THE BOYNE ISLAND SMELTER:
ECONOMIC IMPACT ON THE GLADSTONE REGION

Patrick O'Callaghan and John Mangan
AIBE, University of Queensland

Aluminium Industry and Boyne Smelters Limited (BSL)

Australia: energy-abundant & fully integrated Aluminium supply chain

- One of only three countries in the world along with Brazil and Venezuela.

Qld: Weipa Bauxite is shipped to Gladstone for Alumina refining and Aluminium Smelting at BSL (much of this supply chain is Rio Tinto)

BSL: consumes 1/8 of Qld's electricity

- Recent Smelter closures: Kurri Kurri 2012
- Near miss at Tiwai Point, New Zealand in 2020-2021:
  ``Clean'' aluminium: from hydroelectric power (alumina from Gladstone)
  Needed a deal to keep it open with reduced price for electricity
- Subsidies due to high energy prices (and subsidies in other countries)

- Qld Energy and Jobs Plan:
  - Sustaining heavy industry in Qld is a key part of the transition

Gladstone, Central Queensland

- Central Qld: the energy powerhouse of Qld: 4600MW (but coal-fired)
  - Central QREZ: Qld Energy plans for renewables

- Gladstone (SA3, 2018-19): contains capital, Gladstone, of Central Qld

  $15.5bn aggregate output: approx. 25% of Central Qld, 2% Qld

  29k FTE: approx. 28% of Central Qld, 1.3% of Qld

  63k population: highly skilled, but aging with 0.7% growth

  - Multi-commodity deep-water port plus rail and road infrastructure

- Gladstone is Qld's regional manufacturing hub:

  $5.5bn to $6bn Manufacturing output: of which approx. $1bn is **BSL**

  4k to 4.5k Manufacturing FTE employees: of which 1k at **BSL**

  Heavy industry: Alumina, Aluminium Ammonia, Cement, LNG, Oil refinery

  Growth industries: ag-tech, alumina for batteries, aquaculture, Mining Serv., green {…}

Computable General Eq'm
with
Inter-temporal, Sectoral Euler Equations

Model overview

Forward-looking dynamics: for 19 ANZSIC divisions in the Gladstone region:

Supply = Demand (output = Med + con + Inv + xpo) at each time

Output is a function of kap, lab, med (including imports) and a fixed factor.

Capital depreciates and is optimally replenished to grow the economy.

Balanced growth paths: via technological growth and optimisation

Growth rate is similar for output and capital: each sector grows in range 1% to 2%

Technological progress is fixed-factor augmenting

Euler eq'ns: novel application at the *multisectoral* level

Testable: ``value of capital today'' = ``**expected value** of capital tomorrow''

- Absent in intersectoral models: CoPS; Atalay; Cesa-Bianchi et al; Baqaee—Farhi

More uncertainty and change means Euler eq'ns less likely to hold

- If some Euler eq'ns don't hold, then sectoral shocks more likely to propagate.
- When they don't hold: greater adaptive capacity as capital is already misallocated.

The data

Data sources*:*

Jobs in Australia ABS data: labour per sector for Gladstone 2019.

Input-output flows between sectors: ABS tables 5 and 8 for Australia

Investment flows between sectors:

- investment flows tables from the US Bureau of Economic Analysis
- ABS Gross Fixed Capital Formation by Industry by type of Asset

BLADE: output per sector for Gladstone 2019

Gladstone Port data for Bauxite, Alumina, Aluminium and Coal

- Eg. Bauxite imports

Rio Tinto accounts

Studies on aluminium production e.g.

Gagne and Nappi 2000, Best Available Techniques 2017

Data: initial conclusions

- Amrun mines: Gladstone Bauxite imports less than half of Weipa production
- QAL and Yarwun: Alumina sales to BSL is 15% of total output

No obvious major threats to overall supply chain: Rio Tinto is majority owner

Allows us to focus more on broader Gladstone economic impact

- BSL is between one-quarter and one-sixth of the manufacturing sector
- 80% of Aluminium is exported via Gladstone port
- Subsidy is likely to be over $250 million

Data: regionalising the Australian input-output table

- Modify certain parameters to match estimates e.g. Utilities flows to Manufacturing
- *Within-model tuning* of parameters to approximate observed Gladstone proportions for variables such as *output* and *labour remittances.*

Experiments and shocks

Experiment Type (1): Euler eq’ns hold

1st phase: tune parameters to regionalise *and satisfy Euler eq’ns*

2nd phase: tune capital to obtain a balanced growth path

3rd phase: continue along same path and generate

- ``status quo’’ path
- ``shock’’ (BSL closure) path

Experiment Type (2): Euler eq’ns needn’t hold.

