

THE BOYNE ISLAND SMELTER: ECONOMIC IMPACT ON THE GLADSTONE REGION

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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 Gladstone for AlOx refining and Al smelting at BSL

- Rio Tinto holds majority stake
- 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

BSL: consumes 1/8 of Qld's electricity and large energy subsidy (\$250m+)

- Like other smelters it is in close proximity of energy sources
- Recent Smelter closure: Kurri Kurri 2012
- Near miss at Tiwai Point, New Zealand in 2020-2021:

- Qld Energy and Jobs Plan:

- Sustaining heavy industry in Qld is a key part of the transition

Gladstone, Central Queensland

Gladstone (2018-19 economy, SA3/LGA):

\$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**

- **BSL represents approx. ¼ of Manufacturing activity except in energy consumption**

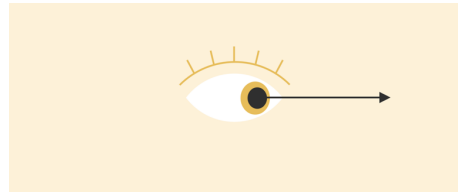
Other Heavy industry: Ammonia, Cement, LNG, Oil refinery

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



Economic Modelling
with
Sector-specific Euler Equations

“emsee” model overview



CGE model with forward-looking dynamics: 19 ANZSIC divisions, Gladstone region:

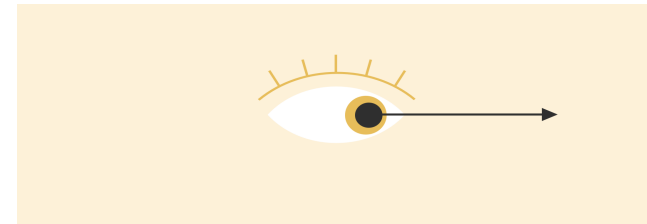
Supply = Demand (output = med + con + inv + xpo) at each time

Output is a function of capital, labour, intermediates (with imports) and a fixed factor.

Capital depreciates and is optimally replenished to grow the economy.

Balanced growth paths: each sector grows in range 1% to 2%

Solve as a sequence of overlapping nonlinear dynamic programs



Sector-specific Euler Eq'ns:

Testable condition: ``value capital today'' = ``**expected value** of capital in the future''

- **When the SEE hold**, capital is optimally allocated across sectors
- Absent in intersectoral models: CoPS; Atalay; Cesa-Bianchi et al; Baqaee and Farhi

Transition to net zero: the SEE are unlikely to hold, but nonetheless important:

- sectoral shocks are more likely to spill over/propagate to other sectors
- the economy has more capacity for adaptation: chance to nudge economy to new equilibria

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 (and Remplan): for 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

Experiments and shocks

Experiment Type (1):

1st phase: tune parameters to regionalise, *all 20 SEE hold*

2nd phase: capital evolves towards a balanced growth path

3rd phase: continue along same path and generate

- “status quo” path
- “shock” (BSL closure) path

Experiment Type (2):

1st phase: tune parameters to regionalise; *not all 20 SEE hold*

2nd phase: capital evolves towards a balanced growth path

3rd phase: continue along same path and generate

- “status quo” path
- “shock” (BSL closure) path

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

- 1/4 decrease in Manufacturing productivity, capital and exports
- 5/6 decrease in Utilities (energy + water) purchases by Manufacturing
- No **exogenous** decommissioning or replacement activity

Experiment (1a) Results Summary

If the SEE hold, the shock is sector-specific and more permanent

Sectoral breakdown of initial -\$1.56bn drop in Aggregate Output

Manufacturing	Utilities	Construction	Transport	Others
-\$1.47bn	-\$45m	-\$23m	-\$4m	-\$17.5m

Closure causes Utilities (energy and water) prices to fall which stimulates Agriculture, Mining and Consumption.

