Giesecke, Maureen Rimmer

Centre of Policy Studies, Victoria University, Melbourne.

Presentation to CGE Workshop, Victoria University, August 10th 2015

Overview

1. A financial CGE model of the Australian economy.
2. Investigate a rise in the compulsory superannuation contribution rate.
3. Concluding remarks.

Australian Superannuation System:

- Defined contribution. Tax preferred.
- Employers compelled to assign 9.5% of each employee's wage to personal superannuation accounts.
- Mandated rate gradually rising to 12%.
- Not accessible until retirement age.

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.

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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

Housing stock, inner & outer suburbs

We require behavioural assumptions relating to (s,d) over (f)

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)

Also: R (s,f,d) F (s,f,d)

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

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

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

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

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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%**

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Optimising behaviour: asset agents

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

NB: Foreign asset allocation: 2% vs 19%

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
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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.

ROR sensitive: If rate of return offered by Banks rises relative to rate of return offered by Government, then asset agents adjust their portfolio shares towards Bank liabilities & away from Government liabilities.

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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	Life insurance	NRH	RH
Banks	0	13	793	111	680	352	166	288	29	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

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.

ROR sensitive: If rate of return on equity rises relative to rate of return on loans, liability agents adjust their capital structure shares towards more debt and less equity.

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Equilibration via rates of return, equity valuations & exchange rate

Asset agent (d) / Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	NRH	RH
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- 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

Linked to nominal GDP

Zero pure profit condition

Zero pure profit condition

Asset agent (d) / Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	NRH	RH
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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

Liability agent (s) \ Asset agent (d)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	NRH	RH
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Asset acq. / FA-CAD / Exog. / Asset acq. / Asset acq. / Investment

Walras' law

PSBR

Investment

Wage bill

Exog.

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Behaviour of domestic asset agents

Domestic optimising asset agents:

In year t, domestic optimising agent d:

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

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

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

$S_d = \sum_{s,f} FLOW_{s,f,d}$

End of year asset values weighted by ROR

Valuation effects

New flows

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

Aggregate addition to asset budget (e.g. savings)

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Behaviour of domestic asset agents

Domestic optimising asset agents:

% change in total value of agent (d)'s end of year assets

Average rate of return received by agent (d)

Solution to above problem, in % change form is:

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

End-of-year holdings

Rate of return on instrument (f) issued by (s) held by (d)

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

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

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Behaviour of foreign asset agents

Foreign asset agents:

E1 = FC/AUD, hence E1*AT1 = foreign currency value

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:

$$S_{Fgn} = \sum_{s,f} E1 \times FLOW_{s,f,Fgn} + new\ assets\ in\ oth.count$$ Flow constraint

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

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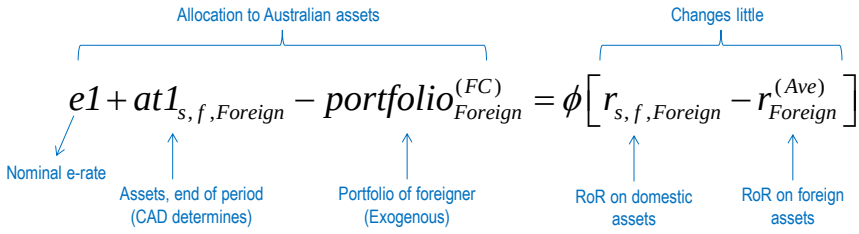
Behaviour of foreign asset agents

Solution to above problem, in % change form is:



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

Behaviour of foreign asset agents

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

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

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

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

$portfolio^{(FC)}_{Foreign} = portfolio_{Foreign} + e1$

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

Households:

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

Foreigners:

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

Superannuation:

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

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Behaviour of liability agent *s*

Liability accumulation:

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

Optimisation problem:

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

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

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

E.g. raise funds to finance Investment, PSBR

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Behaviour of liability agent *s*

Solution to above problem, in % change form is:

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

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

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How to determine R(Inds,Equity,d)

(1) $$R^{(Act)}_{Inds,Equity,\bullet} - 1 = \frac{P_K \cdot K + (\dot{P}_I/100)\cdot K - \sum_{f \neq Equity} \sum_d AT0_{Inds,f,d} \cdot V_{Inds,f,d} \cdot (\mathrm{R}_{Inds,f,d} - 1)}{\sum_d AT0_{Inds,Equity,d} \cdot V_{Inds,Equity,d}}$$

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

V(Inds,Equity,d) unknown in (2). But (2) is scalar equation. Reconciled via uniform shift in ancillary equation.

(2) $$P_I \cdot K + \sum_s \sum_f AT0_{s,f,Inds} \cdot V_{s,f,Inds} = \sum_f \sum_d AT0_{Inds,f,d} \cdot V_{Inds,f,d}$$

Value of physical assets + financial assets = value of liabilities

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How to determine R(Inds,Equity,d)

(3) $$R^{(Exp)}_{Inds,Equity,d} = R^{(Act)}_{Inds,Equity,\bullet}{}^{\alpha} \cdot R^{(Liab)}_{Inds,Equity,d}{}^{(1-\alpha)}$$

ROR on equity (asset holders) = average of ROR on equity (realised) and ROR on equity (new issue)

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Linking WACC & capital formation

