

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 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 capital, labour, intermediates (with 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 *sectoral* level
Testable: “value capital today” = “**expected value** of capital in the future”
• Absent in intersectoral models: CoPS; Atalay; Cesa-Bianchi et al; Baqaee and Farhi

More uncertainty and change imply Euler eq'ns unlikely to hold
• Capital allocations across sectors are on a suboptimal path through time, so
• sectoral shocks propagate across the economy;
• sectors exhibit greater adaptive capacity.

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: 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): 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

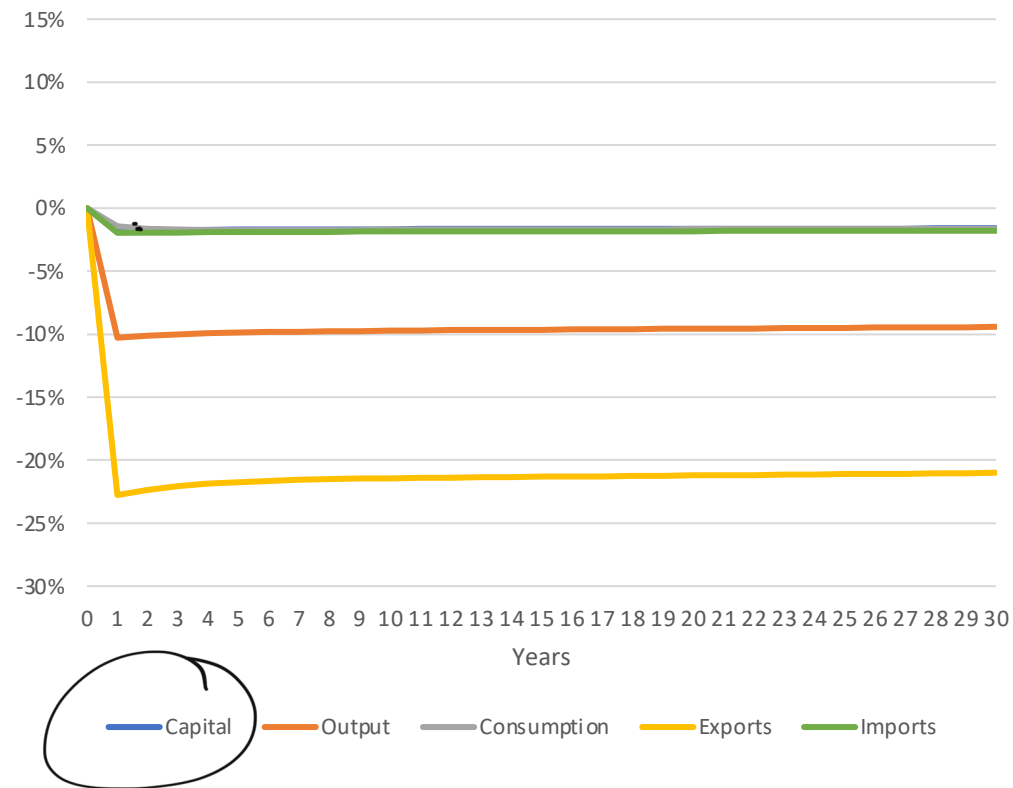
Main message: it is optimal to build up capital in advance of the closure

Results from experiments:

(1a)

