Boyne Smelters
Economic Impact on the Gladstone Region and Queensland

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Aluminium Industry and Boyne Smelters (**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
Inter-{regional, sectoral and temporal} Euler
General Eq'm
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
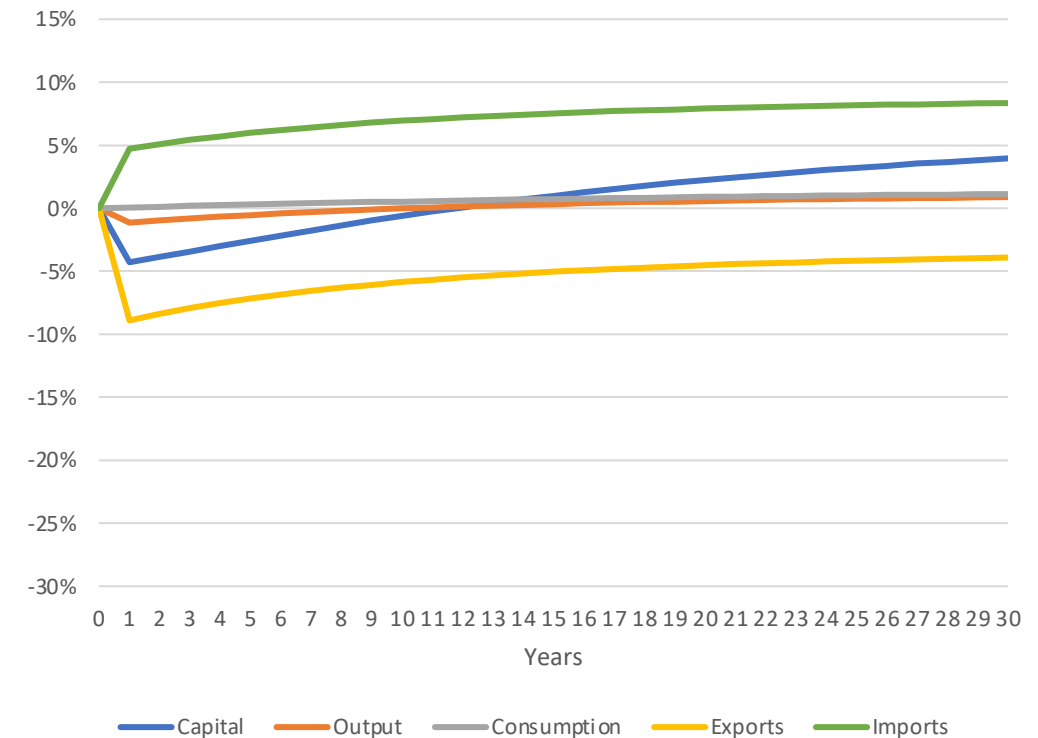
Results from experiments:

(1a)   (2a)

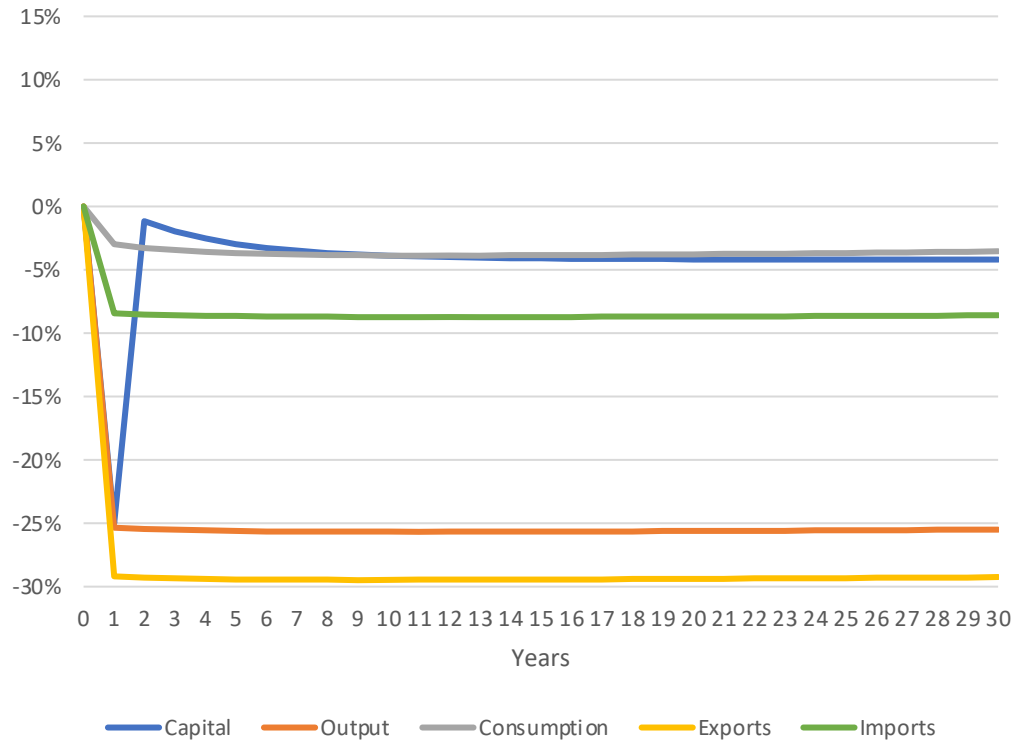# Experiment-shock (1a): **% change relative to status quo, Aggregates**

