

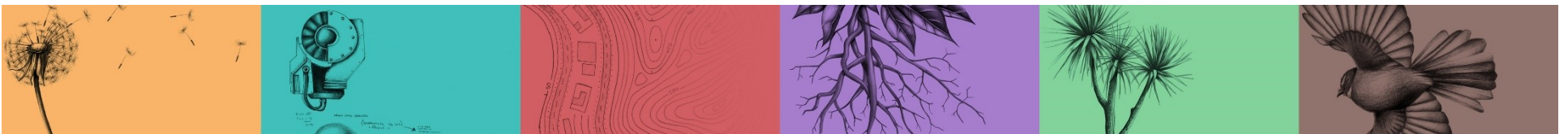
The attractiveness of New Zealand cities: Dynamic adjustment and the role of amenities

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Presentation to NZAE

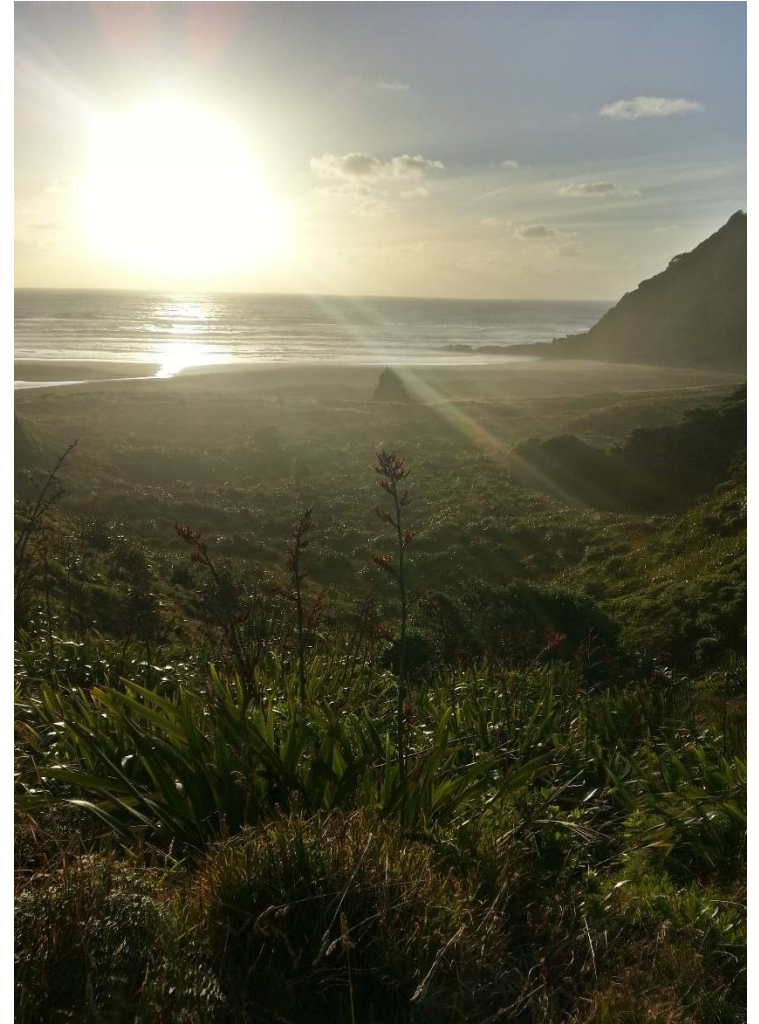
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Questions:

- How do (productive & consumption) amenities affect where people (& firms) choose to locate?
- Compile indicators for quality of life (QL) & quality for business (QB) for 133 settlements from 1976-2013, and test:
 - Which amenities affect QL & QB?
 - Whether QB & QL influence population growth



Methodology: Intuition

(Roback 1982 1988; Gabriel & Rosenthal 2004; Chen & Rosenthal 2008)

- A place with high rents but low wages must have amenities that make it a nice place to live otherwise people would move elsewhere & newcomers would not arrive (“sunshine wages”)
- A place with high rents and high wages must have amenities that make it a good place to do business otherwise firms would move elsewhere & new firms would not be established (“productive”)



The basic model – Roback (1982)

- Workers and firms choose to locate in one of C different (and separated) cities, indexed by $c=1,\dots,C$.
- Firms use (mobile) labour and (immobile) land inputs to produce a tradeable good (Y).
- Workers provide a constant amount of labour, earning a locally determined wage (w_c), which they spend on housing (H_c) or on consumption of Y .
- Price of housing (r_c) is determined locally.
- The traded good sells at the same price ($p_c = 1$) everywhere.
- Cities have different endowments of **productive & consumption** amenities (A_c).