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

Comparison of experiments:

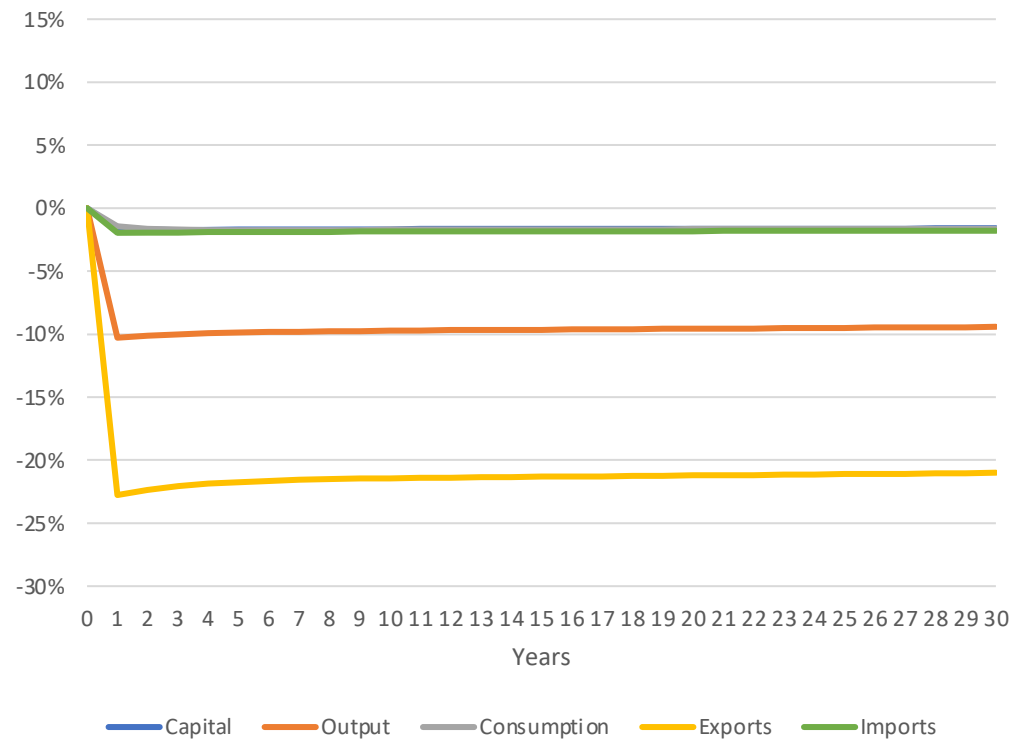
(1a)

All 20 SEE hold

(2a)

