Productivity in Auckland firms
(*there's something about the city*)

Dave Maré,
Senior Fellow, Motu

Motu Public Policy Seminar
Auckland, 10 July 2009

Overview

General discussion

- Why are cities more productive?
- Why is Auckland important?
- Why is productivity important?
- Auckland in context

The relationship between productivity and density

A closer look at productivity in Auckland

- How big is the premium?
- Insights from industry patterns

Why are cities more productive?

Natural advantages

- Harbour, bedrock, water, soil

Productive spillovers

- Sharing [Infrastructure, scale, variety, specialisation, risk-pooling]
- Matching [Getting the right inputs easily, less down-time]
- Learning [Smart people connecting with each other: generation, diffusion & accumulation of knowledge]

Selectivity/ Sorting

- Cities get a disproportionate share of productive firms/ workers

Consumption Amenities

- Wages don't need to be as high as otherwise

Why is Auckland Important?

"Auckland's success will be NZ's success"

- Metro Action Plan Foreword

– Because it is big – 1/3 of population

– Because Auckland firms are more productive

– Because Auckland makes NZ firms more productive

Speculative

– Akld could be doing better

– Akld could make a greater contribution to NZ economic performance

Why focus on productivity?

Productivity isn't everything, but in the long run it is almost everything

– Paul Krugman, (1997) *The Age of Diminished Expectations*, 3rd Edition, Ch 1.

Long run is a misleading guide to current affairs. In the long run we are all dead.

– John Maynard Keynes *A Tract on Monetary Reform*. (1923), Ch 3.

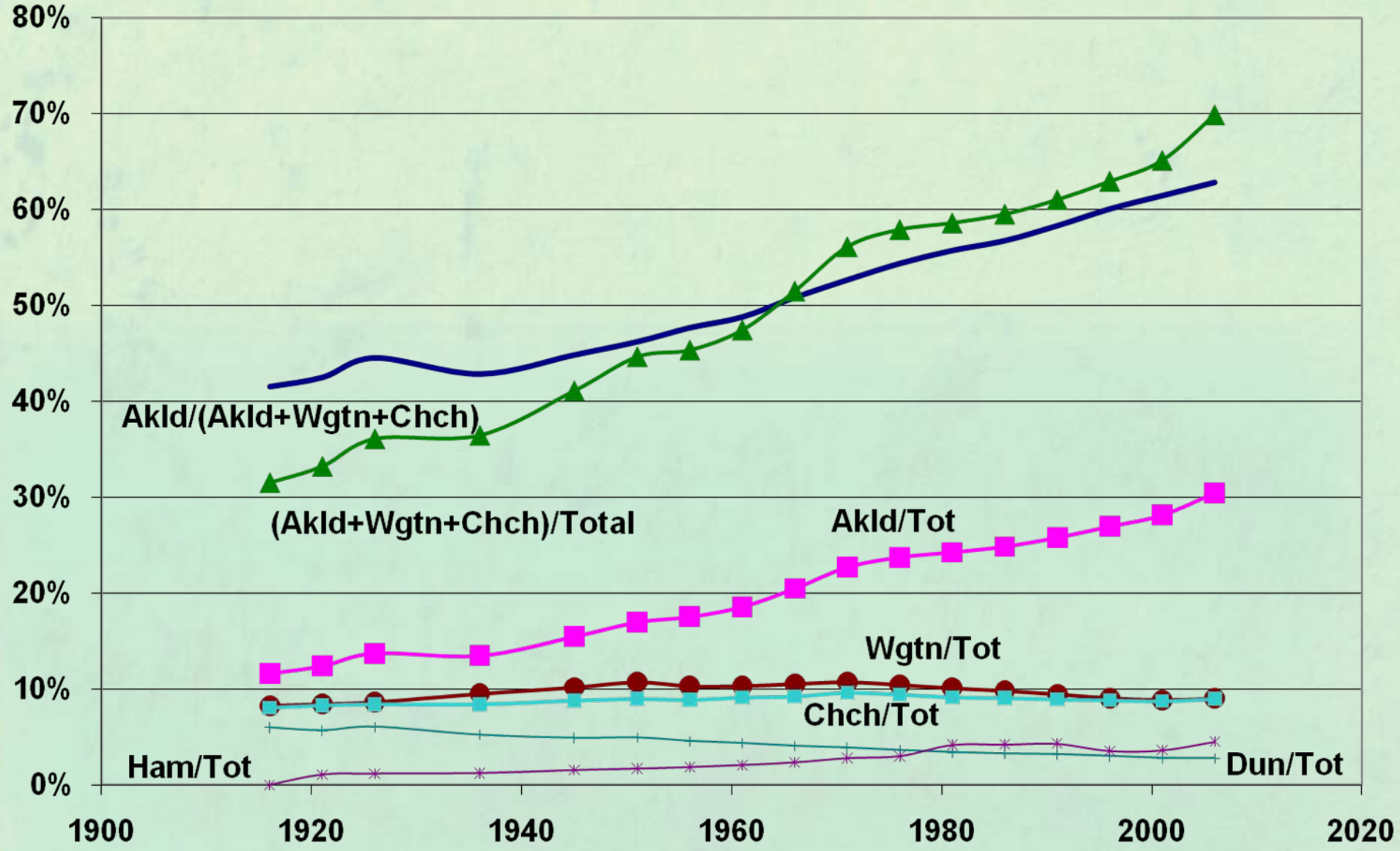
Context: Policy focus

Perception that Auckland is underperforming

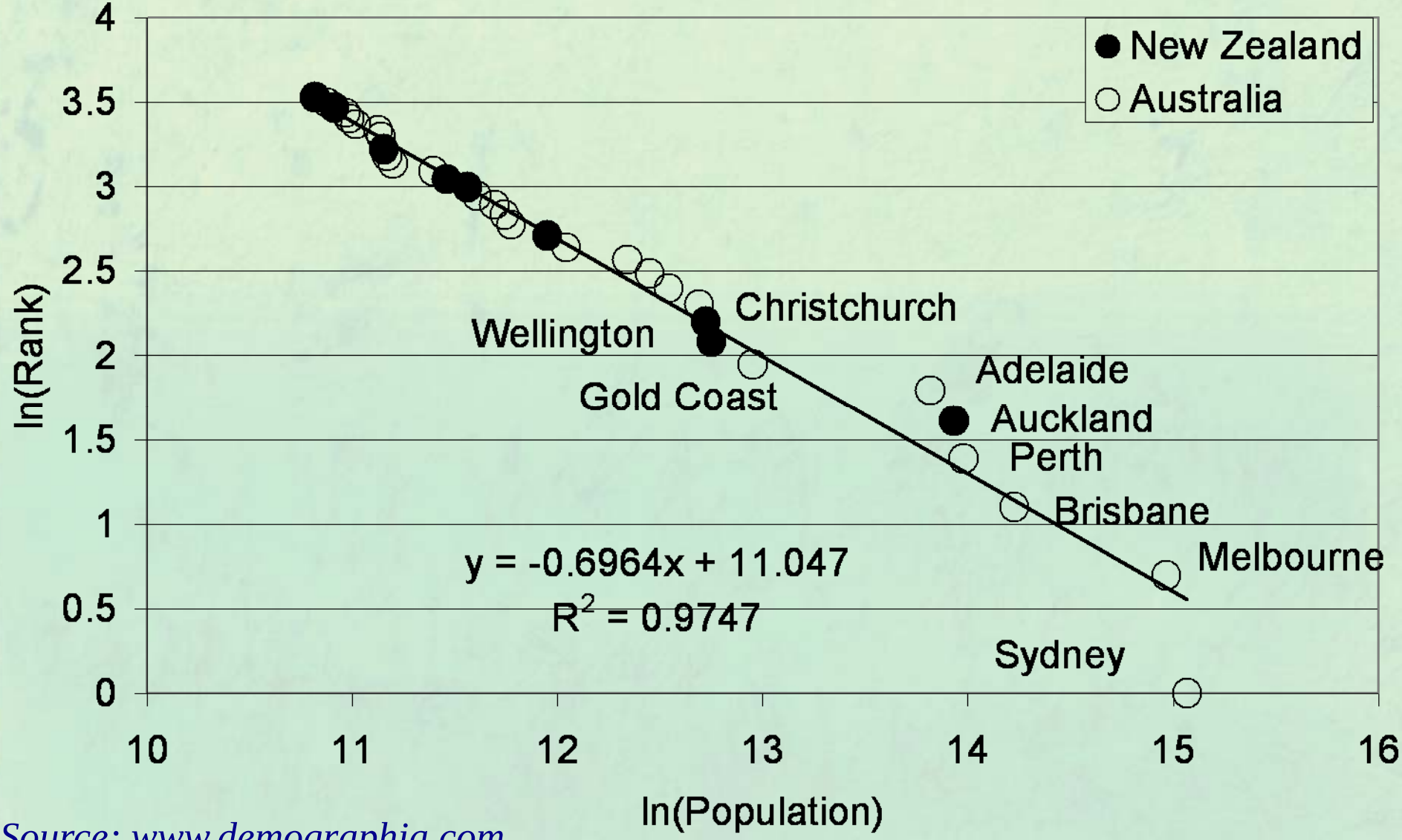
- *"International evidence highlights the importance of having at least one outward facing, global city to lead a nation's economic development. A globally competitive city attracts world-class firms and highly skilled workers, which have significant flow-on effects throughout the economy. The concentration of activity will allow both employers and employees to benefit from specialised labour markets, allow for greater tacit knowledge flows between and within firms and research organisations, and provide the right platform for growing off a critical mass of innovation. Auckland doesn't yet play this role to the extent that major cities do in other economies."*
  - Ministry of Economic Development (2008)

Auckland in context:

Share of NZ population



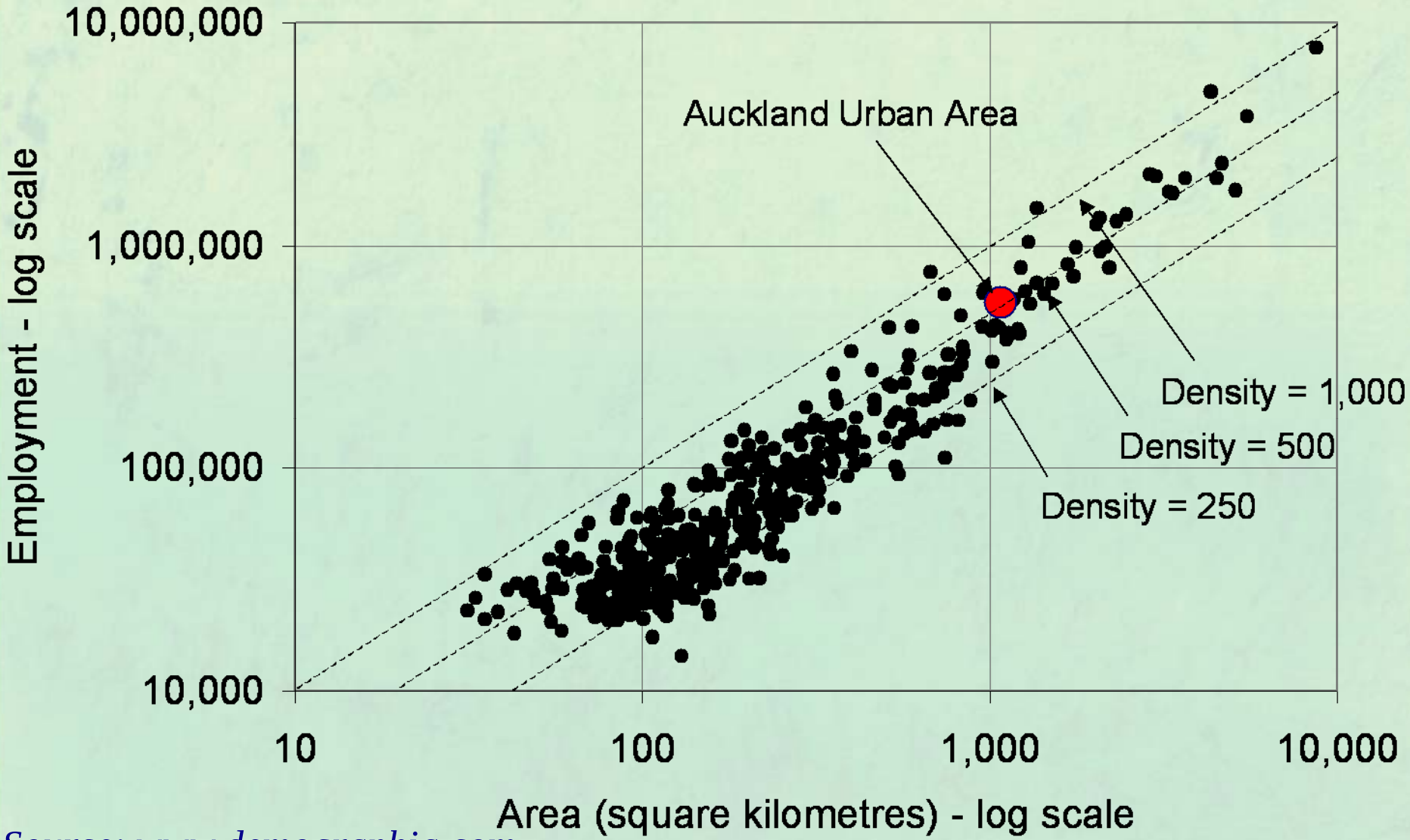
Auckland in context:
the Australasian settlement system



Source: www.demographia.com

Auckland in context

US comparators



Source: www.demographia.com

Auckland in context

US comparators

	Employment (000)	Square km	dens/ sqkm	Population (000)	Square km	dens/ sqkm
AUCKLAND	556	1,074	518	1,125	1,074	1,047
(demographia)					531	2,119
Comparator US cities						
Columbus OH	584	1,030	567	1,133	1,030	1,100
San Antonio TX	581	1,056	550	1,328	1,056	1,258
Orlando FL	575	1,174	490	1,157	1,174	986
Riverside CA	572	1,136	503			
Providence RI-MA	547	1,304	419	1,175	1,304	901
Jacksonville FL	426	1,063	401	882	1,063	830
Cities to emulate?						
Vancouver				1,830	1,120	1,634
Sydney				3,502	2,100	1,668
Singapore				4,000	479	8,351
Large US Cities						
Chicago IL-IN	3,797	5,498	691	8,646	5,952	1,453
Los Angeles CA	4,894	4,320	1,133	13,829	5,812	2,379
New York NY-NJ-CT	7,714	8,683	888	19,712	11,264	1,750

