

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

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## 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 **X**
- Because Auckland firms are more productive **X**
- Because Auckland makes NZ firms more productive **?**
  - System of settlements/ value chains
- Because improvement is easy to get in Auckland **?**

### Speculative (lack of measures/ benchmarks)

- 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*, 3<sup>rd</sup> Edition, Ch 1.

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

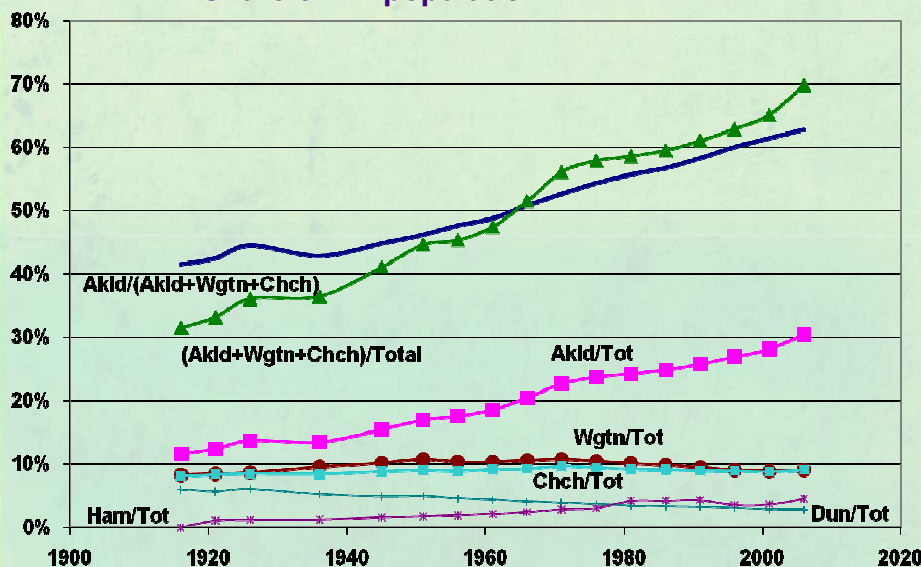
- John Maynard Keynes *A Tract on Monetary Reform*. (1923), Ch 3.

## Context: Policy focus

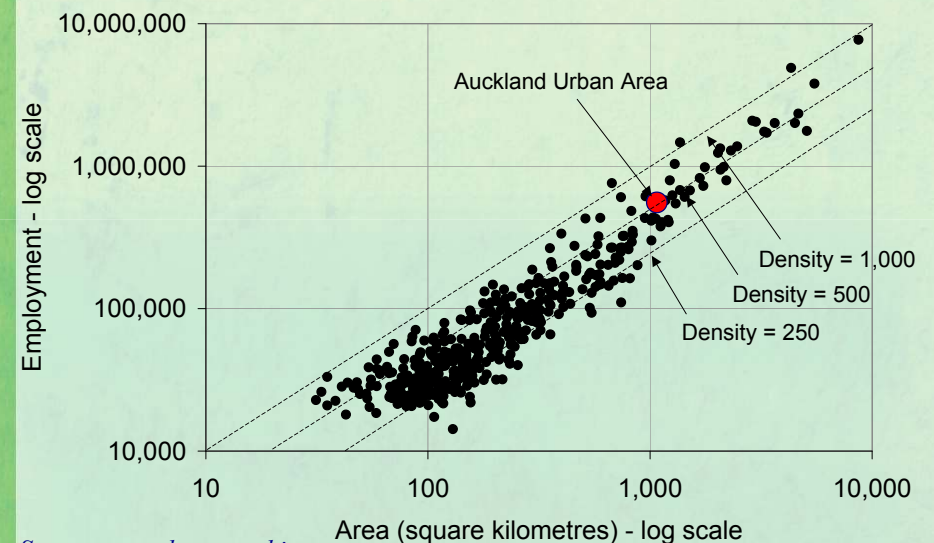
Perception that Auckland is underperforming

- “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 growth in context: Share of NZ population



## Auckland size in context US comparators



Source: [www.demographia.com](http://www.demographia.com)