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

Expected rate of return

Negative function of KGR

Previous year's rate of return

Previous year's capital growth rate

(2) $$F(KGR) = 1 \; if \; KGR = KGR\_Base$$

(3) $$EROR = WACC$$

Weighted average cost of capital

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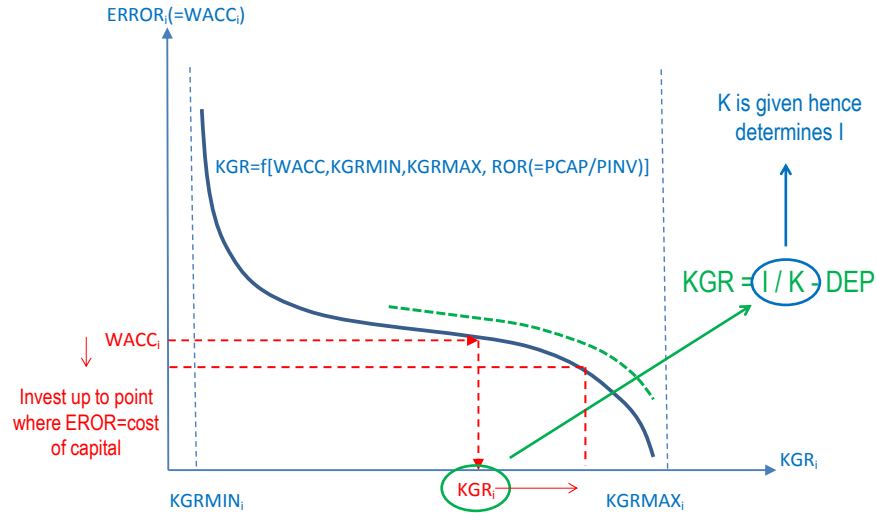
Linking WACC & capital formation



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Move from comp stat to dynamic: numeraire & the labour market.

- The introduction of the financial theory allows for the endogenous determination of both the price level and the exchange rate.
- In a typical CGE model, one of these is the exogenous numeraire.
- Under the new financial theory, the initial nominal wage serves as the numeraire in the new situation in which both the price level and the nominal exchange rate are endogenous.
- In a dynamic model, we require medium-run real wage flexibility to ensure that the unemployment rate does not deviate for extended periods from the NAIRU.
- Hence, in a dynamic model with a theory of the finance sector, we require theory to ensure that the initial nominal wage can serve as the numeraire, while also ensuring that there is medium-run wage flexibility to return the unemployment rate to the NAIRU

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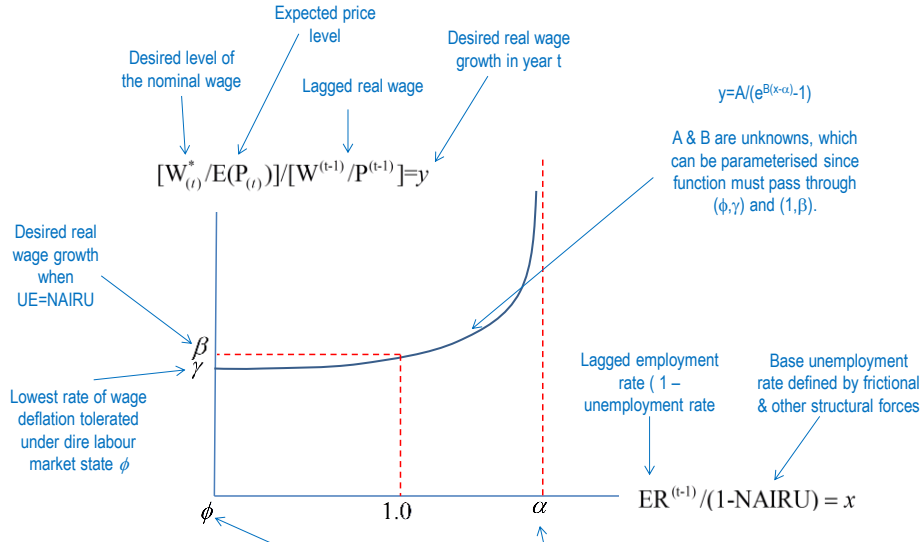
Asymmetric wage adjustment



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Expected inflation and the wage adjustment process.

(1) $[W^{*}_{(t)} / E(P^{(3)}_{(t)})] / [W_{(t-1)} / P^{(3)}_{(t-1)}] = A / (e^{B(ER^{(t-1)}/(1-NAIRU)-\alpha)} - 1)$

(2) $E(P^{(3)}_{(t)}) = P^{(3)}_{(t-1)} \cdot E(T^{(3)}_{(t)})$

Expected CPI, year t — Actual CPI, year t-1 — Expected power (1+rate) of inflation

(3) $E(T^{(3)}_{(t)}) = T^{(3)\text{Trend}}_{(t)}$

Power of the trend inflation rate

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Expected inflation and the wage adjustment process.

$$(4)\quad T_{(t)}^{(3)\text{Trend}} = \xi T_{(t-1)}^{(3)\text{Trend}} + (1-\xi)T_{(t-1)}^{(3)}$$

0.6 — Lagged trend in power of inflation rate — Lagged power of the inflation rate

$$(5)\quad W_t / W_{t-1} = \alpha(W_t^* / W_{t-1}) + (1-\alpha)(W_{t-1} / W_{t-2})$$

0.5 — Workers gradually adjust their wage demands in line with the value of W^*

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Balance sheets of financial intermediaries.

- The Superannuation sector is modelled as one of a number of financial agents mediating the supply and demand for financial instruments.
- To tie-down the credit multiplier outside of the Superannuation sector, we must ensure that the model expresses financial frictions on the balance sheets of traditional financial institutions, e.g.
  - capital adequacy ratios;
  - deposit/reserve ratios.

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Balance sheets of traditional financial intermediaries

Percentage change in bank risk-weighted assets

$$RA\_BANK1 \times p\_ra\_bank1 = \sum_{s \in LA} \sum_{f \in FI} [RISKWGT_{(s,f)} \times AT1_{(s,f,Banks)}] \times (p\_riskwgt_{(s,f)} + a\_t\_1_{(s,f,Banks)})$$

Guided by values from Prudential Standard APS112 (APRA 2013)

$RISKWGT_{(CB,f)} = 0$,
$RISKWGT_{(Govt,f)} = 0.1$,
$RISKWGT_{(s,Cash)} = 0$,
$RISKWGT_{(s,Equity)} = 3.0$,
$RISKWGT_{(Foreigners,DeposLoans)} = 0.4$,
$RISKWGT_{(Inds,DeposLoans)} = 0.4$,
$RISKWGT_{(NonBankFinIn,DeposLoans)} = 0.4$,
$RISKWGT_{(NRH,DeposLoans)} = 0.35$,
$RISKWGT_{(RH,DeposLoans)} = 0.5$,
$RISKWGT_{(NonBankFinIn,Bonds)} = 0.4$,
$RISKWGT_{(Foreigners,Bonds)} = 0.4$

% change in risk-weighted bank assets is share-weighted sum of % changes in risk-weights and value of assets.