Source: www.demographia.com

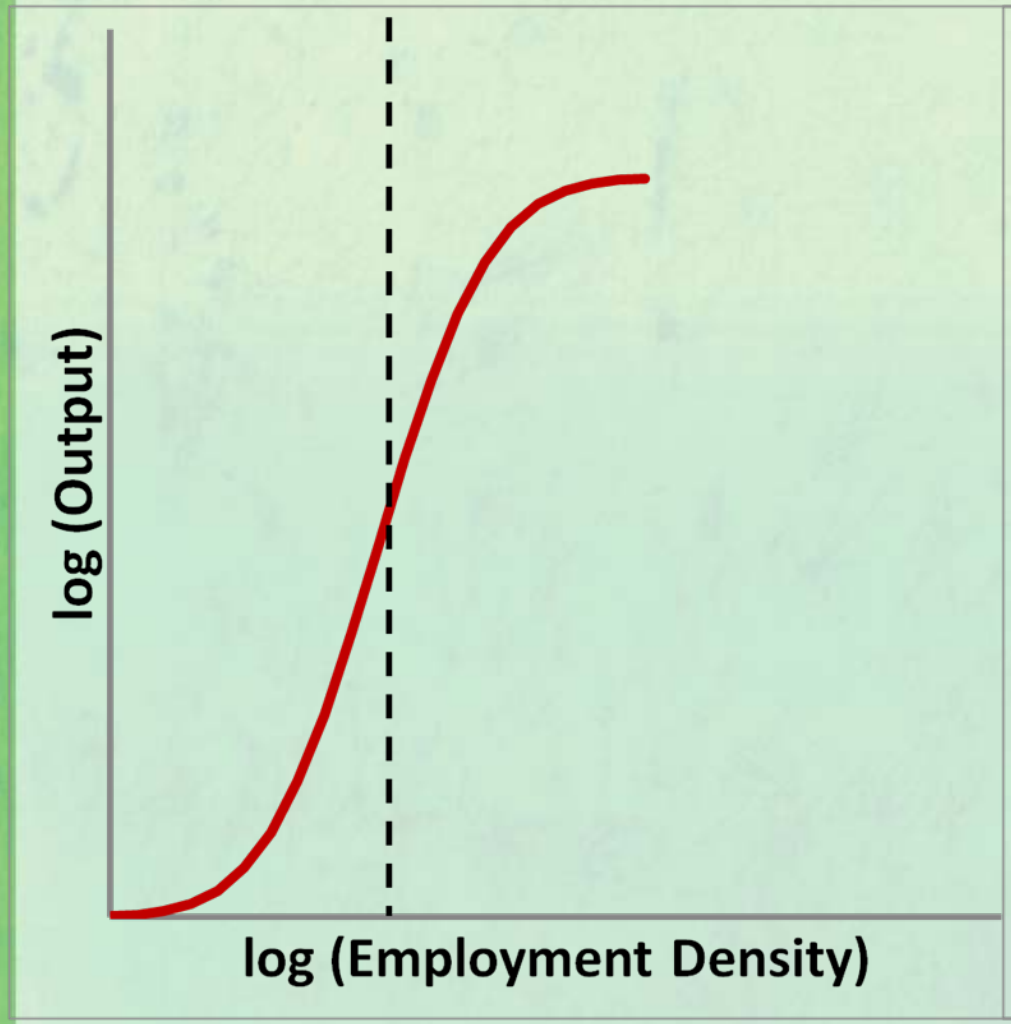
Investigating city productivity

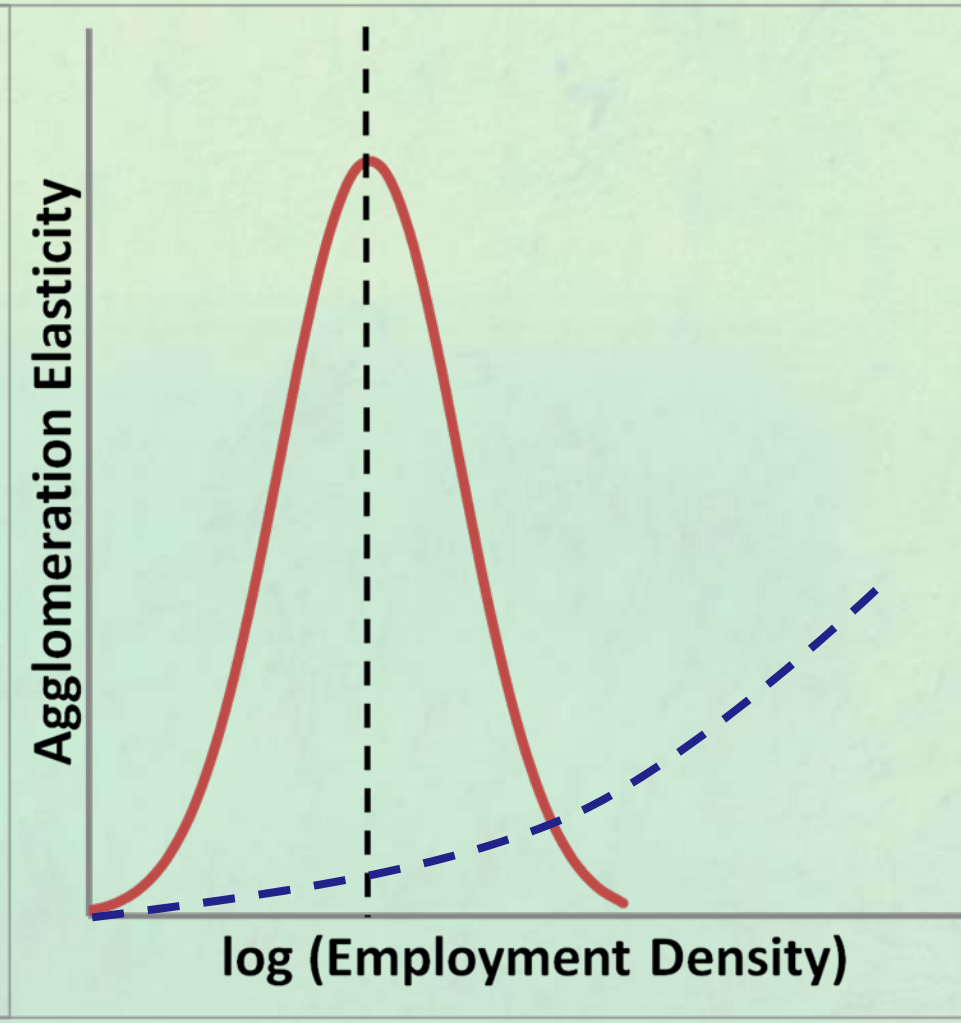
I will use two summary indicators

- Labour productivity
- Multi-factor productivity

1) Examine the relationship between productivity and employment density
2) Examine variation across industries in the strength and nature of this relationship

The density-output gradient & agglomeration elasticities





Empirical Specification

Gross Output Production Function

$$Y = g(U)\, f(K,L,M)$$

- Industry specific parameters; Translog functional form
- *Y, K, M* measured as value (captures allocative efficiency)
- *g(U)*: linear or quadratic

U = Effective employment density

$$U_i = \frac{E_i}{\left(\sqrt{A_i/\pi}\right)^{\alpha}} + \sum_{j}^{i \neq j} \left(\frac{E_j}{\left(d_{ij}\right)^{\alpha}} \right)$$

- E_j =Employment in AU *i*
- D_{ij} = distance from *i* to *j*

□ $\alpha = 1$; *A* = area

- Spatially weighted employment count - distance decay
- Internationally comparable

Data – the *prototype* Longitudinal Business Database

Coverage

- 1999/2000 to 2006/2007
- Economically significant enterprises
  - Employing; part of group; GST>$30k;
  - Private, for-profit; We exclude Public Admin, PersServ, EG&W

Production Function Estimation

- Primary source is Annual Enterprise Survey
- Supplemented with tax information (IR10)

Density

- Measured based on plant (PBN) location
- employment weighted average exposure for each enterprise

Accessed in data laboratory, with suitable protections to protect security and confidentiality

Disclaimers

- Access to the data used in this study was provided by Statistics NZ in accordance with security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular, business or organisation. The results in this paper have been confidentialised to protect individual businesses from identification.
- The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information is published or disclosed in any other form, or provided back to Inland Revenue for administrative or regulatory purposes. Any person who had access to the unit-record data has certified that they have been shown, have read and have understood section 81 of the Tax Administration Act 1994, which relates to privacy and confidentiality. Any discussion of data limitations or weaknesses is not related to the data's ability to support Inland Revenue's core operational requirements.

Estimation Issues

$$Ln(Y_{it}) = \alpha_t + \gamma_j U_{rt} + f_j(K_{it}, L_{it}, M_{it}) + e_{it}$$

i=firm; j=industry; r=location; t=time

Concerned about heterogeneity

- Would the firms observed in dense areas be as productive anywhere?
- Are areas more productive for non-density reasons

Three alternative treatments of e_{it}

- "Pooled": e_{it} is white noise
- "Within local industry": $e_{it} = a_{jr} + u_{it}$; u_{it} is white noise
- "Within enterprise": $e_{it} = a_i + u_{it}$; (fixed effects)

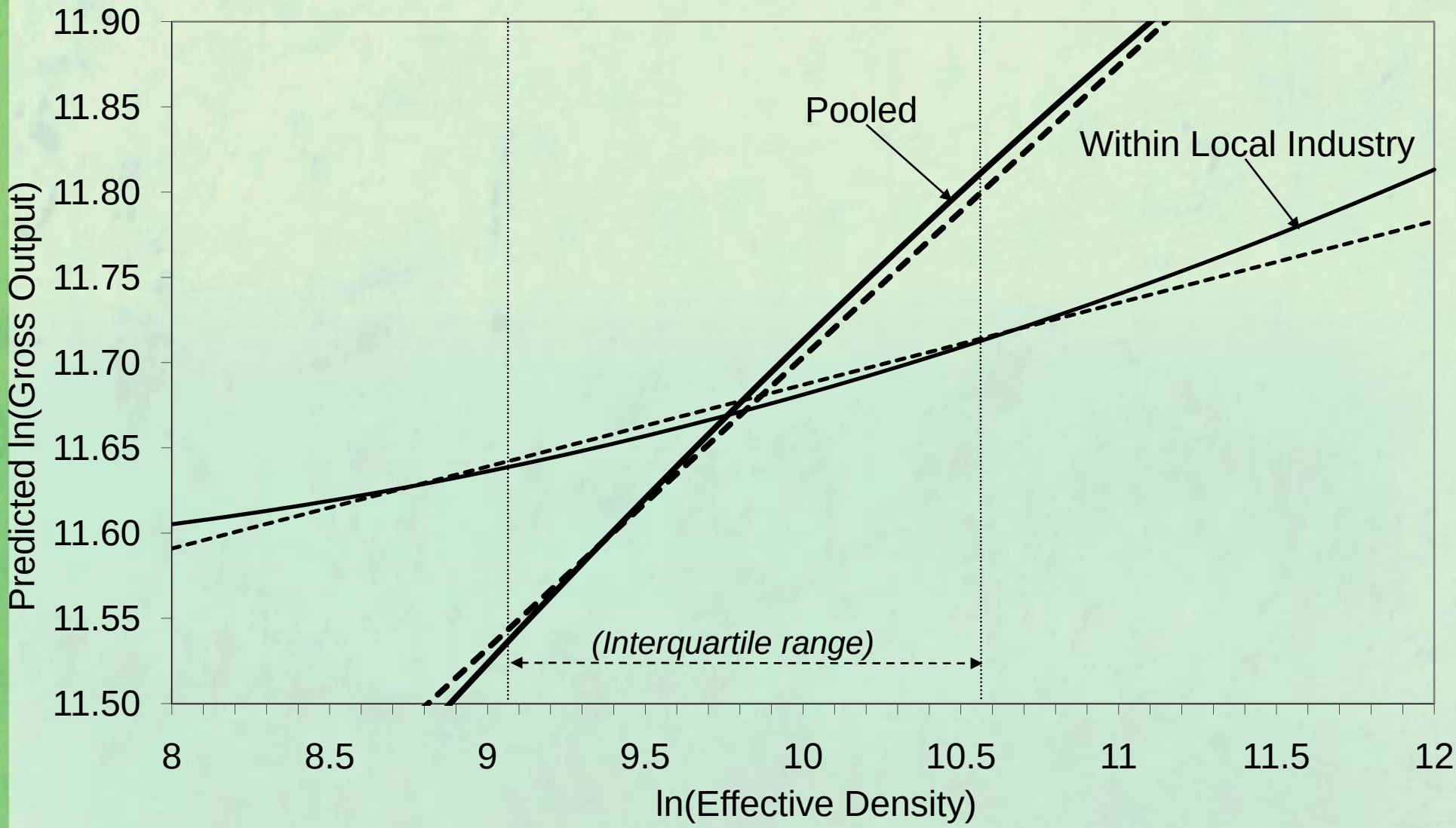
Agglomeration Elasticities

Regression Estimates

	Aggregate production function			*Industry production functions*		
	Pooled	*Within Local Industry*	*Within Enterprise*	*Pooled*	*Within Local Industry*	*Within Enterprise*
	Linear Agglomeration Effects					
ln(EffDens)	0.171**	0.048**	0.015**	0.037**	0.069**	0.010*
	[0.001]	[0.003]	[0.005]	[0.001]	[0.003]	[0.005]
	Quadratic Agglomeration Effects					
ln(EffDens)	0.360**	-0.088*	-0.402**	-0.200**	-0.007	0.184**
	[0.029]	[0.042]	[0.071]	[0.024]	[0.038]	[0.070]
ln(EffDens) squared	-0.009**	0.007**	0.020**	0.012**	0.004*	-0.009*
	[0.001]	[0.002]	[0.003]	[0.001]	[0.002]	[0.003]