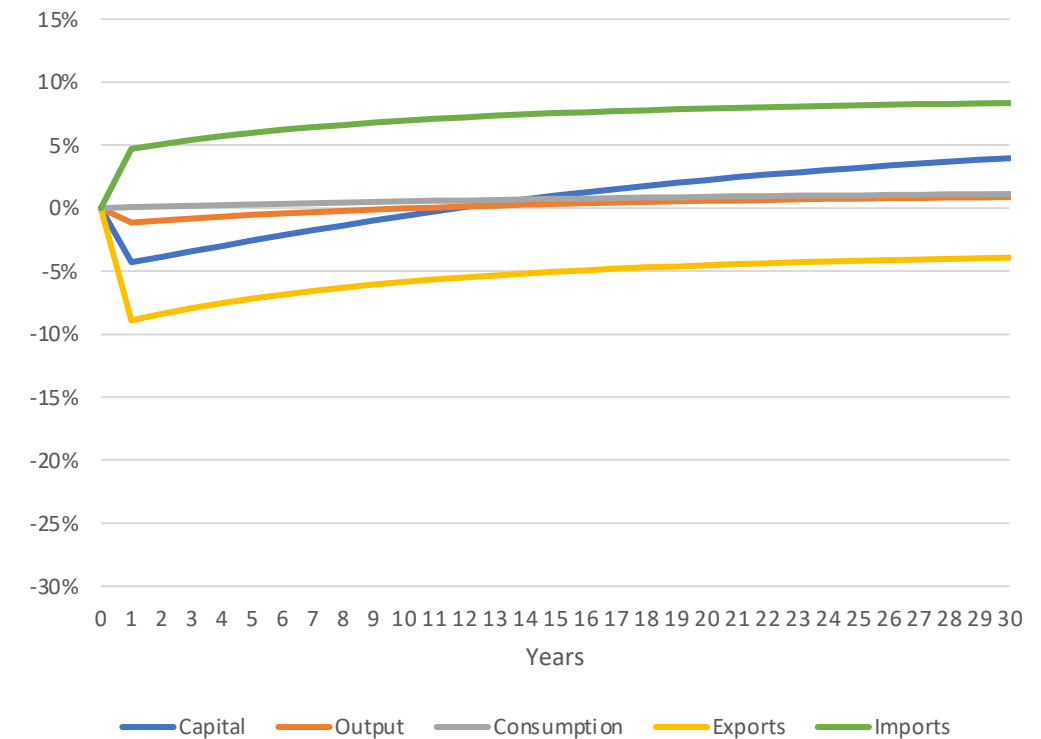
(2a)

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



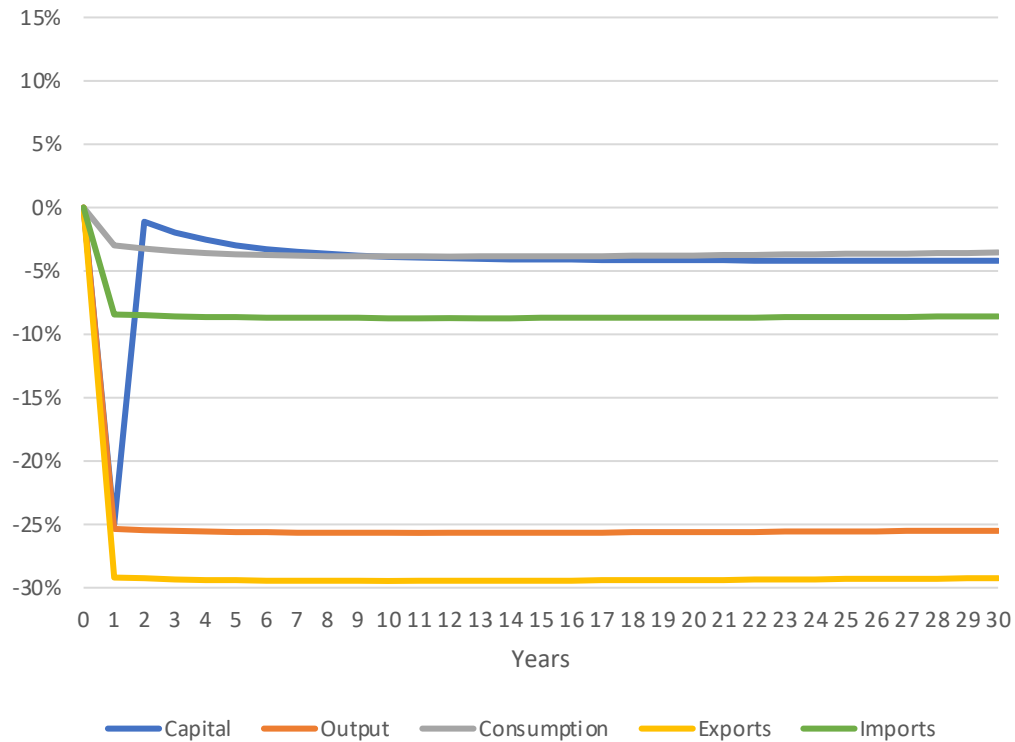
Output permanently down by 10% or \$1.5bn in accordance with productivity shock and with fact that *BSL Output is 6% of aggregate.*

