Intangible investment and firm performance

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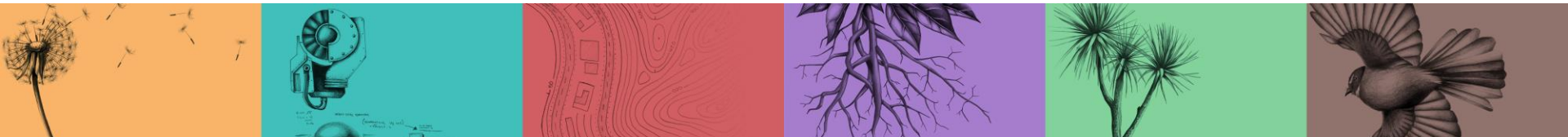
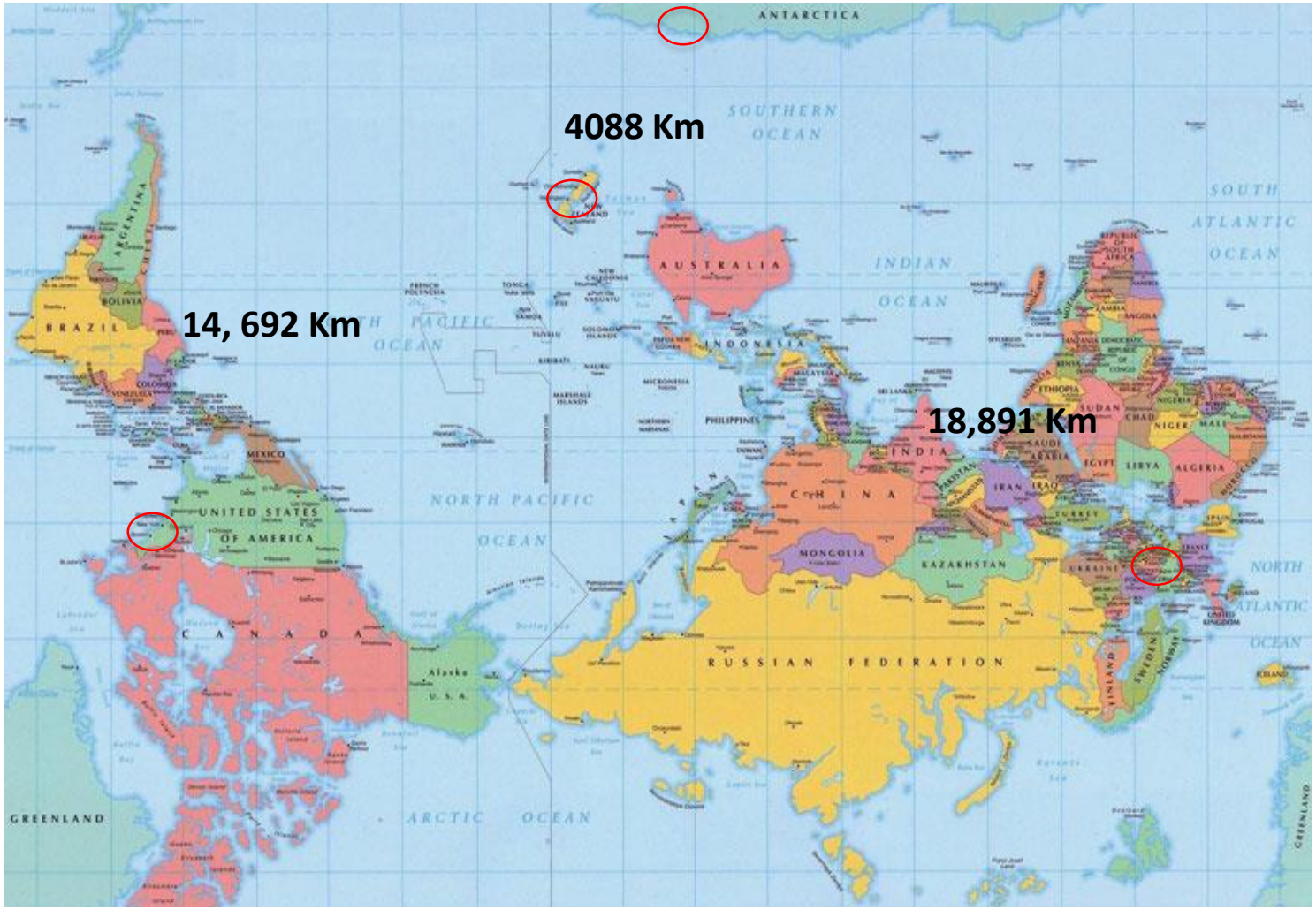


Where I'm from



Motivation (1)

- Intangible investment:
  - Exceeds tangible investment in several countries
  - important source of productivity growth
- Bloom, et al (2014) attributes one-quarter of TFP gaps internationally to "management practices"

Motivation (II)

- "Puzzle" of poor NZ productivity performance
- Popular explanations:
  - Low Business R&D ("BERD")
  - Small and isolated local markets insulate firms from competitive pressure
  - Weak management
- Hard to separate, but can we find any evidence that firms that do invest in intangibles get a productivity benefit?