- 10% higher density is associated with 0.69% higher productivity

Results – Graphically



Industry-specific production functions

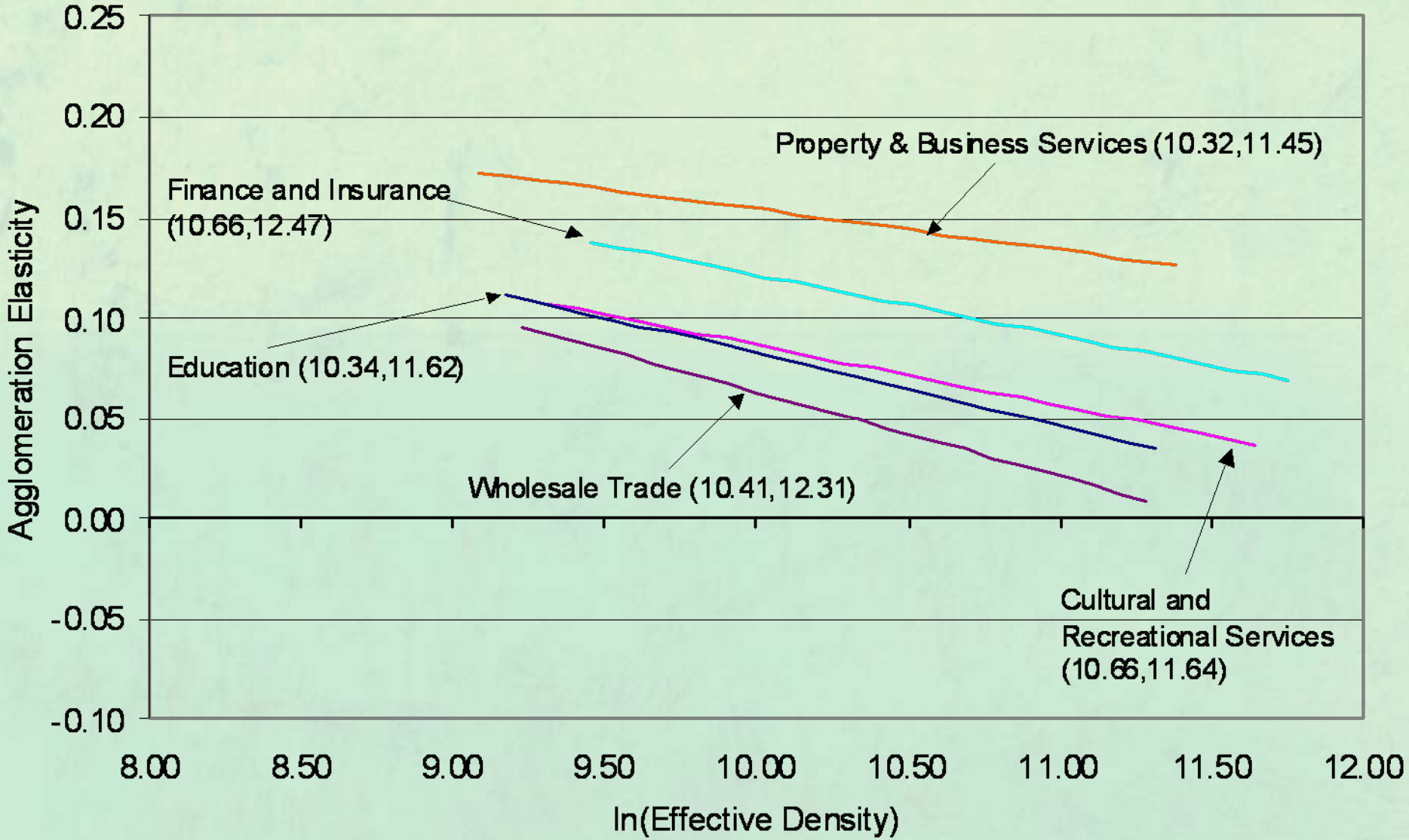
Industry Variation in density effects

Agglomeration Elasticities – by industry

NZ Industry	*Number of Ents*	*NZTA*	*Within Industry*	*Within Local Industry*	*Within Enterprise*
Agriculture, Forestry and Fishing	63,200		0.013**	0.032**	0.041**
Mining & Electricity, Gas & Water	320		0.024	0.035*	0.012
Manufacturing	20,000	0.024	0.049**	0.061**	0.016**
Construction	34,100	0.088	0.039**	0.056**	0.011*
Wholesale Trade	13,200		0.072**	0.086**	0.018**
Retail Trade	34,200	0.044	0.065**	0.086**	0.027**
Accommodation, Cafes and Restaurants	10,500		0.041**	0.056**	0.030**
Transport & Storage	9,800	0.049	0.041**	0.057**	0.014**
Communication Services	2,800		0.053**	0.068**	0.001
Finance and Insurance	3,200	0.18	0.076**	0.087**	-0.006
		0.084			
Property and Business Services	56,500	0.082	0.074**	0.079**	0.000
		0.167			
Government Administration and Defence		0.292			
Education	1,800		0.076**	0.076**	0.022**
Health & Community Services	9,900		0.047**	0.083**	-0.009
Cultural and Recreational Services	1,200		0.062**	0.053**	0.004
Weighted Average*	250,800	0.127	0.049	0.065	0.019
All industries			0.037**	0.069**	0.010*

Decreasing returns to density

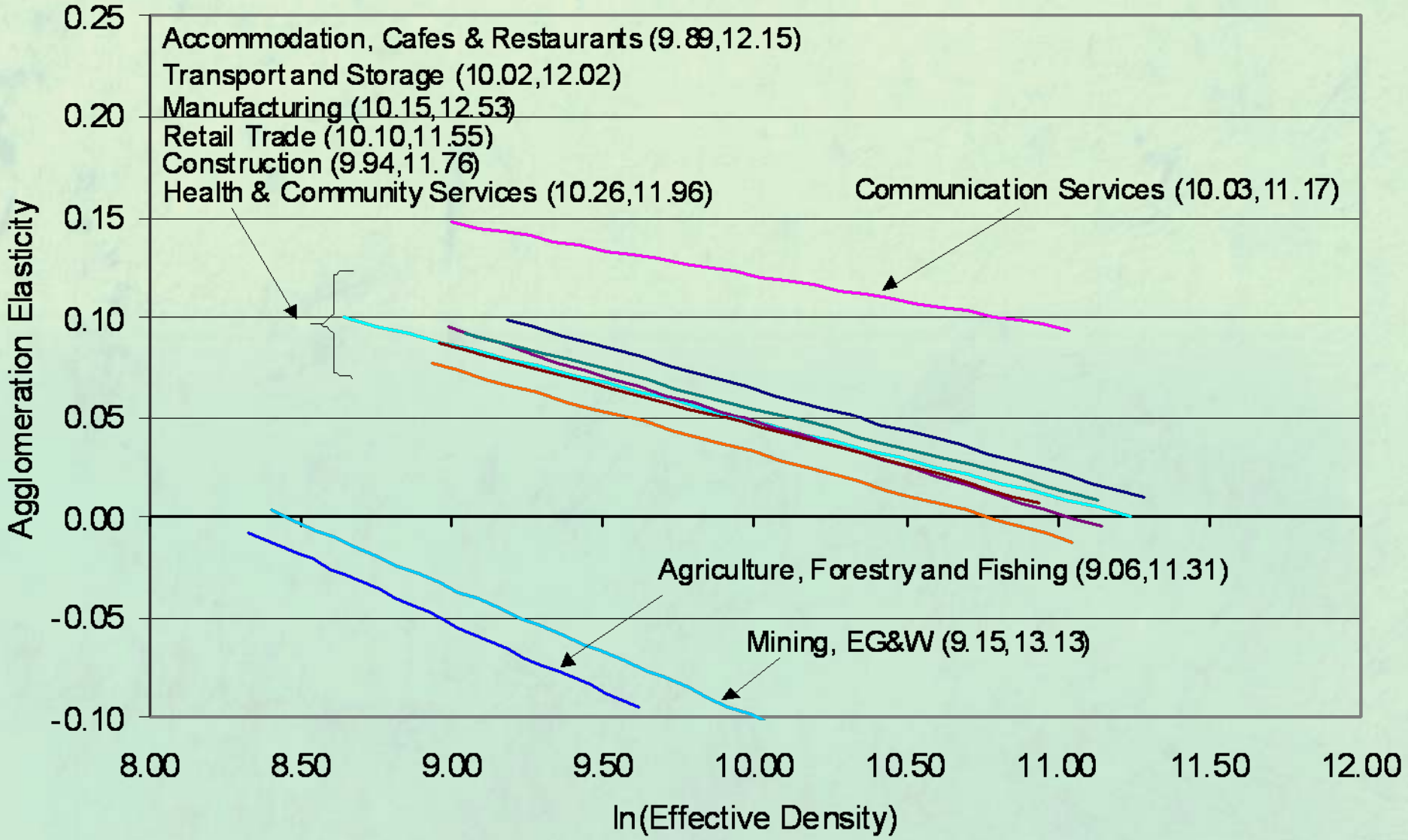
Agglomeration Elasticities – by industry



Quadratic Agglomeration effects; plotted for industry-specific inter-quartile range