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Balance sheets of traditional financial intermediaries

Percentage change in value of bank equity

$$EQ\_BANK1 \times p\_eq\_bank1 = \sum_{d \in AA} AT1_{(Banks,Equity,d)} \times a\_t\_1_{(Banks,Equity,d)}$$

Ratio of bank equity to risk-weighted bank assets

$$p\_ratio\_t1 = p\_eq\_bank1 - p\_ra\_bank1$$

If CAR is exogenous, then equity is no longer a choice variable in the bank's liability optimisation problem.

Non-equity financing needs of commercial banks

$$BIGBUDNEQ_{(s)} \times big\_budl\_neq_{(s)} = BIGBUDGETL_{(s)} \times big\_budl_{(s)} - \sum_{d \in AA} AT1_{(s,Equity,d)} \times a\_t\_1_{(s,Equity,d)}$$

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Balance sheets of traditional financial intermediaries

% change in average cost of non-equity finance

$$ave\_ror\_sne_{(s)} = \sum_{d \in AA} \sum_{f \in FINEQ} [AT1_{(s,f,d)} / BIGBUDNEQ_{(s)}] \times roipowl_{(s,f,d)}$$

Liability optimisation over sources of non-equity finance

$$a\_t\_1\_d_{(Banks,f)} = big\_budl\_neq_{(Banks)} +$$
$$(TAU-1) \times [roipowl\_d_{(Banks,f)} - ave\_ror\_sne_{(Banks)}] + f\_bank\_eq_{(f)}$$

Bank holdings of cash and reserves with central bank

$$BANKRESR \times p\_bankresr = AT1_{(CB,Cash,Banks)} \times a\_t\_1_{(CB,Cash,Banks)} +$$
$$AT1_{(CB,DeposLoans,Banks)} \times a\_t\_1_{(CB,DeposLoans,Banks)}$$

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Banks self-impose a reserve ratio

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Balance sheets of traditional financial intermediaries

% change in household deposits with banks

$$p\_bankdepo = a\_t\_1_{(Banks,DeposLoans,Hlds)}$$

Ratio of bank reserves to bank deposits

$$p\_resratio = p\_bankresr - p\_bankdepo$$

If reserve ratio is exogenous, then "reserve" assets are no longer a choice variable in the bank's asset optimisation problem.

Bank assets excluding cash and deposits with central bank

$$BIGBUDNR_{(d)} \times big\_bud\_nr_{(d)} = BIGBUDGET_{(d)} \times big\_bud_{(d)} -$$
$$AT1_{(CB,Cash,d)} \times a\_t\_1_{(CB,Cash,d)} - AT1_{(CB,DeposLoans,d)} \times a\_t\_1_{(CB,DeposLoans,d)}$$

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Balance sheets of traditional financial intermediaries

Average rate of return earned on non-reserve assets

$$ave\_ror\_nr_{(d)} = \sum_{s \in LANCB} \sum_{f \in FI} (AT1_{(s,f,d)} / [BIGBUDNR_{(d)} + TINY]) \times roipowa_{(s,f,d)}$$

$$+ \sum_{f \in NOTCASHDEP} (AT1_{(CB,f,d)} / [BIGBUDNR_{(d)} + TINY]) \times roipowa_{(CB,f,d)}$$

Non reserve assets held by banks

$$a\_t\_1_{(s,f,Banks)} = big\_bud\_nr_{(Banks)} + ELAS\_AS \times [roipowa_{(s,f,Banks)} - ave\_ror\_nr_{(Banks)}] + f\_bankres1_{(s,f)} \quad (s \in LANCB)(f \in FI)$$

$$a\_t\_1_{(s,f,Banks)} = big\_bud\_nr_{(Banks)} + ELAS\_AS \times [roipowa_{(s,f,Banks)} - ave\_ror\_nr_{(Banks)}] + f\_bankres2_{(s,f)} \quad (s \in CBSET)(f \in NOTCD)$$

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Balance sheets of traditional financial intermediaries

Ratio of bank cash holdings to bank deposits with central bank

$$r\_cash\_cbdep = a\_t\_1_{(CB,Cash,Banks)} - a\_t\_1_{(CB,DeposLoans,Banks)}$$

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Simulation: a rise in the super rate

Closure assumptions:

- Closure of financial intermediation block as described above.
- Labour market: Nominal wages sticky initially, gradually adjusting in response to deviations in the unemployment rate away from the NAIRU.
- Initial wage as a cost to firms does not rise (an announced policy).
- Physical capital market: capital stocks sticky, gradually adjusting in response to returns on physical capital relative to WACC.
- Nominal private consumption linked to nominal disposable income via exogenous savings rate.
- Real public consumption spending exogenous.
- Gross fixed capital formation endogenous.

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

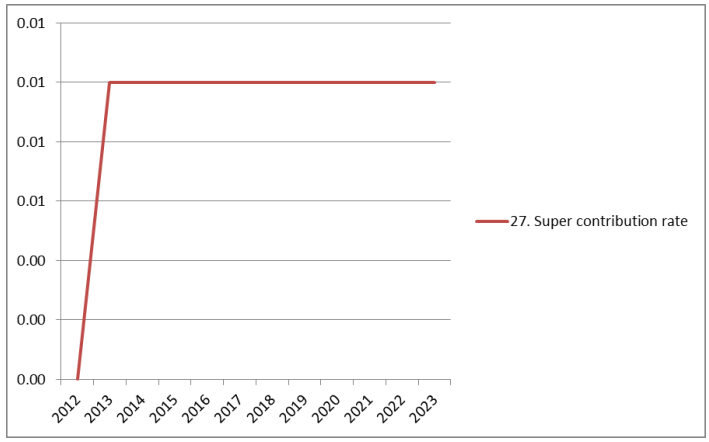
Simulation: a rise in the super rate

We decompose the total consequences of the shock into two components:

An intermediation effect: an increase in the proportion of the household savings stream routed into the superannuation sector, for any given household savings rate.

