Sources of convergence and divergence in university research quality: Evidence from the PBRFS in New Zealand*

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Unique contributions of this paper

- Estimates *β*- and *σ*-convergence properties of the growth of research quality of universities and disciplines (*AQS*) for 2012 to 2018.

- Decomposes unit research quality growth into contributions from exits (X), entrants (E) quality transformation (T) of individual researchers.

- Estimates contributions of X, E and T to convergence (or divergence) of research quality (*AQS*s) of universities and disciplines.

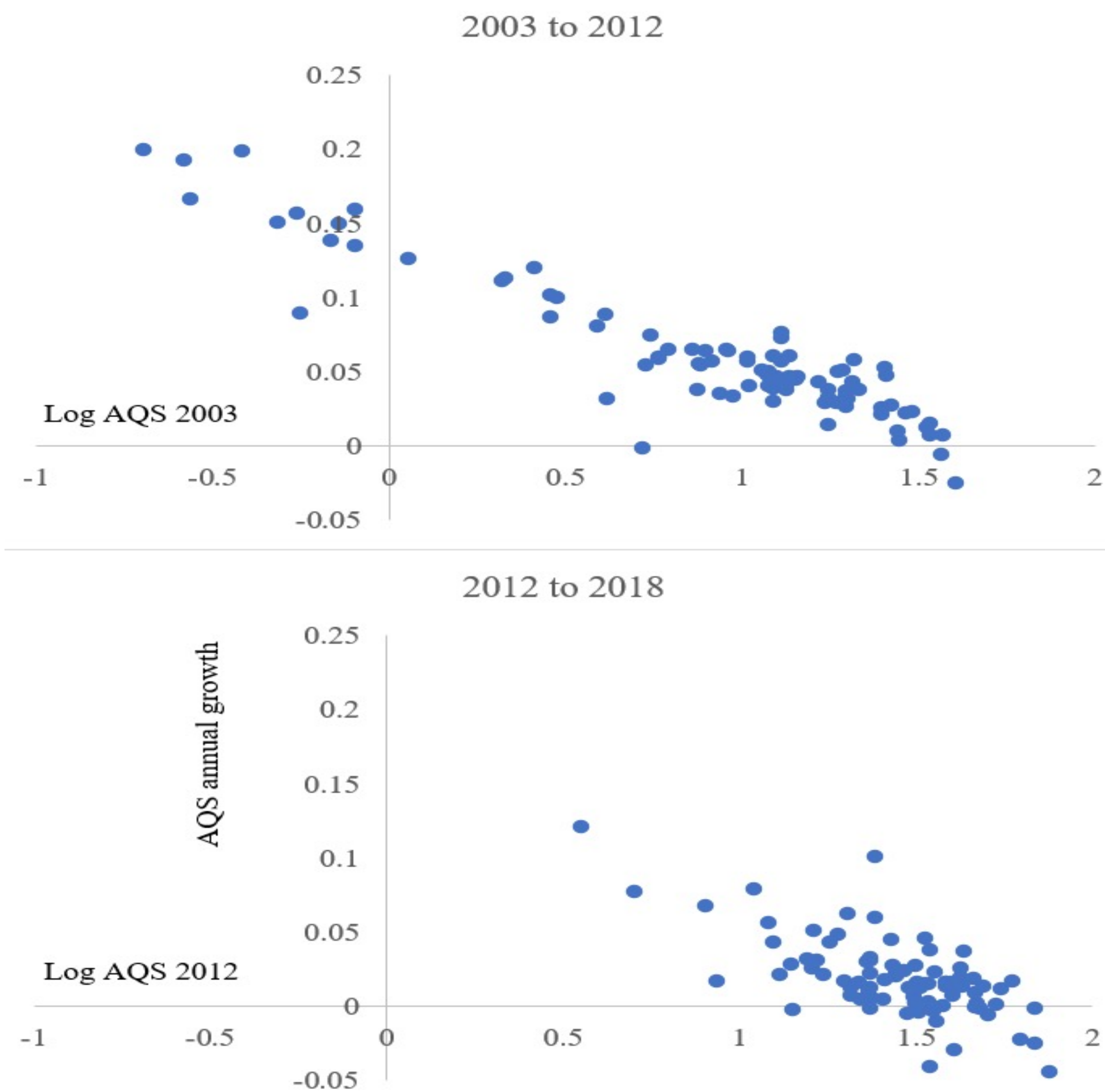
- Made possible by access to an internationally unique dataset:

  (1) Anonymised measures of quality of every researcher in NZ PBRFS: 2003, 2012, 2018.