Sources of productivity difference

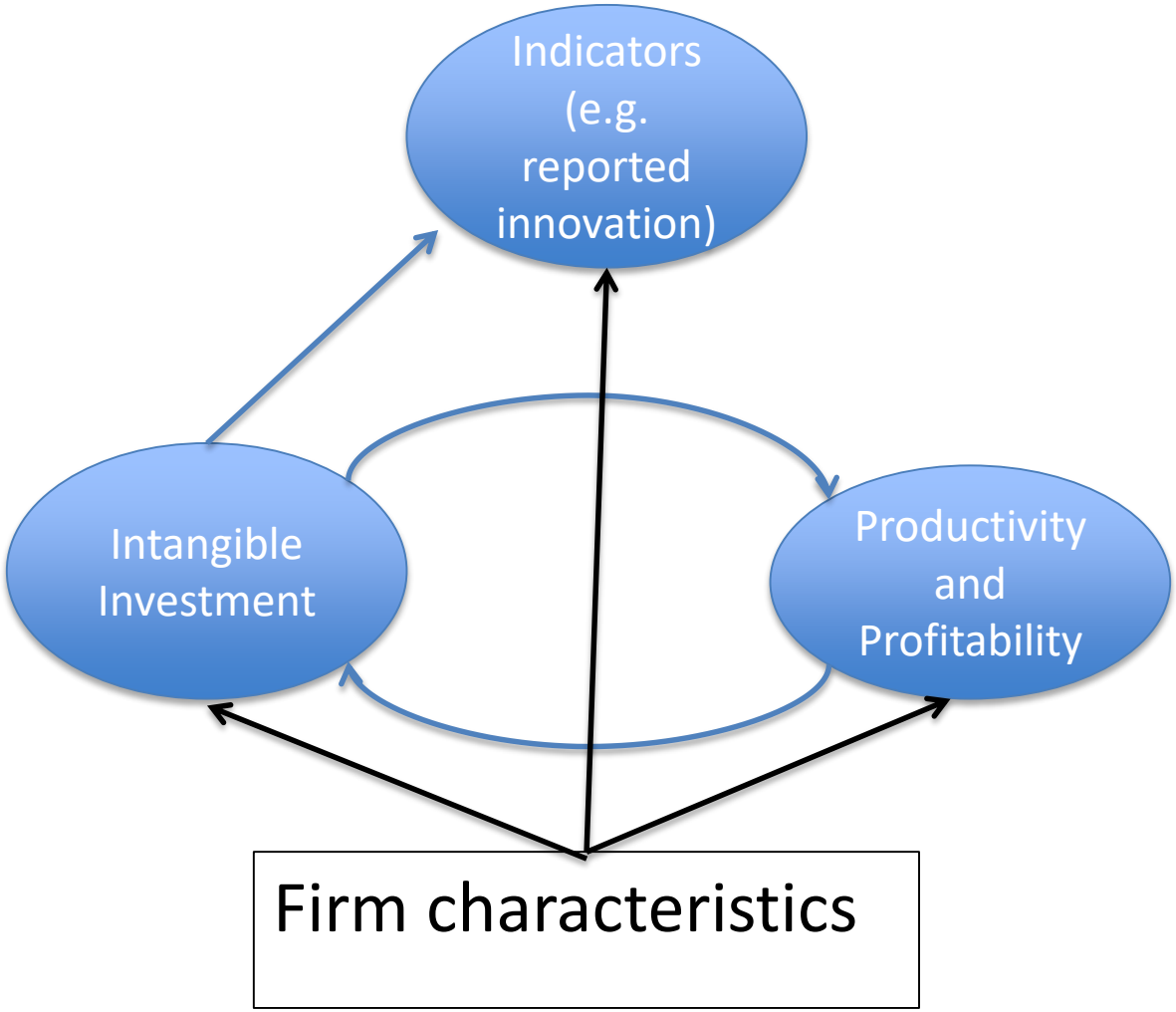
- *By definition*, sources of productivity difference must fall in one of 3 categories:
  1. Manna from heaven
  2. Mismeasurement of inputs or outputs
  3. Some kind of productive asset available to the firm but not captured in measured inputs
- Tradition back at least to Griliches (1979) of thinking of main source of (3) as R&D
- Crepon et al (1998):

  R&D➔Innovation➔Productivity

Our approach

- Intangible investment takes many forms; let the data speak as to their individual or combined impact on firm productivity
- Firms' competitive environment may affect their investment decisions. It should not affect their "true" productivity, but might affect measured productivity
- Wanted to estimate augmented/modified Crepon model
- But first, look at the first-order associations

Modified/augmented Crepon model



Research questions

- What determines whether and to what extent firms invest in intangibles?
- Does competition have a measureable impact on intangible investment?
- What are the returns to intangible investment?

