# The impact of COVID-19 on the geography of Internal Migration in Australia: Estimates from novel data

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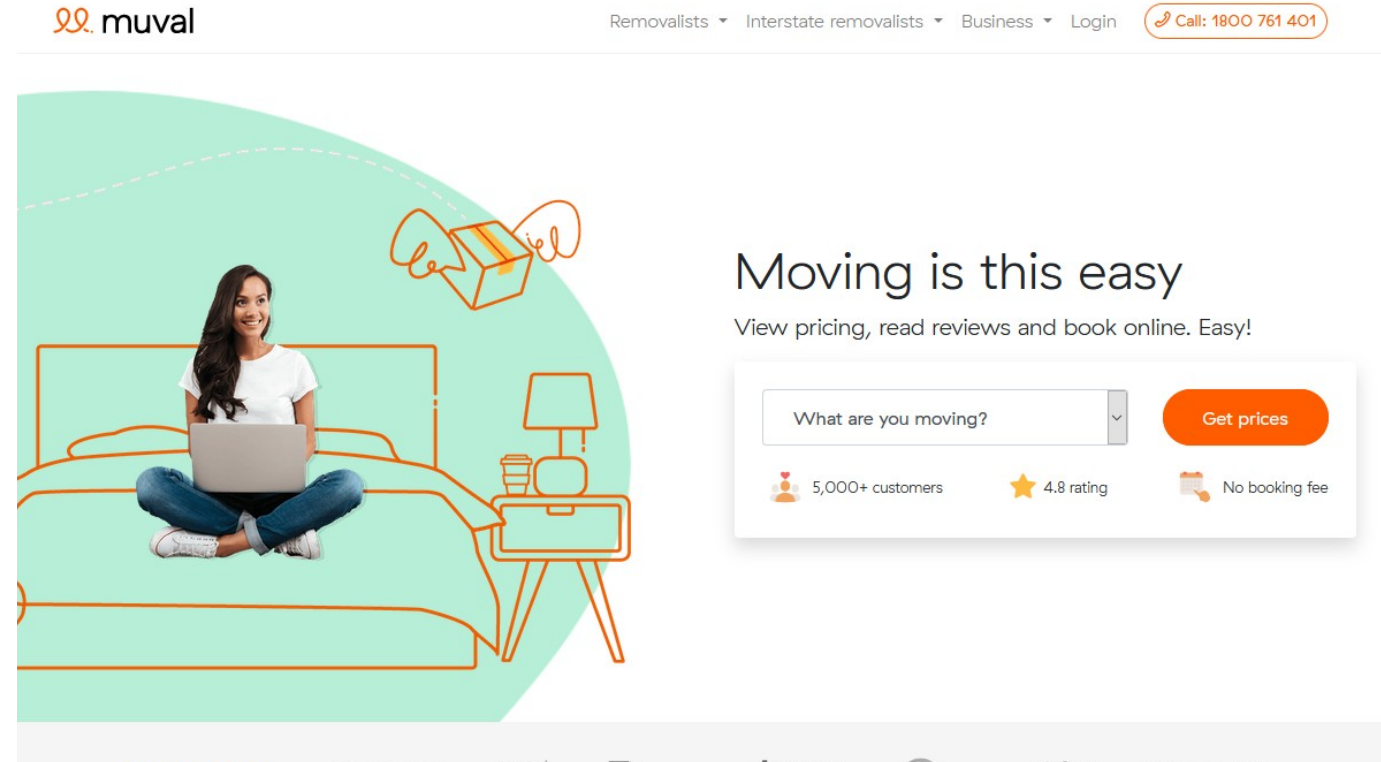
- COVID-19 in Australia was the largest disruption to Australian demography since World War 2 including:

    closure of international borders to non-citizens (March 2020)

    closure of State and territory borders to non–residents (from April 2020) with long quarantine periods for internal migrants

    introduction of widespread lockdowns (March 2020)

- Apparent that these actions would have a long-term impact on the size, composition, and distribution of the population and there was a need for timely data on demographic components

    Fertility, mortality and international migration data released quarterly by the Australian Bureau of Statistics (ABS)

    Internal migration data had a longer time lag and unavailable below the GCCSA geography
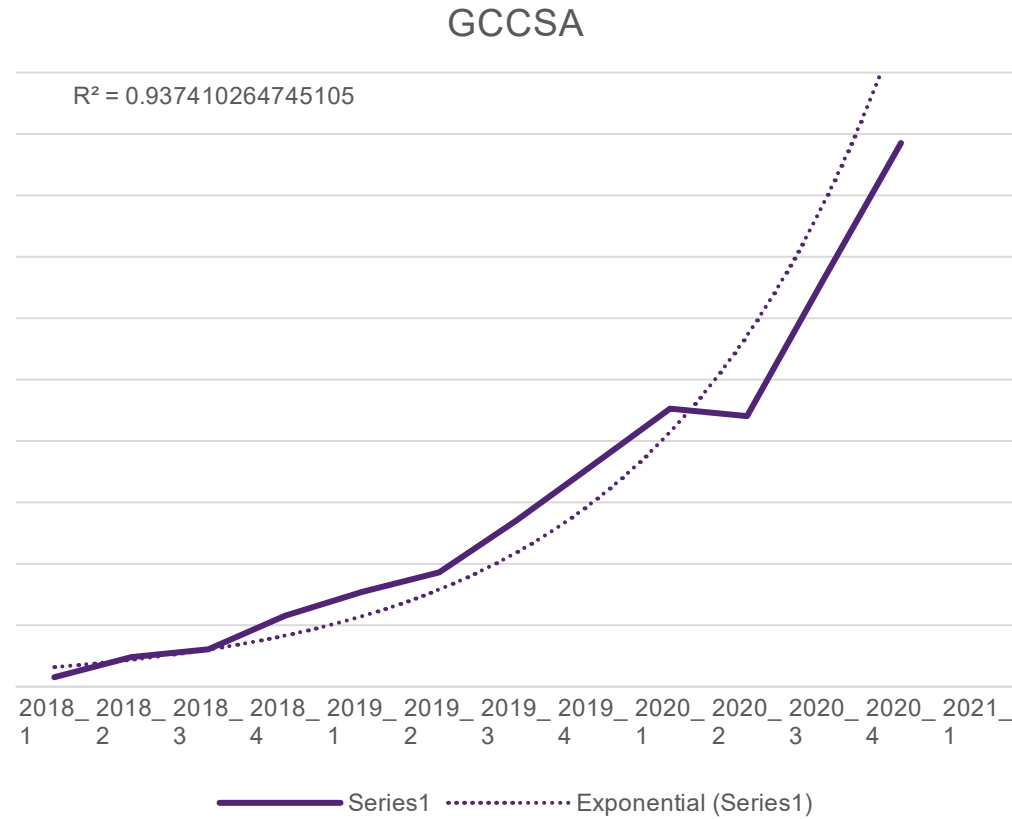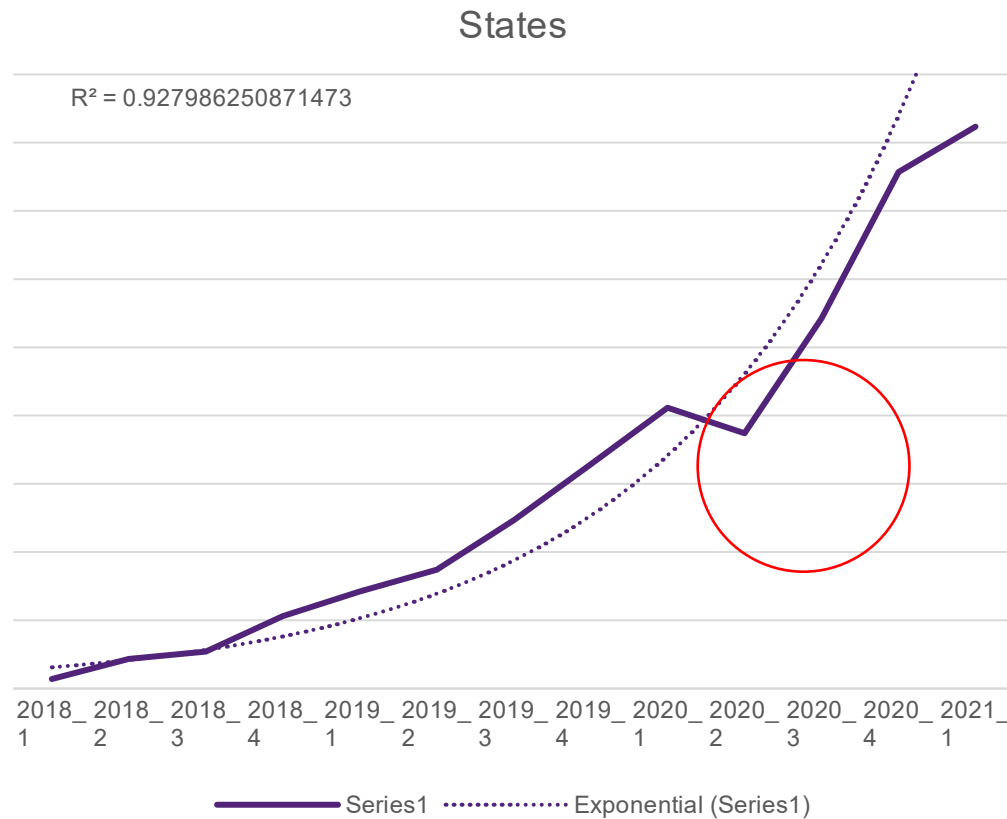
Internal migration data in Australia