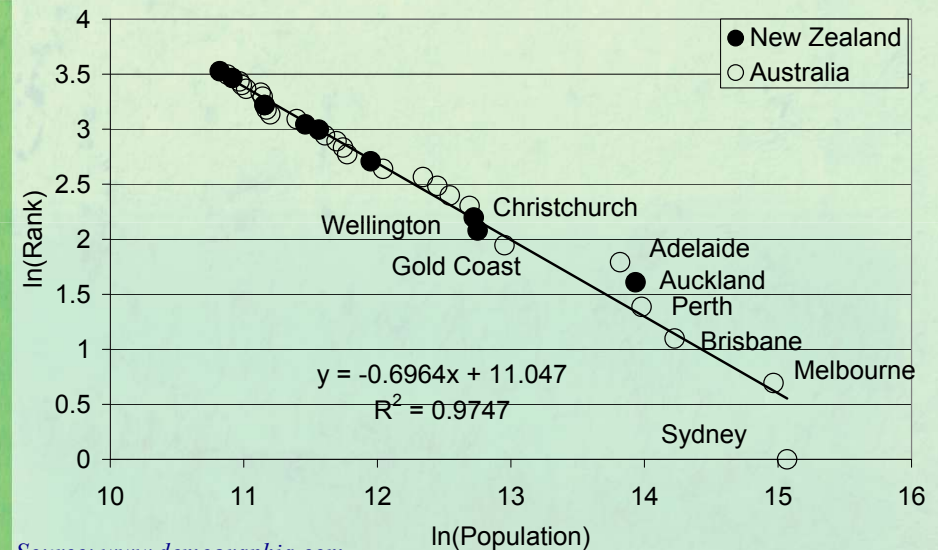
## Auckland size in context

### US comparators

	Employment (000)	Square km	dens/ sqkm	Population (000)	Square km	dens/ sqkm
<b>AUCKLAND (demographia)</b>	<b>556</b>	<b>1,074</b>	<b>518</b>	<b>1,125</b>	<b>1,074</b>	<b>1,047</b>
					<b>531</b>	<b>2,119</b>
<b>Comparator US cities</b>						
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
<b>Cities to emulate?</b>						
Vancouver				1,830	1,120	1,634
Sydney				3,502	2,100	1,668
Singapore				4,000	479	8,351
<b>Large US Cities</b>						
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](http://www.demographia.com)

## Auckland in context: the Australasian settlement system



Source: [www.demographia.com](http://www.demographia.com)

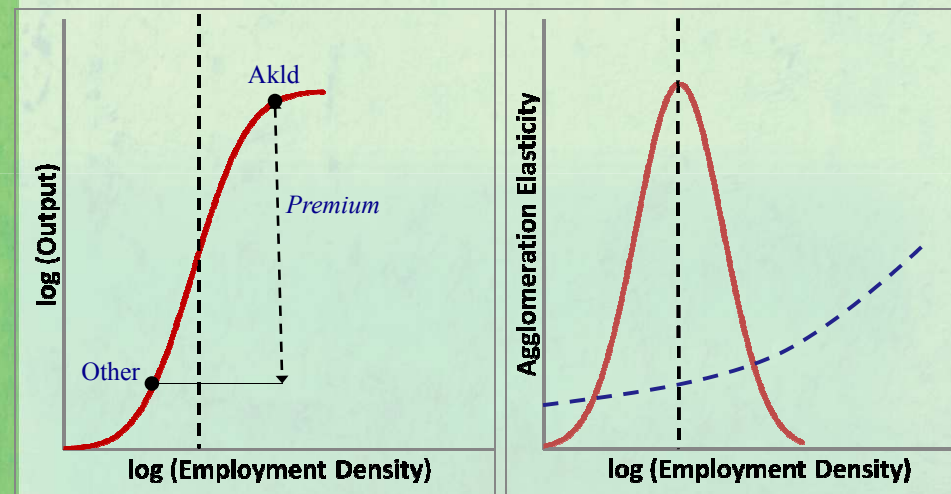
## Investigating Auckland's productivity

I will use two summary indicators

- Labour productivity
- Multi-factor productivity

- 1) Examine the relationship between productivity and employment density
- 2) How much more productive are Auckland firms?
- 3) Examine variation across industries in the strength and nature of these relationships
- 4) Examine the role of Auckland's links with other cities