----------joint with----------

- How good are the measures of intangible investment and innovation?

Data

- Statistics NZ's Longitudinal Business Database
- Focusing on Business Operations Survey Innovation Module (every second year)
  - Rich source of info on intangible indicators
- Link to Fabling and Mare (2015) production data for measures of output, labour, capital and mfp residuals (productivity relative to the average in an industry)

SNZ Official Disclaimer

- Access to the data presented was managed by Statistics New Zealand under strict micro-data access protocols and in accordance with the security and confidentiality provisions of the Statistic Act 1975. Our findings are not Official Statistics. The opinions, findings, recommendations, and conclusions expressed are those of the authors, not Statistics NZ or Motu Economic and Public Policy Research.

Sample

- Firms in BOS innovation module with production function data: 2005, 2007, 2009 & 2011 (no production data for 2013)

- Use both self-reported measures from BOS, and administrative variables from the broader LBD (firm performance, industry, age, ….)

- 17,703 firm-year observations. 8,529 unique firms

BOS intangible indicators

- During the last 2 financial years, did this business do any of the following, whether done to support innovation or not:
  - Acquisition of computer hardware and software
  - Implementing new business strategies or management techniques
  - Organisational restructuring
  - Design (e.g. industrial, graphic or fashion)
  - Market research
  - Significant changes to marketing strategies
  - Employee training
  - R&D (previous 1 year)

BOS intangible expenditure

- Question on last year's expenditure on:
  - R&D
  - Design
  - Marketing and market research (for product development)
  - Other expenditure related to product development

Firm-years investing in intangibles

Intangible activity	Proportion	Number
Acquisition of hardware & software	0.723	27,354
Implementing new business strategies/management techniques	0.429	27,300
Organisational restructuring	0.413	27,315
Design	0.196	27,375
Market research	0.281	27,384
Significant changes to marketing strategies	0.218	27,375
Employee training	0.787	27,441
Research and development	0.123	30,804
Any intangible expenditure	0.327	23,142

Forming intangibles index (0-1)

- $Intangibles\ index =$

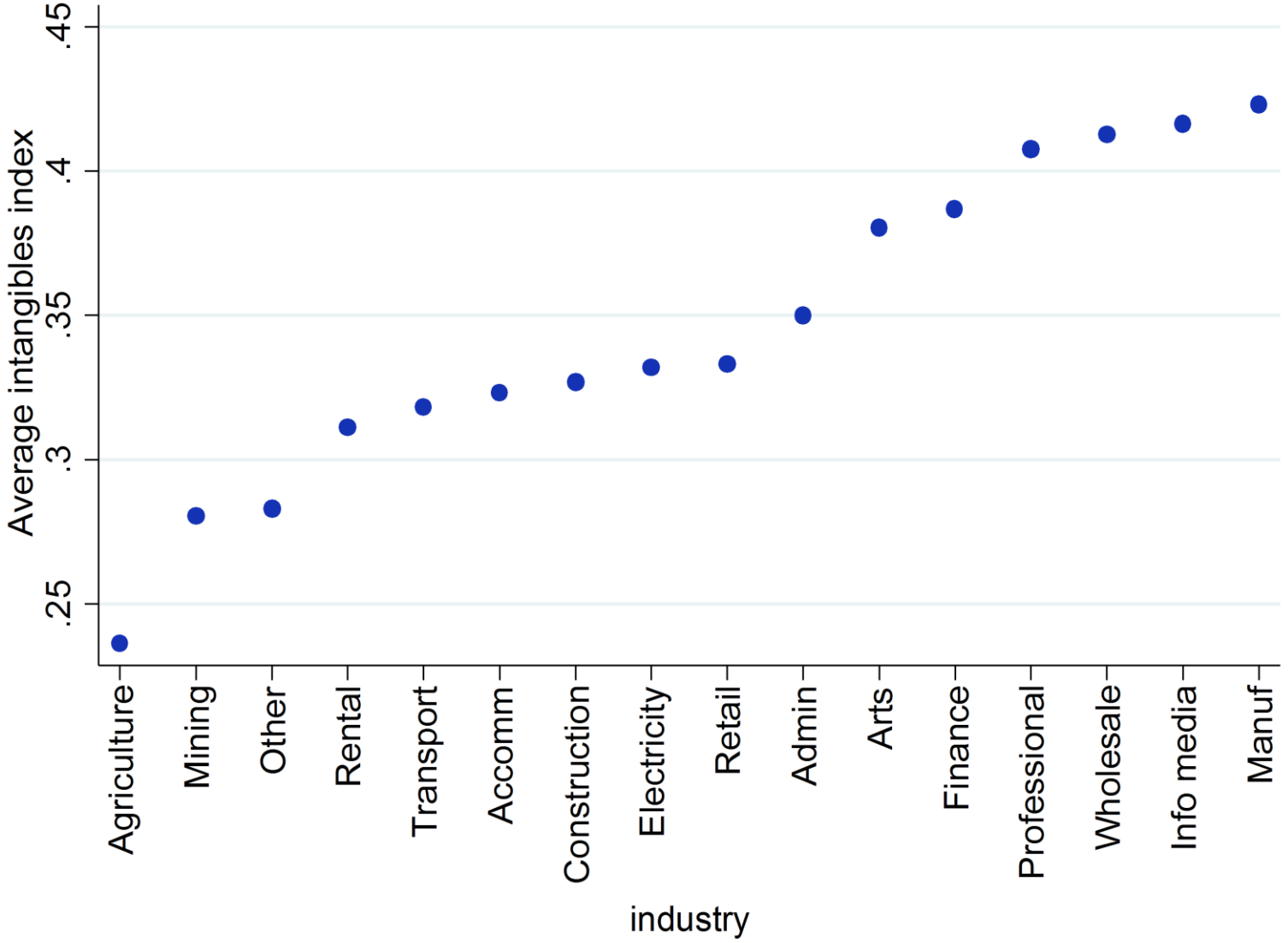
$$\frac{no.of\ intangible\ activities\ engaged\ in}{no.of\ nonmissing\ intangible\ dummies}$$