A savings effect: a rise in the household savings rate: we assume that every $1 of additional forced superannuation contribution represents $0.7 of new saving and $0.3 of displaced savings (Connolly 2007).

Ratio of super contributions to national wage bill (change from baseline)



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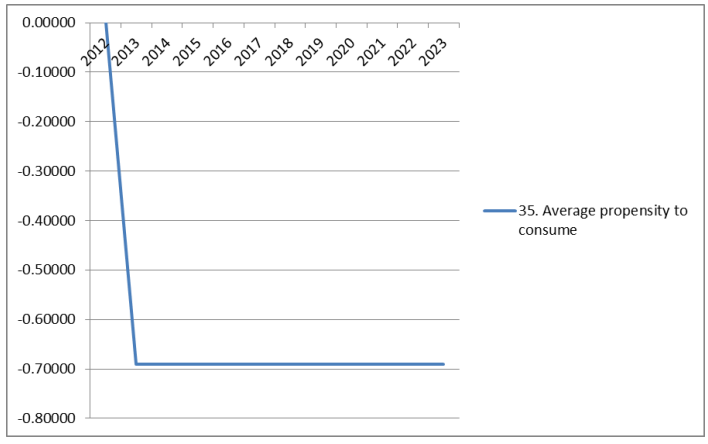
Average propensity to consume (% deviation from baseline)



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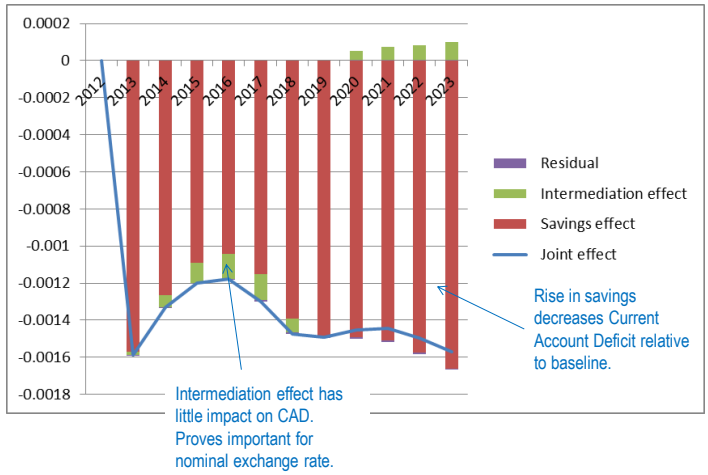
Decomposition of the deviation in the CAD / GDP ratio (% deviation from base)



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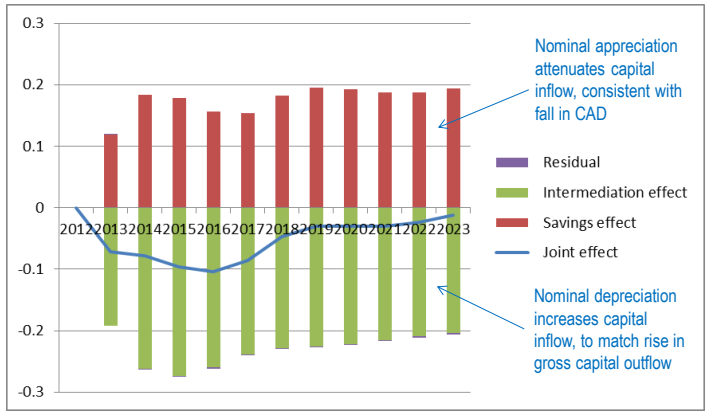
Decomposition of nominal exchange rate ($Foreign/$A)(% deviation from baseline)



For given domestic / foreign rate of return relativity, foreigners desire a given share of the foreign currency value of their portfolios to be in Australian assets.

Nominal appreciation increases that share.

Foreigners rebalance by reducing funds flow to $A assets.

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Change in financial flows ($m.) (intermediation effect only)

Asset agent (d) / Liability agent (s)	Banks	Central Bank	Foreigners	Government	Households	Industries	NBFI	Super	Life insurance	Non-reproducible housing	Reproducible housing	Total
Banks	0	47	1,245	79	-54	484	790	1,832	142	0	0	4,565
Central Bank	3	0	1	4	-30	21	2	0	0	0	0	0
Foreigners	113	-93	0	-125	-332	-430	434	1,422	54	0	0	1,043
Government	-79	24	-231	0	-857	-34	101	164	46	0	0	-866
Households	0	0	0	0	0	0	0	0	0	0	0	0
Industries	1,540	0	-224	52	-2,456	0	669	1,263	73	0	0	917
NBFI	546	21	262	-12	-247	83	0	1,533	910	0	0	3,095
Super	0	0	2	2	7,599	1	4	0	0	0	0	7,609
Life insurance	4	0	15	0	-138	0	14	1,331	0	0	0	1,226
Non-reproducible housing	1,338	0	36	4	-2,003	4	567	33	1	0	0	0
Reproducible housing	1,101	0	29	16	-1,414	3	514	31	1	0	0	281
Total	4,565	0	1,136	40	68	131	3,095	7,609	1,226	0	0	

Expressed as increase in equity interest issued to households

1% of national wage bill is $7.4 b.