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



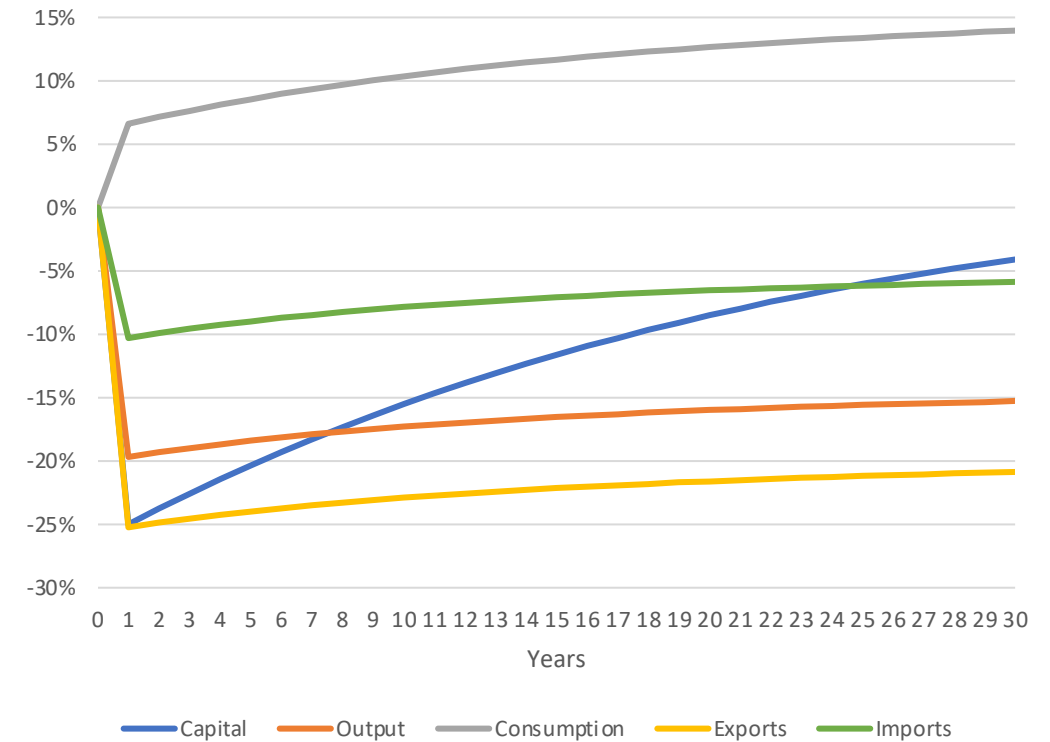
Output falls by 1% or \$0.15bn before converging to 0; impact is transitory (unlike the productivity shock). Consumption is up by 1% in the long run

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



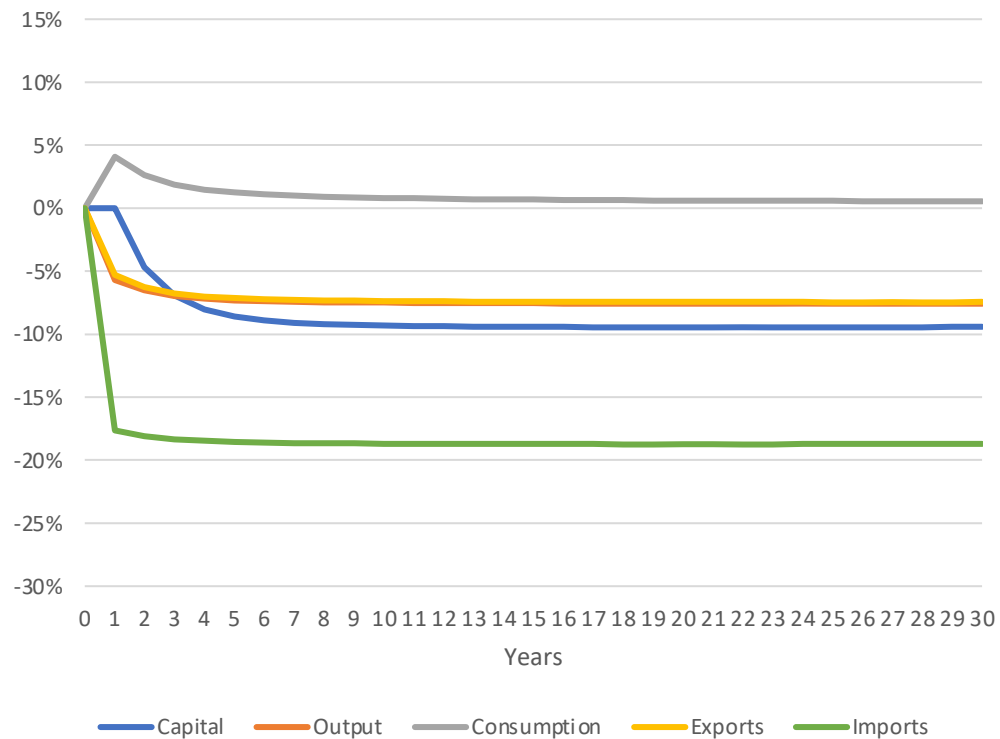
Manufacturing capital immediately returns close to optimal levels: a quick response is optimal.