- $Innovative\ intangibles\ index =$

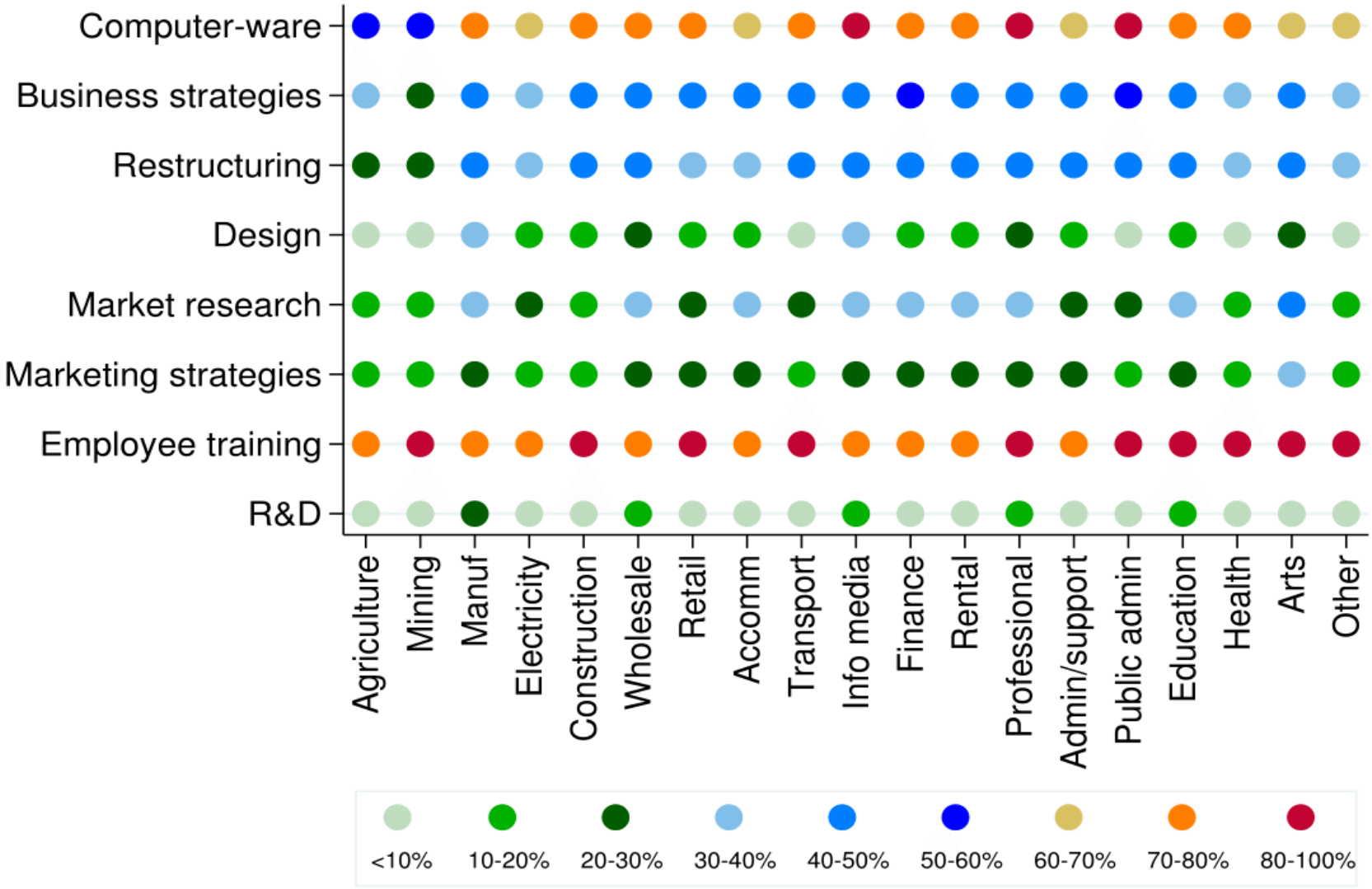
$$\frac{no.of\ intangible\ activities\ engaged\ in\ for\ innovation}{no.of\ nonmissing\ intangible\ dummies}$$