- Regional Migration estimates based on Medicare (health) administrative data
  - States and Territories (9 units); GCCSA (16 units)
  - In response to COVID19, ABS released *provisional* estimates in November 2020 (ref June Quarter)

- Cancelled in June 2021 due to the mass vaccination program

- Quinquennial Census of Population and Housing
  - Undertaken on the 10th of August 2021; Data released in October 2022

Research Question
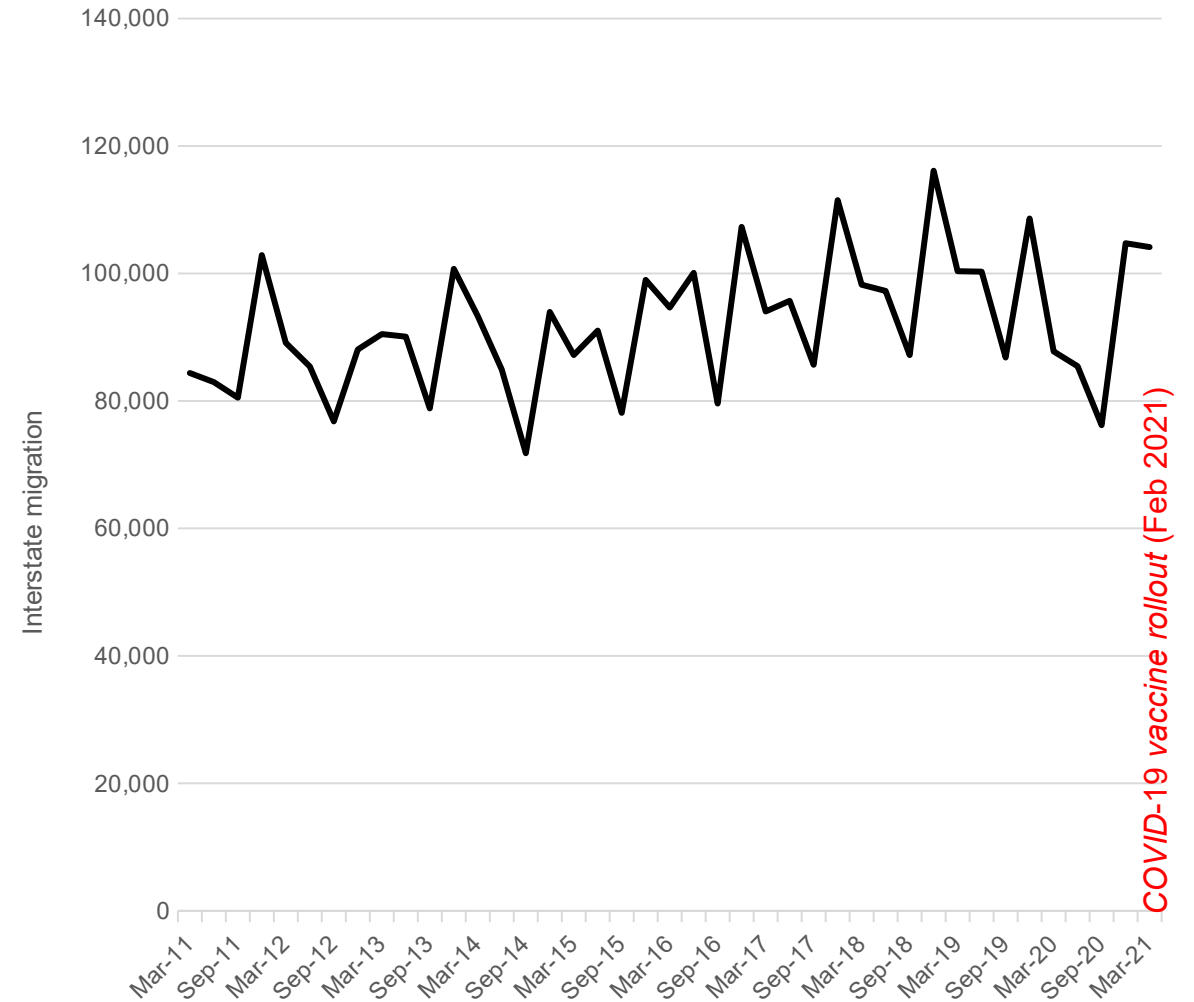
- Is there an alternative source of internal migration statistics in Australia?

