

Modelling the COVID-19 pandemic in a CGE framework

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Representing economic impacts of COVID-19 in a CGE model

- **Domestic demand**: Social distancing affects public and private consumption of many commodities
- **International demand**: General slowing of world economy affects all exports, travel bans impact tourism, international students
- **Fiscal**: JobKeeper, JobSeeker and other support measures, modelled as transfers and wage subsidies
- **Productivity**: working from home, school closures, inefficiencies derived from additional hygiene requirements and social distancing, sick leave
- **Population**: slowing net international and net interstate migration

The following slides show how these shocks fit into the economic framework...

I-O expenditure	Industry (1) [i]	Investors (2) [i]	Households (3) [1]	Exports (4) [1]	Government (5) [1]	Change in stocks (6) [1]	(7) Total Sales
(1) Domestic [c]	V1BAS (c,dom,i)	V2BAS (c,dom,i)	V3BAS (c,dom)	V4BAS(c)	V5BAS (c,dom)	V6BAS (c,dom)	V0BAS (c,dom)
(2) Imported [c]	V1BAS (c,imp,i)						V0BAS(c,imp)
(3) Margins [c*s*m]	V1MAR (c,s,i,m)						V0MAR (c,s,m)
(4) Indirect taxes [c*s]	V1TAX (c,s,i)						V0TAX(c,s)
(5) Labour [o]	V1LAB(o,i)						V1LAB_I(o)
(6) Capital [1]	V1CAP(i)						V1CAP_I
(7) Land [1]	V1LND(i)						V1LND_I
(8) Prod taxes [1]	V1PTX(i)						V1PTX_I
(9) Oth costs [1]	V1OCT(i)						V1OCT_I
(10) Total exp.	V1TOT(i)	V2TOT(i)	V3TOT	V4TOT	V5TOT	V6TOT	V0TOT

We update every price and quantity in this table in a “bland” way from quarter to quarter to form a base case, based on the 3 P’s: Population, Productivity and Participation.

The model contains theories that determine how expenditure on goods and services and factors respond to price, income and other variables.

We assume supply = demand for goods and services; prices of goods and services are determined by zero pure profit conditions. Factor markets depend on model dynamics.

We can apply structural shocks to any aspect of commodity or factor demand or supply to derive an alternative to the base case. Multiple scenarios may be derived in this way.

I-O expenditure

(1) Domestic [c]

(2) Imported [c]

(3) Margins
[c*s*m]

(4) Indirect taxes
[c*s]

(5) Labour [o]

(6) Capital [1]

(7) Land [1]

(8) Prod taxes [1]

(9) Oth costs [1]

(10) Total exp.

Industry
[i] (1)

V1BAS
(c,dom,i)

V1BAS
(c,imp,i)

V1MAR
(c,s,i,m)

V1TAX
(c,s,i)

V1LAB(o,i)

Affected by **social distancing** regulations:
How deep and for how long? Full or incomplete recovery?

V1TOT(i)

Investors
[i] (2)

V2BAS
(c,dom,i)

V2BAS
(c,imp,i)

V2MAR
(c,s,i,m)

V2TAX
(c,s,i)

V2TOT(i)

House-
holds [1] (3)

V3BAS
(c,dom)

V3BAS
(c,imp)

V3MAR
(c,s,m)

V3TAX
(c,s)

V3TOT

Exports
[1] (4)

V4BAS(c)

V4TAX(c)
s=dom only

V4TOT

Government
[1] (5)

V5BAS
(c,dom)

V5BAS
(c,imp)

V5MAR
(c,s,m)

V5TAX
(c,s)

V5TOT

Change in
stocks [1] (6)

V6BAS
(c,dom)

V6BAS
(c,imp)

V6TOT

(7) Total
Sales

V0BAS
(c,dom)

V0BAS(c,imp)

V0MAR
(c,s,m)

V0TAX(c,s)

V1LAB_I(o)

