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**

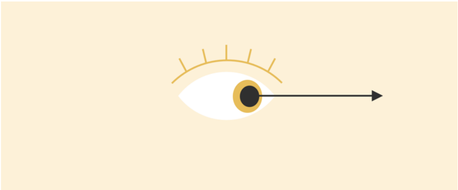
- **BSL represents approx. ¼ of Manufacturing** activity except in energy consumption

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

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

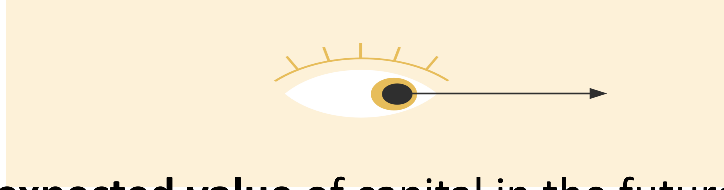
Economic Modelling
with
Sector-specific Euler Equations

``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, inter**med**iates (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: some SEE will fail 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

- This 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)

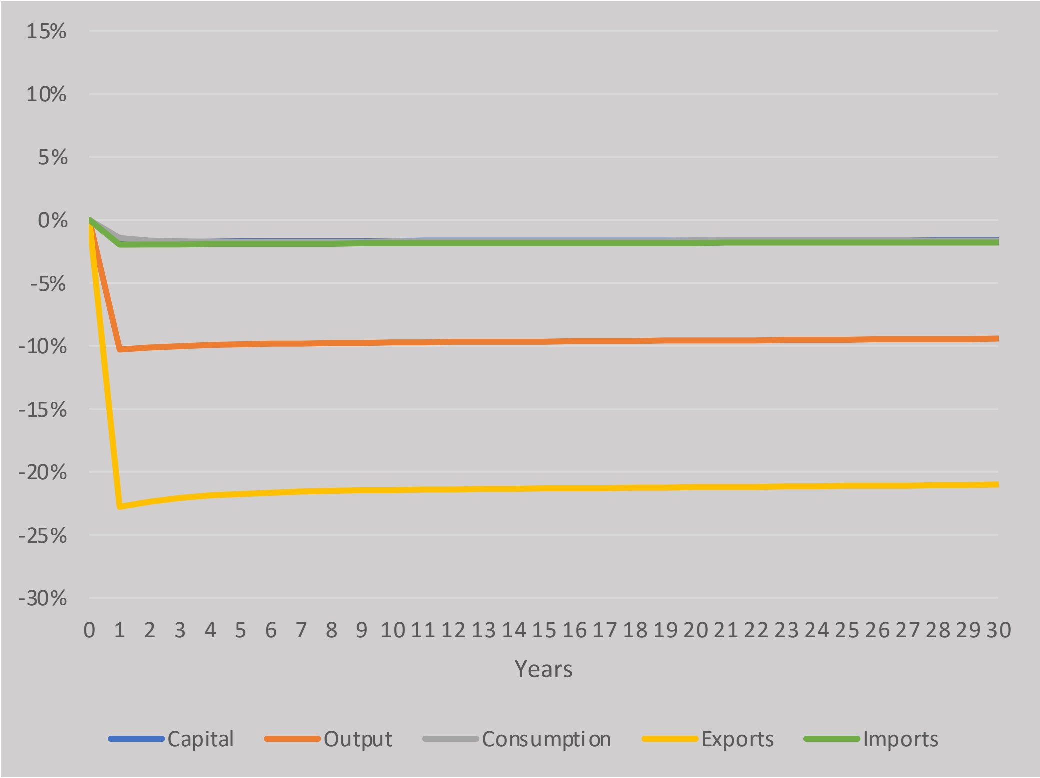
All 20 SEE hold

(2a)