  - Accurate, timely; ongoing; high spatial resolution

- Emerging data: Muval

    Australian removalist aggregation site

    Collects origin-destination flow data for proposed moves

    Proximate to actual migration behaviour

    Potentially suffers from compositional and spatial bias

    No demographic detail (e.g. age, sex etc.)

Muval users over time

States

R² = 0.927986250871473

GCCSA

R² = 0.937410264745105

2018_1 2018_2 2018_3 2018_4 2019_1 2019_2 2019_3 2019_4 2020_1 2020_2 2020_3 2020_4 2021_1
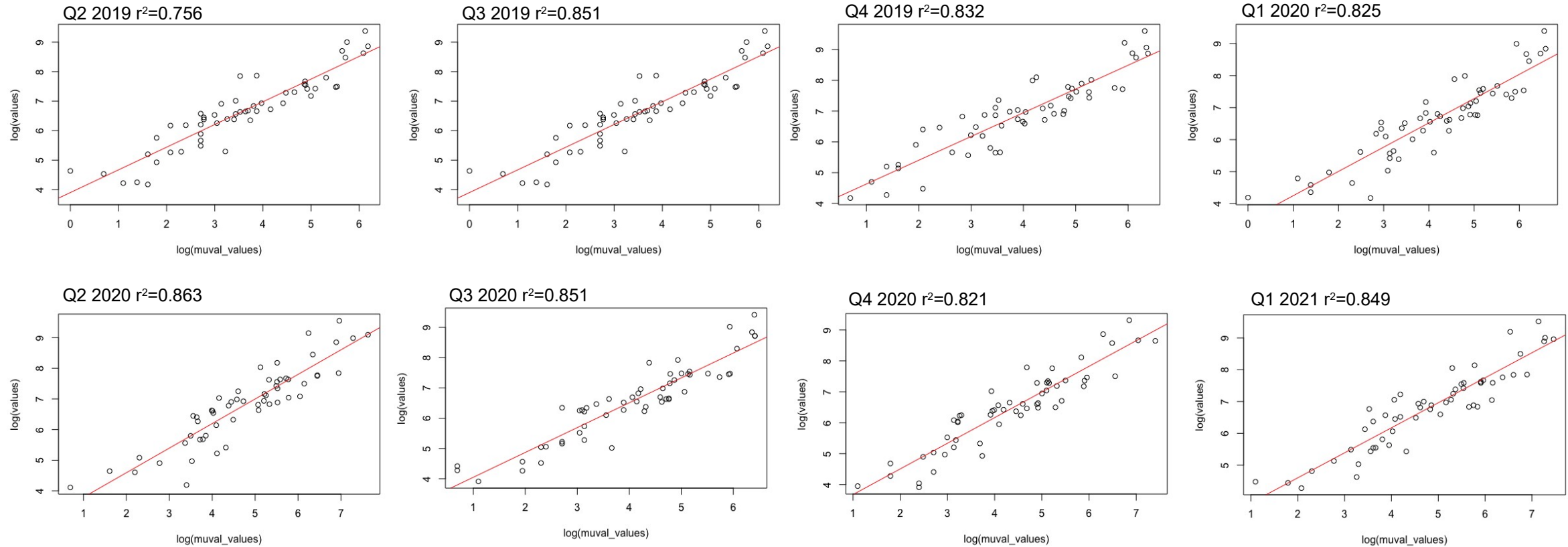
—— Series1 ·········· Exponential (Series1)

Exponential growth in customer base however the impact of lockdowns is apparent

Comparison with ABS Prime Data

OLS models for each quarter – State level (OD pairs)

Q2 2019 r²=0.756
Q3 2019 r²=0.851
Q4 2019 r²=0.832
Q1 2020 r²=0.825
Q2 2020 r²=0.863
Q3 2020 r²=0.851
Q4 2020 r²=0.821
Q1 2021 r²=0.849

Reasonable fit at the State Level

OLS models for each quarter – GCCSA level (OD pairs)
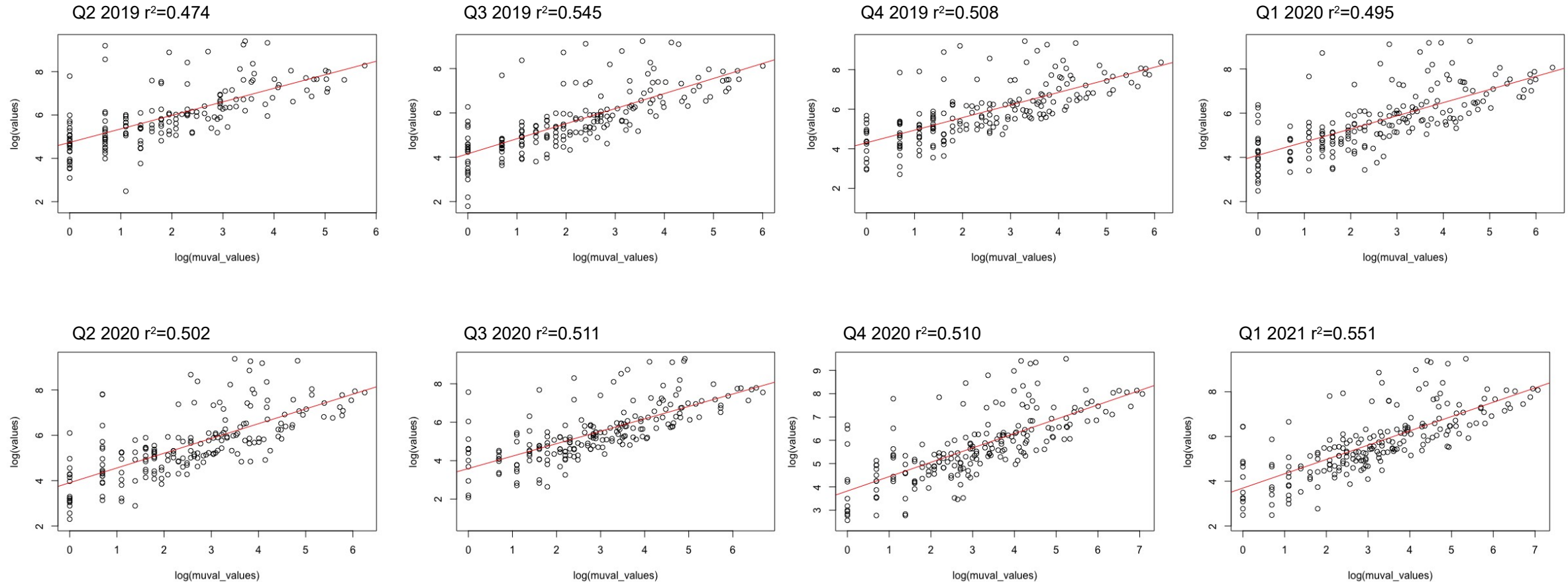
Fit less good at the GCCSA level – the impact of spatial bias
Small number problem (O*D interactions)