## The density-output gradient & agglomeration elasticities



# 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*



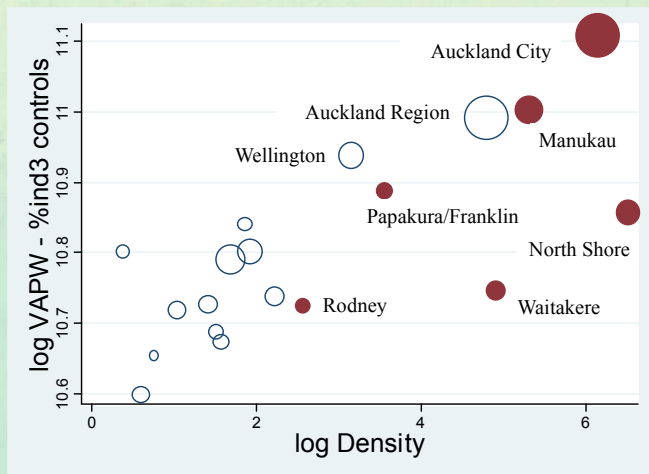
## Disclaimers

- 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.



## Labour productivity and density

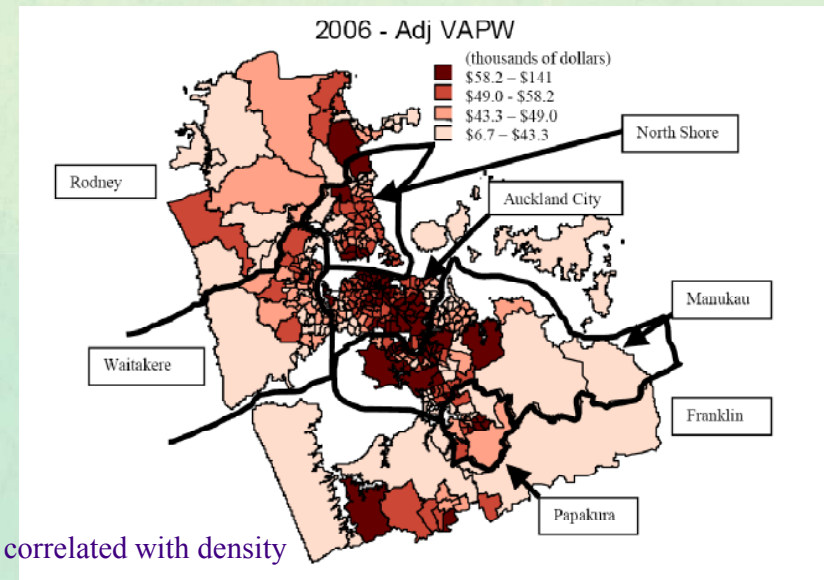
### Territorial Authorities / Regional Councils



Based on productivity differences within 3-digit industries

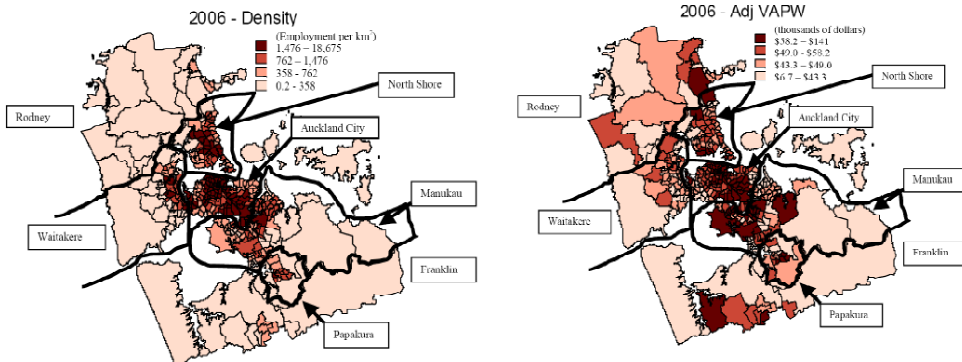


## Areas within Auckland



# Labour productivity and density

Denser areas have higher labour productivity  
 – (Similar patterns in other years)



