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 (2018-19 economy, SA3/LGA), 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**

  Other Heavy industry: 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, inter**med**iates (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''

- We tend to smooth consumption across time
- Absent in intersectoral models: CoPS; Atalay; Cesa-Bianchi et al; Baqaee and Farhi

Transition to net zero: Euler eq'ns unlikely to hold, but important implications for whether shock propagate and economy can transform.

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

Data: initial conclusions

- 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

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

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 which experiment we run

Experiment (1a) Results Summary

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

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 (b) shock: labour is immobile

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 CoPS approach

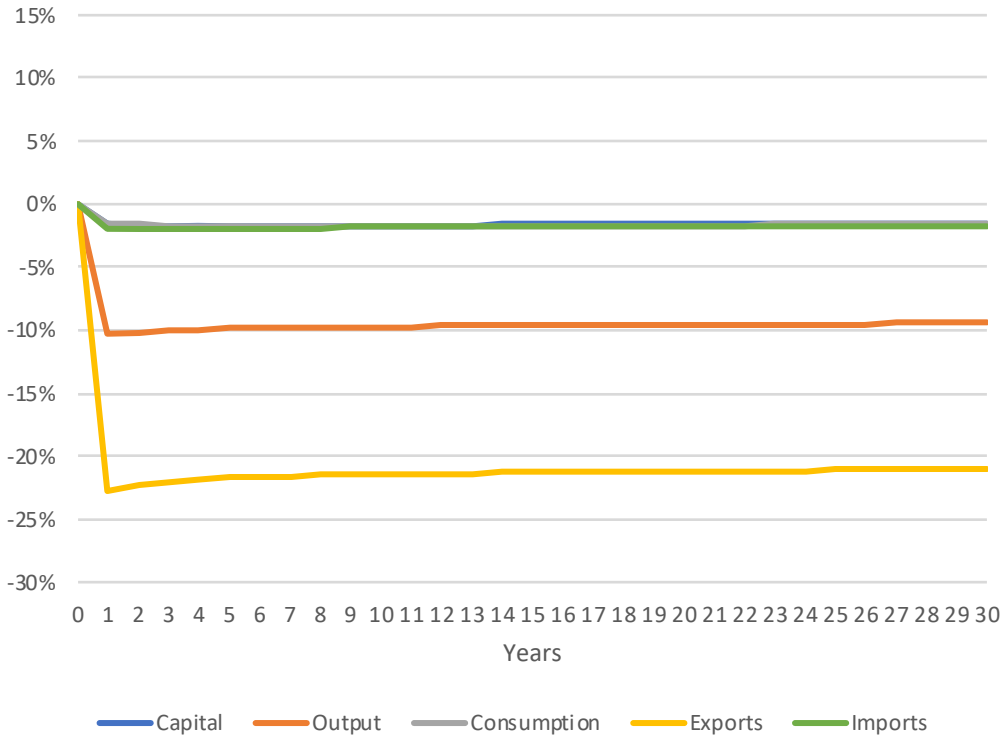
Main message: it is optimal to build up capital in advance of the closure

Comparison of experiments:

(1a) (2a)