Comparison with ABS Census data

Predicting migration flows at the SA4 level

Data

- **Dependent**: log(1-year migration data) (*2021 Australian Census of Population and Housing*)

- **Independent:** log(Muval) (*August 2020 – July 2021*)

- **Control variables:** Capital city dummies; State dummies

Methods

- ***Separate*** stepwise (bidirectional) linear regression models for inflows and outflows to SA4

- Repeated cross-fold validation (Refaeilzadeh et al 2009)

- Predict flows to and from SA4s (2019, 2020, 2021,2022) and constrain so total ins= total outs

- Convert rates to ranks to examine the changing geography of flows

- Calculate volatility metric -Mean Absolute Rank Change

Repeated cross-fold validation

Model 1 Results

	Dependent variable:	
	log(CensusIn)	log(CensusOut)
	(1)	(2)
log(MuvalIn)	0.57*** (0.05)	
log(MuvalOut)		0.55*** (0.03)
Constant	6.00*** (0.30)	6.19*** (0.20)
Observations	88	88
R^2	0.61	0.76
Adjusted R^2	0.60	0.76
Residual Std. Error (df = 86)	0.40	0.33
F Statistic (df = 1; 86)	132.61***	276.43***
Note:	*p<0.1; **p<0.05; ***p<0.01	

Inflows
88 samples 1 predictor No pre-processing
Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 78, 79, 79, 80, 79, 79, ...

Resampling results:
RMSE   Rsquared   MAE
0.3821084   0.6362161   0.2940461

Outflows
No pre-processing Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 80, 79, 79, 77, 80, 78, ... Resampling results:

RMSE   Rsquared   MAE
0.3196027   0.8079805   0.2421914

Model (2)

Model Results

	Dependent variable:	
	log(CensusIn)	log(CensusOut)
	(1)	(2)
log(MuvalIn)	0.39*** (0.05)	
log(MuvalOut)		0.24*** (0.05)
log(Population)	0.36*** (0.07)	0.42*** (0.08)
CapitalCity	0.18*** (0.05)	0.30*** (0.08)
Qld	-0.02 (0.06)	
SA	-0.29*** (0.08)	-0.25*** (0.09)
WA	-0.23*** (0.07)	-0.07 (0.08)
Tas	-0.88*** (0.13)	-0.63*** (0.13)
NT	-0.52*** (0.15)	
ACT	-0.50** (0.19)	
Constant	2.66*** (0.69)	2.74*** (0.84)
Observations	88	88
R^2	0.93	0.89
Adjusted R^2	0.92	0.88
Residual Std. Error	0.18 (df = 78)	0.23 (df = 81)
F Statistic	107.46*** (df = 9; 78)	109.79*** (df = 6; 81)

Note: *p<0.1; **p<0.05; ***p<0.01

Repeated cross-fold validation

Inflows
88 samples 9 predictor No pre-processing

Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 80, 79, 79, 77, 80, 78, ...
Resampling results:
RMSE   Rsquared   MAE
0.1988188   0.9098008   0.1628274

Outflows
88 samples 8 predictor No pre-processing

Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 80, 79, 79, 77, 80, 78, ...
Resampling results:
RMSE   Rsquared   MAE
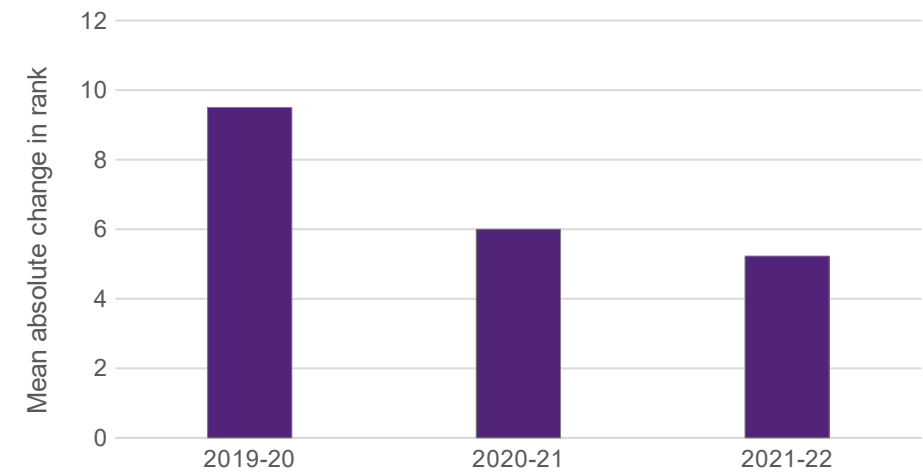0.251158   0.8823241   0.1933329