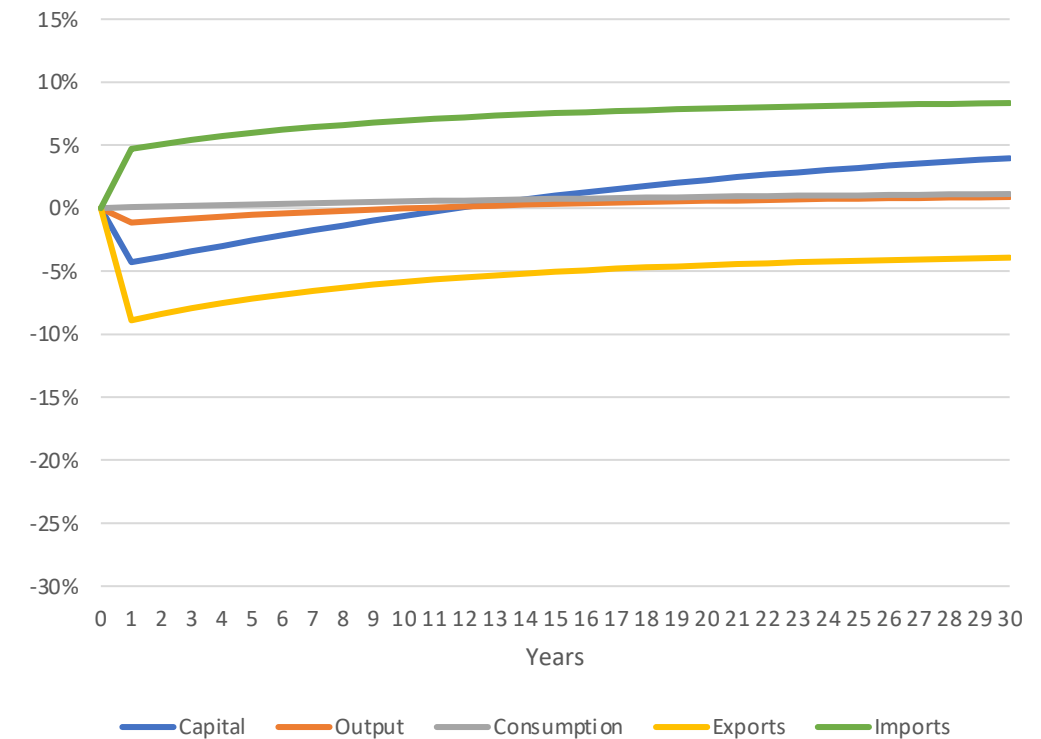
Not all 20 SEE hold

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



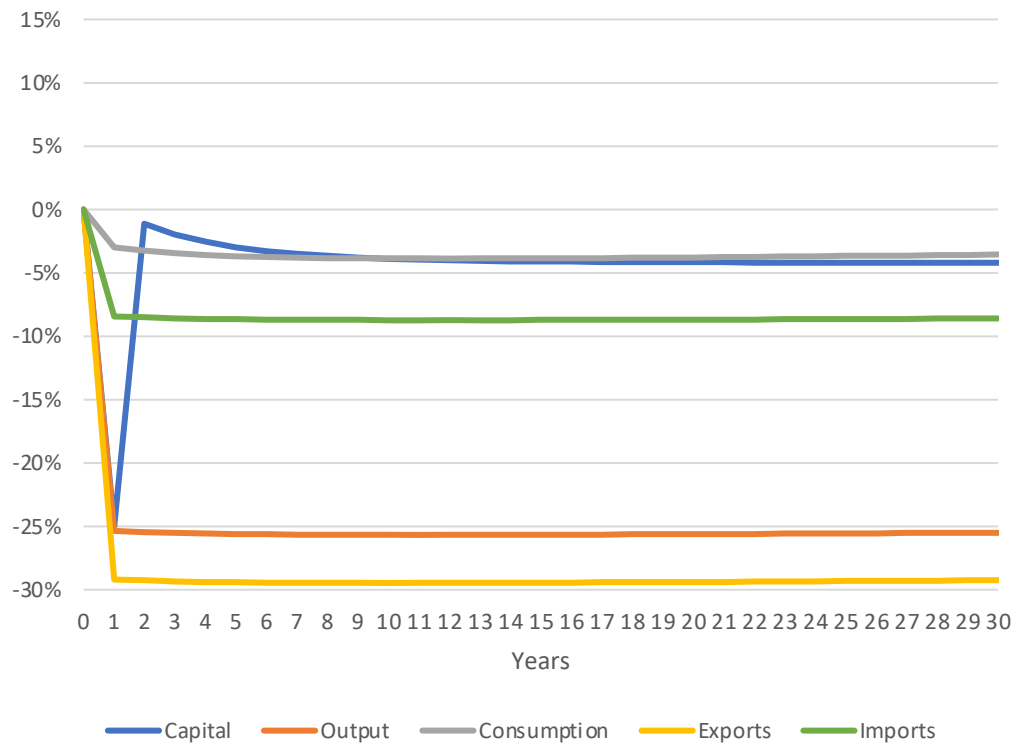
Aggregate Output permanently down by 10% or \$1.5bn in accordance with productivity shock
 Aggregate Capital permanently down by 1.6-1.7%

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



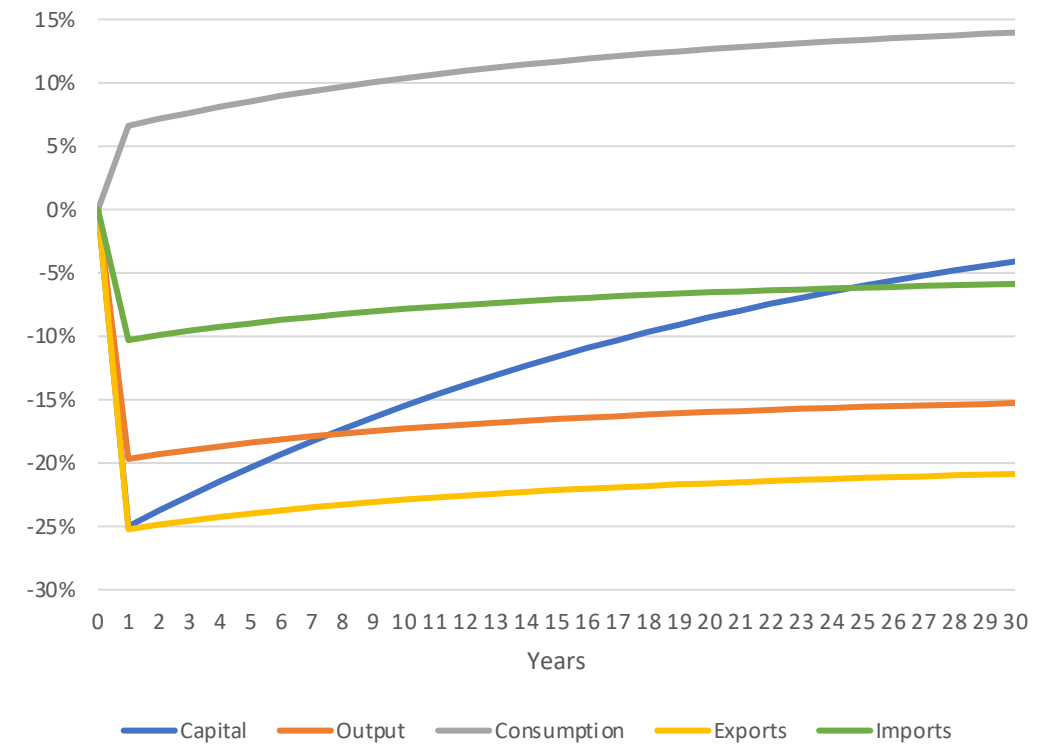
Output falls by 1% or \$0.15bn before converging to 0; impact is transitory (unlike the productivity shock).
 Consumption is up by 1% in the long run