# Labour productivity and density

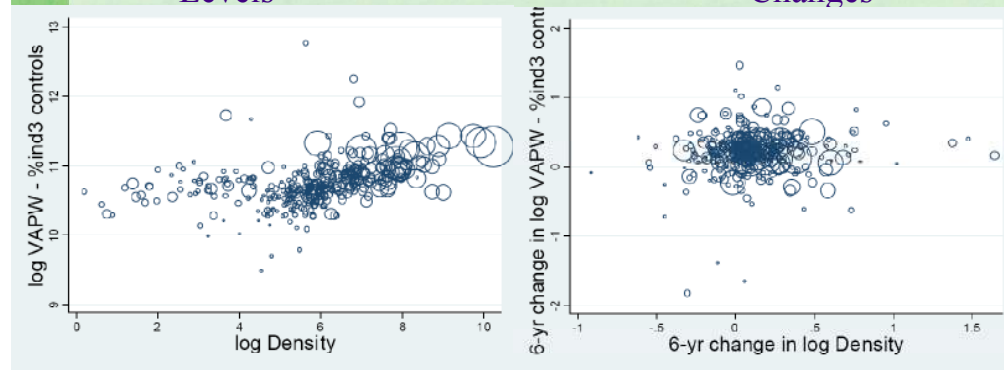
Area Units within Auckland

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



# Empirical Specification: MFP

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

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

- $E_j$  = Employment in AU  $j$
- $D_{ij}$  = distance from  $i$  to  $j$
- $\alpha = 1; A =$  area

- Spatially weighted employment count - distance decay
- Internationally comparable

# MFP and density: Estimation issues

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

$i = \text{firm}; j = \text{industry}; r = \text{location}; t = \text{time}$

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

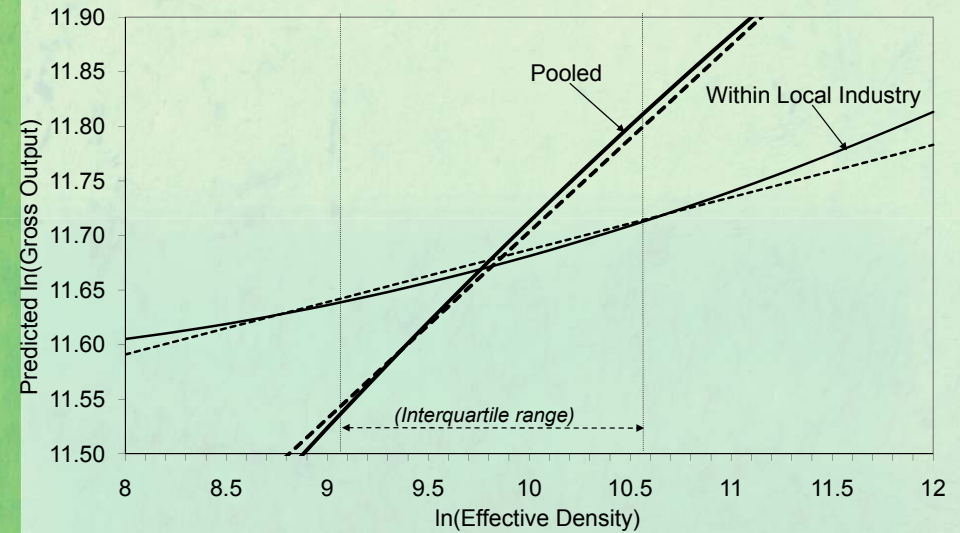
## Regression Estimates



	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** [0.001]	0.048** [0.003]	0.015** [0.005]	0.037** [0.001]	0.069** [0.003]	0.010* [0.005]
Quadratic Agglomeration Effects						
ln(EffDens)	0.360** [0.029]	-0.088* [0.042]	-0.402** [0.071]	-0.200** [0.024]	-0.007 [0.038]	0.184** [0.070]
ln(EffDens) squared	-0.009** [0.001]	0.007** [0.002]	0.020** [0.003]	0.012** [0.001]	0.004* [0.002]	-0.009* [0.003]