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Change in financial flows ($m.) (intermediation effect only)

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Industries	1,540	0	-224	52	-2,456	0	669	1,263	73	0	0	917
NBFI						83	0	1,533	910	0	0	3,095
Super						1	4	0	0	0	0	7,609
Life insurance						0	14	1,331	0	0	0	1,226
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Reproducible housing	1,101	0	29	16	-1,414	3	514	31	1	0	0	281
Total	4,565	0	1,136	40	68	131	3,095	7,609	1,226	0	0	

Increase in our demand for foreign assets must be approximately matched by rise in foreign demand for our assets

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

+1,136 – 1,043 = $93 m. movement towards current account deficit (GE effect: first guess is $ 0 m.)

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Nominal exchange rate movement (intermediation effect)

- *Ceteris paribus*, the shift in savings to the superannuation sector represents an autonomous increase in domestic holdings of foreign assets of approximately $A 1.4 b. (net = c.$A 1.0 b.) . . . But . . .
- Δ foreign liabilities – Δ foreign assets = Δ CAD
- Hence, with ΔCAD = 0 as a first approximation, we require foreign liabilities to rise by c. $A 1.0 b if foreign assets rise by $A 1.0 b.
- *Ceteris paribus*, foreigners hold a given share of their portfolio, expressed in $FC, in Australian assets.
- To induce them to hold $A 1.0 b. more domestic assets, the nominal exchange rate ($FC / $A) must depreciate.

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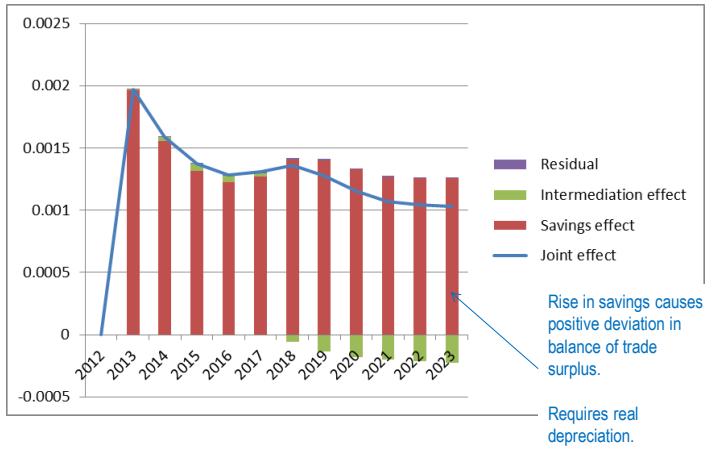
Decomposition of deviation in BOT/GDP ratio (% deviation from baseline)



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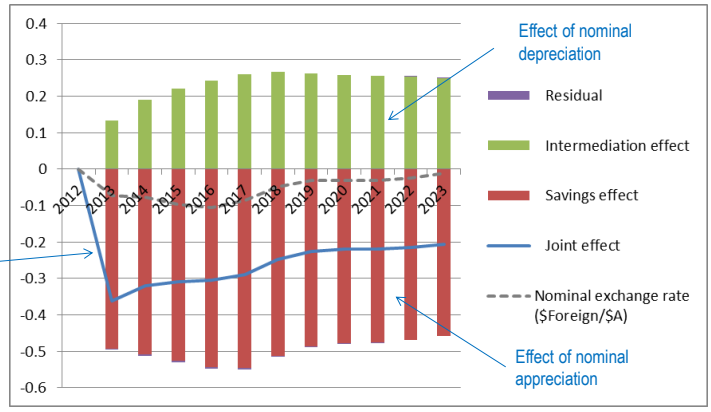
Decomposition of GDP deflator deviation (% deviation from baseline)



Note real depreciation

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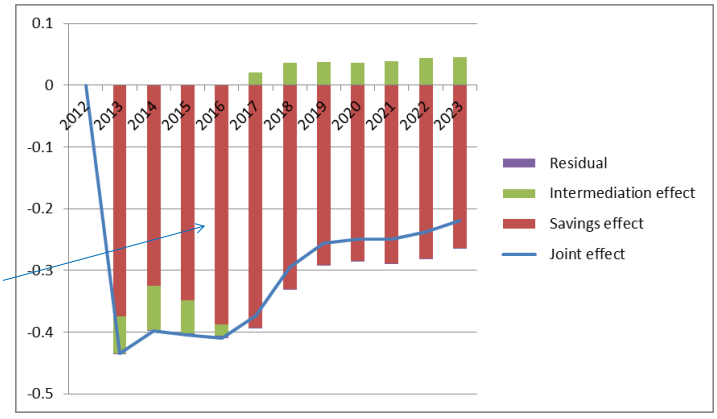
Decomposition of real exchange rate deviation (% deviation from baseline)



...but why does the BOT moves towards surplus..?

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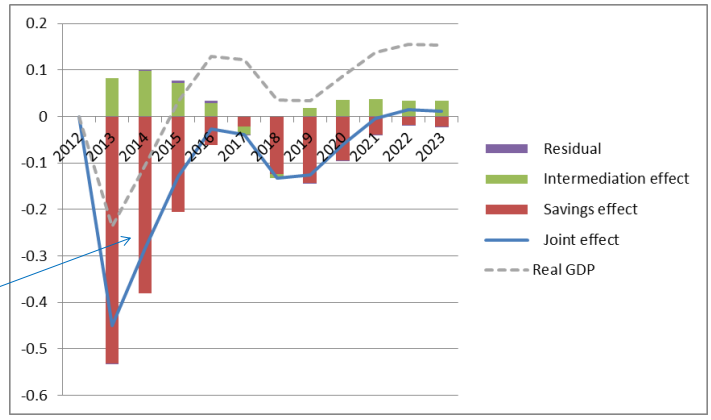
Decomposition of real gross national expenditure (% deviation from baseline)



-ve deviation in real GNE caused by savings effect.