- Three phases as above
- Intended to capture Gladstone as an economy in transition with major uncertain changes relating to emissions targets given its current industry.

Type (a) shock: one-off “MIT shock” agents don’t see coming

- One quarter decrease in Manufacturing productivity, capital and exports
- 5/6 decrease in Utilities (energy and water) purchases by Manufacturing
- No decommissioning or replacement activity
- Labour is mobile

Main message: depends on whether Euler Eq’ns hold

Type (b) shock: labour is immobile

- Preferences are Leontief in labour: fixed proportions of each type of labour

Main message: the shock is worse and permanent

Type (c) shock: the agents know in advance and can plan for it

- Distinguishes the model from the Centre of Policy Studies approach

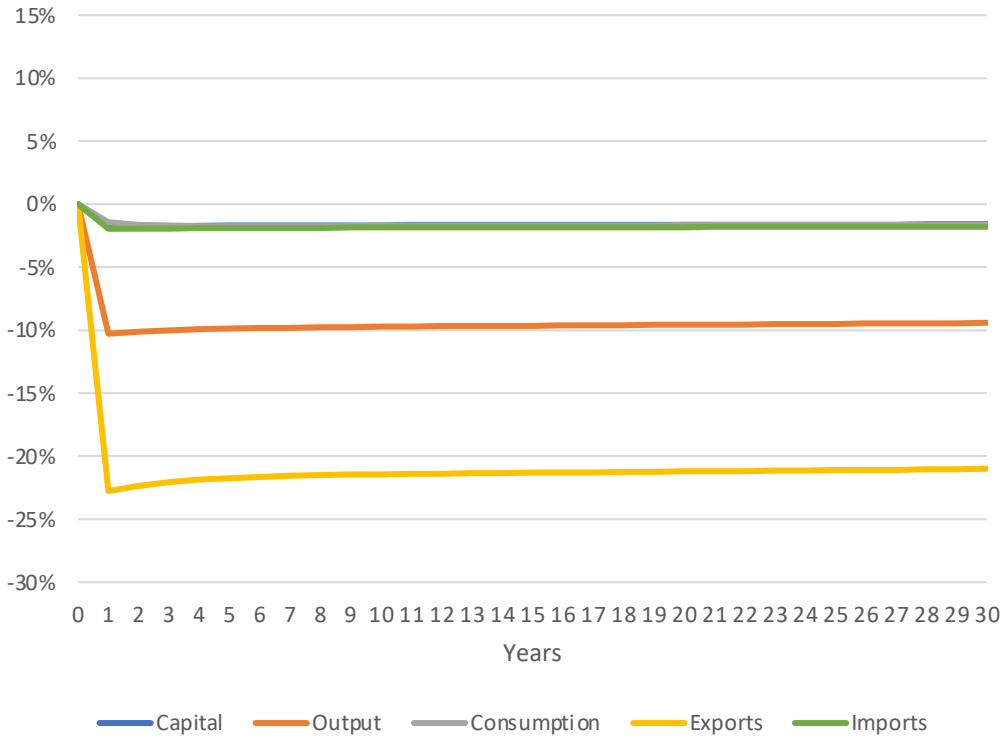
Main message: it is optimal to build up capital in advance of the closure

Results from experiments:

(1a) (2a)