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



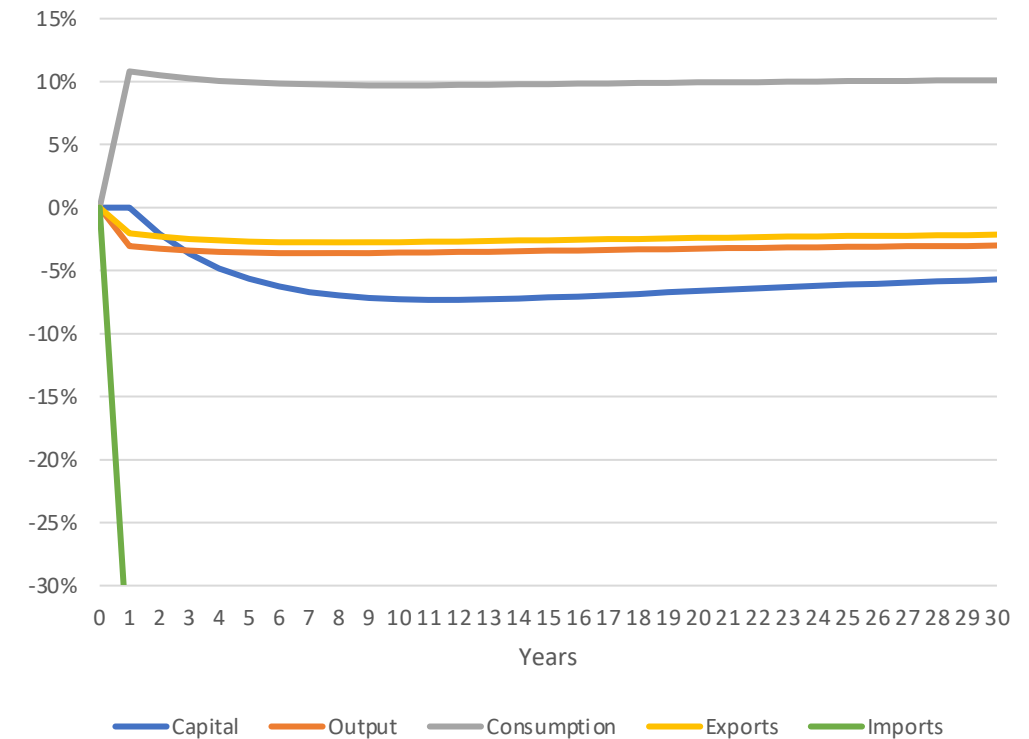
Manufacturing capital takes much longer to return to previous levels as they were not as efficient.