The basic model: Workers

Workers gain utility from consumption of housing and consumption goods, and from local amenities:

$$U_{ic} = f_u(A_c)H_{ic}^{\alpha}Y_{ic}^{1-\alpha}$$

They locate in the city that maximizes their utility.

Workers' expenditure is determined by their (city-specific) wages, allocating it to housing and goods consumption according to standard FoCs, giving **indirect utility** (where $\kappa_v = \alpha^{\alpha}(1 - \alpha)^{1-\alpha}$):

$$v_{ic} = \kappa_v f_u(A_c) \frac{w_c}{r_c^{\alpha} p_c^{1-\alpha}}$$

The basic model: Firms

- Firm j produces Y_{jc} using housing (land) H_{jc} and labour L_{jc} , at prices of r_c and w_c respectively:

$$Y_{jc} = f_y(A_c)H_{jc}^{\gamma}L_{jc}^{1-\gamma}$$

- Profit maximisation under perfect competition yields standard FoC's for housing & labour, and a marginal cost function (where $\kappa_p = \gamma^{\gamma}(1 - \gamma)^{1-\gamma}$):

$$r_c^{\gamma}w_c^{1-\gamma} = \kappa_p f_y(A_c)p_c$$

The basic model: Equilibrium

- Spatial equilibrium requires that indirect utility and marginal costs are equalised across cities, implying (where \bar{v} is the equilibrium level of utility, and recalling that $p_c=1$):

$$r_c^\gamma w_c^{1-\gamma} = \kappa_p f_y(A_c) \quad (\text{firms})$$

$$\text{and: } r_c^{-\alpha} w_c = \bar{v} / (\kappa_v f_u(A_c)) \quad (\text{households})$$

- Solving for rents and prices yields equilibrium conditions in which each of $\ln r_c$ and $\ln w_c$ are functions of amenities (A_c).

Dominant amenity impact (Chen & Rosenthal, 2008)

	$\frac{\partial \ln w_c}{\partial \ln A_c} < 0$	$\frac{\partial \ln w_c}{\partial \ln A_c} > 0$
$\frac{\partial \ln r_c}{\partial \ln A_c} < 0$	Negative production amenity	Negative consumption amenity
$\frac{\partial \ln r_c}{\partial \ln A_c} > 0$	Positive consumption amenity	Positive production amenity

QB and QL

- Given the theory, we calculate measures for Quality for Business (**QB**) and Quality of Life (**QL**) as per Chen & Rosenthal:

$$Q_B = \gamma \ln r_c + (1 - \gamma) \ln w_c$$

and
$$Q_L = \alpha \ln r_c - \ln w_c$$

Data

Disclaimer: Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in the study are the work of the authors, not Statistics New Zealand.

- We use census unit record data for both r_c & w_c
 - for each census 1976 – 2013 (37 years)
- Rents (for non-owner-occupied private dwellings) are quality-adjusted by regressing on:
 - # rooms, #bedrooms, dwelling type, available heating types
- Wages (earnings of FT employees) are quality-adjusted by regressing on:
 - Age, gender, ethnicity, qualifications

Data are for 133 settlements

- Settlements range in population from:
 - 1976: 162 (Mangawhai Heads) – 740,925 (Auckland)
 - 2013: 741 (Waiouru) – 1,308,828 (Auckland)
- Analyses are for 2nd -tier (& smaller) settlements
 - i.e. excluding Auckland, Wellington, Christchurch
 - also exclude 3 outliers (Twizel, Turangi, Waiouru)