Experiment-shock (1a): **% change relative to status quo,**

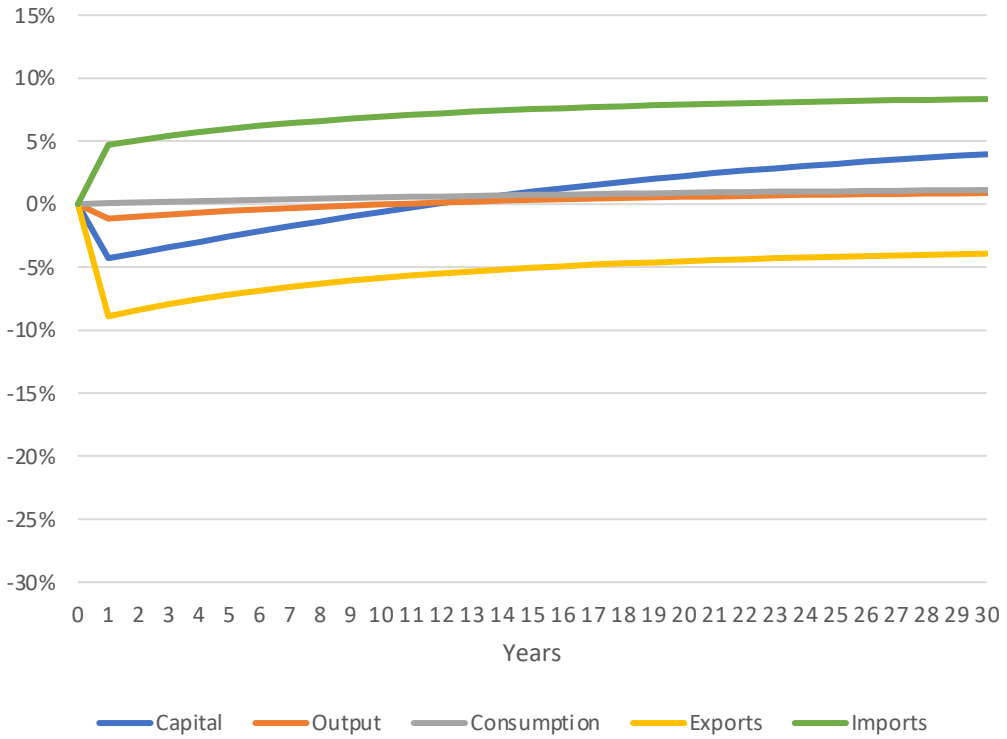
Aggregates



Output permanently down by 10% or $1.5bn in accordance with productivity shock and with fact that *BSL Output is 6% of aggregate*.

Experiment-shock (2a): **% change relative to status quo,**

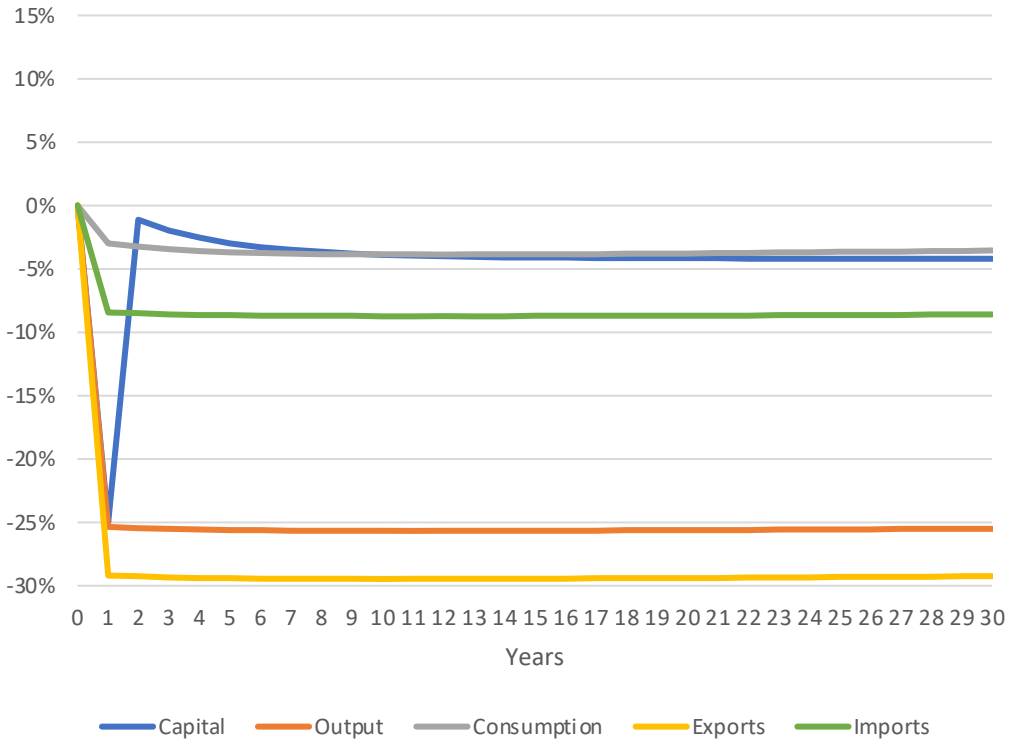
Aggregates



Output falls by 1% or $0.15bn before converging to 0; impact is transitory (unlike the productivity shock). Consumption is up by 1% in the long run