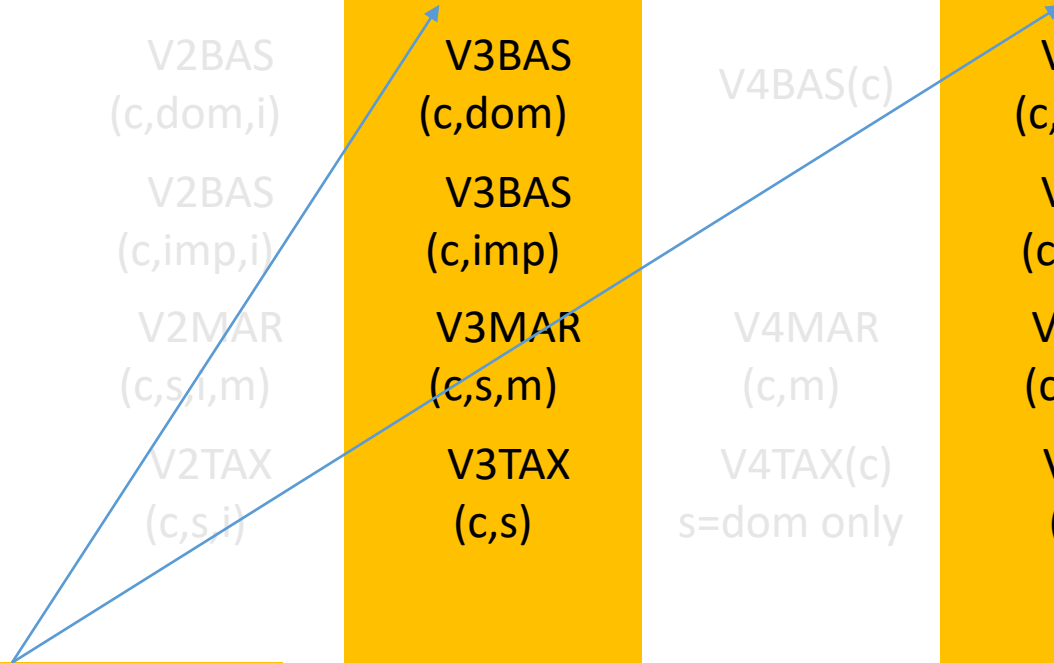
V1CAP_I

V1LND_I

V1PTX_I

V1OCT_I

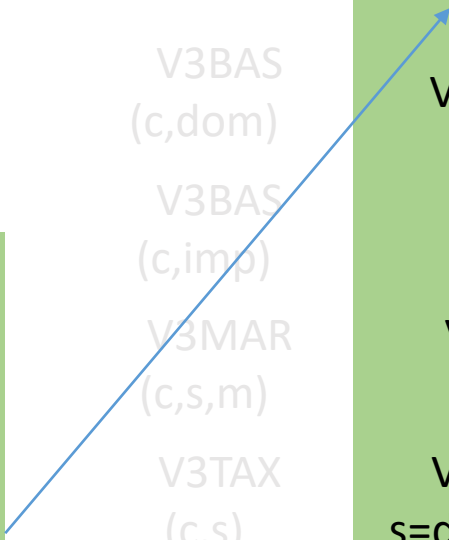
V0TOT



I-O expenditure	(1) Industry [i]	(2) Investors [i]	(3) Households [1]	(4) Exports [1]	(5) Government [1]	(6) Change in stocks [1]	(7) Total Sales
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(2) Imported [c]	V1BAS	V2BAS	V3BAS (c,imp)	V4BAS(c)	V5BAS (c,imp)	V6BAS (c,imp)	V0BAS(c,imp)
(3) Margins [c*s*m]	Exports of commodities and services especially tourism and education impacted by international downturn and travel bans .			V4MAR (c,m)	V5MAR (c,s,m)	V6BAS	V0MAR (c,s,m)
(4) Indirect taxes [c*s]				V4TAX(c) s=dom only	V5TAX (c,s)		V0TAX(c,s)
(5) Labour [o]							V1LAB_I(o)
(6) Capital [1]							V1CAP_I
(7) Land [1]							V1LND_I
(8) Prod taxes [1]							V1PTX_I
(9) Oth costs [1]							V1OCT_I
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Exports of commodities and services especially tourism and education impacted by **international downturn and travel bans**.

How deep and for how long? Full or incomplete recovery?



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Fiscal shocks affect total household expenditure and industry usage of factors (among other things).

- JobKeeper, JobKeeper, and other measures already announced.
- Anticipation/testing of further measures?