***Not** all 20 SEE hold*

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

Aggregates

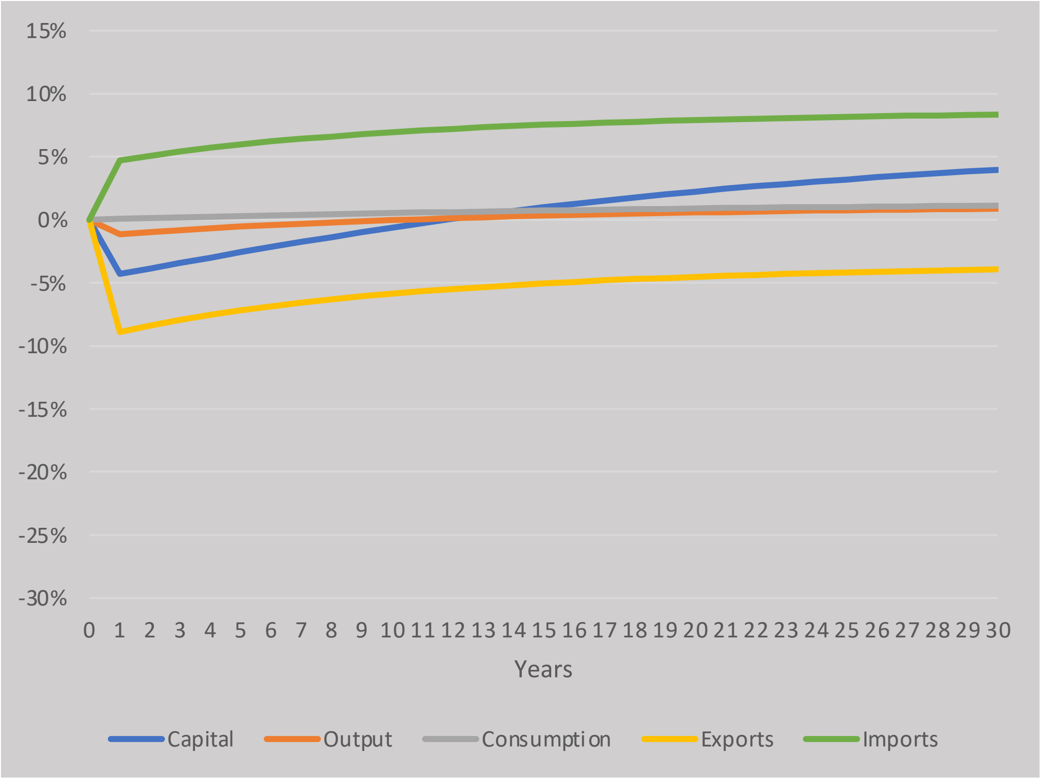


Aggregate Output permanently down by 10% or $1.5bn in accordance with productivity shock