Experiment-shock (1a): **% change relative to status quo,**

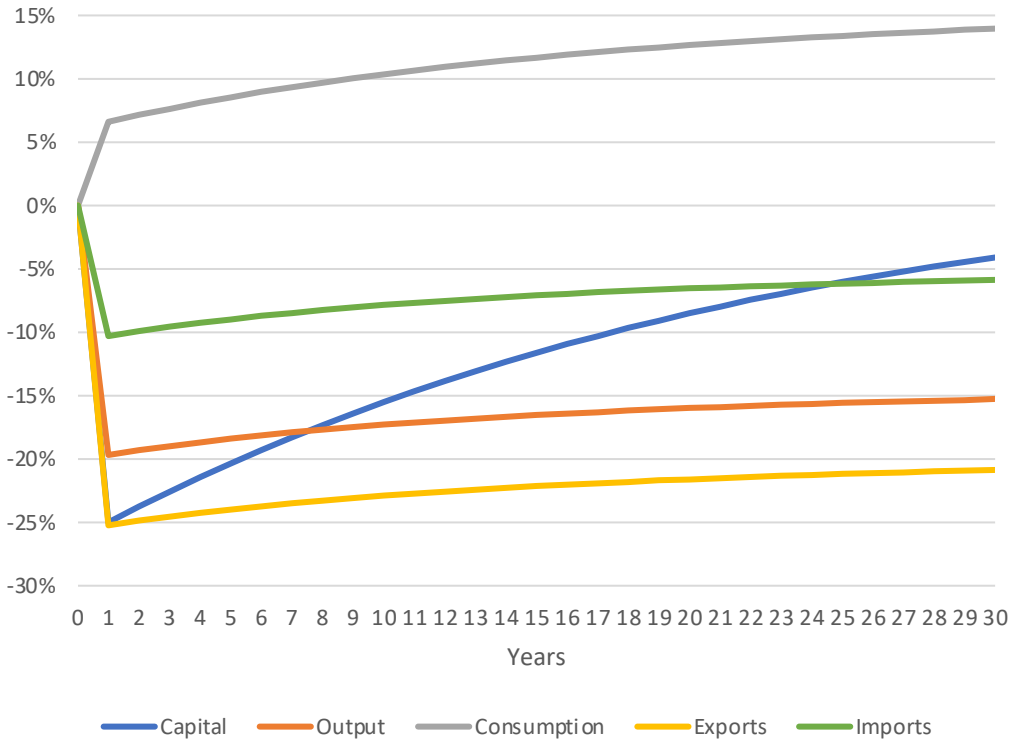
Manufacturing



Manufacturing capital immediately returns close to optimal levels: a quick response is optimal.