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



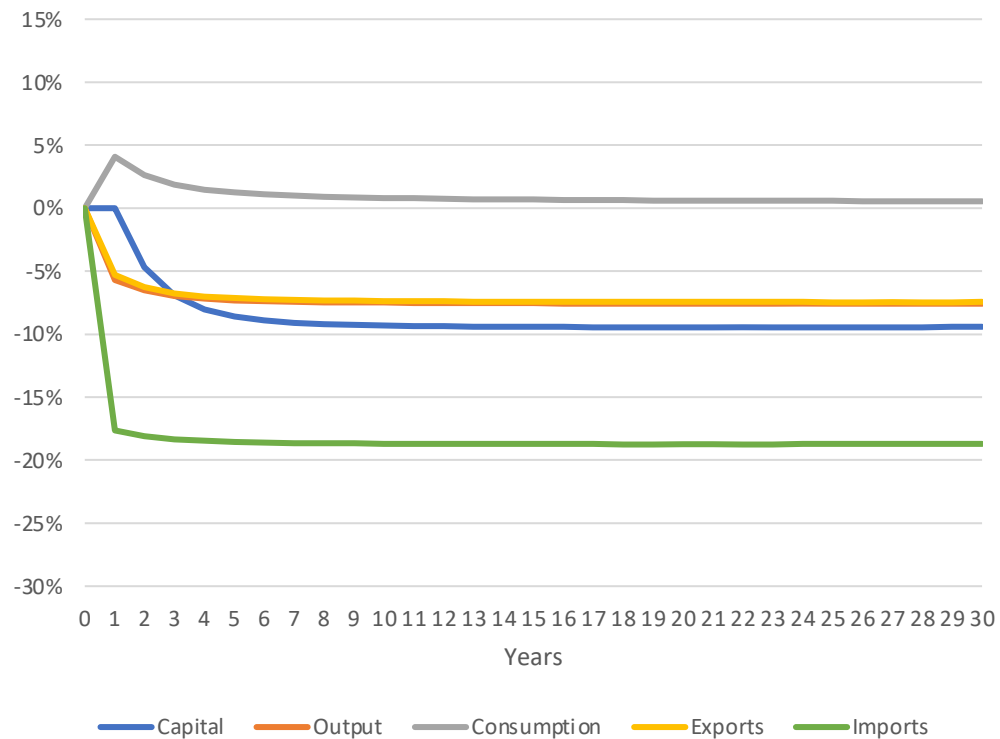
Manufacturing capital immediately returns back to previous levels: a quick response is optimal.