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

# Results – Graphically



Industry-specific production functions

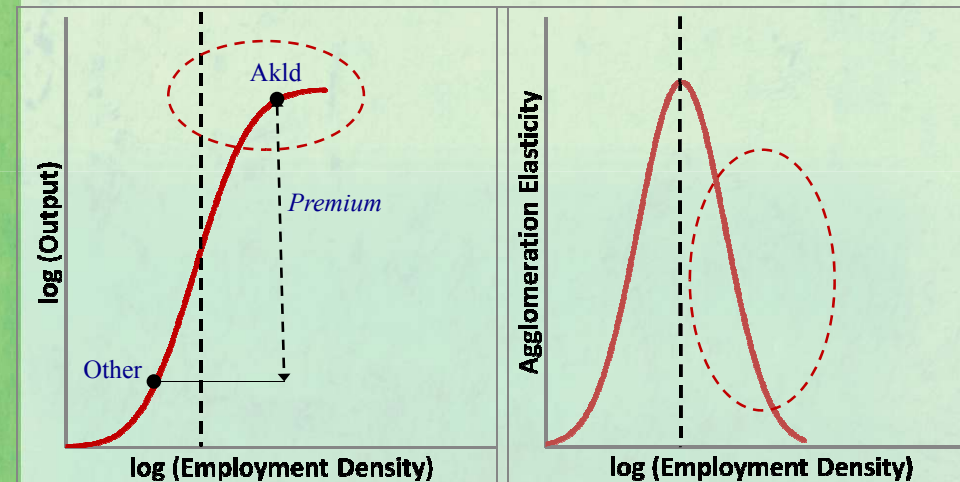
# Industry Variation in density effects

## Agglomeration Elasticities – by industry



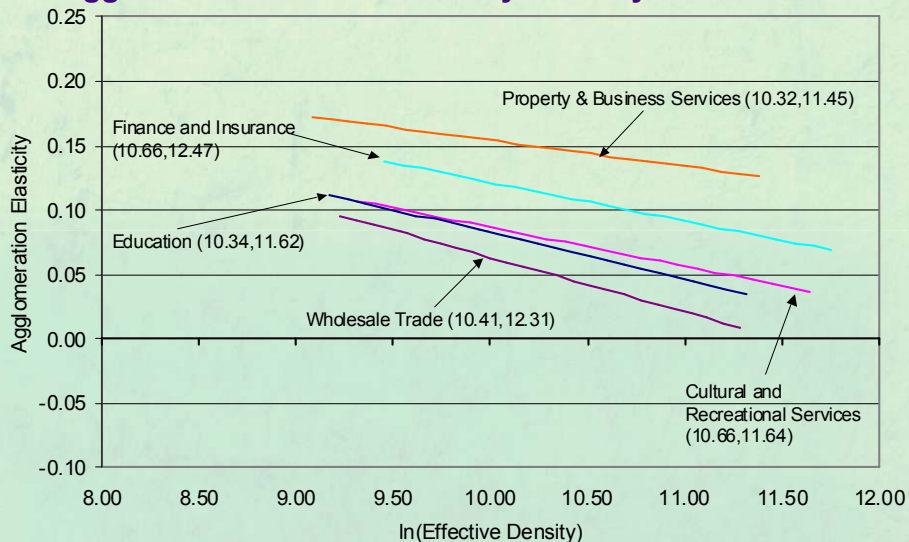
NZ Industry	Number of Ents	NZTA	Within Industry	Within Local Industry	Within Enterprise
Agriculture, Forestry and Fishing	63,200		0.013**	0.032**	0.041**
Mining & Electricity, Gas & Water	320		0.024	0.035*	0.012
Manufacturing	20,000	0.024	0.049**	0.061**	0.016**
Construction	34,100	0.088	0.039**	0.056**	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
Property and Business Services	56,500	0.082	0.074**	0.079**	0.000
Government Administration and Defence		0.167			
Education	1,800	0.292	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*