Experiment-shock (2a): **% change relative to status quo,**

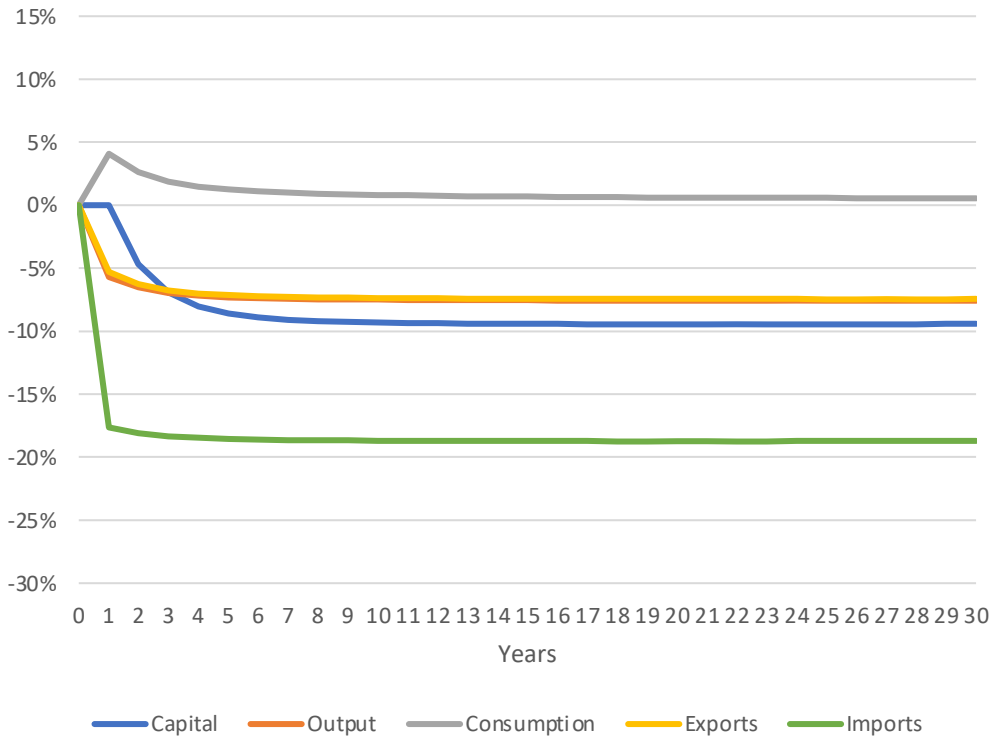
Manufacturing



Manufacturing capital takes much longer to return to previous levels as they were not as efficient.

Experiment-shock (1a): **% change relative to status quo,**

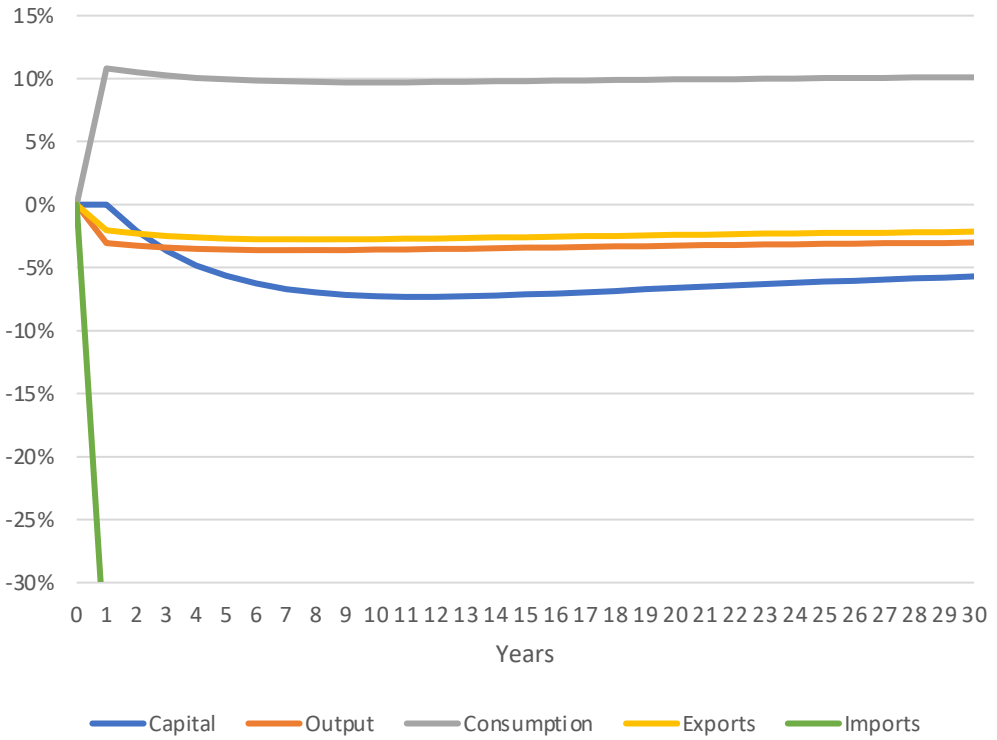
Utilities



Utilities (Energy and Water) price initially fall by 4%;
Consumption up compensating for falls elsewhere;
Capital down by 9% in the long run.