Experiment-shock (2a): **% change relative to status quo, Aggregates**
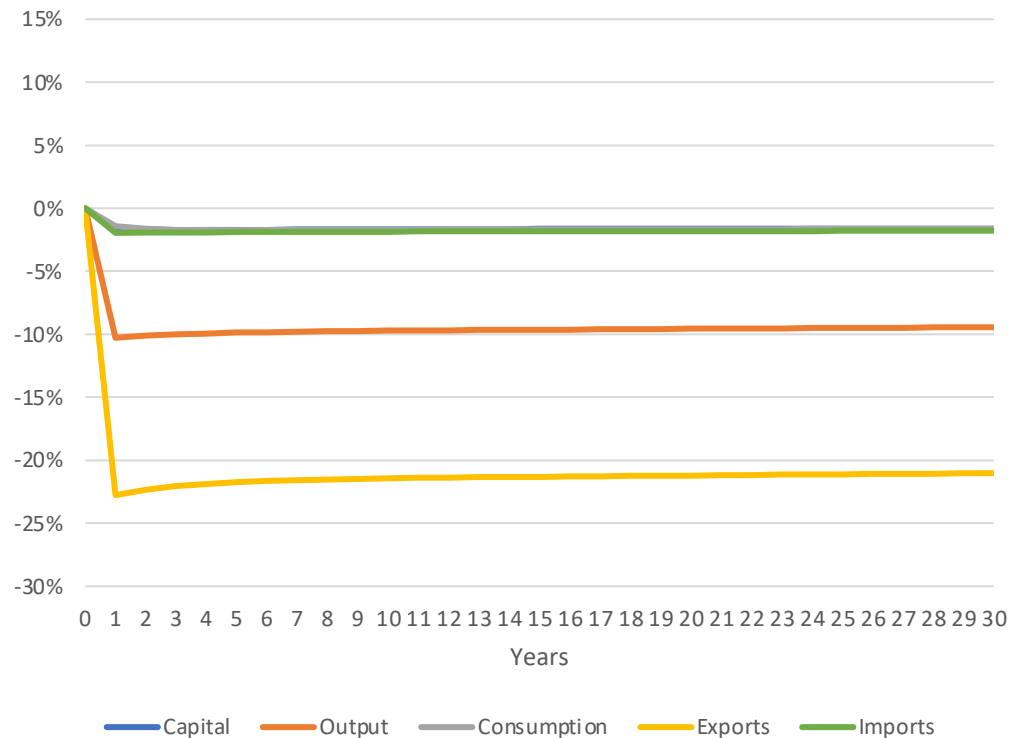
Output permanently down by 10% or $1.5bn in accordance with productivity shock and fact that BSL Output is 6% of aggregate.