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



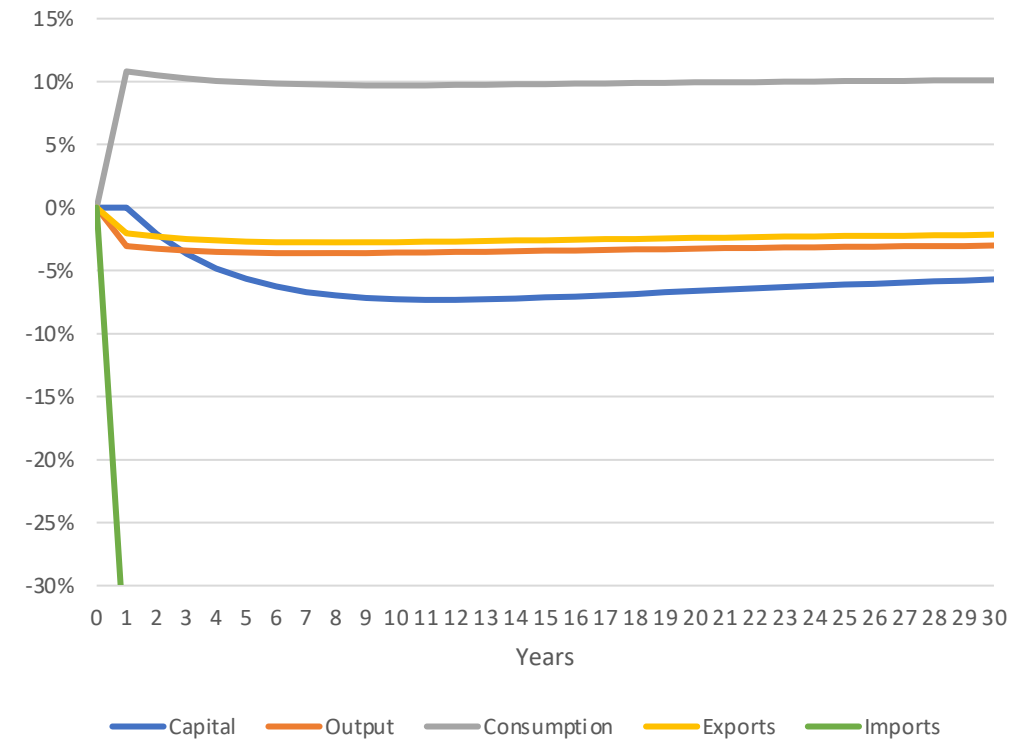
Manufacturing capital takes much longer to return to previous levels as they were not as efficient.

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



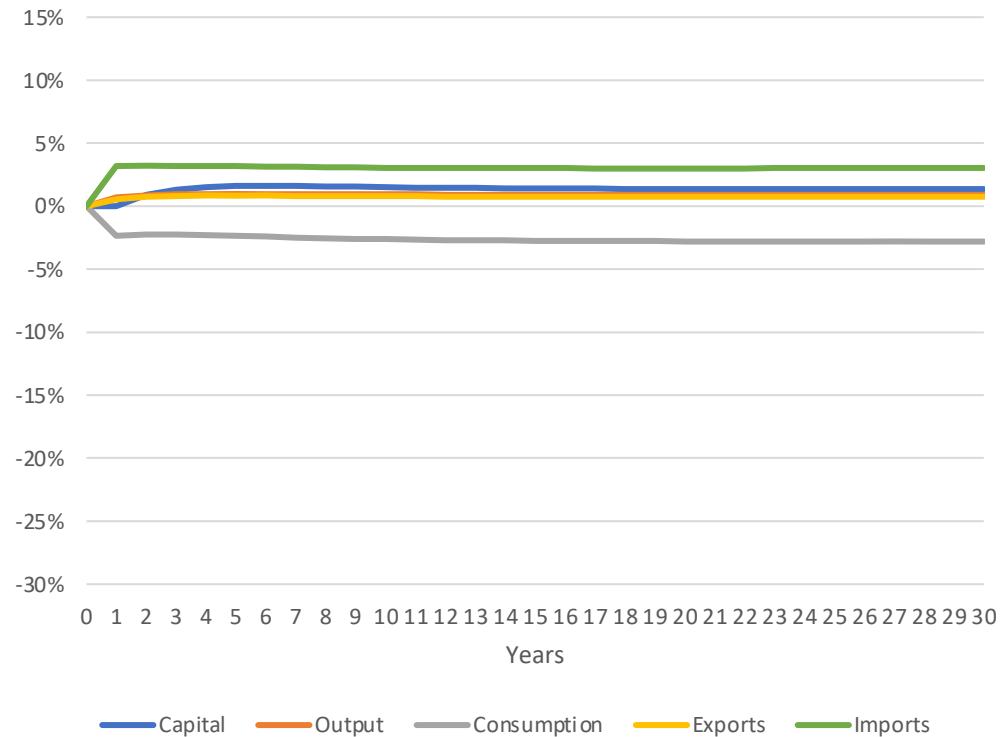
Utilities (Energy and Water) price initially fall by 4%;
Consumption up compensating for falls elsewhere;
Capital down by 9% in the long run.