In-migration Ranks
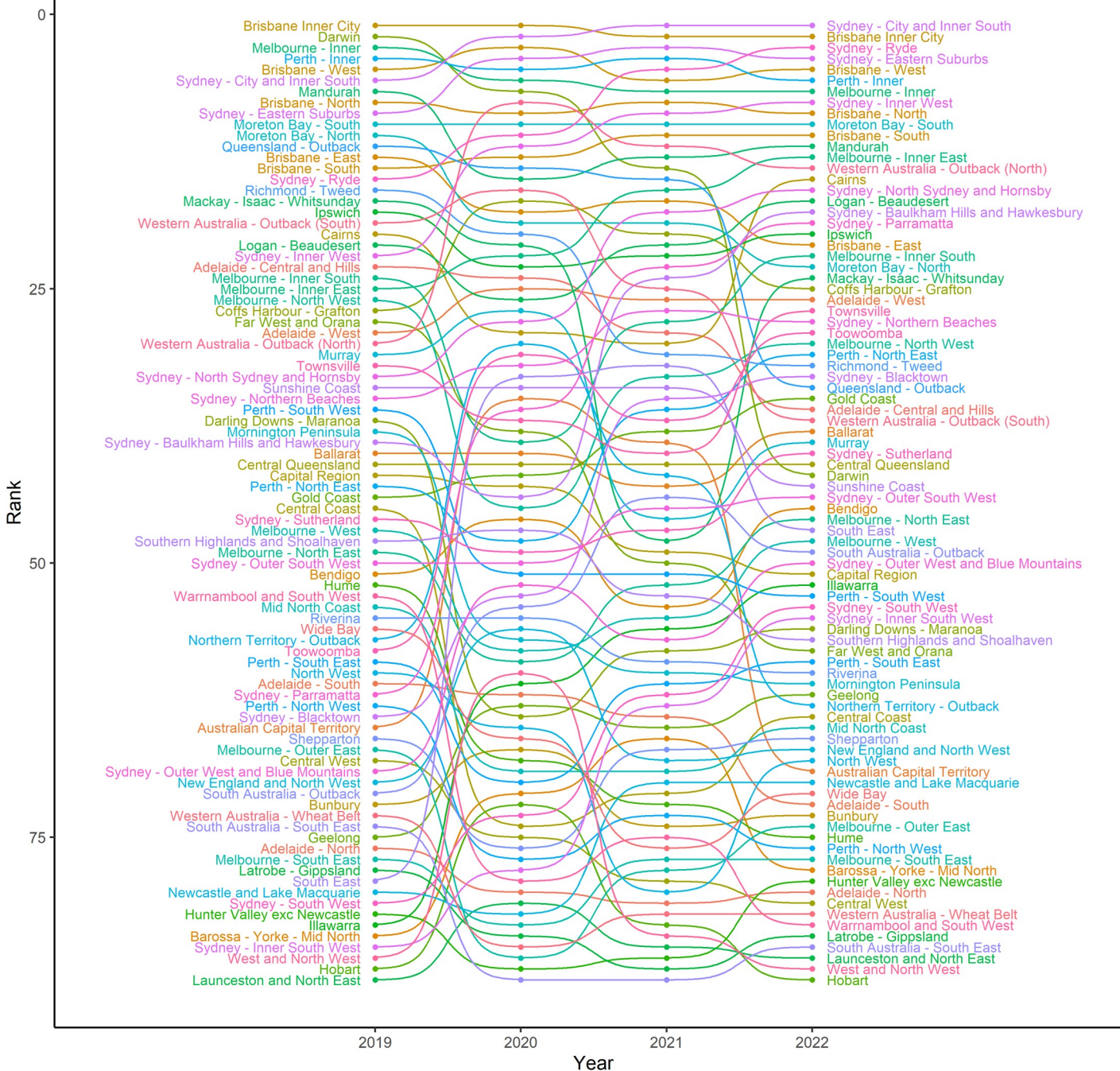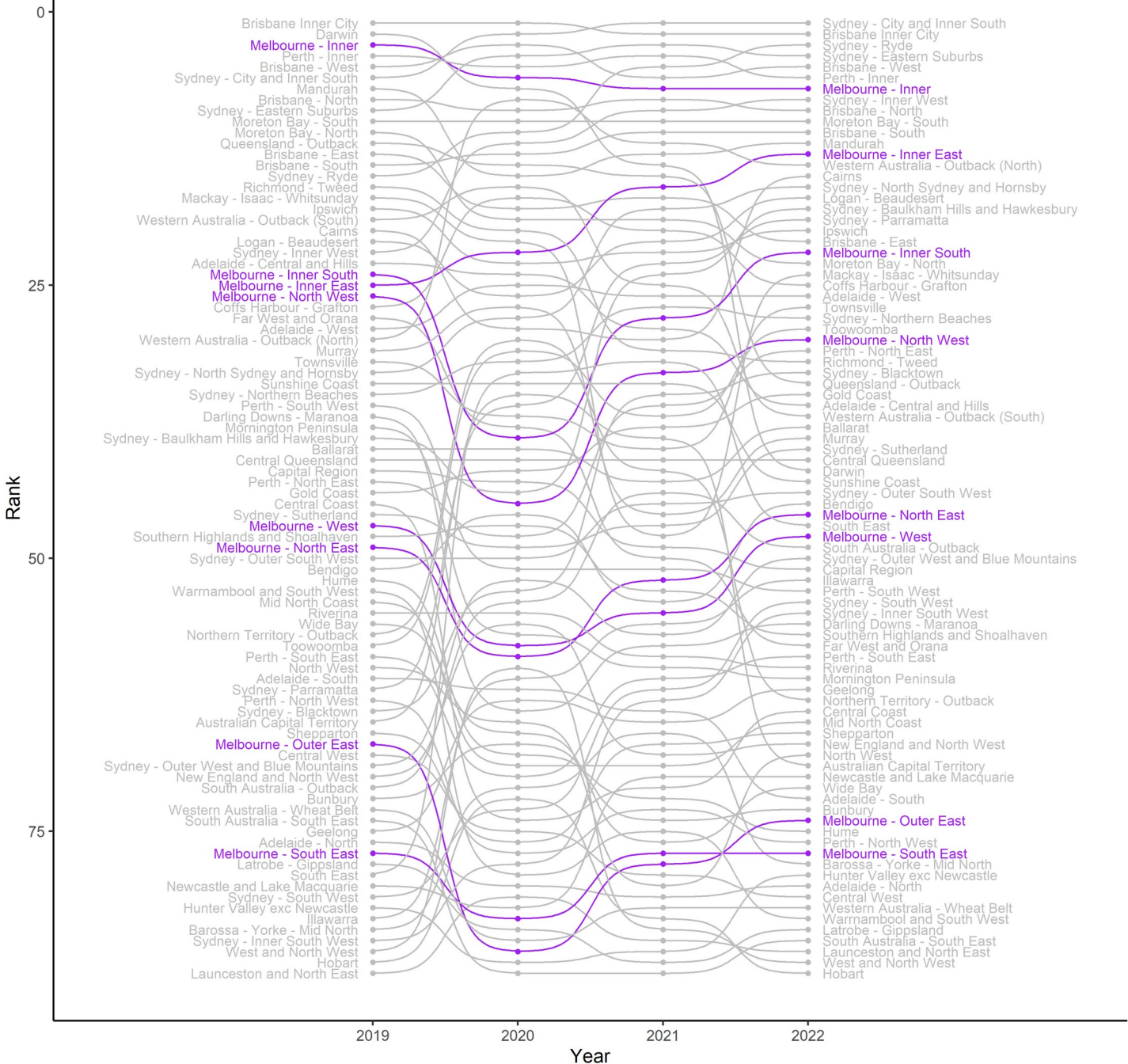
Inflows