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

Aggregates

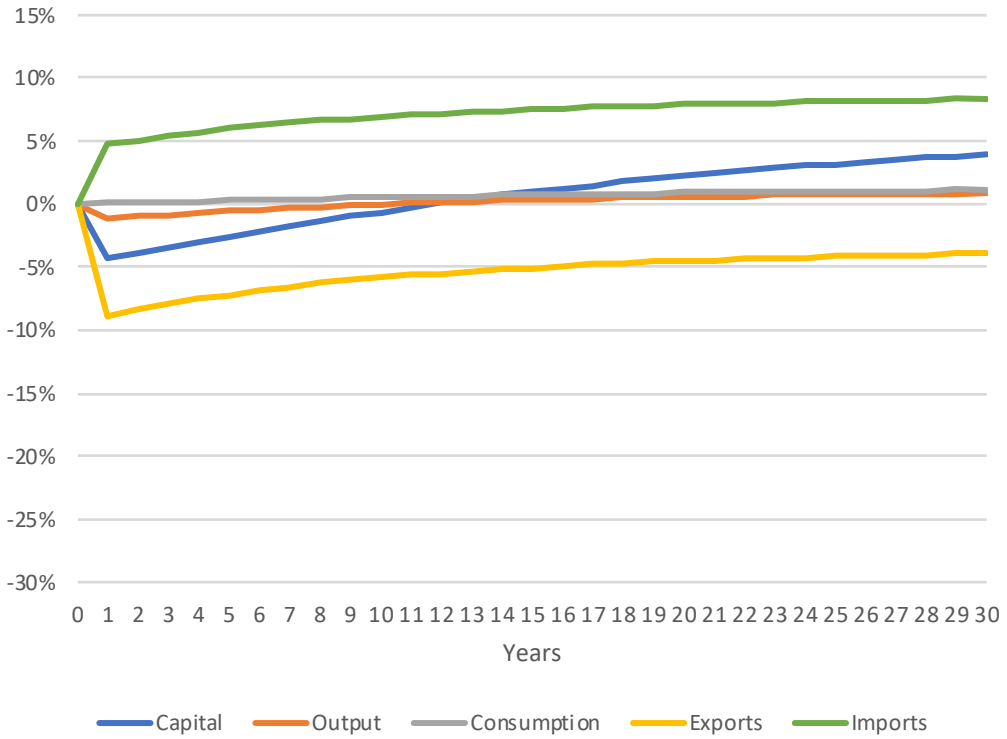


Aggregate Output permanently down by 10% or $1.5bn in accordance with productivity shock

Aggregate Capital permanently down by 1.6-1.7%

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

Aggregates

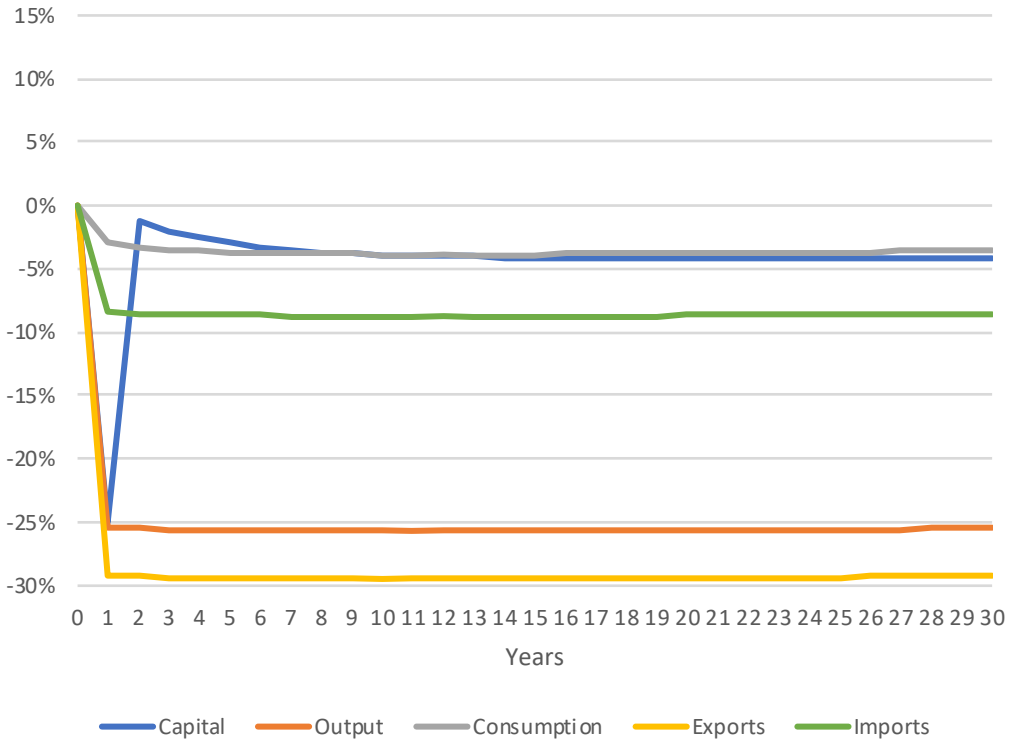


Output falls by 1% or $0.15bn before converging to 0; impact is transitory (unlike the productivity shock).