V1LAB(o,i)
V1CAP(i)
V1LND(i)
V1PTX(i)
V1OCT(i)

V3TOT

I-O expenditure	(1) Industry [i]	(2) Investors [i]	(3) Households [1]	(4) Exports [1]	(5) Government [1]	(6) Change in stocks [1]	(7) Total Sales
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Changes in **productivity** affect costs of production, prices and competitiveness.

- Immediate impact derived from inefficiencies of social distancing.
- Longer term impact may be positive (improvements to telecommuting, adoption of technology), or negative (scarring in job market, loss of education/skills)
- How much/how long/permanence?

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Population affects labour supply and aggregate private and public demand (among other things)

V3TOT

V5TOT

V1LAB_I(o)

COVID-19: challenges and departures from standard CGE modelling

- Capital utilization: Standard assumption of full capital utilization is not suitable when faced with significant demand reduction.
 - Capital idling theory added to model (Dixon and Rimmer 2010 recession paper)
- Quarterly modelling: 4 times as tricky, 4 times as slow!
 - Just a scaling problem? Stock/flow relationships.
- International travel**
 - Dummy industries reflect export bundling for foreign tourists and students, and consumption bundling and import substitution for local tourists
 - Tourism Satellite Accounts, Balance of Payments (travel credit and debit) and I-O tables

COVID-19: challenges and departures from standard CGE modelling (2)

- Large and complicated subsidies and welfare**
 - JobKeeper: subsidy or transfer payment?
- Unusual labour market/demographic interactions

$$HOURS = \left(\frac{HOURS}{EMPLOYED} \right) \left(\frac{EMPLOYED}{LABOURFORCE} \right) \left(\frac{LABOURFORCE}{POP} \right) POP$$

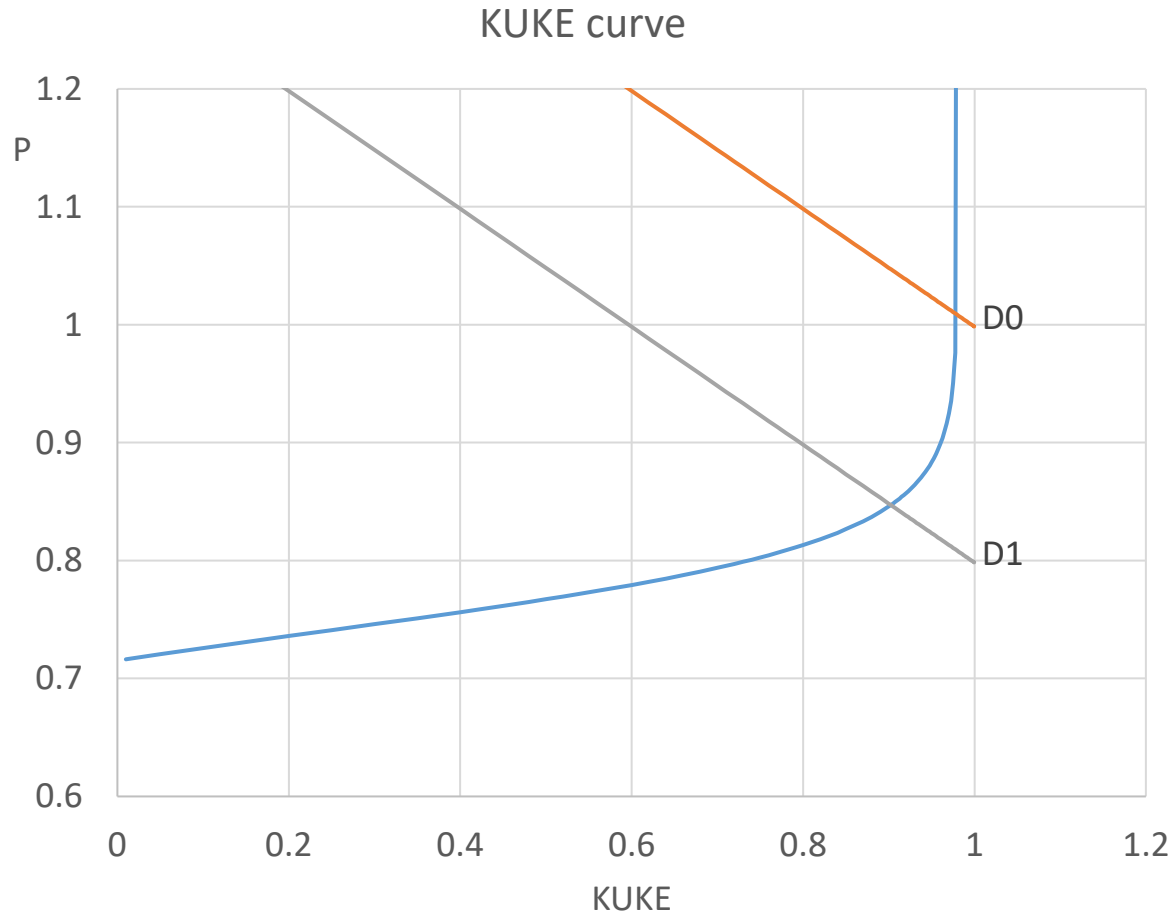
Average hours per person: affected by JobKeeper, zero for many individuals. Impact of sick leave.