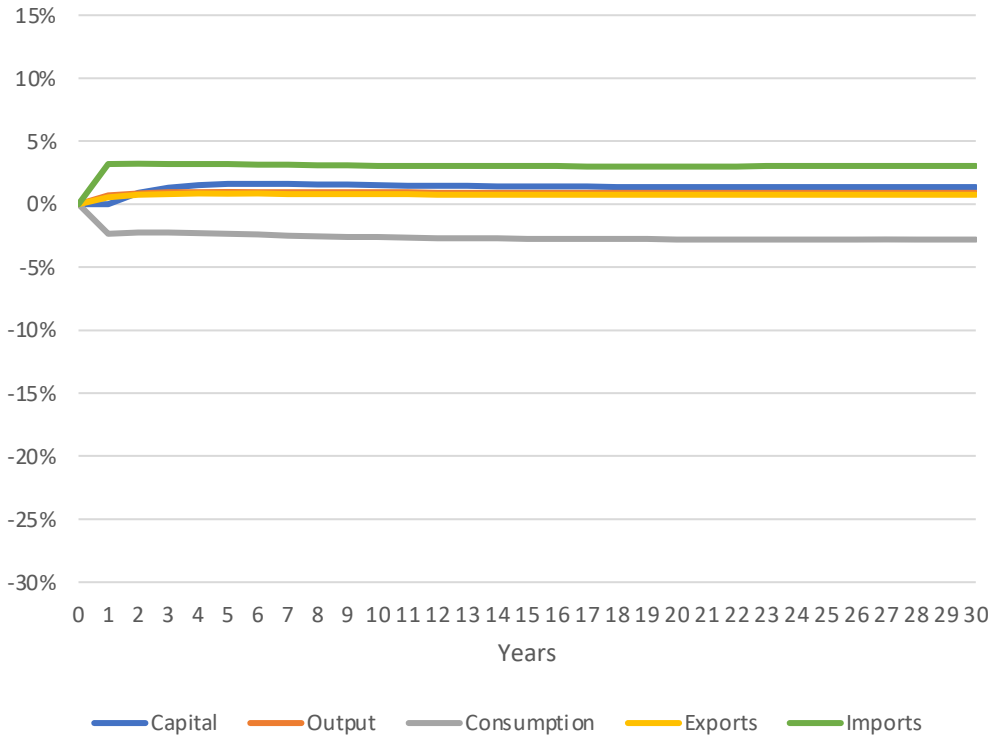
Experiment-shock (2a): **% change relative to status quo,**

Utilities



Utilities price down by 10% and remains there;
Capital down by 6% in the long run;
As prop'n of output: imports down from 12.5% to 8%

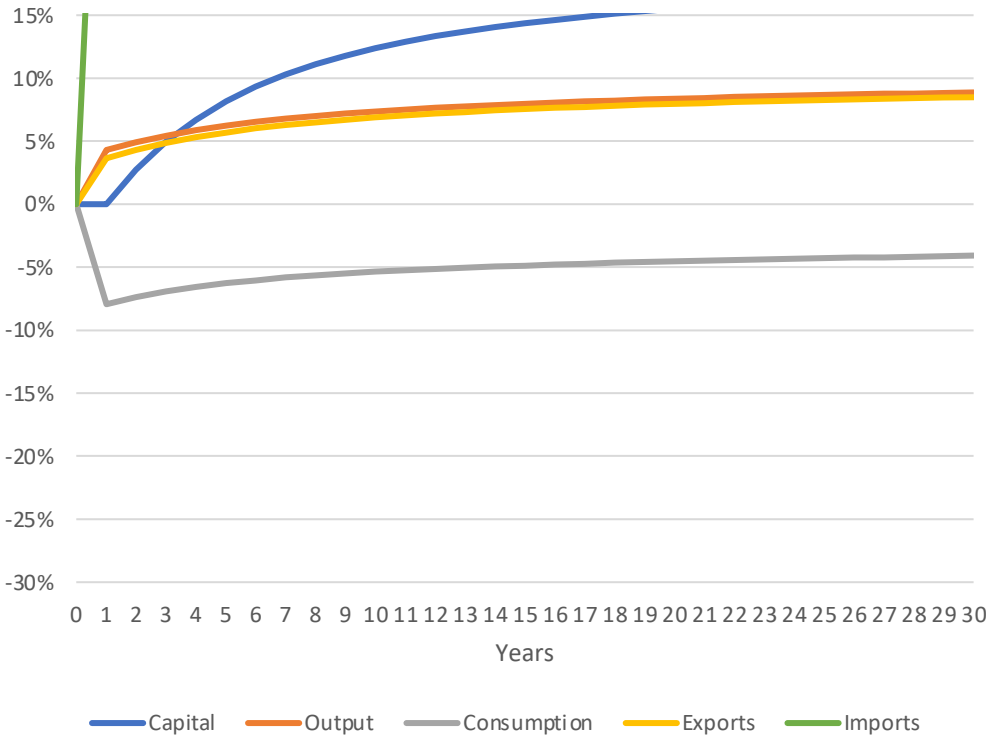
Experiment-shock (1a): **% change relative to status quo,**
Agriculture (Similar pictures for Mining.)