  (2) Longitudinal data enabling identification of X, E & T by research quality of each researcher and by university & discipline, and

  (3) Enabling estimation of effects of age, gender, unit size (FTE) & prior convergence rate of *AQS*s.

Initial research quality and growth (*AQS*s universities, disciplines, disciplines in universities)



Annual AQS growth convergence equation to be estimated for 2012 to 2018

$$\log AQS_{ijt} - \log AQS_{ijt-1} = \gamma + \beta_1 \log AQS_{ijt-1} + \beta_2 \log AQS_{ijt-2} + \varepsilon_{ijt}$$

where:

- $\log AQS_{ijt} - \log AQS_{ijt-1}$ is annualised log changes of *AQS* for university *j* and discipline *i*
- *t* = 2018,   *t-1* = 2012,   *t-2* = 2003
- Full β-convergence effect $=(\beta_1+\beta_2)$
- Allows for university and discipline fixed effects & random shocks (e.g., earthquakes)
- Convergence tests also conditioned by median age of researchers, gender ratio, size of unit (FTE), and
- Shift and slope dummies, progressively eliminated using ‘general-to-specific’ (*Gets*) approach of Campos, Ericsson, Hendry (2005), Castle, Doornik, Hendry (2011) and Hendry & Doornik (2014)

Final β-convergence regression results for *AQS* growth, 2012 to 2018

	Coefficient	Standard Error	t-value
$\log AQS_{2012}$	-0.1167	0.0116	-10.09
$\log AQS_{2003}$	0.0220	0.0048	4.55
$D_{AFE} \times \log AQS_{2012}$	-0.0154	0.0044	-3.48
Constant	0.1699	0.0140	12.13
Long-run convergence *	-0.0947	0.0086	-10.99
$R^2 = 0.605$	Adj-$R^2 = 0.591$	F (3, 83) = 42.33	Obs = 87

Notes: * Long run convergence standard errors are obtained by re-parameterising equation (1) such that RHS variables include $\ln AQS_{2012}$ and ($\ln AQS_{2012} - \ln AQS_{2003}$), instead of $\ln AQS_{2012}$ and $\ln AQS_{2003}$, giving estimates of ($\beta_1 + \beta_2$) and β_2 respectively.

Full-period (2012 to 2018) convergence rates are

$$\beta_1 = -0.1167 \times 6 = -0.7002$$

$$\beta_1 + \beta_2 = (-0.1167+0.0220) \times 6 = -0.5682$$

What is influencing *AQS* convergence? How could X, E, T contribute to convergence?

- **PBRFS incentives:**

Previous papers have shown that university responses varied by initial research quality of the university in ways consistent with the new incentives created by the PBRFS.

- **Exits:**

Universities with largest initial proportion of non-research active (R) staff have lowest initial *AQS* and achieve proportionally higher *AQS* growth from removing Rs.

Scope to do this declines over time, as stock of Rs declines.

- **Entrants:**

Initially easier for some universities to recruit researchers close to highest quality incumbents, but this becomes harder as *AQS* of incumbent researchers improves.

Budget constraints: as quality of incumbents rises over time, it requires higher salary to recruit higher quality new researchers to match quality of incumbents.