- Alternatively do principal component analysis (PCA) on the 8 intangible dummies

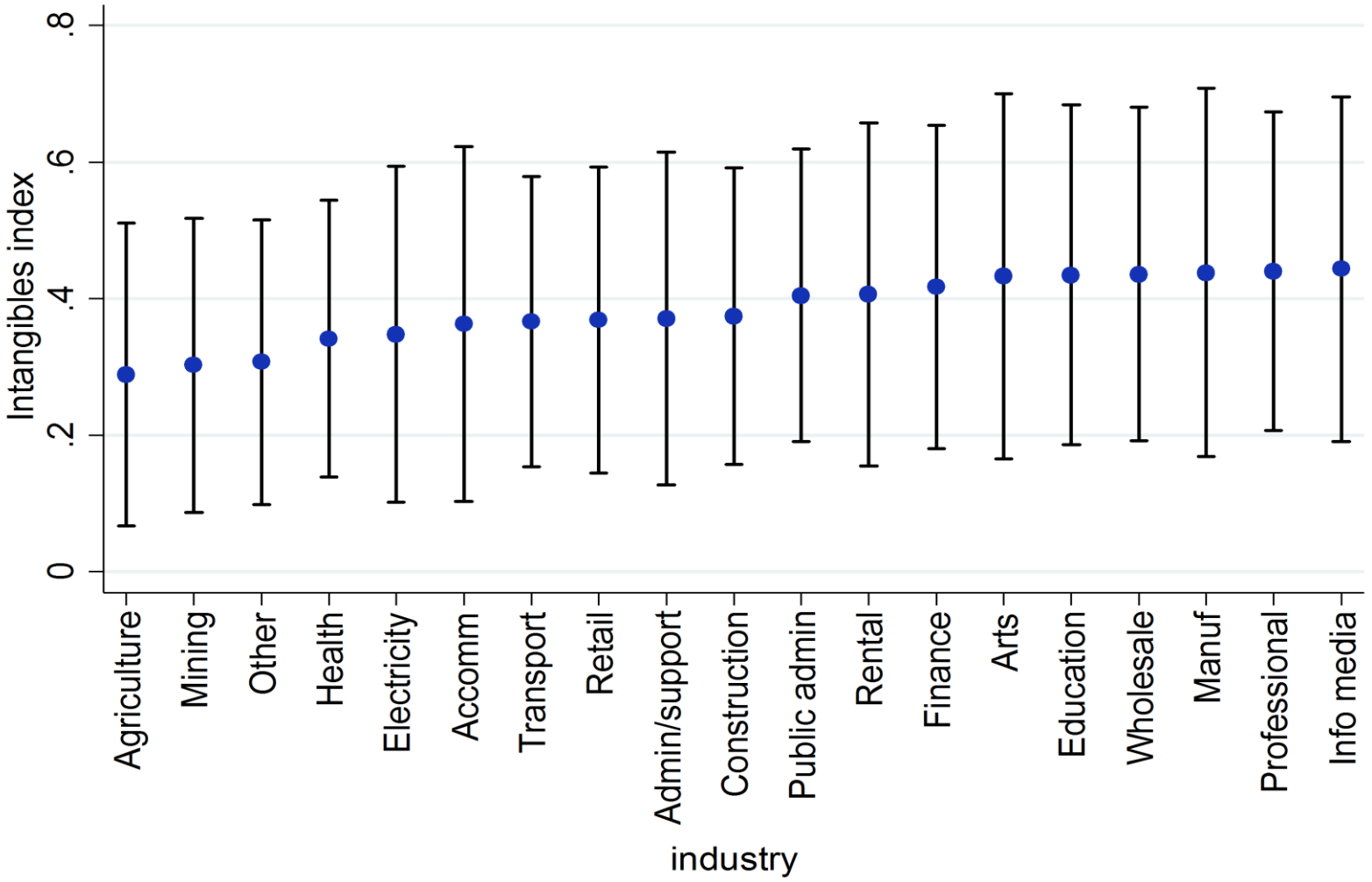
Intangible investment by industry



Intangible investment by industry



Range of Intangible investment by industry (One S.D.)