Consumption is up by 1% in the long run

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

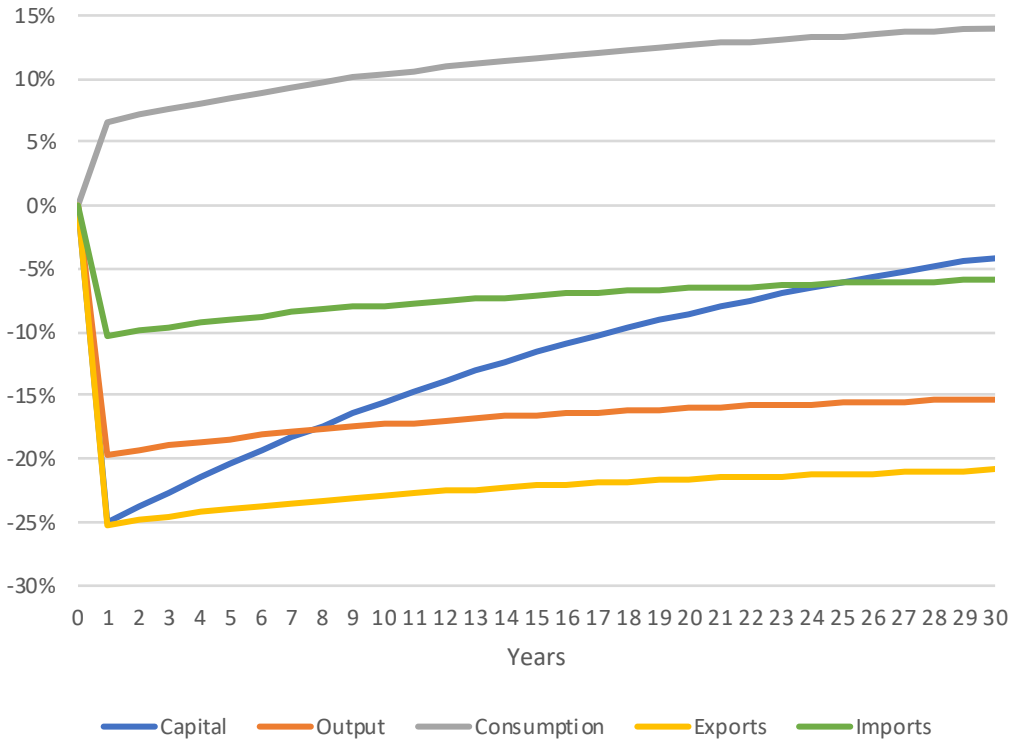
Manufacturing



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

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

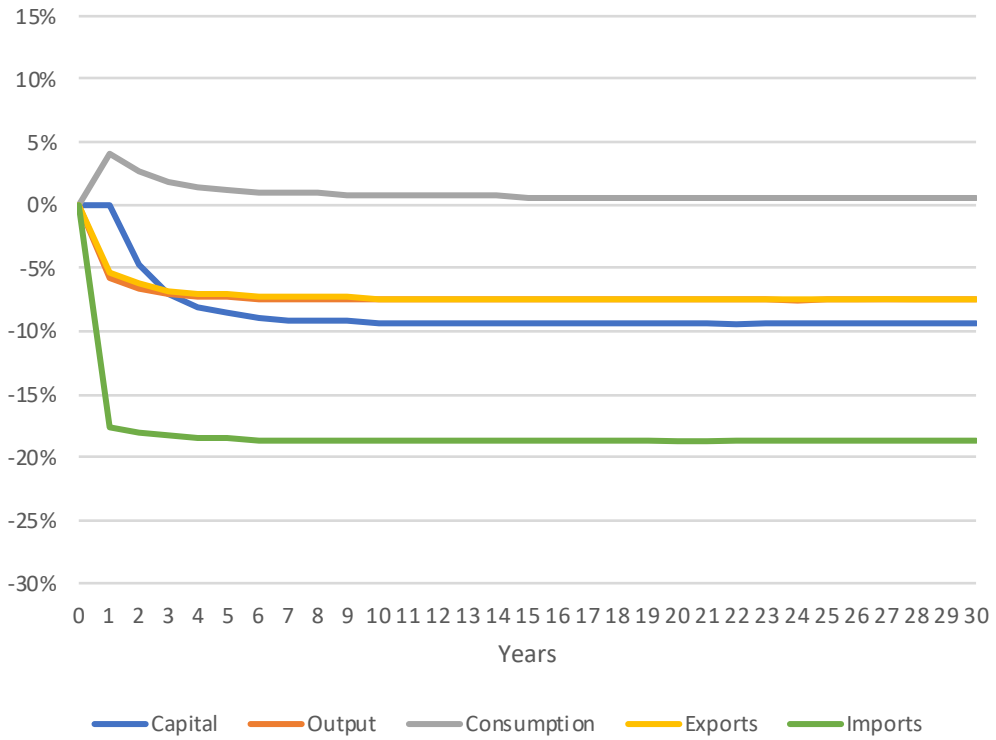
Manufacturing



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

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

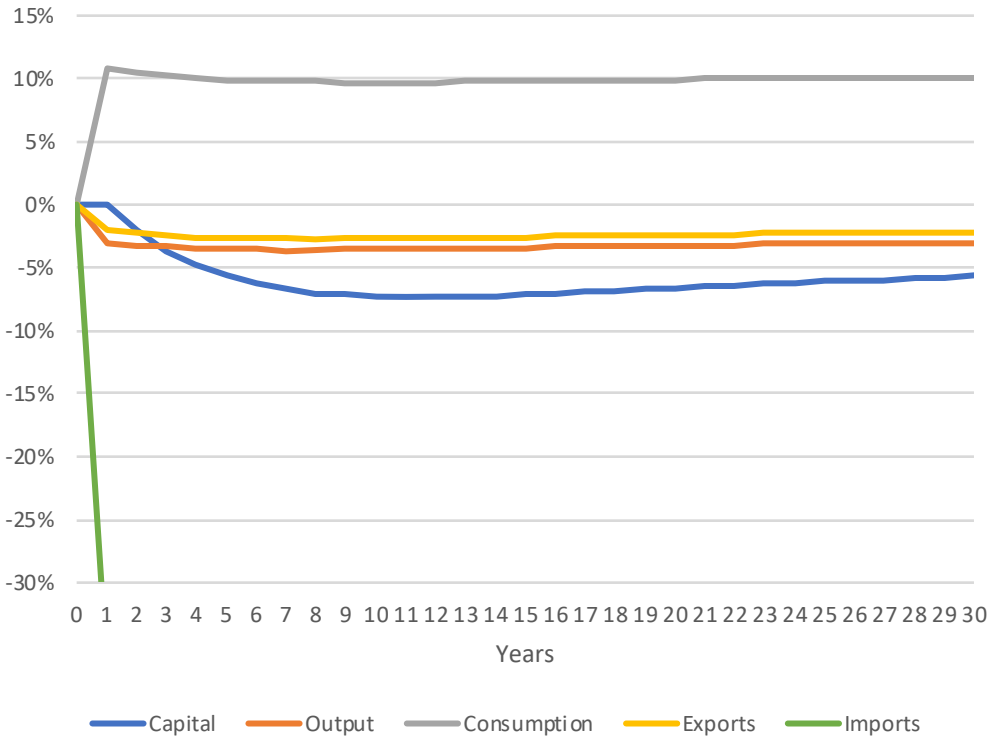
Utilities