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

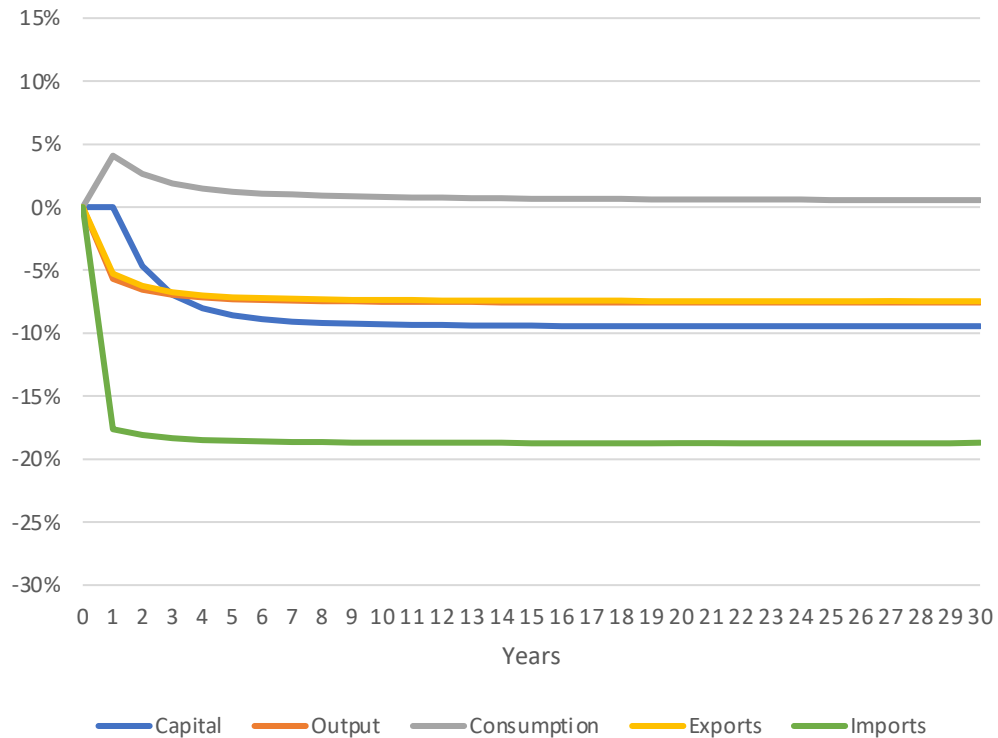Experiment-shock (1a): **% change relative to status quo, Manufacturing**