Self-reported competition, all years

Reported competition	Firm count	Fraction
Captive market	621	0.036
1 or 2 competitors	3,096	0.180
Many competitors, some dominant	9,753	0.567
Many competitors, none dominant	3,165	0.184
don't know	561	0.033

Correlates of intangible investment

Dependent variable:	Intangibles index (0–1)	Any intangible expenditure
Full time equivalent (ln) (2-yr lagged)	0.062***	0.051***
	-0.003	-0.004
Output growth 4-2 yrs ago relative to industry	0.020***	0.025**
	-0.006	-0.01
Perceived captive market (2-yr lagged)	-0.041***	-0.065***
	-0.014	-0.023
1 or 2 competitors (2-yr lagged)	-0.006	-0.016
	-0.007	-0.013
Many competitors, none dominant (2-yr lagged)	-0.005	-0.016
	-0.007	-0.012
Doesn't know competition (2-yr lagged)	-0.077***	-0.097***
	-0.016	-0.022
R squared	0.252	0.454

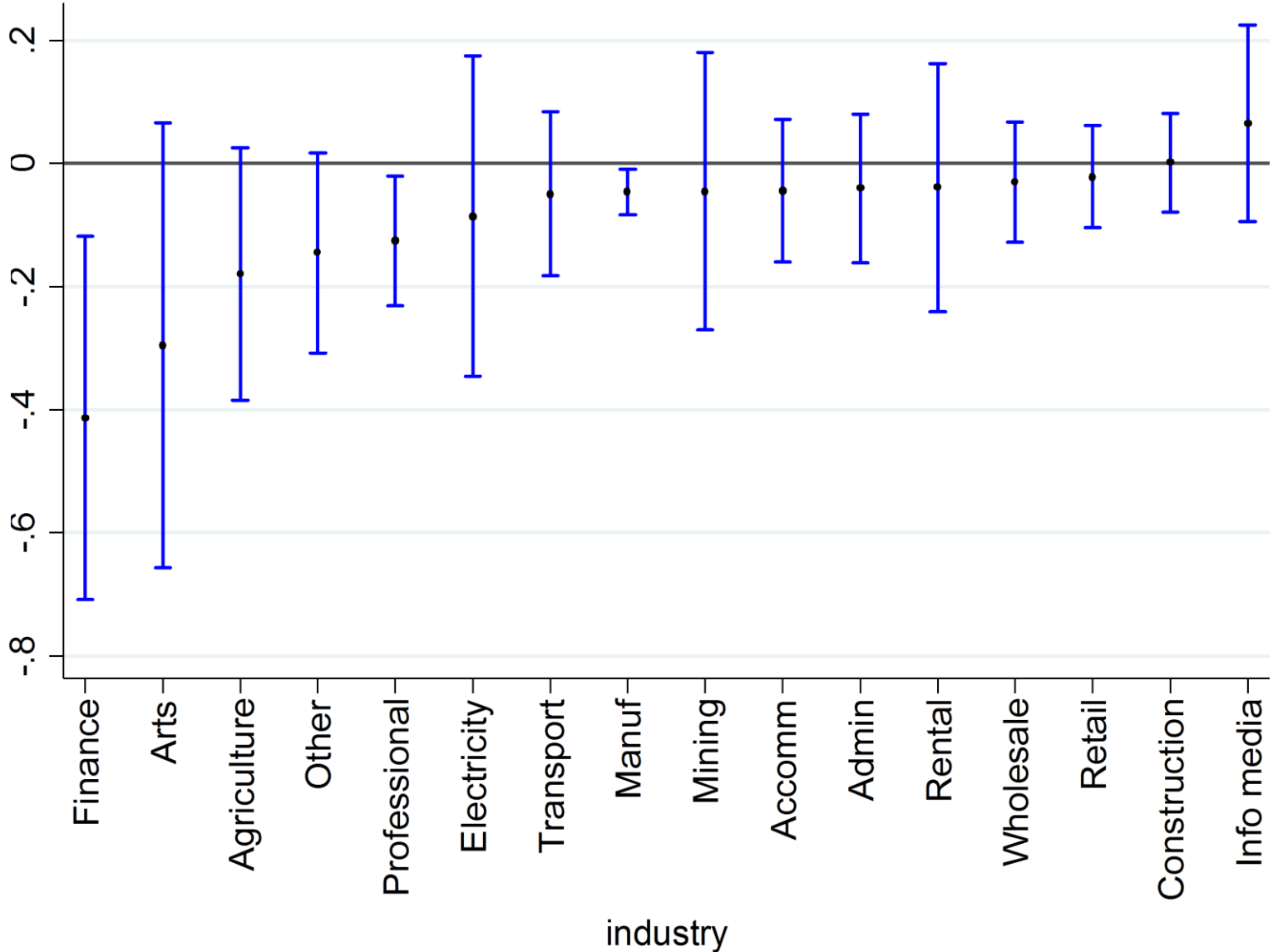
Effect of intangibles on firm performance