(Un)employment rate: usually assumed to absorb all/most of the change in HOURS

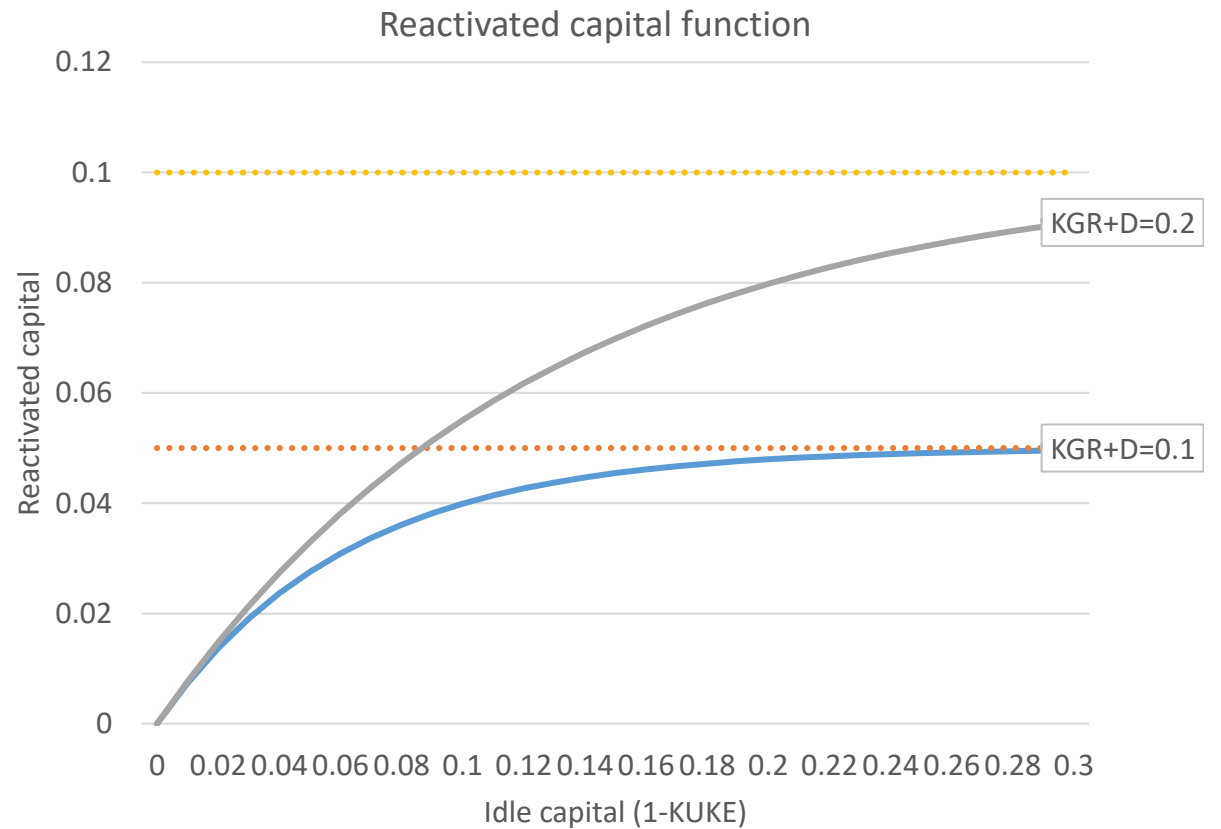
Participation rate: usually stable but fell 3.2pp (March to May 2020), suspension of mutual obligation may have played a role

Population: large fall in contribution from net overseas migration

KUKE: capital idling



Capital is “not quite” a fixed factor. As capital rentals drop, utilization drops, putting a floor on how far rentals can drop in one period.
Capital growth rates, as justified by expected rates of return, are satisfied by both investment and reactivated capital.