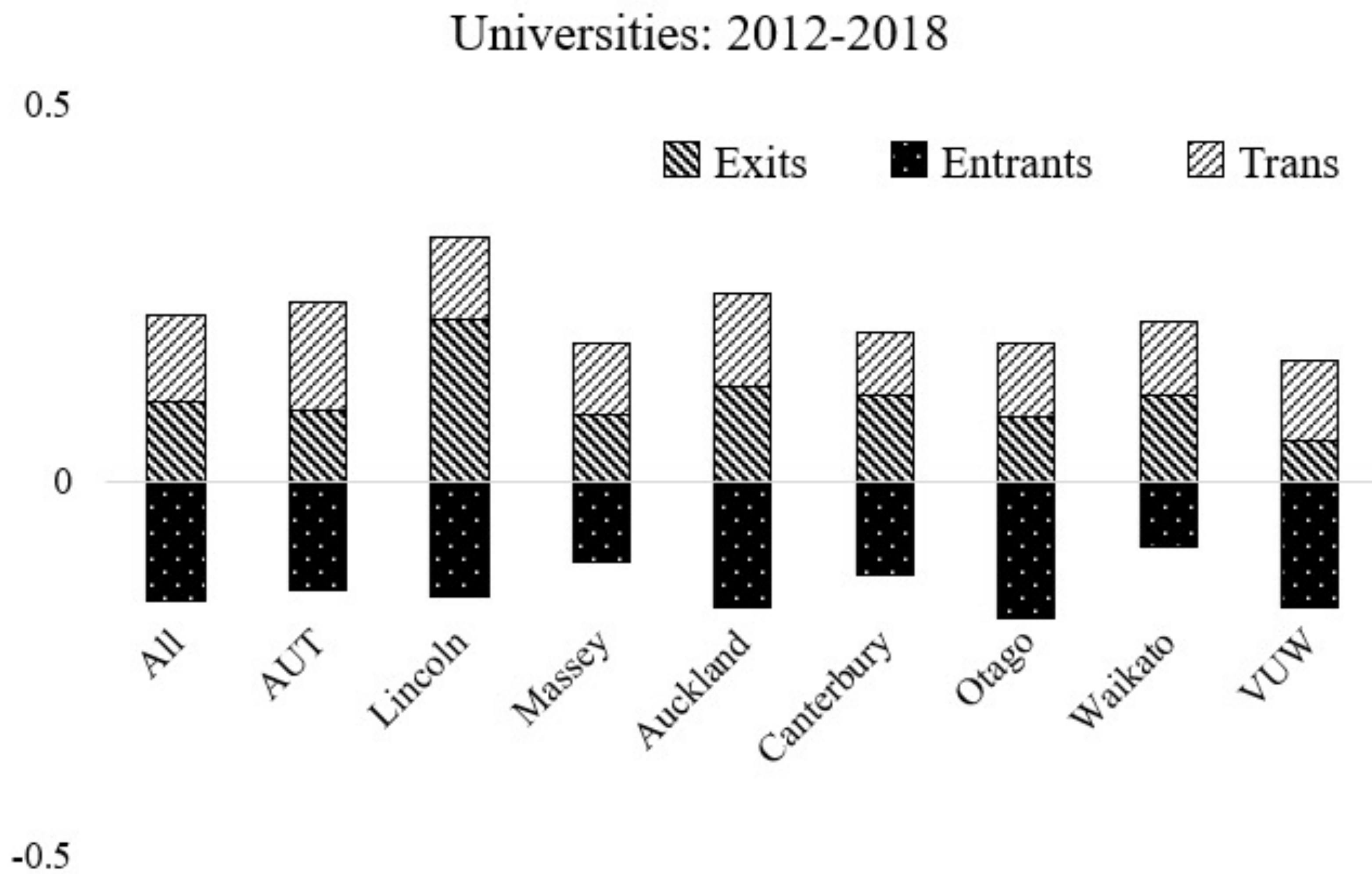
- **Transformation of incumbents:**

Initial improvements easier the further incumbents are from the research quality ‘frontier’.

As incumbents approach ‘frontier’, it requires more investment and innovation to redefine the ‘frontier’. Nevertheless, average annual contribution from Ts was higher in 2012-2018.

Limits of the NZ PBRFS scoring method. Possible ‘limits’ posed by panels.