- Effect of intangibles on subsequent productivity and profitability:
  - Industry fixed effects
  - Allow intangible coefficient to vary by industry
  - Look at level of mfp and changes in mfp
- Firm fixed effects
- Correlation in the x-section between intangible intensity and average performance

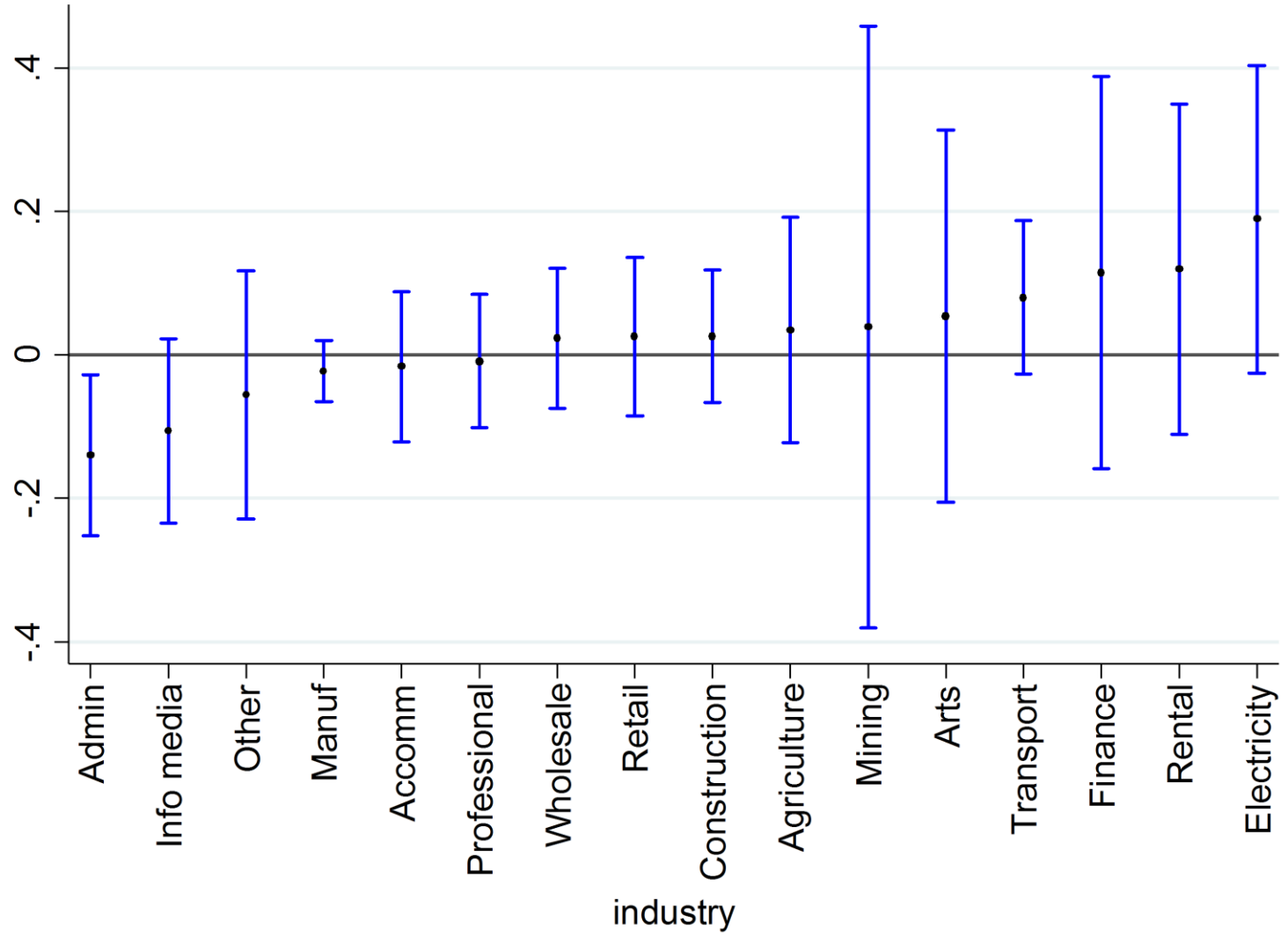
Intangible investment and MFP

Dependent variable:	MFP residual	2-yr change in MFP	Indicator for >5% increase in MFP
Intangibles index (2-yr lagged)	-0.064***	0.024	0.051**
	(0.020)	(0.015)	(0.024)
Perceived captive market	0.040	0.020	0.016
	(0.044)	(0.020)	(0.035)
Perceived 1 or 2 competitors	0.017	0.007	0.014
	(0.011)	(0.008)	(0.015)
Perceived many competitors, none dominant	-0.008	-0.001	-0.021
	(0.011)	(0.009)	(0.015)
Doesn't know competition	0.011	-0.007	0.023
	(0.034)	(0.026)	(0.032)
Proportion of successes			0.316
R squared	0.144	0.091	0.125

Coefficient on high intangibles index in mfp regression, by industry



Coefficient on high intangibles index, by industry (dep variable: change in mfp)



Other tests

- Firm fixed effects (nothing)
- Cross-section regression (negative)
- Profitability (negative)
- Labour productivity (positive)
- Quantile regression for MFP—similar across quantiles, some tendency for negative effect to concentrate in most productive quantiles

Intangible investment and firm growth

Dependent variable:	Gross output (ln)	Labour (ln)	Capital (ln)
	(1)	(3)	(5)
Intangibles index (2-yr lagged)	0.112***	0.092***	0.120***
	(0.024)	(0.021)	(0.024)
Doesn't-know intangibles index (2-yr lagged)	-0.038	-0.003	-0.012
	(0.059)	(0.042)	(0.070)
Gross output (ln) (2-yr lagged)	0.889***	0.065***	0.106***
	(0.018)	(0.012)	(0.015)
Labour (ln) (2-yr lagged)	0.080***	0.929***	0.031**
	(0.016)	(0.013)	(0.016)
Capital (ln) (2-yr lagged)	0.034***	-0.002	0.858***
	(0.009)	(0.007)	(0.013)
R squared	0.919	0.903	0.924

What does intangible investment improve?

Dependent variable:	High customer satisfaction	High employee satisfaction
Intangibles index (2-yr lagged)	0.055***	0.060***
	(0.019)	(0.021)
Doesn't-know intangibles index (2-yr lagged)	-0.128***	-0.105**
	(0.041)	(0.044)
Arrogance index (1–3)	0.593***	0.418***
	(0.012)	(0.014)
Proportion of successes	0.628	0.493

Summary

- Intangible investment indicators vary plausibly across industries, with significant within-industry heterogeneity