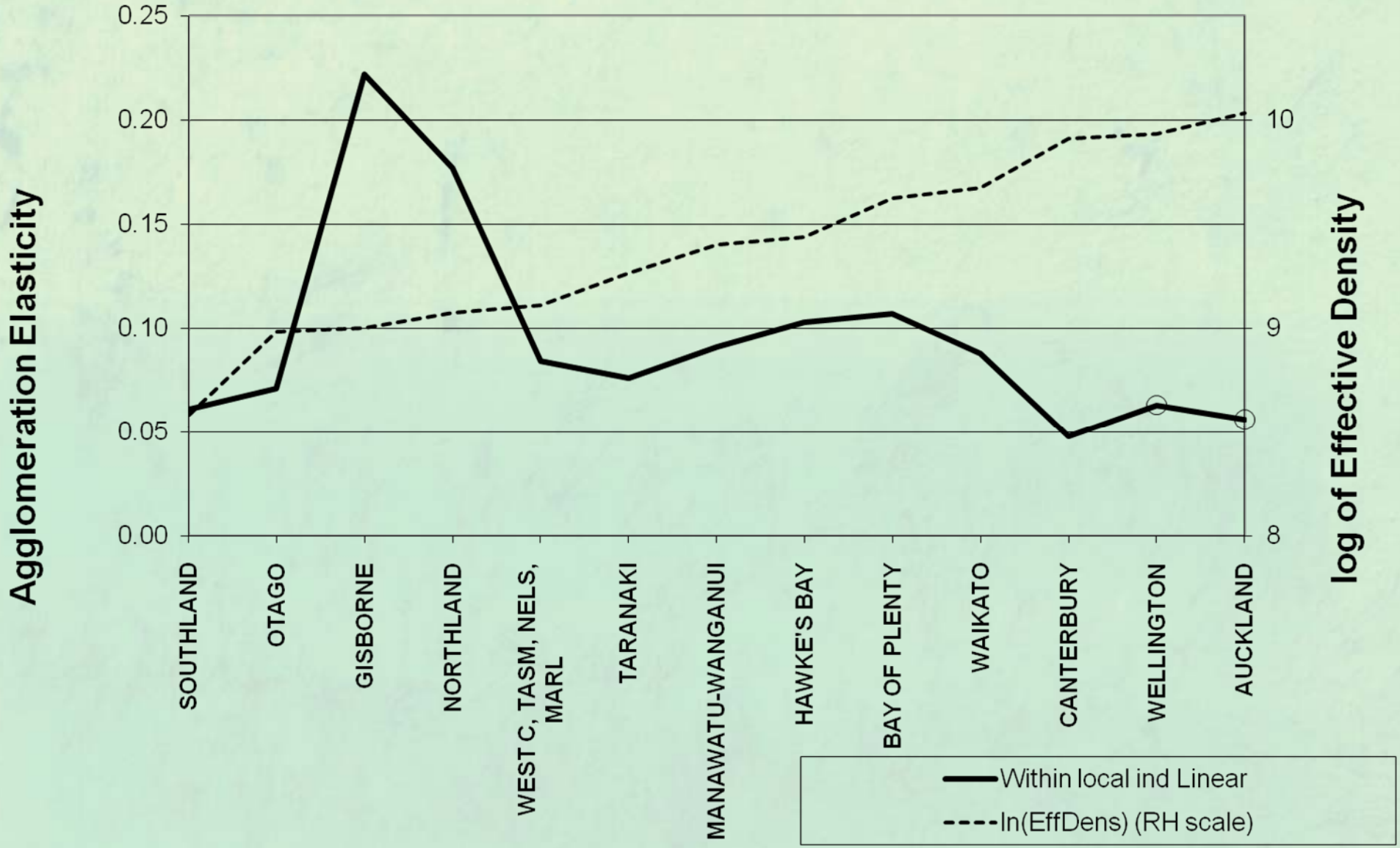
Decreasing returns to density

Agglomeration Elasticities – low-dens industries



Decreasing returns to density (?)

Agglomeration Elasticities – by region



How big is Auckland's productivity premium?

Labour productivity = Current price value added per worker (VAPW)

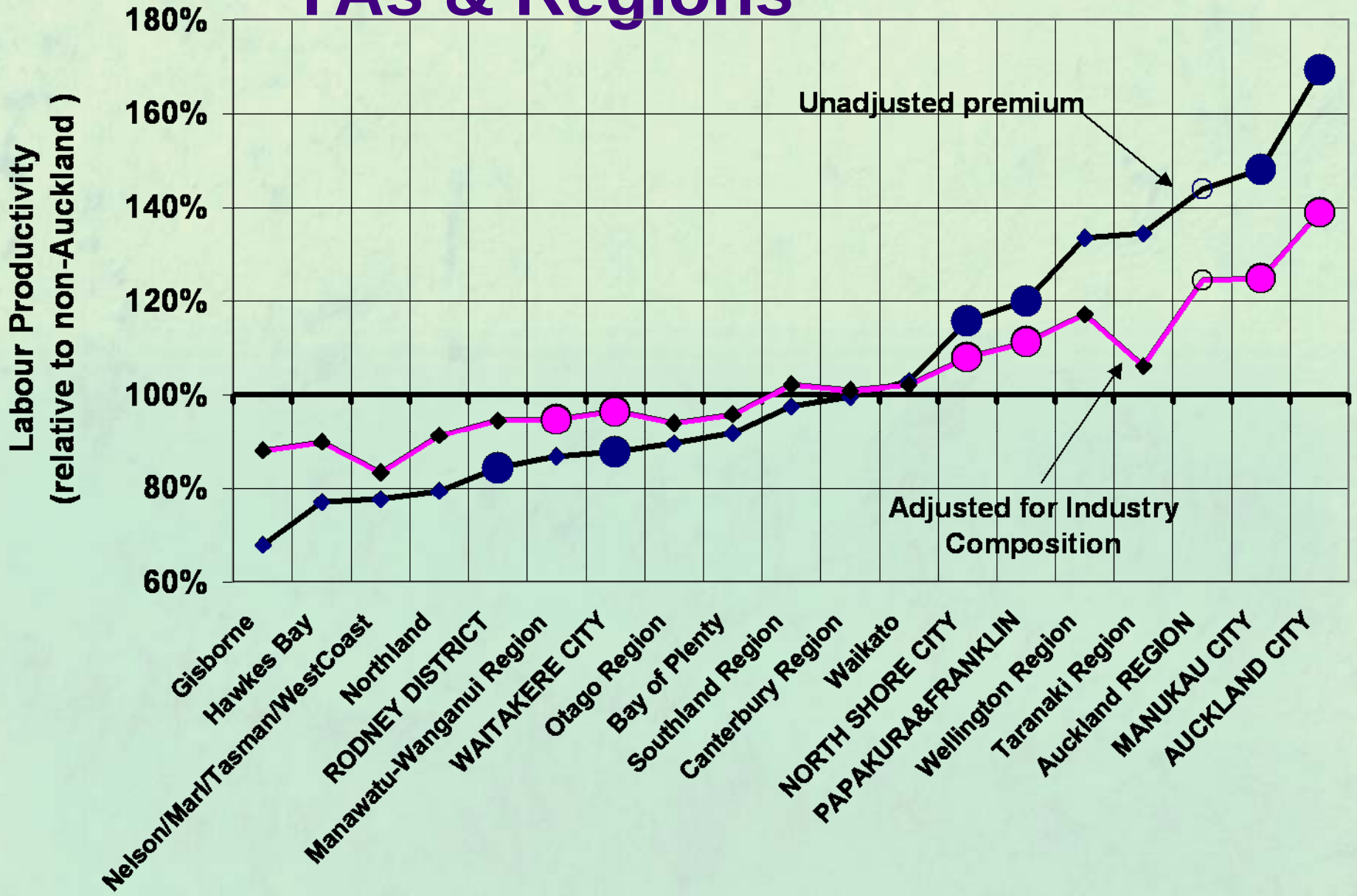
- Value added
  - Value of output *less* value of intermediate inputs
  - Main source is AES postal returns
    - 10% of enterprises, 50% of employment
    - Otherwise net GST sales, adjusted for stock change
- Labour Input
  - Average monthly payroll count (LEED rolling mean employment) plus working proprietor input, aligned to enterprise's balance date
- Includes technical and allocative (price) advantages

Auckland Productivity premium

2006	VAPW ($000)	Premium	Industry Adj VAPW ($000)	Premium	Area (km2)	Share of NZ Emp	Density
Akld Region	$65	**144%**	$60	**125%**	4,993	33%	118
Urban Area	$68	**151%**	$62	**129%**	1,074	31%	518
CBD	$107	**238%**	$82	**171%**	6	4%	13,584
Non-Akld	$45	**100%**	$48	**100%**	245,000	67%	5

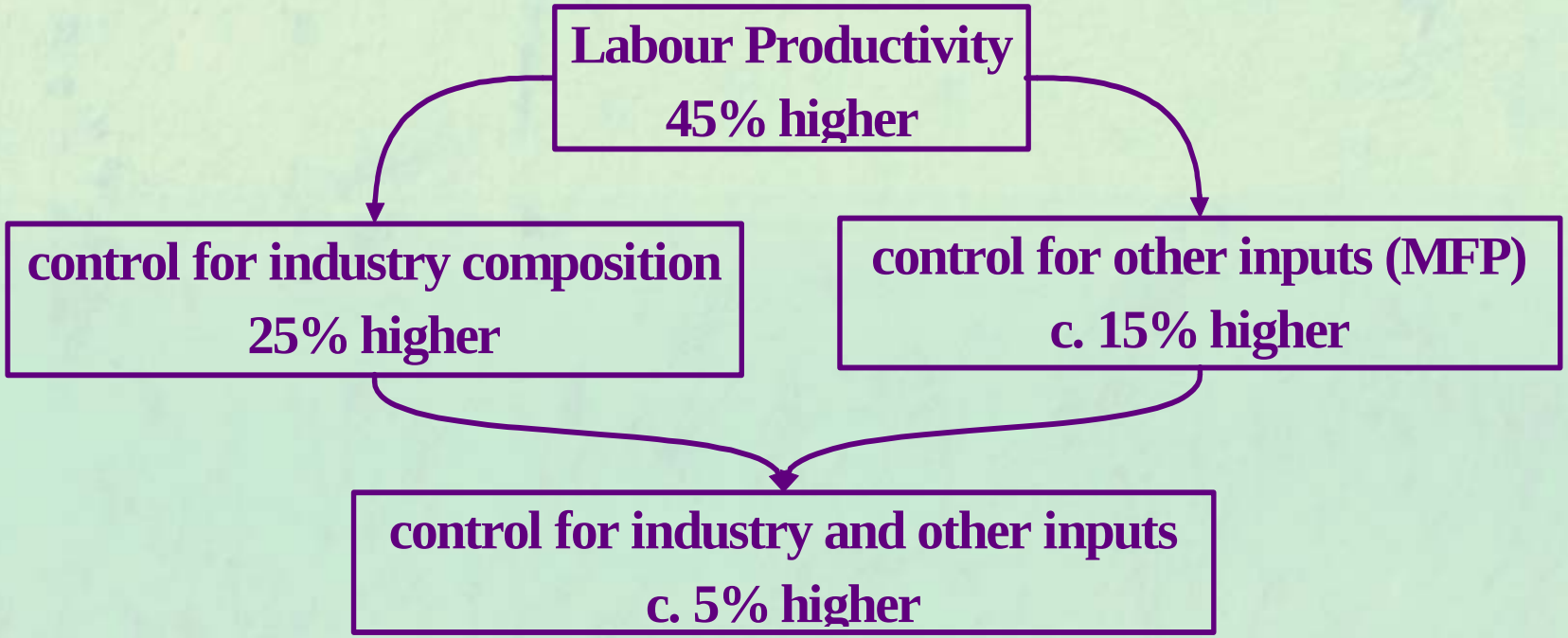
- Akld Urban Area is 51% more productive than non-Akld
  - Is this big enough?
- 40% of the premium is due to Auckland having industries that would be more productive anywhere
- The remainder is due to Auckland firms being industry leaders
  - Industries that concentrate in Akld have larger premia
- Employment density higher where VAPW is higher