Government assistance

- Transfer from government to households – impact on household income
- Payments that change cost of doing business change incentives, have impact on employment
 - Job Keeper

JobKeeper –wage subsidy or transfer?

Employer with employees on different wages

Adam owns a real estate business with two employees. The business is still operating but Adam expects that turnover will decline by more than 30 per cent in coming months. The employees are:

- Anne, who is a permanent full-time employee on a salary of \$3,000 per fortnight before tax and who continues working for the business; and
- Nick, who is a permanent part-time employee on a salary of \$1,000 per fortnight before tax and who continues working for the business.

Adam is eligible to receive the JobKeeper Payment for each employee, which would have the following benefits for the business and its employees:

- The business continues to pay Anne her full-time salary of \$3,000 per fortnight before tax, and the business will receive \$1,500 per fortnight from the JobKeeper Payment to subsidise the cost of Anne's salary and will continue paying the superannuation guarantee on Anne's income;
- The business continues to pay Nick his part-time salary of \$1,000 per fortnight before tax and an additional \$500 per fortnight before tax, totalling \$1,500 per fortnight before tax. The business receives \$1,500 per fortnight from the JobKeeper Payment which will subsidise the full cost of Nick's salary. The business must continue to pay the superannuation guarantee on the \$1,000 per fortnight that Nick is earning. The business has the option of choosing to pay the superannuation guarantee on the additional \$500 (before tax) paid to Nick under the JobKeeper Payment.

JobKeeper example. Source: https://treasury.gov.au/sites/default/files/2020-04/Fact_sheet_JobKeeper_Info_for_Employers.pdf

- ANNE: JobKeeper = 50% wage subsidy
- NICK: JobKeeper = 100% wage subsidy plus \$500 transfer per fortnight
- JobKeeper looks like a 62.5% wage subsidy ($2,500/4,000$) but should it be modelled this way?
- If the business was offered a 62.5% wage subsidy it would probably expand...
 - But Nick and Anne are the only people for whom this subsidy applies

JobKeeper –wage subsidy or transfer?