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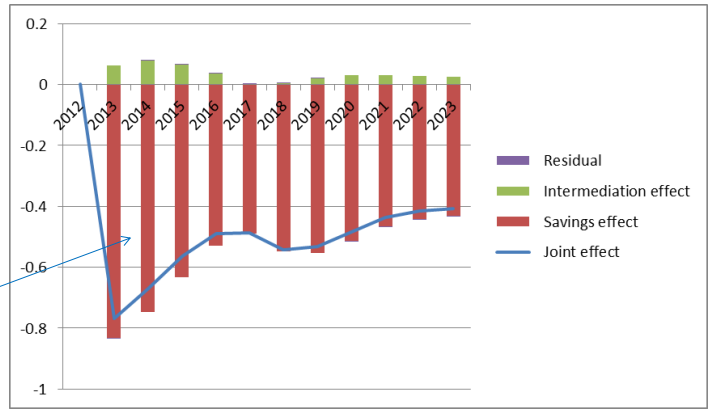
Decomposition of private consumption deviation (% deviation from baseline)



-ve deviation in real GNE caused by savings effect, via fall in C.

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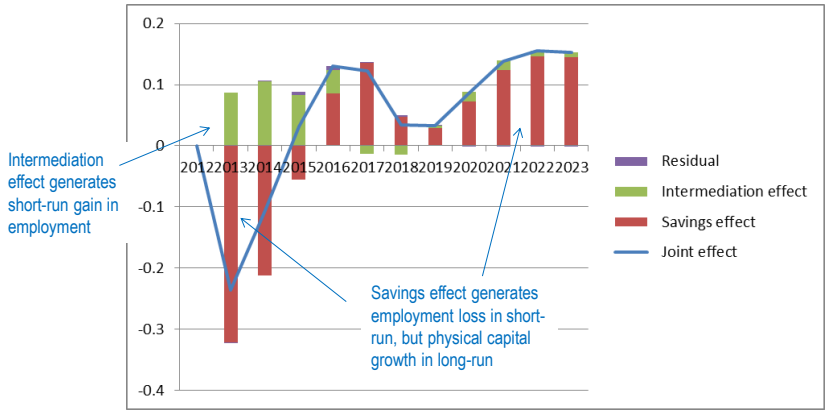
Decomposition of real GDP deviation (% deviation from baseline)



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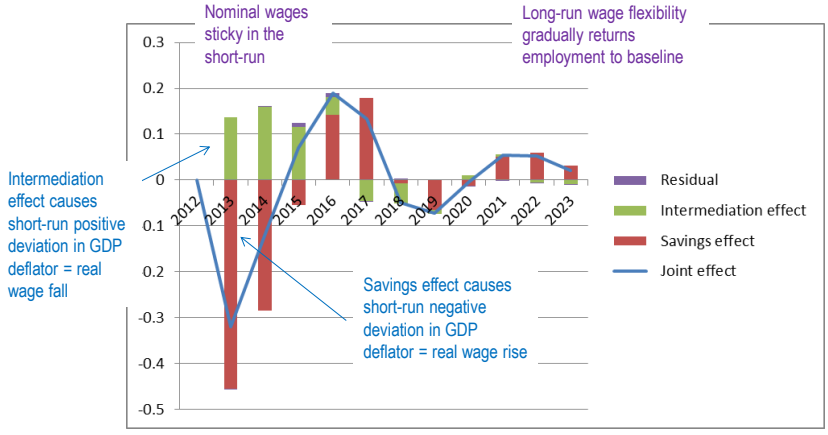
Decomposition of employment deviation (% deviation from baseline)



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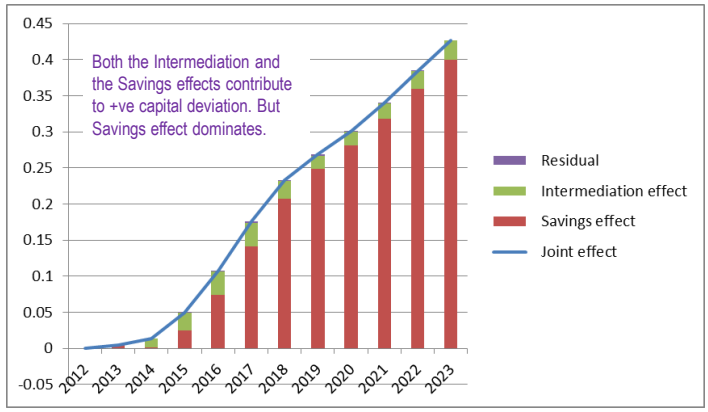
Decomposition of physical capital deviation (% deviation from baseline)



…why is the capital stock deviation positive and growing..?

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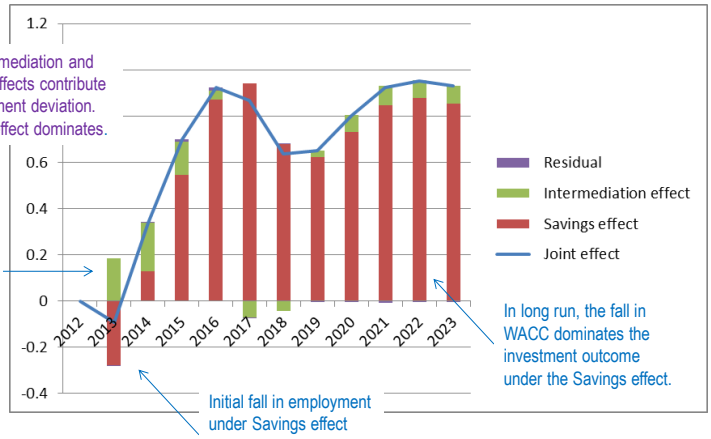
Decomposition of real investment deviation (% deviation from baseline)



Initial rise in employment under Intermediation effect causes K/L ratio to fall, & MPK to rise.

Initial fall in employment under Savings effect causes K/L ratio to rise, & MPK to fall.

In long run, the fall in WACC dominates the investment outcome under the Savings effect.

…why is the investment deviation positive..?