Relative Productivity: TAs & Regions



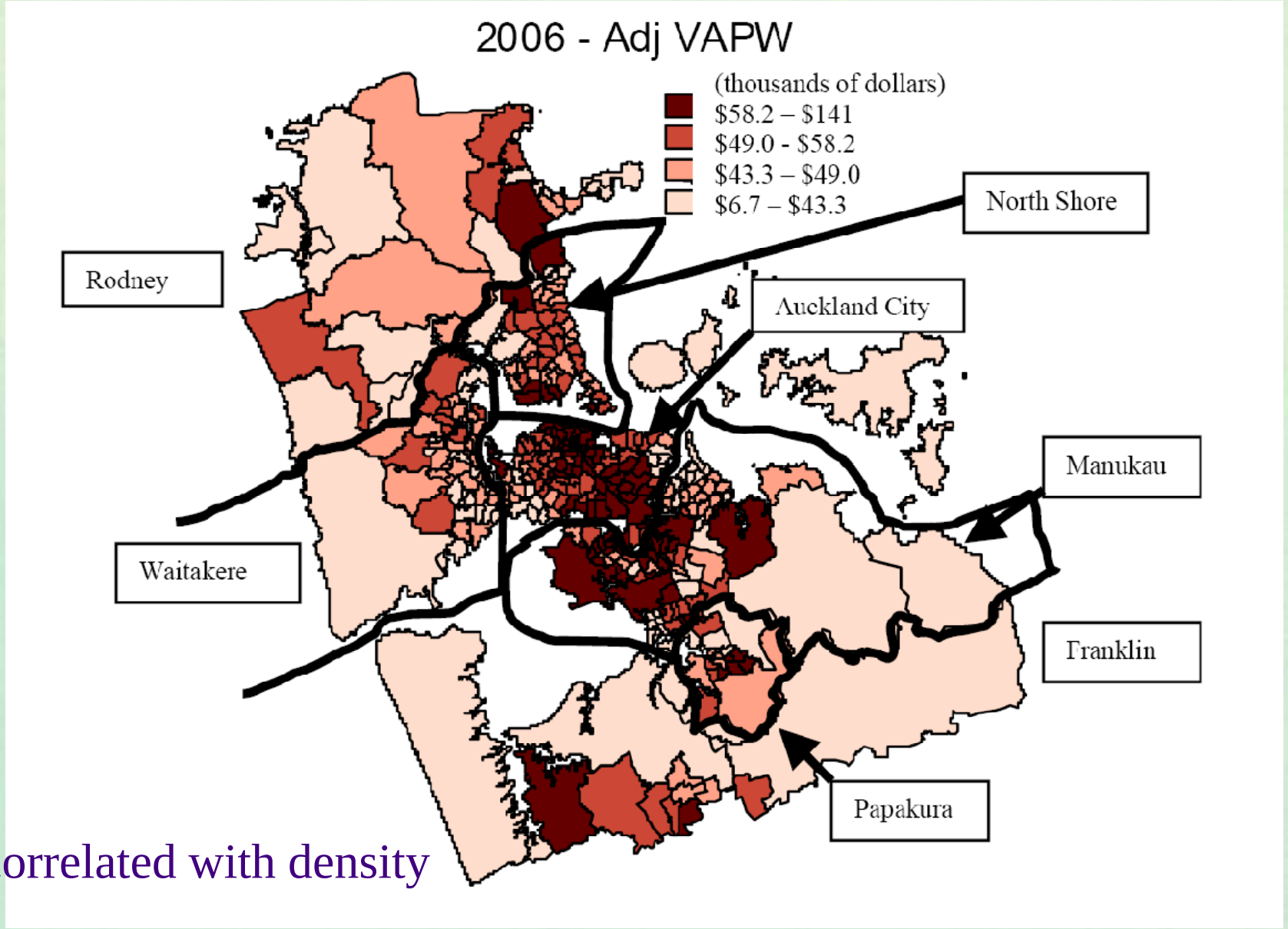
Auckland v the rest of NZ

- Auckland productivity premium
  - relative to ‘non-Auckland’