Aggregate Capital permanently down by 1.6-1.7%

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

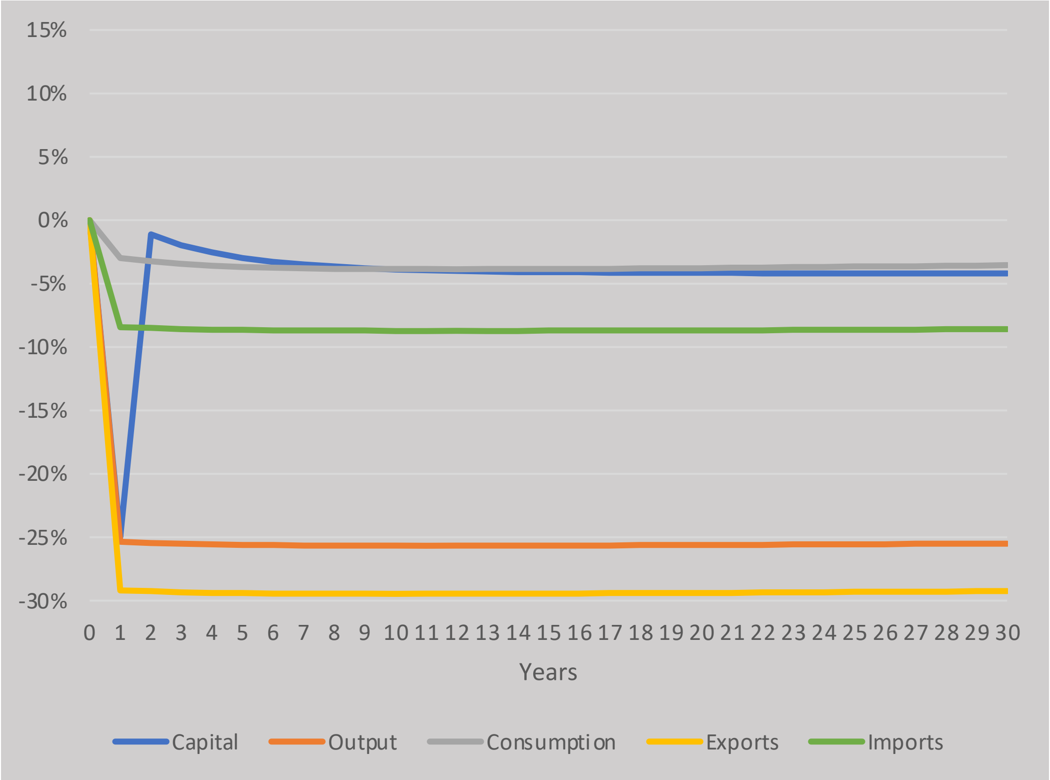
Aggregates



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

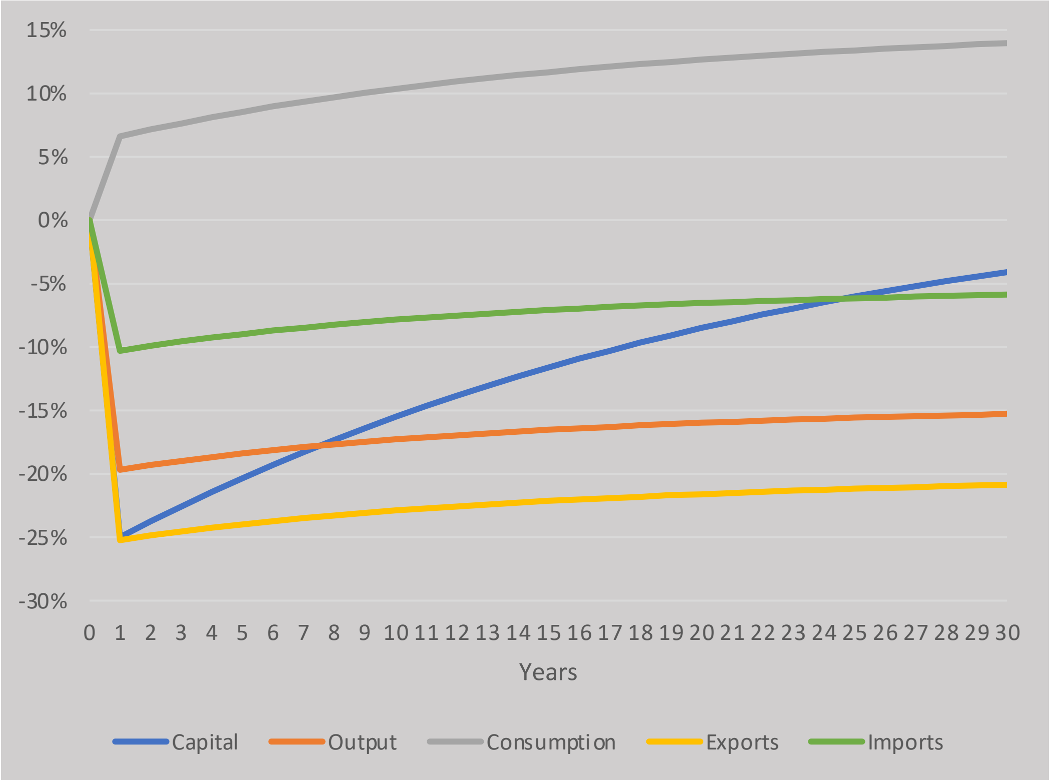