# The density-output gradient & agglomeration elasticities



## Decreasing returns to density

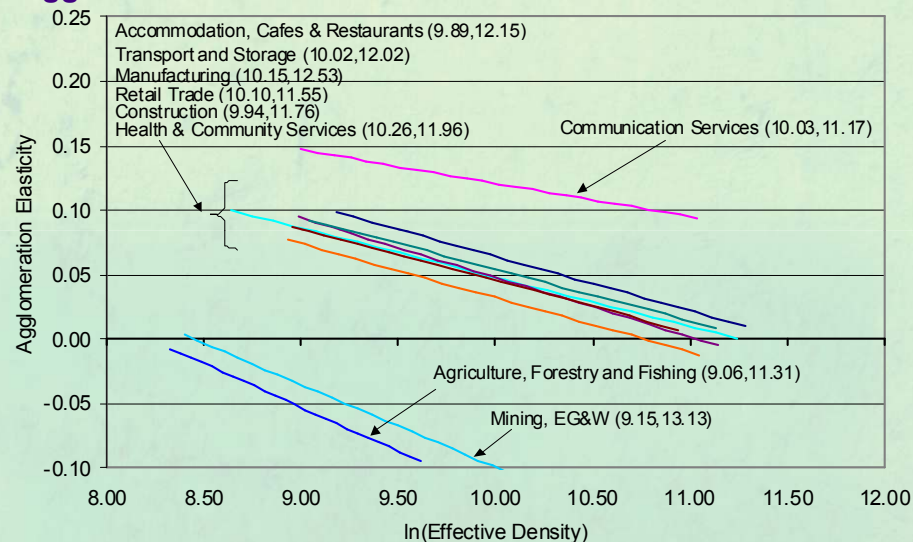
### Agglomeration Elasticities – by industry



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

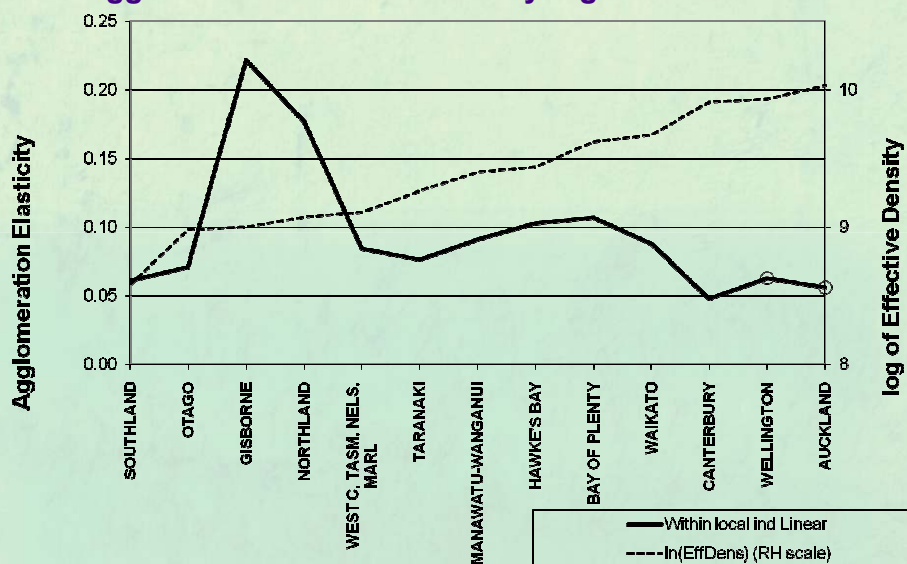
## Decreasing returns to density

### 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)

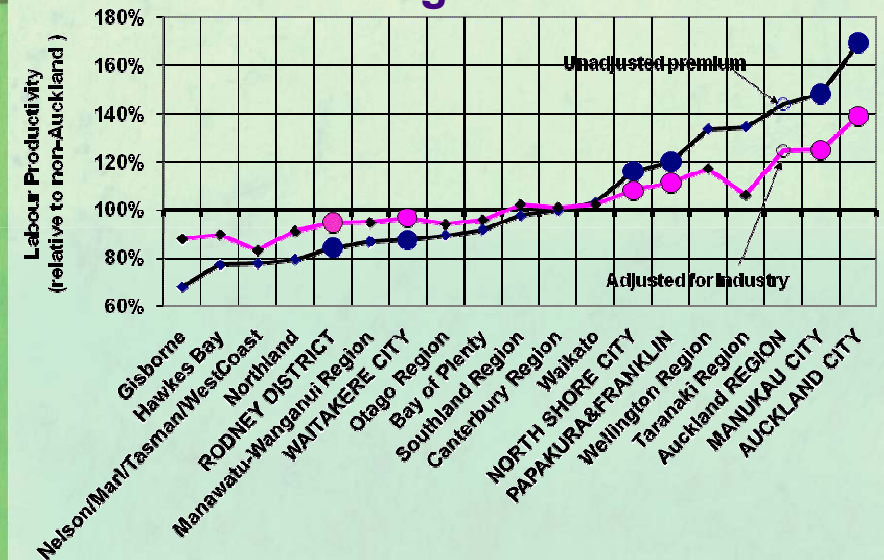
- Value added
  - Value of output *less* value of intermediate inputs
  - Main source is AES postal returns
    - 10% of enterprises, 50% of employment
    - Otherwise net GST sales, adjusted for stock change
- Labour Input
  - Average monthly payroll count (LEED rolling mean employment) plus working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