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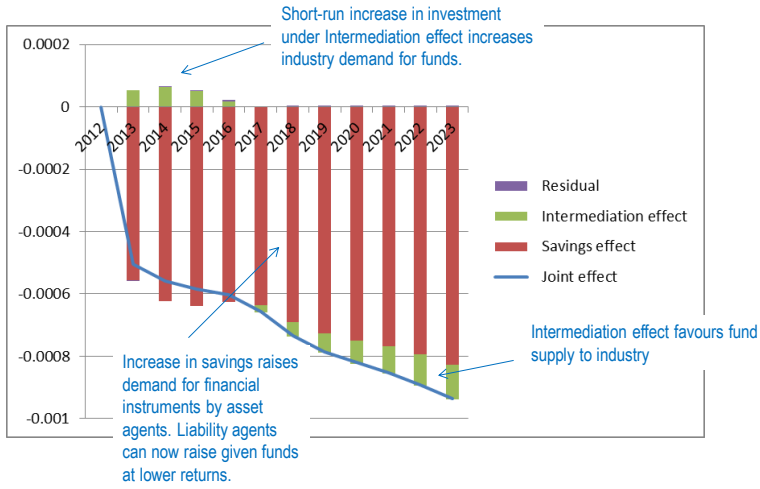
Decomposition of industry WACC deviation for (% deviation from baseline)



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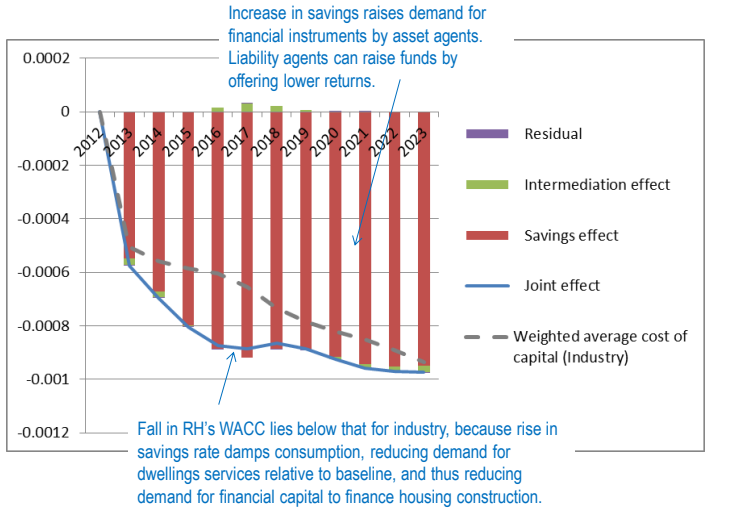
Decomposition of WACC deviation for Reproducible Housing (% dev from base)



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Concluding remarks:

- **Next steps – model development:**
  - Embed explicit central bank policy rules.
  - Link real activities of financial intermediaries to financial intermediation activities.
- **Next steps – simulations:**
  - Superannuation and: macro growth and stability, efficiency of capital supply, other current financial policy issues.
  - Other current policy topics: impact of new bank regulations, macro prudential policy, housing prices and macro stability.

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TERM modelling since 2002

Glyn Wittwer
Centre of Policy Studies, Victoria University
CoPS workshop 10 August 2015

TERM rules: the Horridge approach

First you must disaggregate the national IO table in sectors that need more detail

2

Our strategy is to work at the maximum level of sectoral disaggregation

3

We do not attempt to bring together all the regional input-output tables

In China, for example, the 30 regional IO tables are of little or no use to us

4

.. because different technologies across regions tend to reflect compositional differences in broad sectors

5

That is, you can reduce industry technology differences between regions by using more sectors

In Australia, we separate coal, gas, oil & renewable electricity generation

We avoid inventing numbers. Everything is a share of the original ABS number.

Even our inter-regional trade matrices are based on detailed estimates of regional supplies and demands and the gravity assumption

6

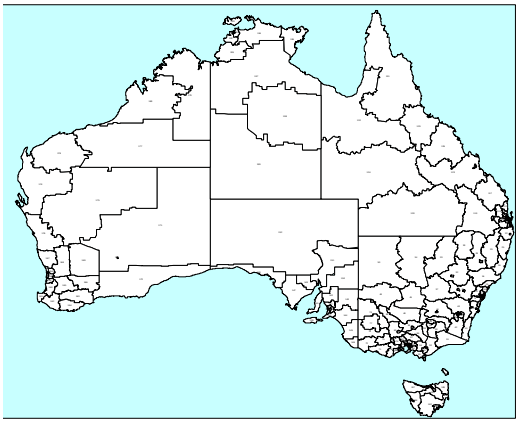
TERM has been used to analyse…

- Hypothetical plant disease outbreaks for Plant Health Australia
- Adverse events (earthquakes etc.) for Geoscience Australia
- Various productivity scenarios for Victoria's Dept of Primary Industries
- Port channel deepening
- Infrastructure projects such as East-West Link, dam construction
- Construction and operation of mines
- Gambling tax scenarios

7

Small region representation

- We started with 50+ statistical divisions
- Now, the master database of TERM, which is aggregated for every application, has 205 regions



- Important in Murray-Darling Basin analysis

8

Murray-Darling Basin

- 2007 Water Act included two main parts:
  1. Water buybacks -- irrigation associations don't like because it reduces their importance. Current Minister of Agriculture halted buybacks
  2. Infrastructure upgrades -- NFF etc. like, because they spend $0.5 million per irrigator while solving little
- Buybacks started during drought so job losses due to drought were blamed on buybacks

9

Droughts v. buybacks

- 2007 Water Act included two main parts:
  1. Water buybacks -- irrigation associations don't like because it reduces their importance. Current Minister of Agriculture halted buybacks
  2. Infrastructure upgrades -- NFF etc. like, because they spend $0.5 million per irrigator while solving little
- Buybacks started during drought so job losses due to drought were blamed on buybacks
- It is quite obvious looking at price data that drought is the main driver of irrigation water prices, not the volume of irrigation water allocated each year (surprisingly weak driver)