Consumption is up by 1% in the long run

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



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

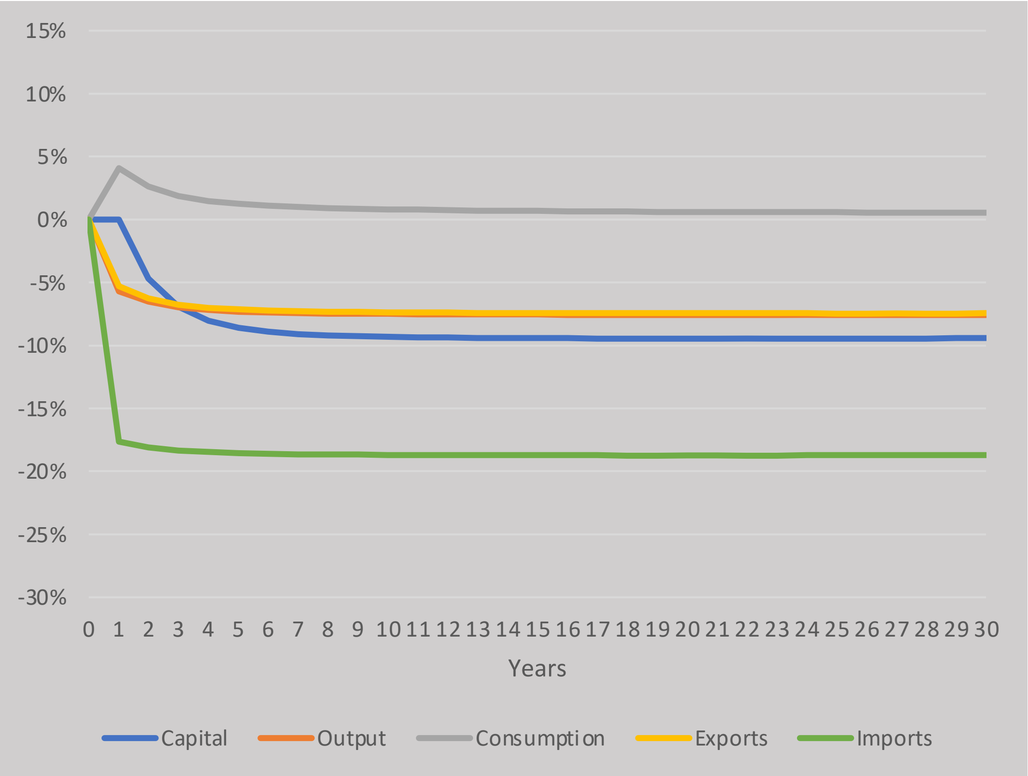
Experiment-shock (2a): **% change relative to status quo,**
Manufacturing