## Auckland Productivity premium

2006	VAPW (\$000)	Industry Adj VAPW (\$000) Premium	Area (km <sup>2</sup> )	Share of NZ Emp	Density		
Akld Region	\$65	<b>144%</b>	\$60	<b>125%</b>	4,993	33%	118
Urban Area	\$68	<b>151%</b>	\$62	<b>129%</b>	1,074	31%	518
CBD	\$107	<b>238%</b>	\$82	<b>171%</b>	6	4%	13,584
Non-Akld	\$45	<b>100%</b>	\$48	<b>100%</b>	245,000	67%	5

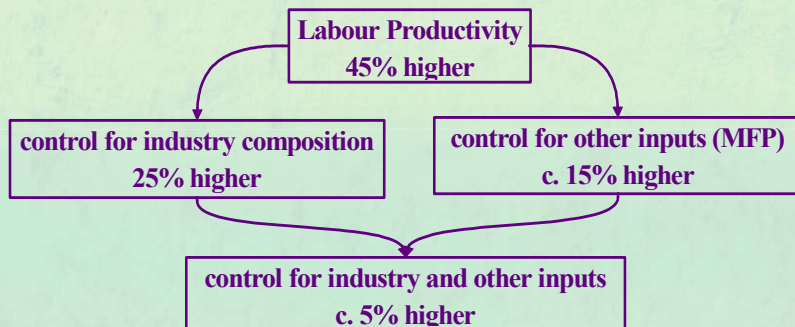
- Akld Urban Area is 51% more productive than non-Akld
  - Is this big enough?
- 40% of the premium is due to Auckland having industries that would be more productive anywhere
- The remainder is due to Auckland firms being industry leaders
  - Industries that concentrate in Akld have larger premia
-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

## Relative Productivity: TAs & Regions



## Auckland v the rest of NZ

- Auckland (region) productivity premium
  - relative to 'non-Auckland'



MFP: Common production function, with different industry intercepts

## 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





## Highlights: Productivity and density

- Firms in denser areas have higher productivity
  - Double the density is associated with productivity that is 5-10% higher
- The *marginal* effect of density is lower at high densities
  - Is the cost of increased density also lower?
- Is the estimated relationship really causal?
  - Policies to increase density may have other impacts.
    - eg: land rents, negative spillovers on other locations



## Highlights: Auckland productivity premium

- Firms in the Auckland Urban Area have labour productivity that is 51% higher than that of firms outside the Auckland region
  - 2/5 of this premium is due to Auckland having disproportionately more productive industries
  - Of the remaining 25% to 30% premium, the majority is accounted for by different factor inputs (eg: capital intensity)
- Focus shifts to explaining the sorting of industries and inputs across locations



## Highlights:

- Auckland productivity premium is widespread across industries
  - With ‘interesting’ variation in location patterns/ size of premium/ importance of own-industry density
- Further focused analysis needed to ‘unpack’:
  - The role of local amenities
  - Functional / trade links between Auckland & other centres
    - Compared with importance of Auckland’s market size
  - The source of productivity advantages for local services



## Future research directions

- Extensions to existing work
  - Further analysis of Auckland MFP (rather than labour prod)
- Analyse the role of self-selection and local amenities
  - Firm and population location patterns (GUEDO project)
- Insights from case-studies
  - Event Studies (infrastructure)
  - Firm studies (same firm operating in different locations)
- What is the role of links between Auckland and other cities?
  - Value chains; Trade; freight
- Policy applications
  - Urban form, Zoning, clusters, infrastructure

## References

- Maré D C, and Graham D J (2009) "Agglomeration Elasticities in New Zealand" *Motu Working Paper 09-forthcoming* (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](http://www.motu.org.nz)