Average annual contributions of X, E, T to *AQS* growth



Regression results for AQS growth components, X, E and T (using *Gets* approach)

	Exits	Entrants	Trans.
$\log AQS_{2012}$	**-0.0433** (0.011)**	**-0.1230** (0.0506)**	**-0.0424** (0.0119)**
$\log AQS_{2003}$	**0.0152** (0.0057)**	**0.0584** (0.0233)**	**-0.0257** (0.0042)**
Age_{2012}	†	†	-0.0014 (0.0005)**
D_{MU}		-0.0793 (0.0249)**	0.1027 (0.0231)**
D_{LU}			-0.0185 (0.0059)**
D_{AUT}	0.1802 (0.046)**		
$D_{MU}\times\log AQS_{2012}$			-0.0810 (0.0167)**
$D_{LU}\times\log AQS_{2012}$	0.0185 (0.0048)**		
$D_{AUT}\times\log AQS_{2012}$	-0.1468 (0.0387)**		
D[illegible]			-0.2612 (0.0389)**
D[illegible]		1.4487 (0.4731)**	
D[illegible]		-0.1004 (0.0300)**	
D[illegible] $\times\log AQS_{2012}$			0.1795 (0.0298)**
D[illegible] $\times\log AQS_{2012}$		-0.9478 (0.2857)**	
$D_{AFE}\times\log AQS_{2012}$			-0.0136 (0.0033)**
Constant	0.0704 (0.0133)**	0.0707 (0.0618)	0.1899 (0.0321)**
Adj-R^2	0.434	0.326	0.784
Regression F	14.2	7.21	35.65
Obs.	87	78††	87
Long-run convergence:	**-0.0281** (0.0082)**	**-0.0646** (0.0384)	**-0.0681** (0.0092)**

Notes: This table shows the estimated regression coefficients and standard errors are in parentheses).

** (*) = significant at 1% (5%).

† Adding Age_{2012} is not statistically significant.

†† There are fewer observations for entrants due to 9 observations where *AQS* fell between 2012 and 2018, such that the log difference is undefined.

Convergence properties of X, E and T contributions to AQS growth

- All three components contributed toward convergence of university and discipline research quality (*AQS*). β_1 negative in all three cases.

- For X and E, $\beta_2 > 0$ implying effect of $\log AQS_{ijt-2}$ is to reduce full convergence rate.

- For T, $\beta_2 < 0$ implying additional negative effects of $\log AQS_{ijt-2}$ increasing full rate of convergence.

- Estimated magnitudes suggest largest effects on *AQS* growth are from E and T (-0.065 and -0.068) with convergence effects from X smaller (-0.028).

- Few statistically significant deviations from a uniform convergence rate across universities and disciplines.

- σ-convergence of X, E and T not evident at level of universities and disciplines, but mixture of convergence and divergence among disciplines within universities.

Conclusions

- Strong common degree of β-convergence in NZ university and discipline research quality (*AQS*), with possible exception 'Accounting, Economics and Finance'.

- Strong σ-convergence over 2003 to 2012 maintained during 2012 to 2018, despite much reduced dispersion of *AQS* levels across universities and disciplines by 2012. For disciplines, σ -convergence was substantially reduced during 2012 to 2018, with σ-divergence in some cases.

- Contrast with the effects of the UK RAE/REF. But evidence of convergence in Italian VQR.

- A distinguishing feature of this paper is the attention given to sources of convergence:

  - Decomposition of contributions of X, E and T research quality growth.
  - All three components (X, E and T) contributed to *AQS* convergence (or catch-up).
  - X, E and T convergence rates relatively uniform across universities and disciplines, with a few exceptions
  - σ-convergence of X, E and T not evident at level of universities and disciplines, but mixture of convergence and divergence among disciplines within universities.

- Insights for public policy:

  - Importance of clear objectives and incentive structure when designing PBRFSs.
  - The time-limit to the suitability of a particular PBRFS design and the evaluation parameters.
  - Recent review is largely absent on these important outcome and design issues.