Significant volatility in the ranking of SA4s

Peaked in 2019-2020 before declining in subsequent intervals
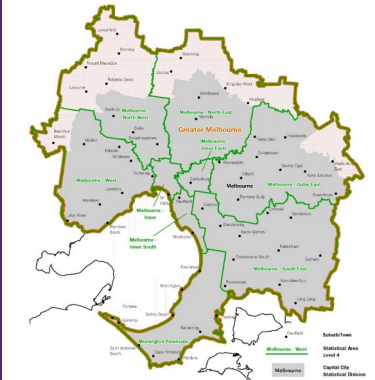
Volatility Index
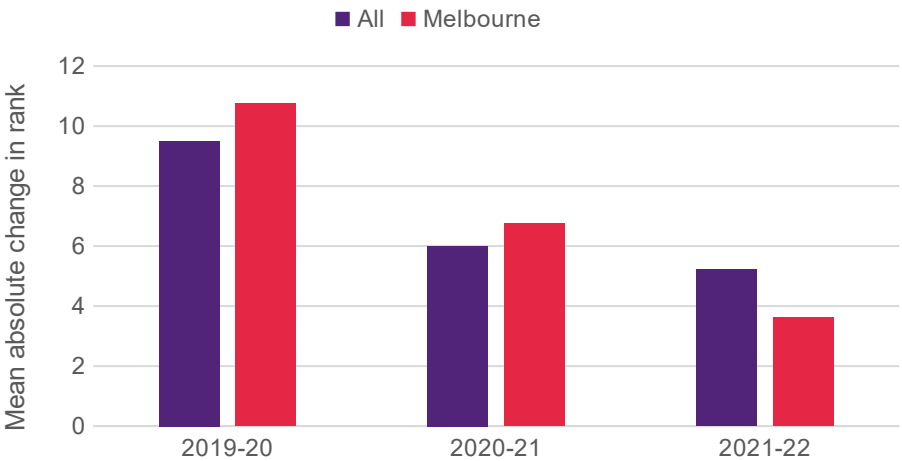
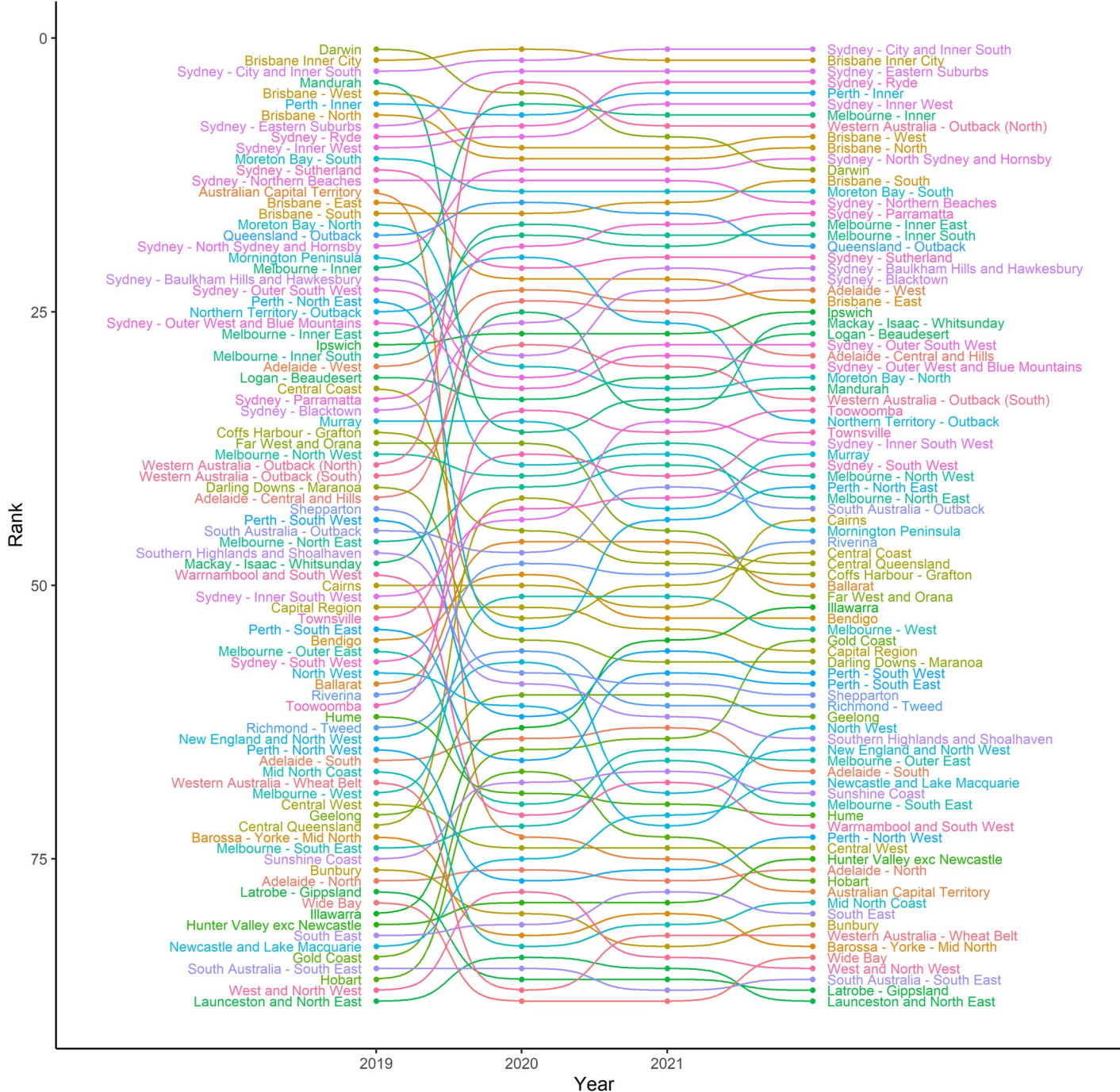In-migration Ranks

Melbourne GCCSA

263 days in lockdown

ABS data show a drop in arrivals to Melbourne GCCSA between 2020 and 2019 (~20,000)

Estimates suggest a drop in arrivals followed by a recovery
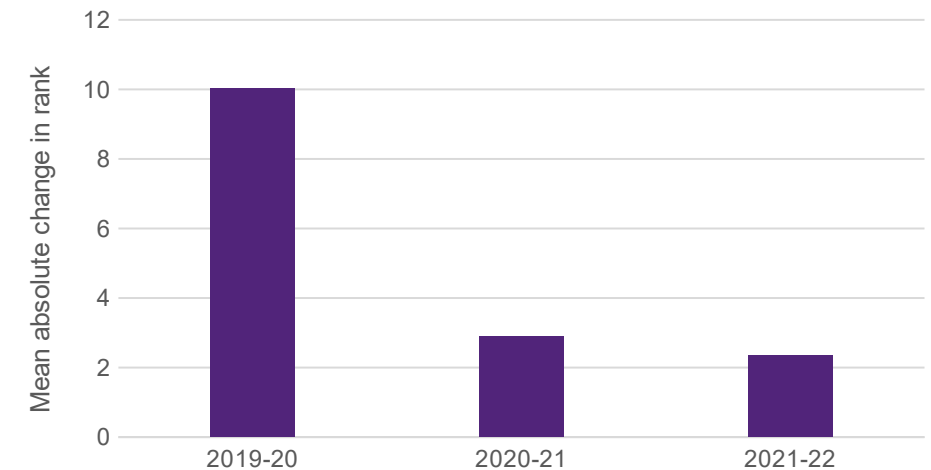
Volatility Index

Out-migration Ranks

Outflows

More volatility in the ranking of SA4s cf inflows in 2019-2020

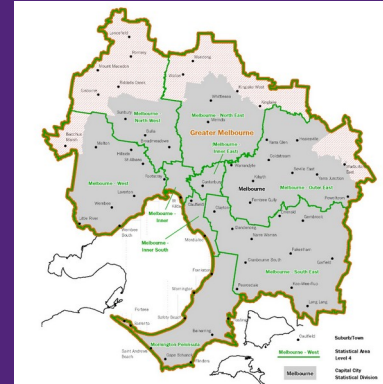Peaked in 2019-2020 before declining in subsequent intervals