MFP: Common production function, with different industry intercepts

Areas within Auckland

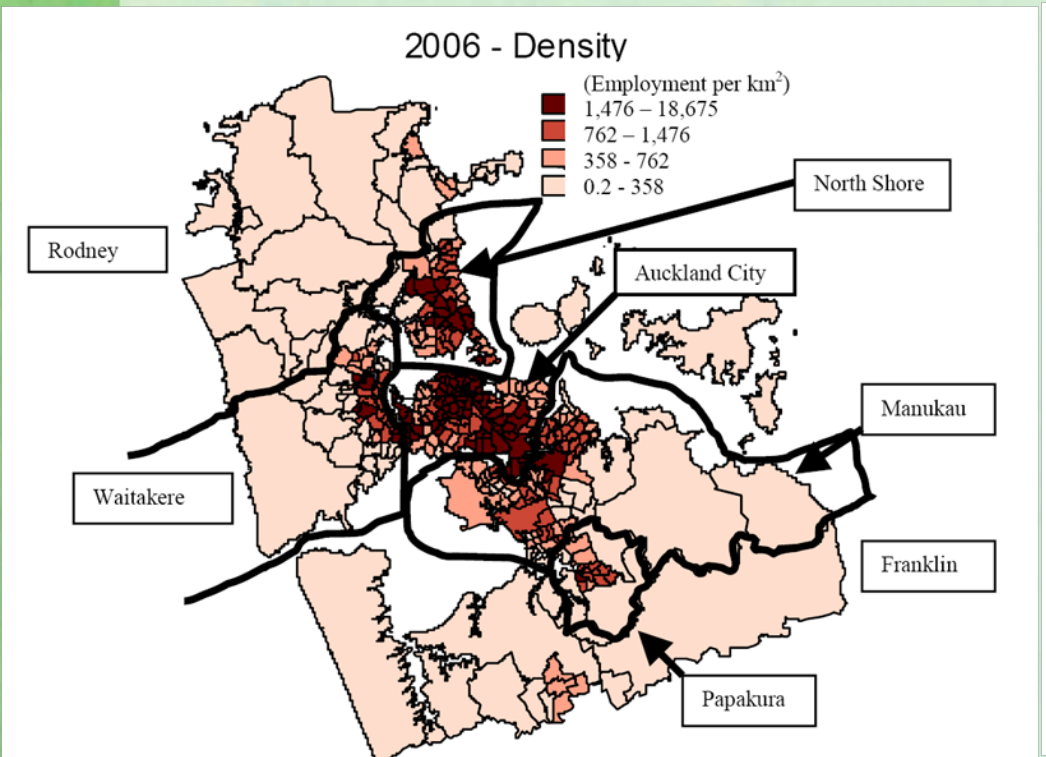


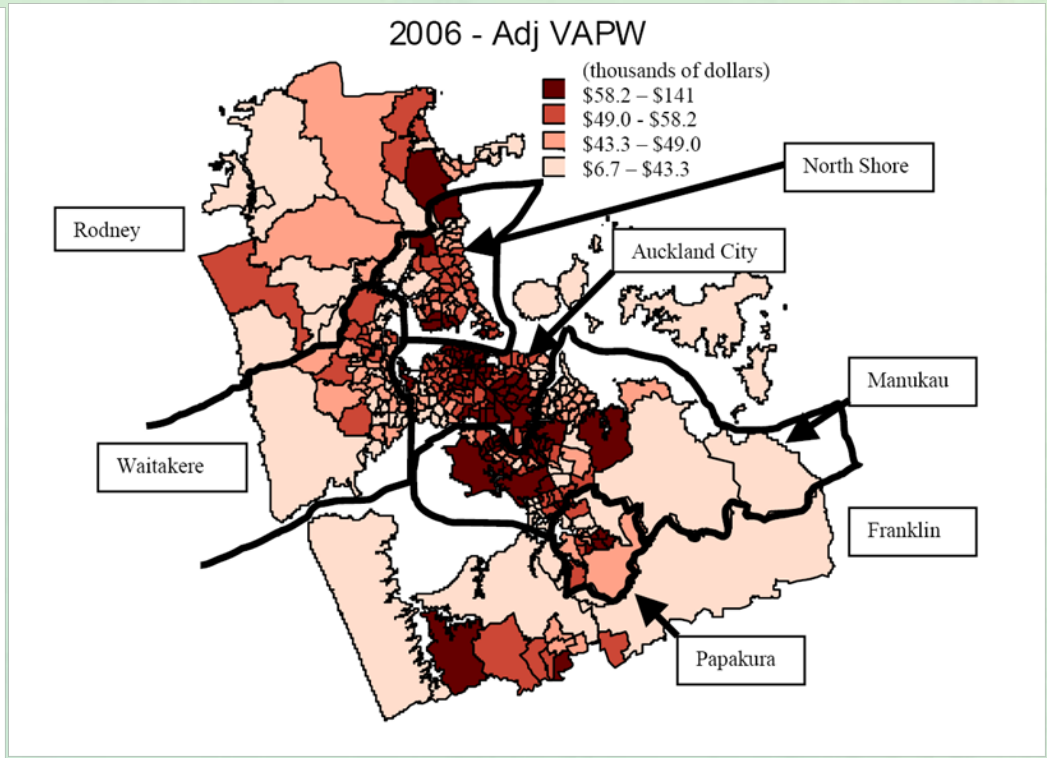
Clearly correlated with density

Labour productivity and density

Denser areas have higher labour productivity

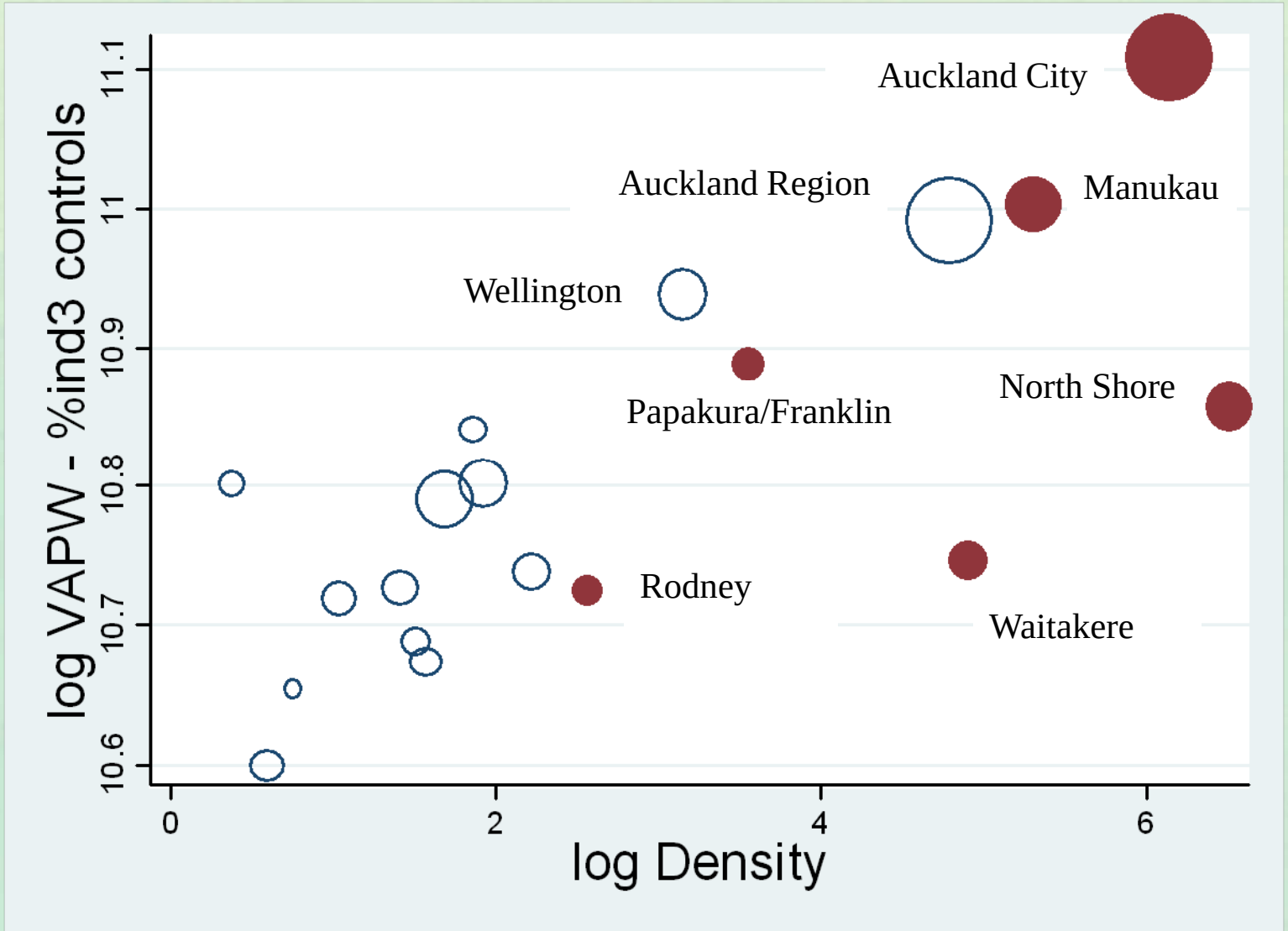
– (Similar patterns in other years)





Labour productivity and density

Territorial Authorities / Regional Councils



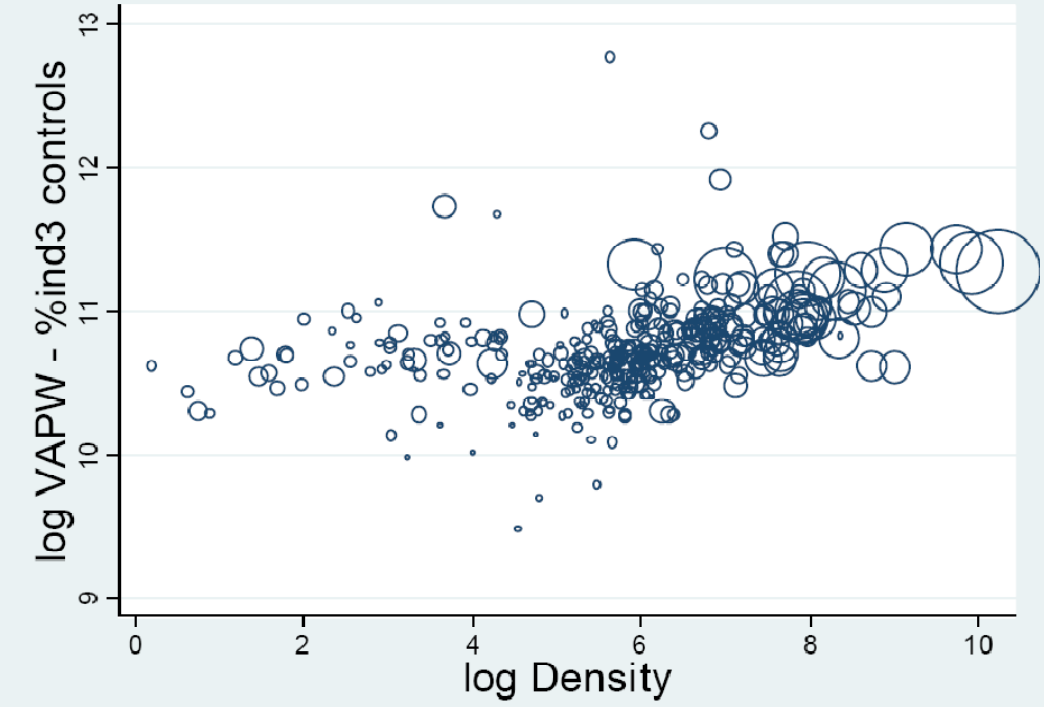
Labour productivity and density

Area Units within Auckland

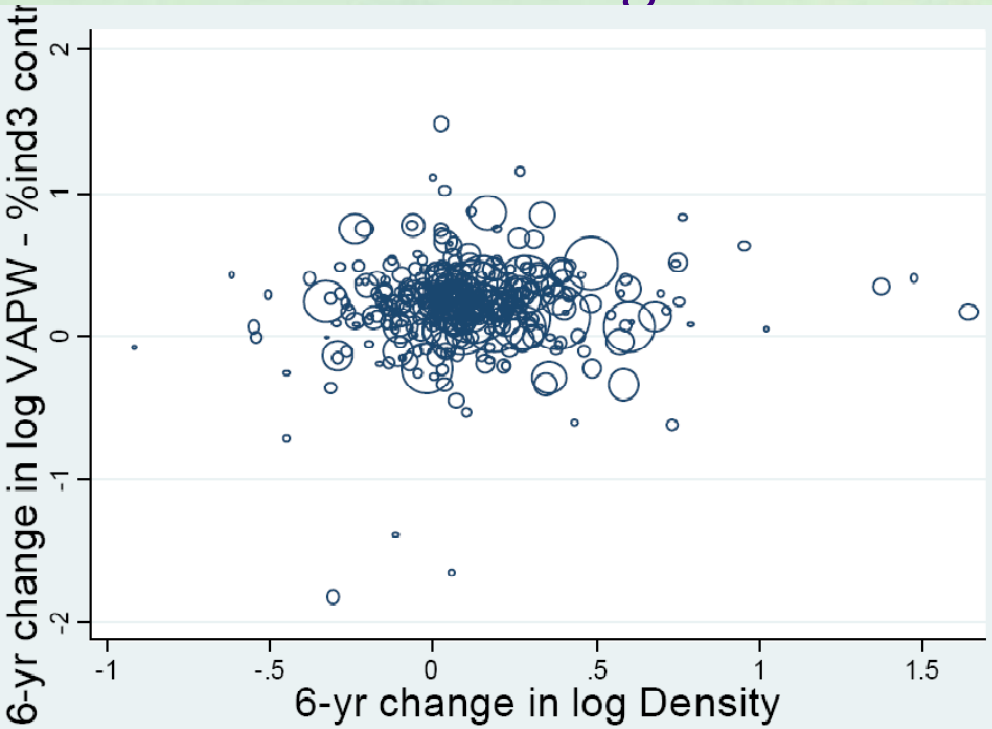
Cross-sectional relationship is stronger than the relationship between changes

- Dense places are more productive
- but increasing density not linked to increasing productivity
  - Possibly not enough variation in density to identify an effect

Levels



Changes



Industries within Auckland

Why are Auckland firms more productive than non-Auckland firms in the same industry?