Cheaper energy and water prices cause Capital, Output, Exports and Imports to rise.

Consumption falls due to increases in other demand.

Experiment-shock (2a): **% change relative to status quo,**
Agriculture



Similar, but more extreme:

Capital up by over 15% in the long run.

As prop'n of output: imports up from 10% to 15%

Summary of results
and
Key takeaways

Results Summary

If Euler eq'ns hold, then the impact is more permanent.

Sectoral breakdown of initial -$155m drop in Aggregate Output				
Manufacturing	Utilities	Construction	Transport	Others
-$147m	-$45m	-$23m	-$4m	-$17.5m

Closure causes energy and water prices to fall which stimulates Agriculture, Mining *and* Aggregate Consumption.

- But Gladstone is connected to NEM, so the fall in energy prices would be less significant as benefits are spread over a much larger region.

Key takeaways

- *Sectoral* Euler eq'ns matter for shock propagation and economic response
  - These are absent in existing models

- With transition to net zero: capital is out-of-date & lots of uncertainty:
  - Euler eq'ns unlikely to hold, so greater propagation of shocks & opportunity for change
  - In this context, a flexible and mobile workforce is especially valuable.

- BSL is important to Gladstone's economy
  - Transition needs to be handled with care as it is a major consumer of energy
  - Needs a backup supply of energy (currently Gladstone Power Station)
  - Early decisions are valuable: e.g. Kurri Kurri closure 2012; power station approval in 2021

- With right energy transition, Gladstone Aluminium is internationally competitive

  June 2022: Rio Tinto calls for clean Gladstone Aluminium by 2030.
  September 2022, Qld Energy Plan: supergrid can keep Gladstone in proximity of power supply

References

- Queensland Government (2022). *Energy and Jobs Plan*. https://www.epw.qld.gov.au/energyandjobsplan . Retrieved October 2022
- Queensland Government. https://yoursayhpw.engagementhq.com/understand-qrez/news_feed/central . Retrieved October 2022
- Gladstone Regional Council. https://www.gladstone.qld.gov.au/downloads/file/3466/gladstone-region-investment-prospectus . Retrieved October 2022
- Acemoglu, D., & Guerrieri, V. (2008). Capital deepening and nonbalanced economic growth. *Journal of political Economy*, *116*(3), 467-498.
- Atalay, E. (2017). How important are sectoral shocks?. *American Economic Journal: Macroeconomics*, *9*(4), 254-80.
- Baqaee, D. R., & Farhi, E. (2019). The macroeconomic impact of microeconomic shocks: Beyond Hulten's theorem. *Econometrica*, *87*(4), 1155-1203.
- Dixon, P., & Rimmer, M. T. (2020). *Developing a DSGE consumption function for a CGE model*. Centre of Policy Studies (CoPS), Victoria University.
- Gagné, R., & Nappi, C. (2000). The cost and technological structure of aluminium smelters worldwide. *Journal of Applied Econometrics*, *15*(4), 417-432.
- Cusano, G., Rodrigo Gonzalo, M., Farrell, F., Remus, R., Roudier, S., Delgado Sancho, L. (2017). *Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries. Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control)* (No. JRC107041). Joint Research Centre (Seville site).
- Australian Bureau of Statistics (ABS), 2018-2019. *Tables 5 and 8: Industry by Industry Flow Table*. Released May 2021.
- Bureau of Economic Analysis (2003). *Capital flow data for 1997*. https://www.bea.gov/news/2003/capital-flows-us-economy-1997
- Port of Gladstone, “Trade Statistics Data,” https://www.gpcl.com.au/trade- statistics, Retrieved April 2020
- Rio Tinto, (2019). *Annual Report Production, Reserves and Operations*. Retrieved in April 2020. https://www.riotinto.com/invest/reports/annual-report