2013 quality of life (QL) rankings

Top 5

1. Whitianga
2. Motueka
3. Coromandel
4. Queenstown
5. Katikati

Bottom 5

134. Tokoroa
133. Hawera
132. Te Kauwhata
131. Eltham
130. Winton

2013 quality for business (QB) rankings

Top 5

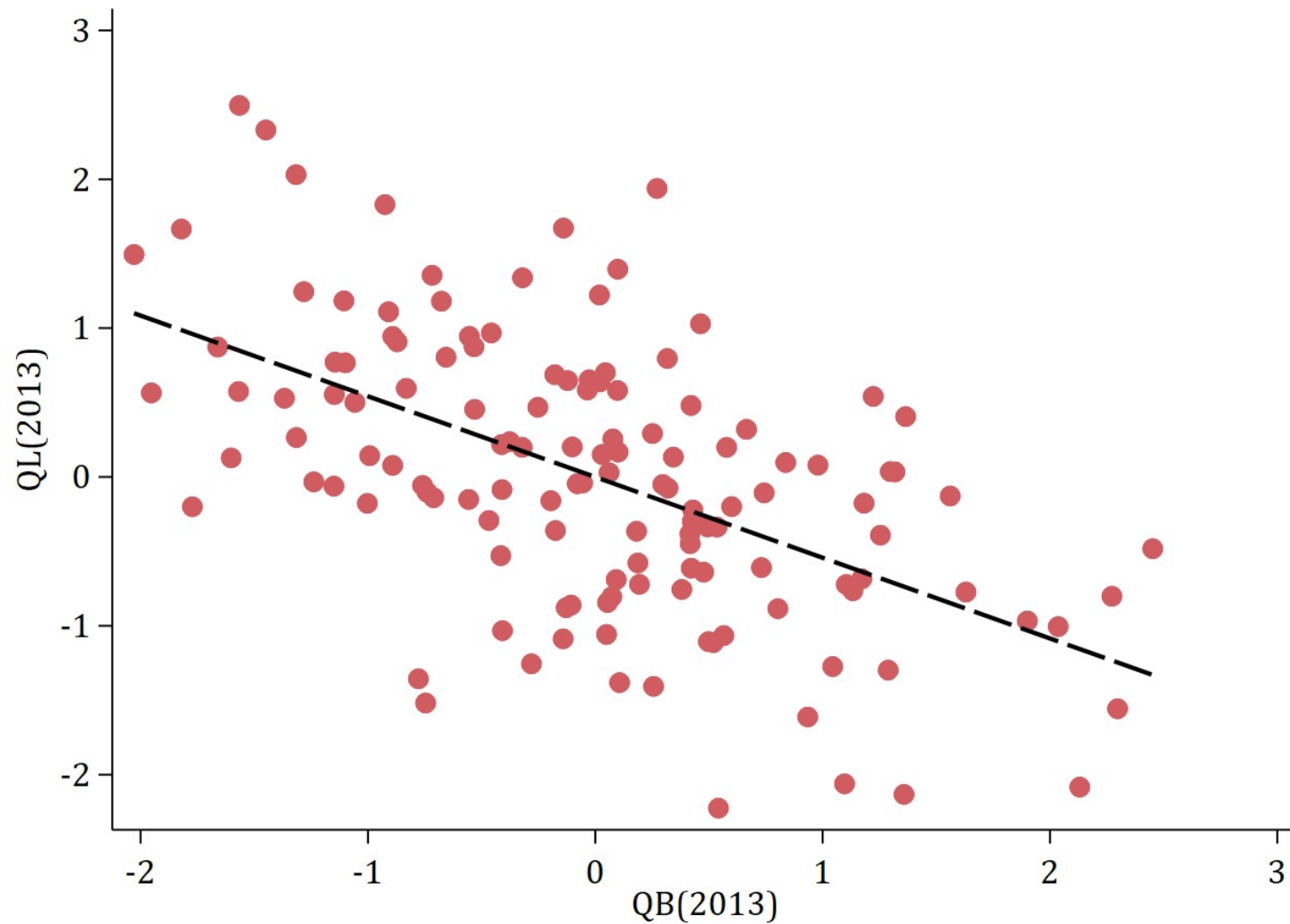
1. Rolleston
2. Waiuku
3. Auckland
4. Te Kauwhata
5. Wellington