- Intangible investment
  - (weakly) increasing with firm size
  - (weakly) decreasing with firm age
  - lower for captive markets
  - (very weakly) increasing with prior firm growth
- Impact on productivity and profitability dubious at best
- After intangible investment, firms grow faster and improve on ‘soft’ performance indicators

Interpretation

- Survey responses poor indicators?
- ‘Hard’ benefits after longer period or with very variable lags?
- Firms seeking growth (absolute increase in revenue and profits) rather than return on investment?
- New Zealand is different?

BOS innovation indicators

Activities to support innovation

14 Mark all that apply for each item listed. During the last 2 financial years, did this business do any of the following?

Note:
- to innovate means to develop or introduce new or significantly improved: goods or services; operational processes; organisational or managerial processes; or marketing methods.
- it is acceptable to mark both 'done to support innovation' and 'done, though not to support innovation', if applicable

	done to support innovation	done, though not to support innovation	not applicable	don't know	
acquisition of machinery and equipment	1	2	3	4	B1401
acquisition of computer hardware and software	1	2	3	4	B1402
acquisition of other knowledge (eg licences, patents or other intellectual property)	1	2	3	4	B1403
implementing new business strategies or management techniques	1	2	3	4	B1404
organisational restructuring	1	2	3	4	B1405
design (eg industrial, graphic or fashion design)	1	2	3	4	B1406
marketing the introduction of new goods or services	1	2	3	4	B1407
market research	1	2	3	4	B1408
significant changes to marketing strategies	1	2	3	4	B1409
employee training	1	2	3	4	B1410

BOS innovation expenditure

15 For the last financial year, please estimate this business's combined expenditure on **product development and related activities:**

If any answers are 'zero' please write **0**

research and development (copy answer from question 11 on page 4 in Section A)	$, , ,	B1501
design	$, , ,	B1502
marketing and market research (for product development)	$, , ,	B1503
other expenditure related to product development (eg prototyping, trials, commercialisation)	$, , ,	B1504
TOTAL product development and related activities	$, , ,	B1505