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

Manufacturing capital immediately returns close to optimal levels: a quick response is optimal.
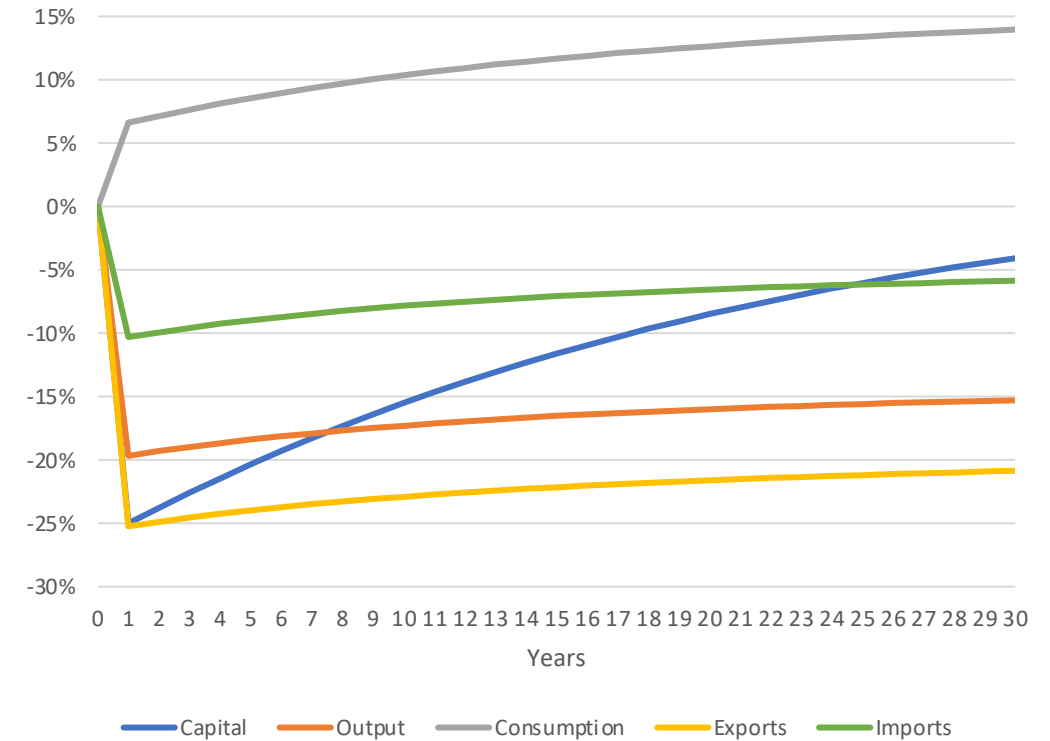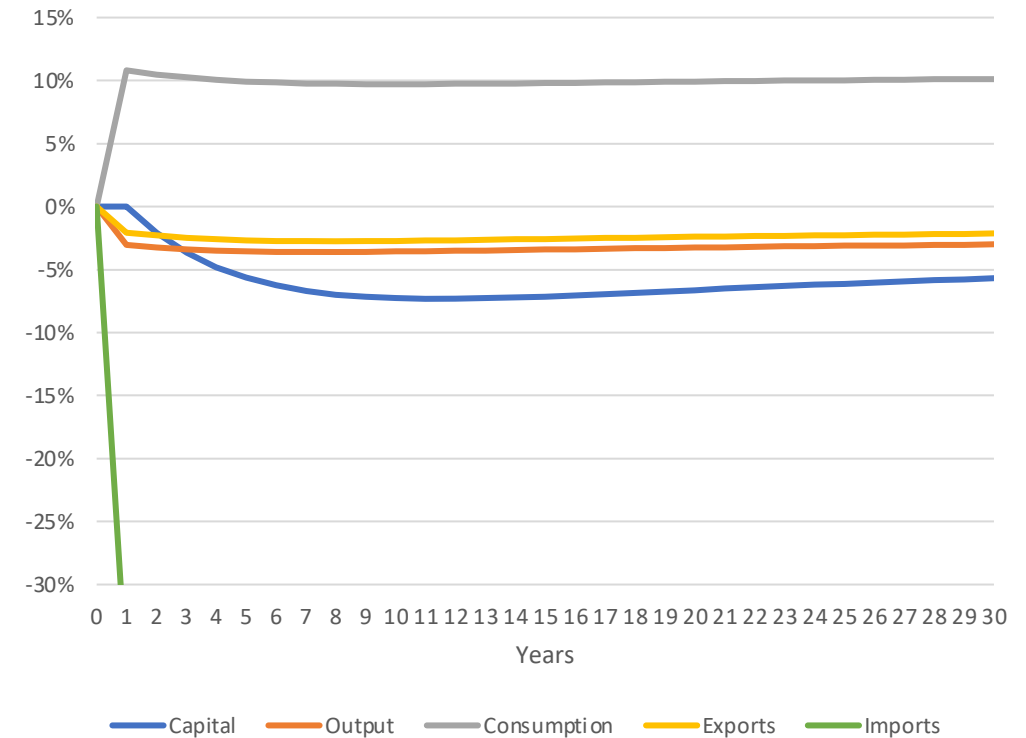
Manufacturing capital takes much longer to return to previous levels as they were not as efficient.

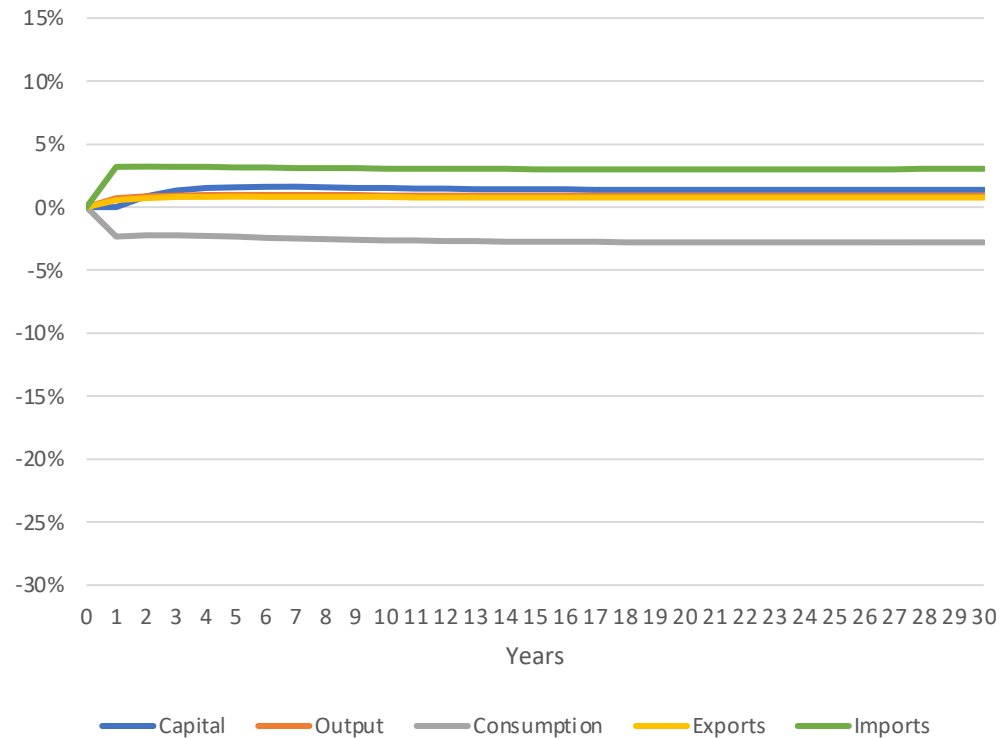# Experiment-shock (1a): **% change relative to status quo, Utilities**