Volatility Index

Out-migration Ranks

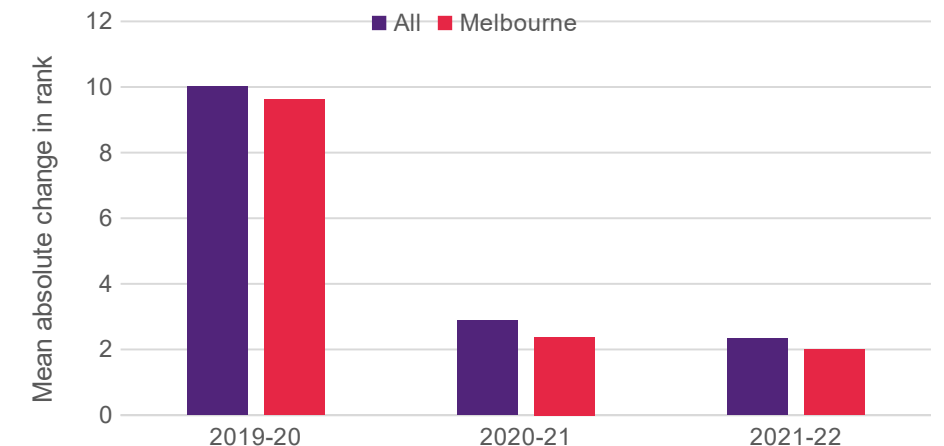(y-axis: Rank; x-axis: Year — 2019, 2020, 2021)

Melbourne GCCSA

ABS data show an increase in departures from Melbourne GCCSA between 2020 and 2019 (~4,000)

Estimates suggest an increase in departures of many SA4s – this persists into 2022
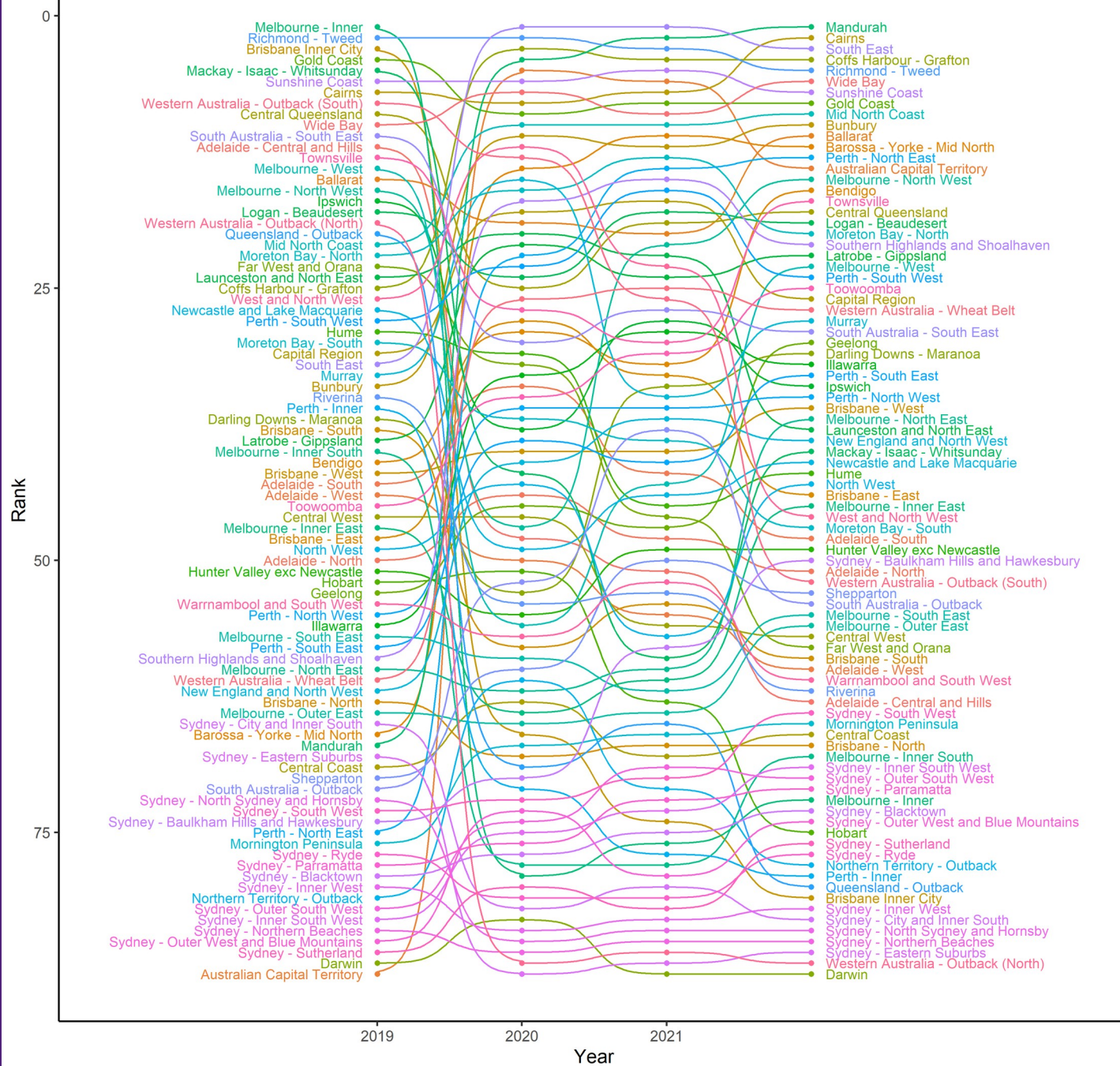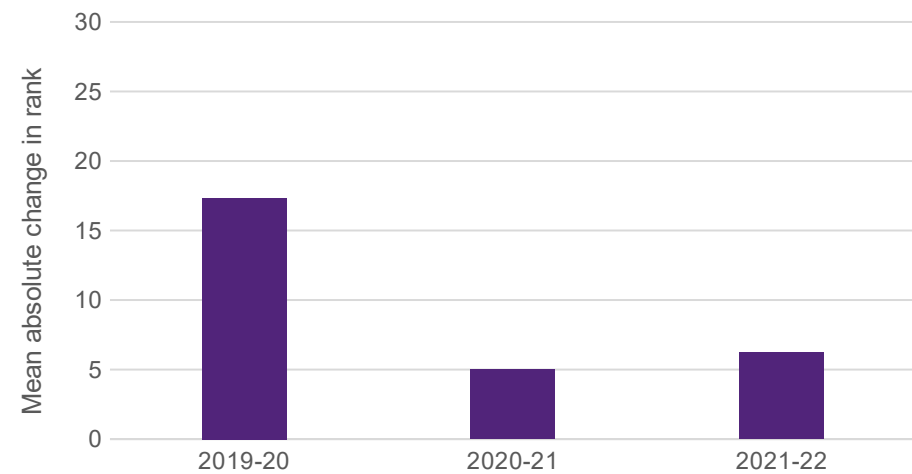
Volatility Index