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



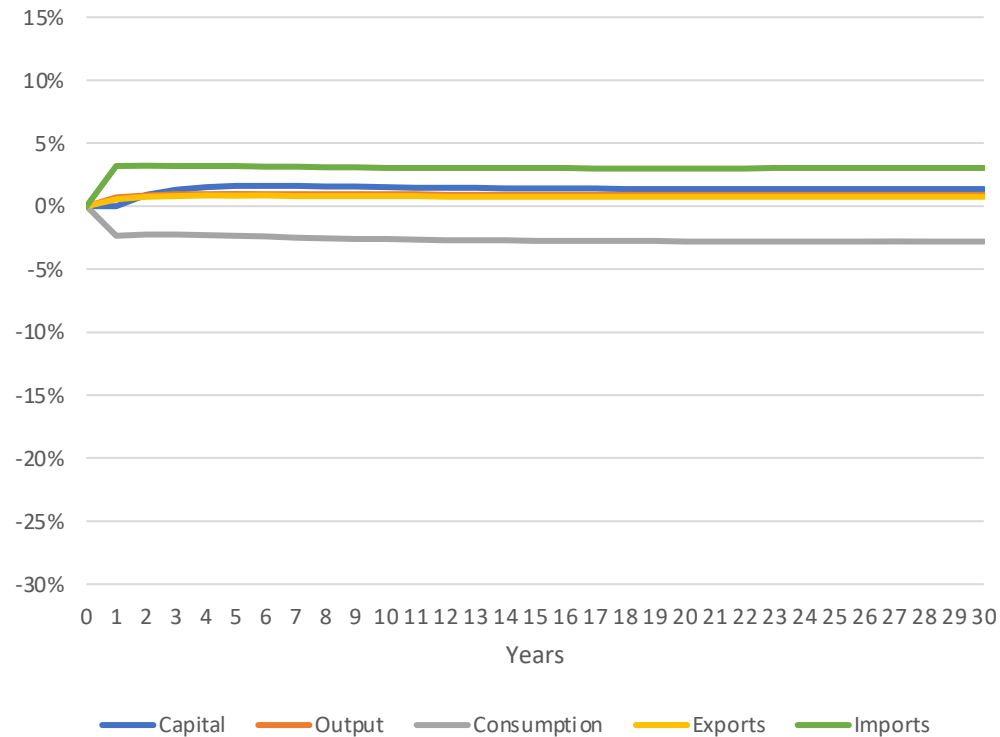
Utilities (Energy and Water) price initially fall by 4%;
 Consumption up compensating for falls elsewhere;
 Capital down by 9% in the long run.

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



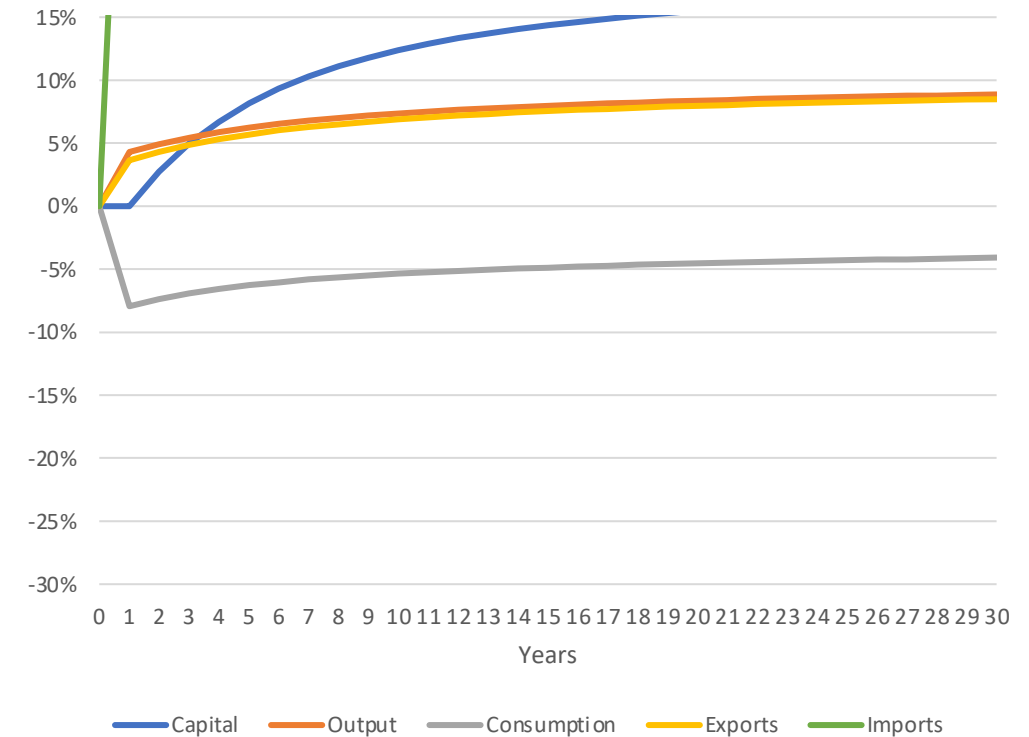
Utilities price down by 10% and remains there;
 Capital down by 6% in the long run;
 As prop'n of output: imports down from 12.5% to 8%

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 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

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