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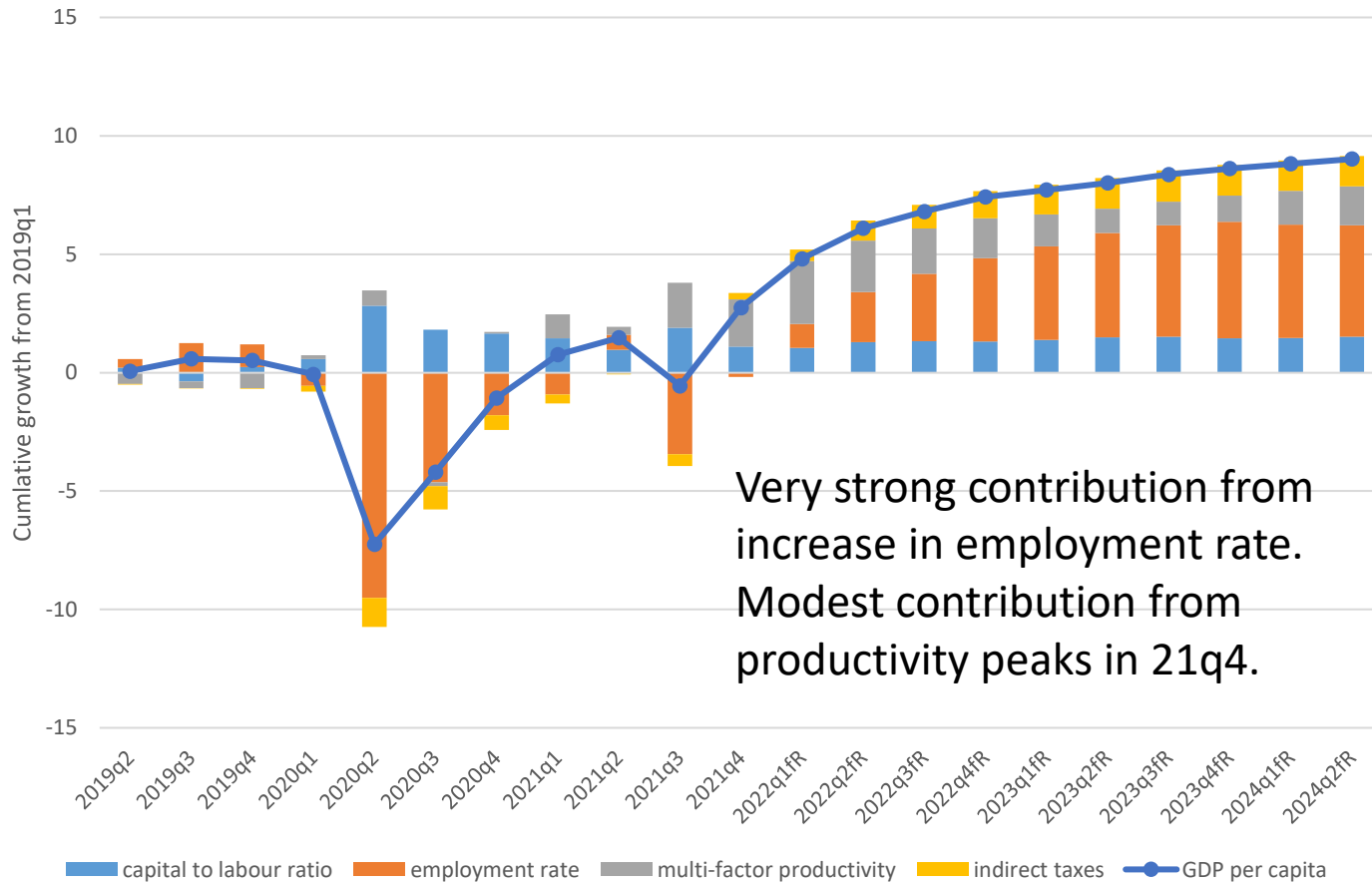
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- Suppose pre-Covid Anne generates \$5,000 in sales
 - \$3,000 salary for Anne + \$2,000 profit for Adam
- During Covid what happens to Anne's sales?
 - If Anne's sales = \$3,001
 - Without JobKeeper, Adam's profit = \$1, Anne remains employed
 - Under JobKeeper, Adam's profit = \$1,501, JK like a transfer to Adam.
 - If Anne's sales = \$2,999
 - Without JK, Adam makes a loss, Anne is sacked
 - Under JK, Adam's profit = \$1,499, Anne remains employed, JK like a wage subsidy

Impact of COVID on GDP per capita

Contribution to real per capita GDP growth, 2019-2026



Very strong contribution from increase in employment rate. Modest contribution from productivity peaks in 21q4.

GDP identity:

$$y = Ll + Kk - a$$

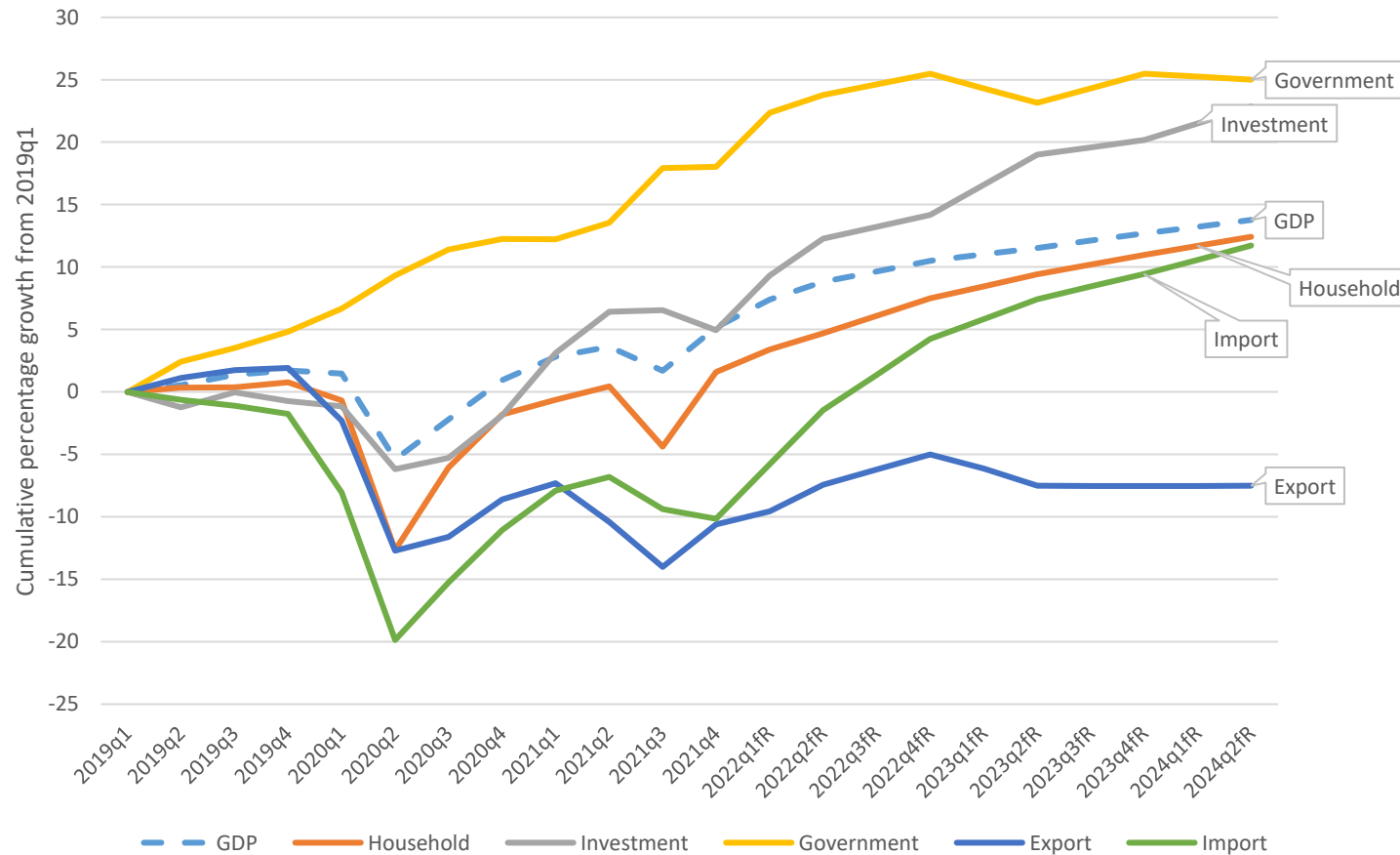
Rearrange for GDP per capita decomposition:

$$y - pop = (l - pop) + K(k - l) - a$$

Note in long run it's all productivity because:

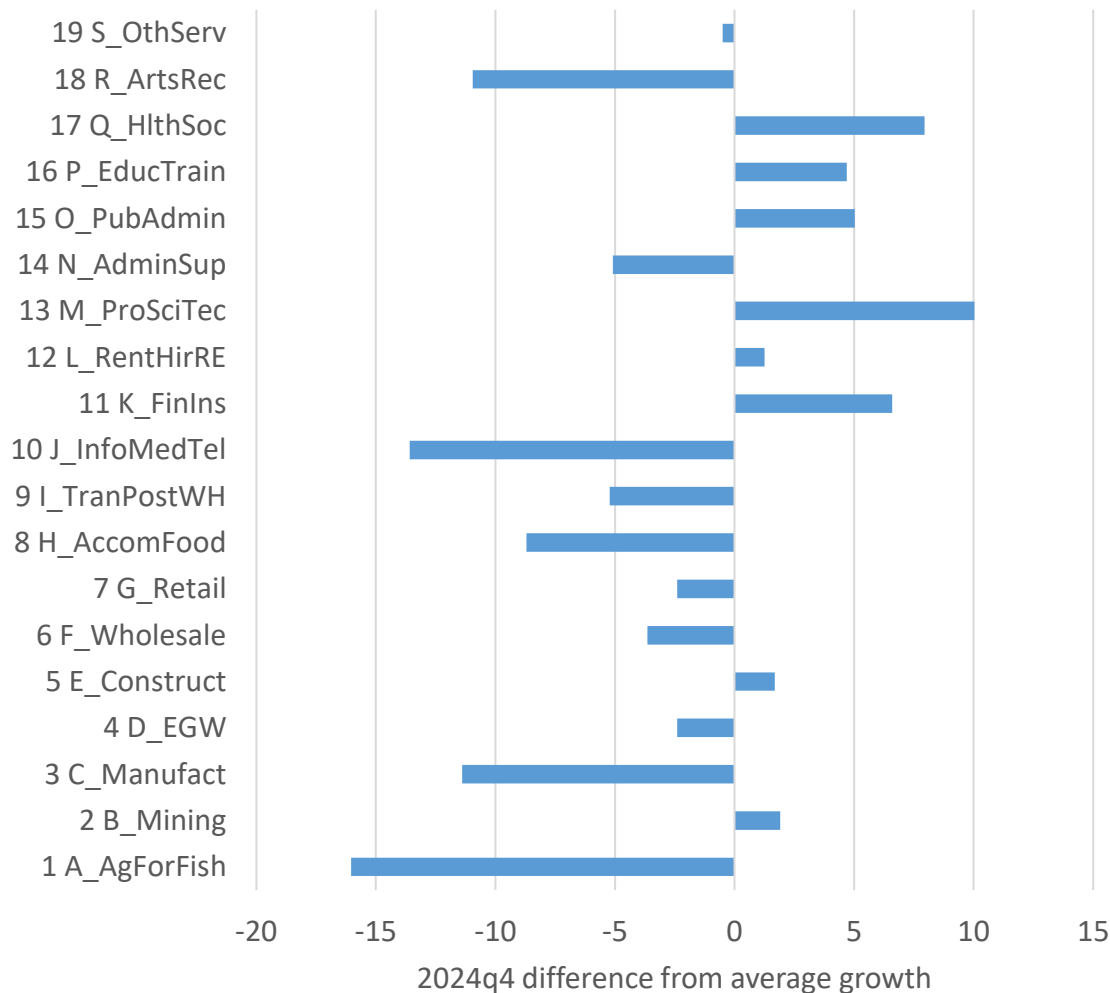
$$K(k - l) \approx -\frac{K}{L}a$$

Impact of COVID on GDP expenditure



- National accounts and RBA forecasts
- Varying paths for major components of GDP expenditure have impacts on industry employment
 - Tight labour markets and specific shortages

Difference from average growth, 2024q2



- Employment impacts relate to:
 - What we want
 - Trends in tastes: what we want
 - Macro impacts, e.g. investment links to construction, household links to retail
 - Where we get it from
 - Role of import competition
 - How we make it
 - Role of technical change
 - Major disturbances to any of the above (so far only the pandemic)

Conclusions

- Covid-19 has imposed major disturbances on many aspects of the economy:
 - Domestic demand
 - International demand
 - Productivity
 - Fiscal support
 - Population
- Shocks of varying size, over varying time frames
- CGE modelling provides a framework in which to understand the economic impacts of the pandemic and recovery at a detailed macro level. Great platform for scenario analysis.

Some CoPS CGE models

Model	Features	Good for...
VURM/VURMTAX (Australia)	<ul style="list-style-type: none"> • Separate, trading state/territory economies • State and federal government accounts • Very detailed treatment of taxes (VURMTAX) 	<ul style="list-style-type: none"> • Industry analysis • Taxation policy • Marginal excess burden (VURMTAX) • Federal/state issues
TERM (Australia)	<ul style="list-style-type: none"> • Separate, trading regional economies (SA3) • Very detailed industries 	<ul style="list-style-type: none"> • Industry analysis • Regional analysis
VUEF	<ul style="list-style-type: none"> • Single region • Many occupations • Skill-occupation constraints 	<ul style="list-style-type: none"> • Occupation analysis • Forecasting • Industry analysis
GTAP (not CoPS)	<ul style="list-style-type: none"> • World economy – many regions • Aggregate trade is balanced: total imports = total exports 	<ul style="list-style-type: none"> • Trade policy analysis • Industry analysis (especially trade-exposed)
CoPS international	<ul style="list-style-type: none"> • TERM and VU style models for many countries: • China, US, Indonesia, South Africa, various Middle East and Africa 	
Newer models	<ul style="list-style-type: none"> • Cities • Financial 	<ul style="list-style-type: none"> • Supply Chain • DSGE