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

Utility price initially fall by 4%;
Consumption up compensating for falls elsewhere;
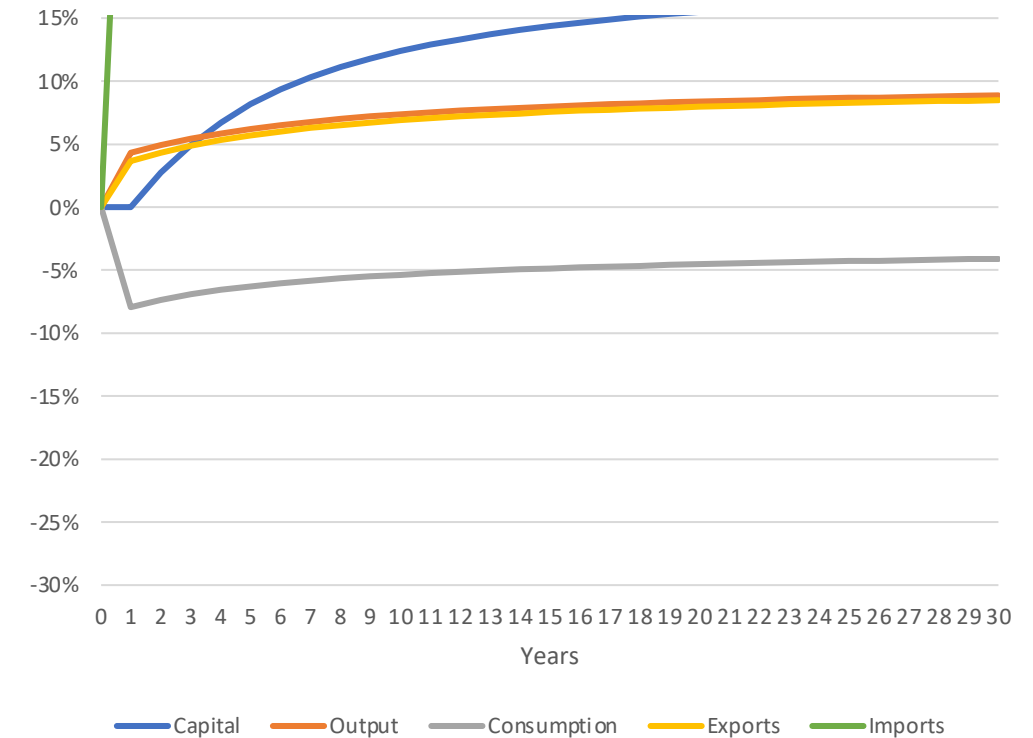Capital down by 9% in the long run.

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**

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

Capital, output, exports, imports and price up
Consumption down
(Similar pictures for Mining.)

Similar, but more extreme with
Capital up by over 15% in the long run.
As prop'n of output: imports up from 10% to 15%

Key takeaways

- Economic impact of BSL closure on Gladstone
  Output: Aggregate, Manufacturing and Utilities all **down** and *permanently if Euler eq'ns hold*
  - Aggregate -$155m; Manufacturing -$147m; Utilities -$45m; Construction -$23m; Transport -$4m; …
  Agriculture, **Mining** and **Aggregate Consumption** rise: *but only if Utilities prices fall enough*
  - Gladstone is connected to the NEM, so price effect would be small.

- In the context of 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) and water
  - Early decisions are valuable: e.g. Kurri Kurri closure 2012, power station approved 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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