Different stories fit different industries

- Urbanisation
  - Scale of the market, Diversity
- Localisation
  - Interactions *within* industry
- (Only?) cities can offer localisation *and* urbanisation benefits

Summarising industry patterns

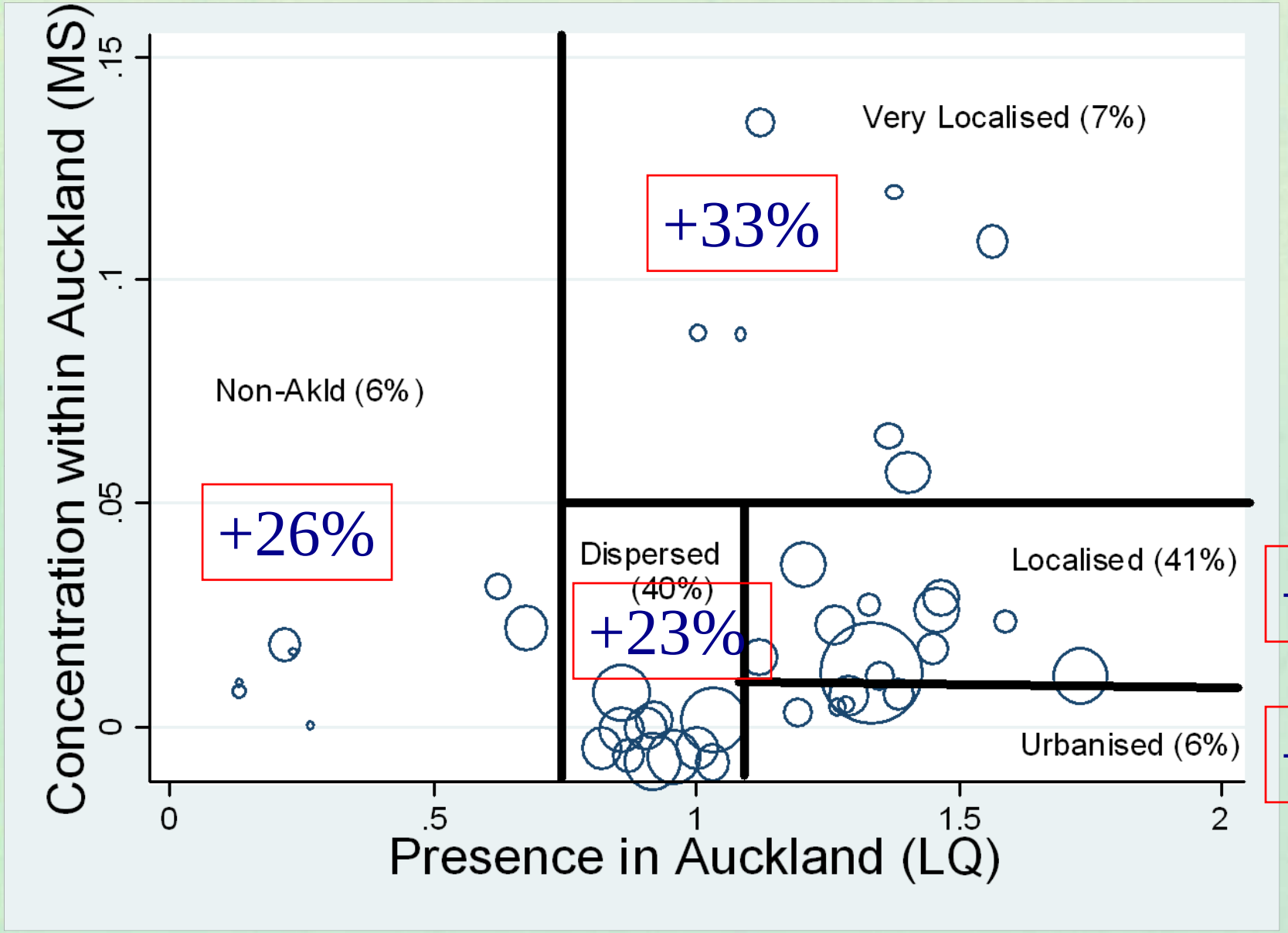
Different issues for ‘local services’ and ‘outward-focused’ industries

- Although both must perform well in a well-functioning city

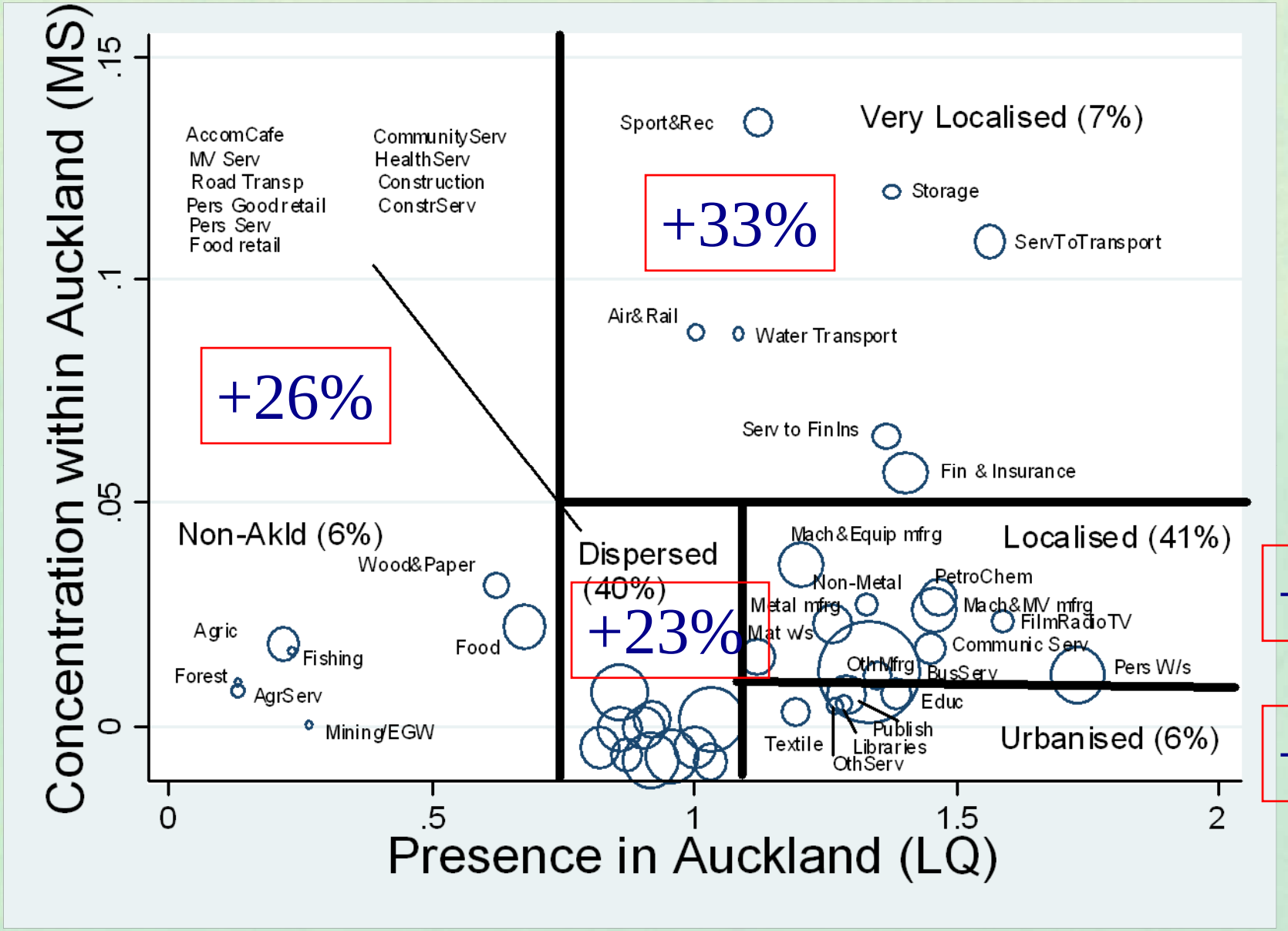
Grouping of industries based on:

- How over-represented they are in Auckland
  - Locational Quotient
- How ‘bunched’ they are within Auckland
  - Maurel Sedillot index of geographic concentration

Productivity variation between industries within Auckland



Productivity variation between industries within Auckland



Density elasticities

	Auckland Premium (log difference)		*Effective density Elasticity*		*Effective density Elasticity*		*Own-industry Effective Density Elasticity*	
Non-Akld	1.265	**	0.287	**	0.656	**	0.825	**
	(0.03)		(0.08)		(0.10)		(0.13)	
Dispersed	1.225	**	0.236	**	0.276	**	0.570	**
	(0.01)		(0.02)		(0.02)		(0.06)	
Urbanised	1.185	**	0.160	**	0.132	**	0.194	*
	(0.03)		(0.04)		(0.04)		(0.11)	
Localised	1.280	**	0.514	**	0.337	**	0.804	**
	(0.01)		(0.02)		(0.02)		(0.05)	
V. Localised	1.333	**	0.663	**	0.106		1.115	**
	(0.03)		(0.05)		(0.07)		(0.10)	

Note: Labour productivity results are not directly comparable with previous (mfp) agglomeration elasticity estimates

Highlights

- Firms in the Auckland Urban Area have labour productivity that is 51% higher than that of firms outside the Auckland region
- 40% of this premium is due to Auckland having disproportionately more productive industries
- Firms in denser areas have higher productivity
  - Double the density is associated with productivity that is 5-10% higher
- Auckland productivity premium is widespread across industries
  - Variation in location patterns/ size of premium/ importance of own-industry density

Future research directions

- Firm and population location patterns
- Analysis of Auckland MFP (rather than lab prod)
- Event Studies (infrastructure)
- Linkages
  - Value chains
  - Trade/ freight
- Policy applications
  - Zoning, clusters, infratructure
  - Will still require looking beyond the data

References

Maré D C, and Graham D J. (2009) "Agglomeration Elasticities in New Zealand," *Motu Working Paper* 09-06 (and NZTA Research Report 376).

Maré, D C. (2008) "Labour Productivity in Auckland Firms," *Motu Working Paper* 08-12 (and *MED Occasional paper* 08/09.

Maré. D C & Timmins, J. (2006) "Geographic concentration and firm productivity," *Motu Working Paper* 06-08.

Maré, D C. (2005) "Concentration, Specialisation and Agglomeration of firms in New Zealand," *Motu Working Paper* 05-12.

www.motu.org.nz