10

Compare drought and buybacks (assuming factor rigidity)

	Drought SMDB 2007-08 relative to forecast	Buybacks relative to forecast 3500 GL
Dry-land productivity	-49%	
Irrigation: rain	-56%	
: water	-56%	-32%
Compensation	No	Full
Process	Involuntary	Voluntary

11

Compare drought and buybacks (assuming factor rigidity)

	Drought SMDB 2007-08 relative to forecast	Buybacks relative to forecast 3500 GL
Dry-land productivity	-49% *6.8=-3.3%	
Irrigation: rain	-56%} *6.1=-3.4%	
: water	-56%}	-32% -1.2
Total GDP loss	-6.7%	-1.2%

12

Compare drought and buybacks (TERM-H2O)

	Drought SMDB 2007-08 relative to forecast	Buybacks relative to forecast 3500 GL
Dry-land	**-2.7%** [not -3.3%]	**+0.5%** [not -0]
Irrigation: rain	**-1.9%** [not -3.4%]	
: water		**-0.8** [not -1.2%]
Non-agriculture	**-1.1%** [not 0]	**-0.3%** [not 0]
Total GDP loss	**-5.7%**	**-0.6%**

13

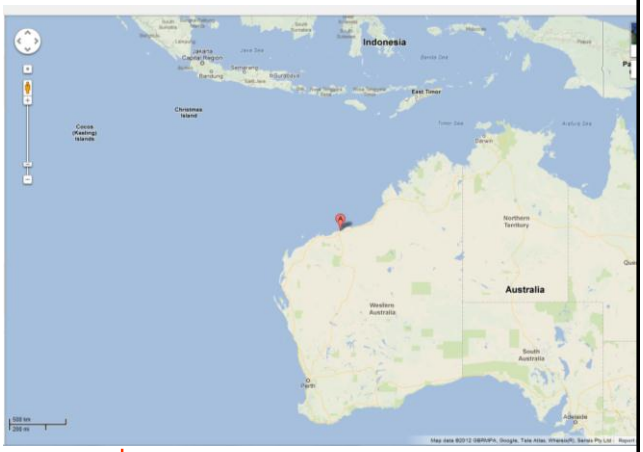
Link to economic impact multiplier analysis

Prices almost always play a part, diminishing multipliers

Port Hedland real estate

Port Hedland real estate

Port Hedland real estate at the height of the boom



$1,850,000

"Port Hedland house passed in at auction in million-dollar dive, sign mining boom over"

Source: ABC online 7 February 2015

When we model mining construction in TERM

- Usually, we get a spectacular spike in housing rentals during the early years of a construction boom
- These may taper off slowly through a housing supply response
- Housing rentals crash back to the baseline forecast when the construction phase ends

19

Other countries: USA

- Three master databases
- One has 512 sectors in 70 regions
- 120 sectors x 436 congressional districts
- 82 region master database with California's main irrigated counties represented separately

20

Preamble on water

- There are economists around who believe that water prices ought to be equalised between urban and rural users
- This has a questionable economic basis: water is one of a number of factors: think of
  LAND(rural), LAND(urban), CAPITAL(rural), CAPITAL(urban)
- You make rental rates more unequal on relatively fixed factors as you equalise water prices
- Trading between users with relatively mobile factors (mobile farm capital) does enhance efficiency
- Trading between rural and urban users may be at the expense of "virtual water trading"

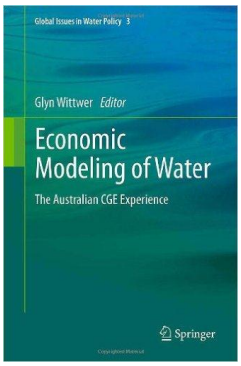
21

Californian drought

- Almonds growers are scapegoats for California's water woes
  -- Not a century of grand engineering schemes
  -- Not a complete lack of respect for the environment of indigenous communities
  -- Not an absence of water trading and pricing according to scarcity

22

USAGE-TERM-H2O



- It is a poor person's TERM-H2O
- No research funding
- No dynamics
- Full CGE model with 14 bottom-up regions covering 12 central Californian irrigation regions
  + Rest of Calif + Rest of USA
- Has the factor allocation theory of TERM-H2O
- Competition for water, land, capital and labor

23

Regions in USAGE-TERM-H2O

24

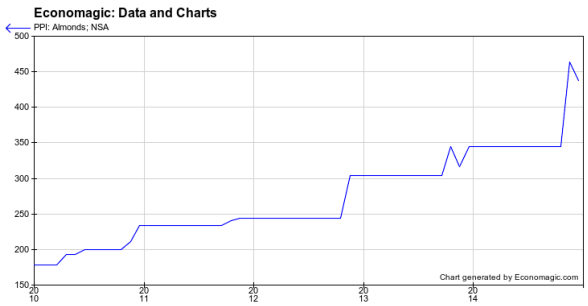
Scenario

- Cut back water used in agriculture in 12 Californian counties by 40%
- Allow water trading between irrigators
- This is physically possible but institutionally difficult at present
- However, water trading is occurring due to the desperation of perennial crop producers
- But trade volumes and prices aren't appearing in records anywhere

25

In this world, almonds are the new OPEC cartel

- California accounts for 80% of global production
- Drought has reduced Californian and global almond supply
- This has pushed prices up



- The greater the water shortage faced by almond producers (through water trading rigidities), the higher the price of almonds
- This provides terms-of-trade gains as scarcity worsens
- Moving water from almond producers to Californian households has perverse impacts
- Terms-of-trade gains are inequitable: unemployment worsens at the same time as farm (almond) prices soar

26

Conclusions

- I have been involved in over 60 projects in Australia using TERM
- Small regions suffer price impacts so IO analysis has problems
- Using CGE analysis results in insights we would miss otherwise: buybacks (terms-of-trade gains, water price offsets for falling land rentals); drought – rigidities may results in gains from some producers at expense of wider economy

27