■ All ■ Melbourne

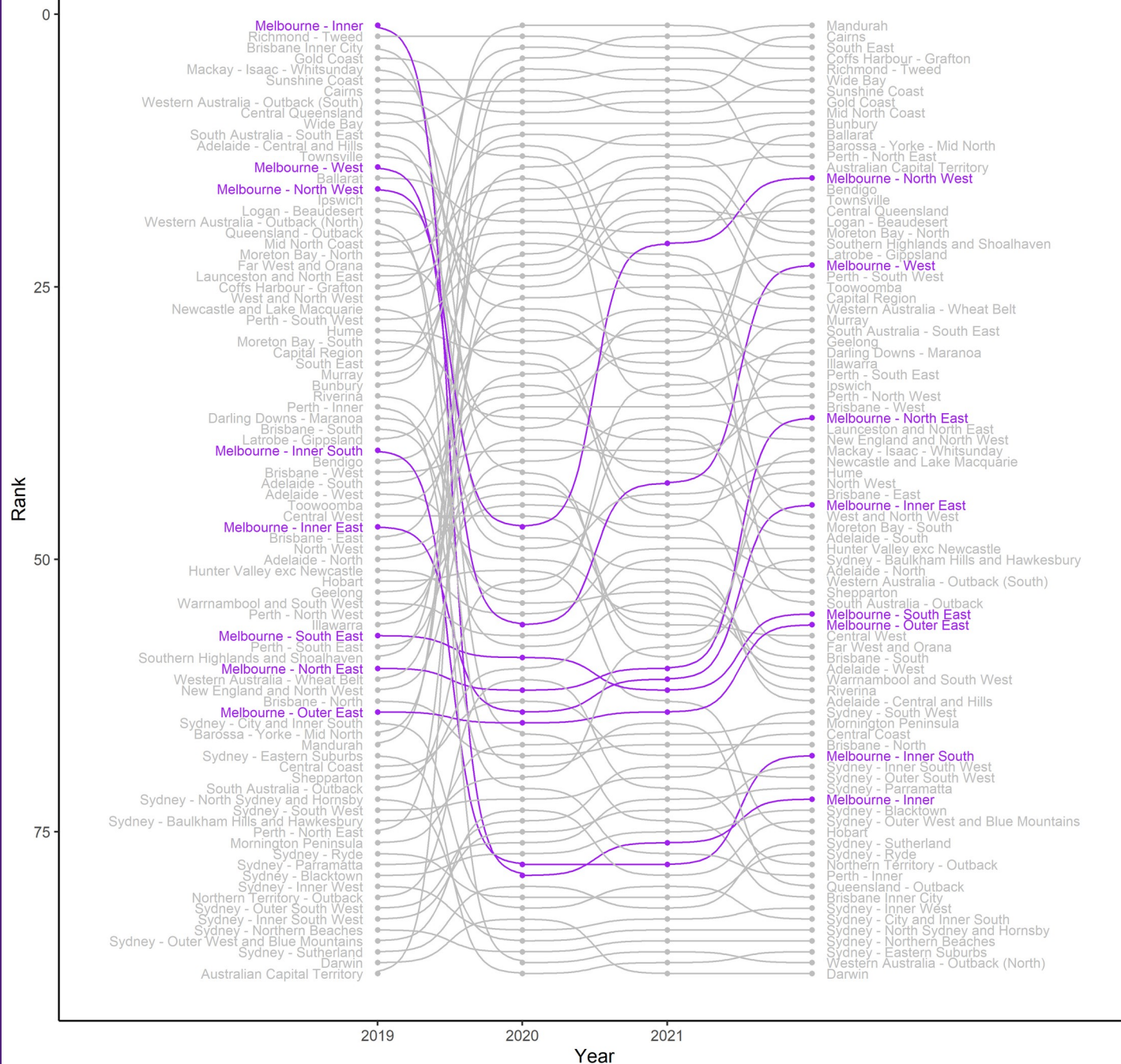(y-axis: Mean absolute change in rank; x-axis: 2019-20, 2020-21, 2021-22)

Net-migration Ranks

Net flows

Most volatile measures

Peaked in 2019-2020 before declining in subsequent intervals
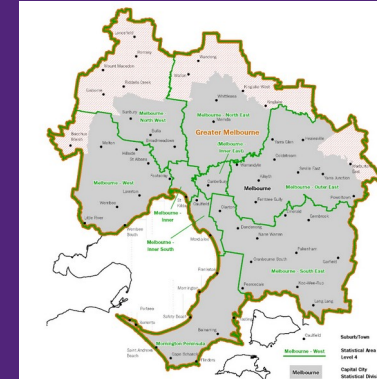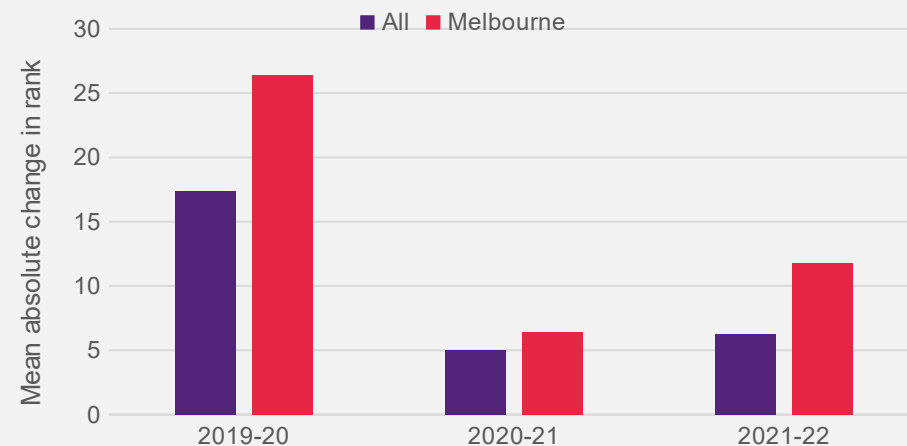
Volatility Index

Melbourne GCCSA

ABS data show a decline in net migration to Melbourne GCCSA between 2020 and 2019 (~26,000)

Large drop in ranking for Melbourne Inner and Melbourne Inner South and slow recovery.

Conclusions

Key findings

- Significant promise from novel sources of data on internal migration. Estimates can be generated in close to real-time but also backcast to fill gaps at higher spatial resolution;

- Growth in Muval client-based limits the use in forecasting levels but useful leading indicator for shifting spatial distribution;

- Uncertainly associated with estimates (MAE ~ 15-20%). Results for individual SA4s need to be interpreted with some caution

- Useful to understand changing system dynamics over time.

Future steps

- Continued empirical work to understand key shifts in the migration system due to COVID-19

- Creation of nearcast estimates for 2023

- Explore the refinement of methods through averaging with other data sets.