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

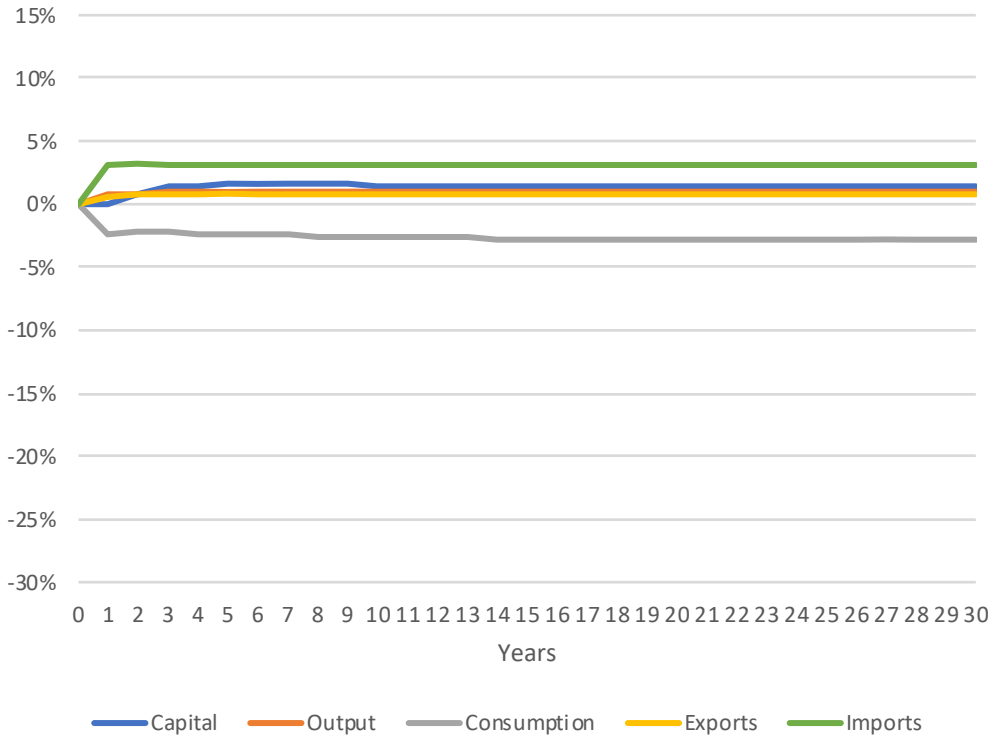
Experiment-shock (2a): **% change relative to status quo,**

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%

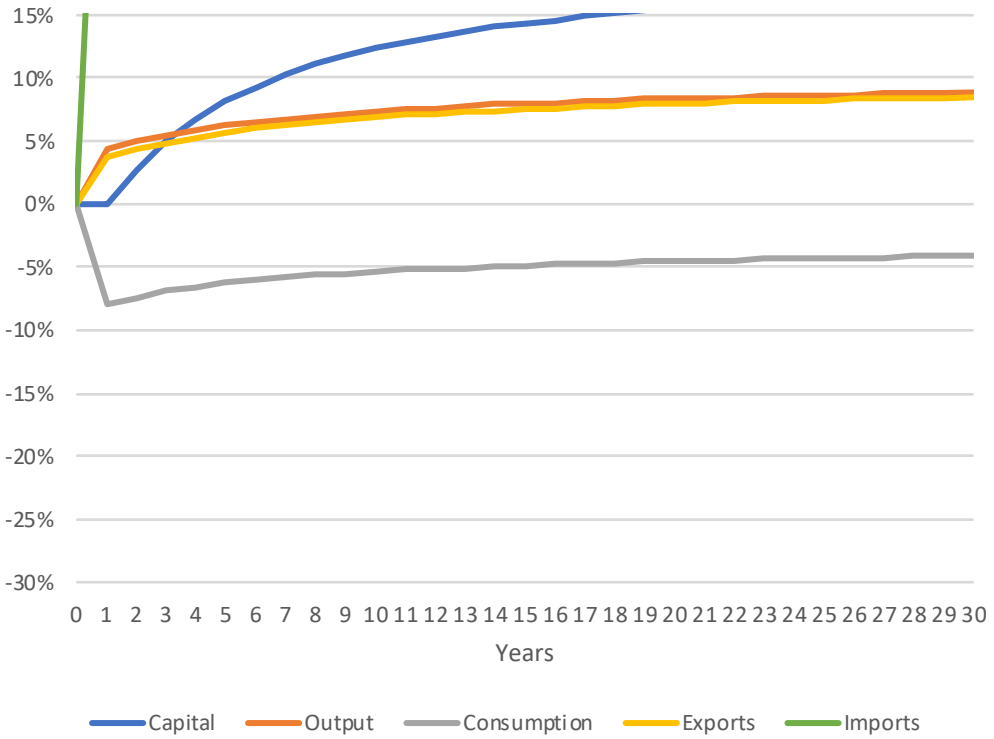
Experiment-shock (1a): **% change relative to status quo,**
Agriculture (Similar pictures for Mining.)



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%

Key takeaways

Key takeaways

- *Sectoral* Euler eq'ns matter for shock propagation and economic response
  - If they hold, then the shock is more sector-specific (less macroeconomic).

- Transition: uncertainty and out-of-date capital, so sectoral Euler equations unlikely to hold
  - greater propagation of shocks, but also opportunity for change

- By allowing sectoral Euler equations to fail in ways that reflect the current transition:
  - we can explore ways to transform the economy

- 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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