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



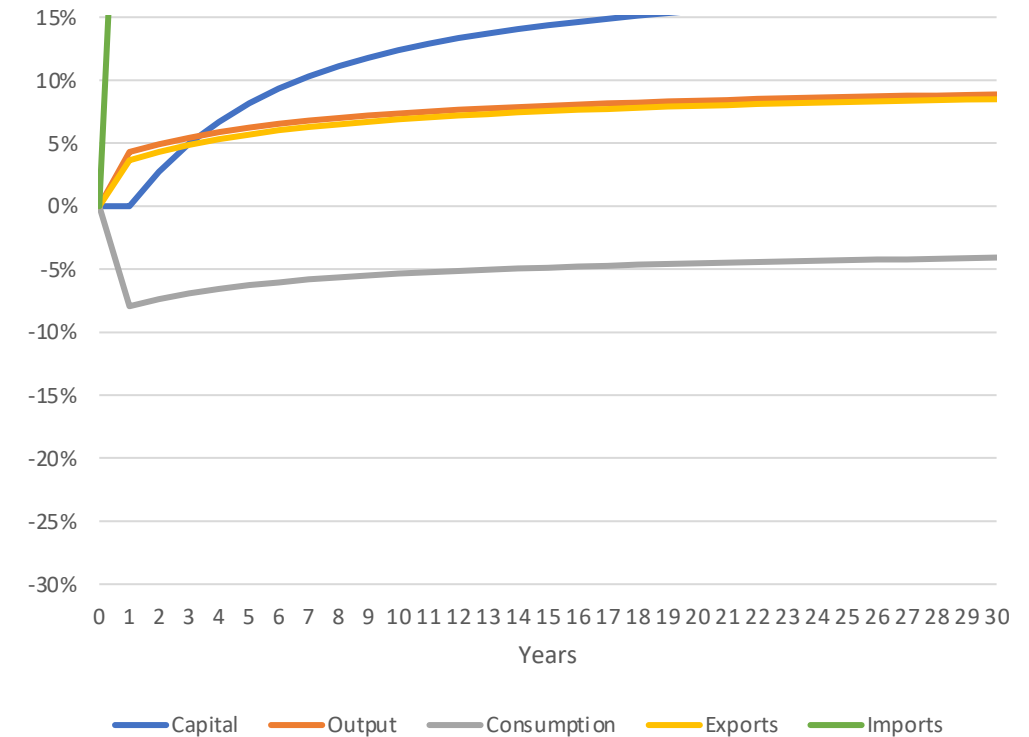
Utilities price down by 10% and remains there;
Capital down by 6% in the long run;
As prop'n of output: imports down from 12.5% to 8%

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%

Key takeaways

Economic modelling with the SEE:

- The SEE are testable conditions with a long history in macroeconomics and finance
- If the SEE hold, then the shock is more sector-specific (less macroeconomic).

Transition: uncertainty and out-of-date capital, so the SEE are unlikely to hold

- greater propagation of shocks, but also opportunity for change

Policy implications: by estimating how the SEE fail to hold, we can

- identify paths of least resistance for transforming the economy

BSL is important to Gladstone's economy and Qld's Al/AlOx supply chain

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

With right energy transition, Gladstone Aluminium can be 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

Articles:

- 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.
- Cai, Y., & Judd, K. L. (2021). A Simple but Powerful Simulated Certainty Equivalent Approximation Method for Dynamic Stochastic Problems (No. w28502). National Bureau of Economic Research.
- 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).
- 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.
- Na, S., Anitescu, M., & Kolar, M. (2021). A fast temporal decomposition procedure for long-horizon nonlinear dynamic programming. *arXiv preprint arXiv:2107.11560*.

Data:

- Australian Bureau of Statistics (ABS), 2018-2019. *Tables 5 and 8: Industry by Industry Flow Table*. Released May 2021.
- Australian Bureau of Statistics, Business Longitudinal Analysis Data Environment (BLADE), 2018-2019, <https://www.abs.gov.au/about/data-services/data-integration/integrated-data/business-longitudinal-analysis-data-environment-blade>
- Bureau of Economic Analysis (2003). *Capital flow data for 1997*. <https://www.bea.gov/news/2003/capital-flows-us-economy-1997>
- Gladstone Regional Council. <https://www.gladstone.qld.gov.au/downloads/file/3466/gladstone-region-investment-prospectus> . Retrieved October 2022
- 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
- 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.