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

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

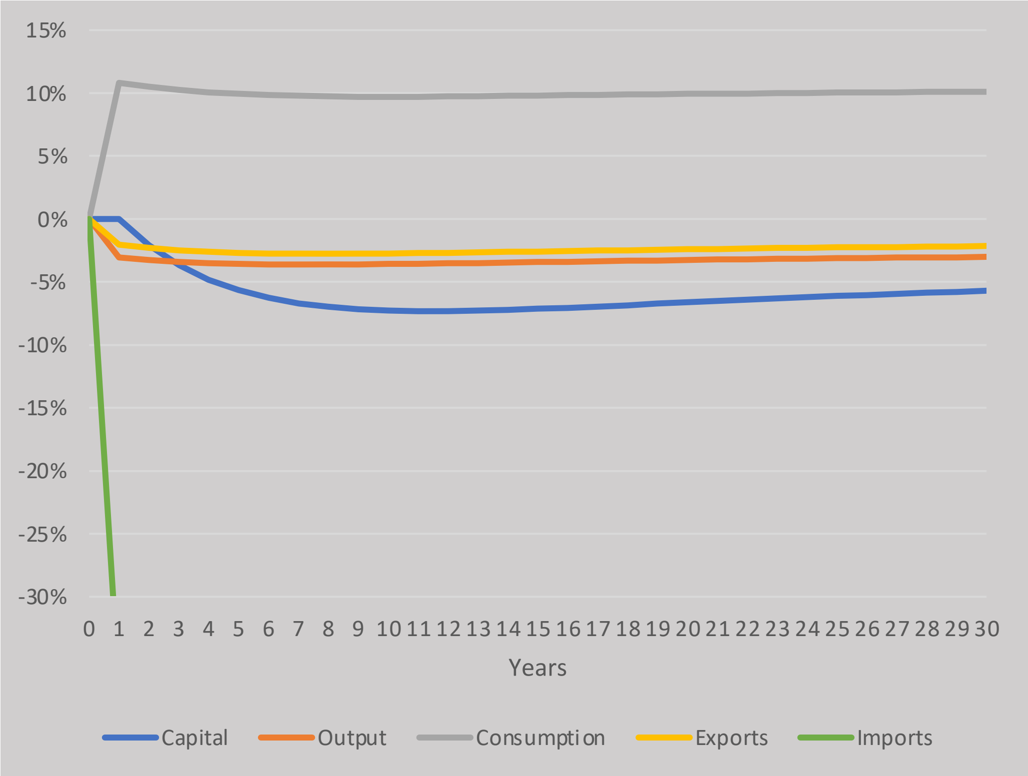
Utilities



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

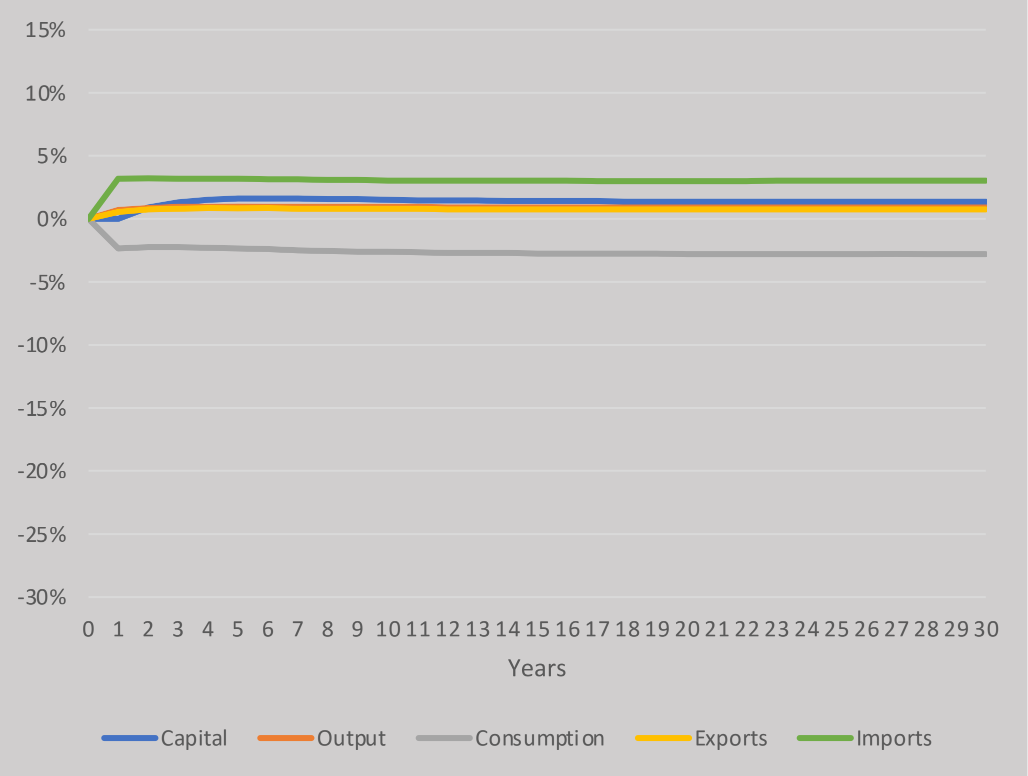
Experiment-shock (2a): **% change relative to status quo,**

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%

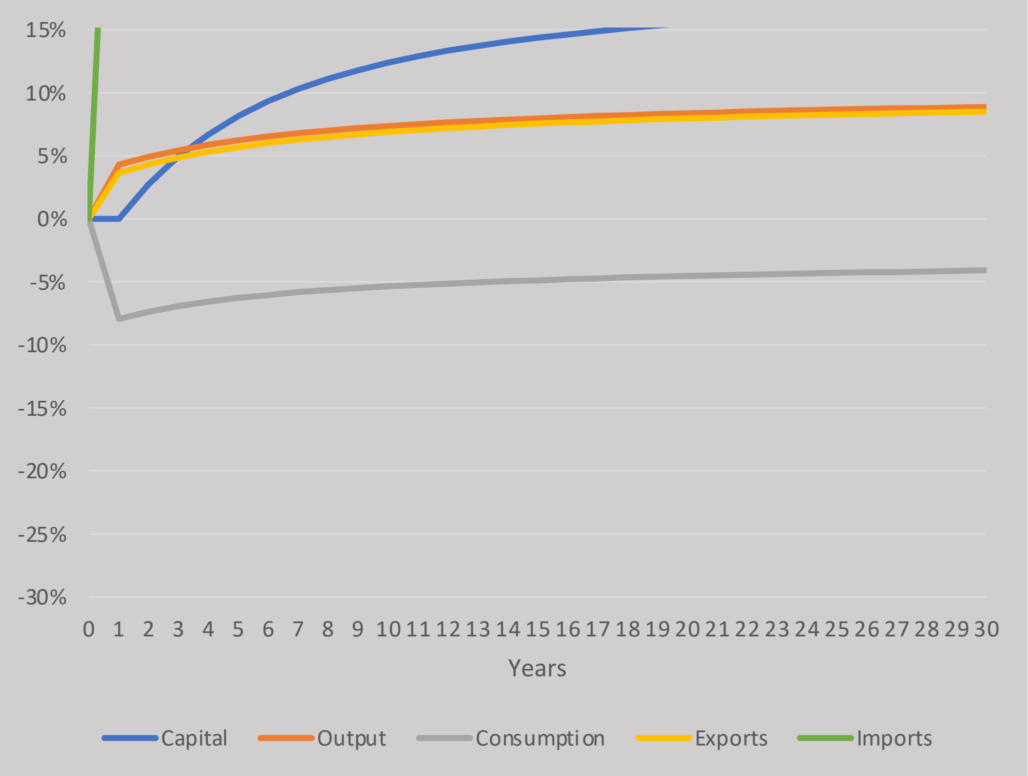
Experiment-shock (1a): **% change relative to status quo,** **Agriculture** (Similar pictures for Mining.)



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

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