Bottom 5

134. Opotiki
133. Taumaranui
132. Moerewa
131. Murupara
130. Waipawa

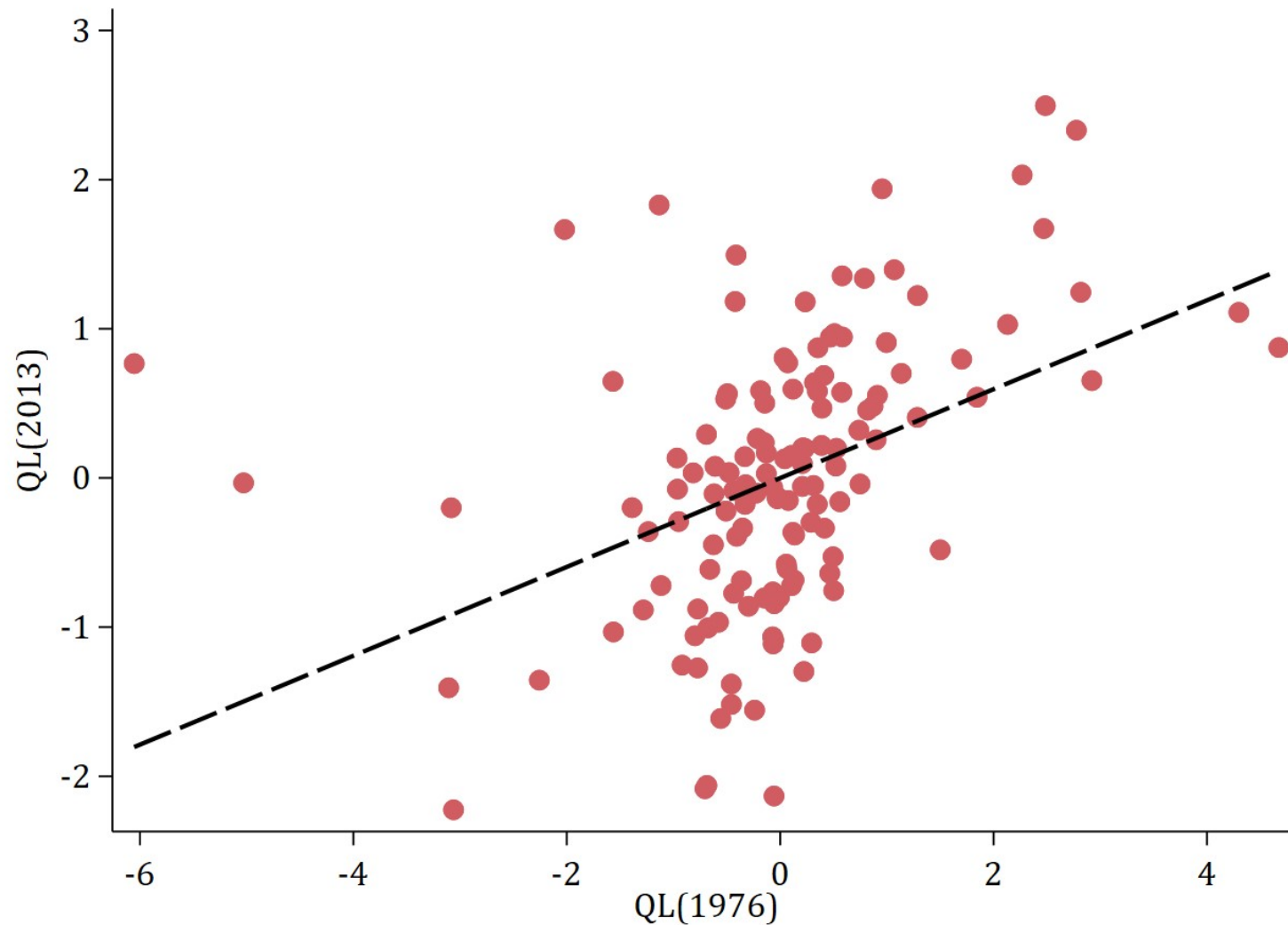
2013 relationship between QL & QB

- inverse relationship (as per other countries)



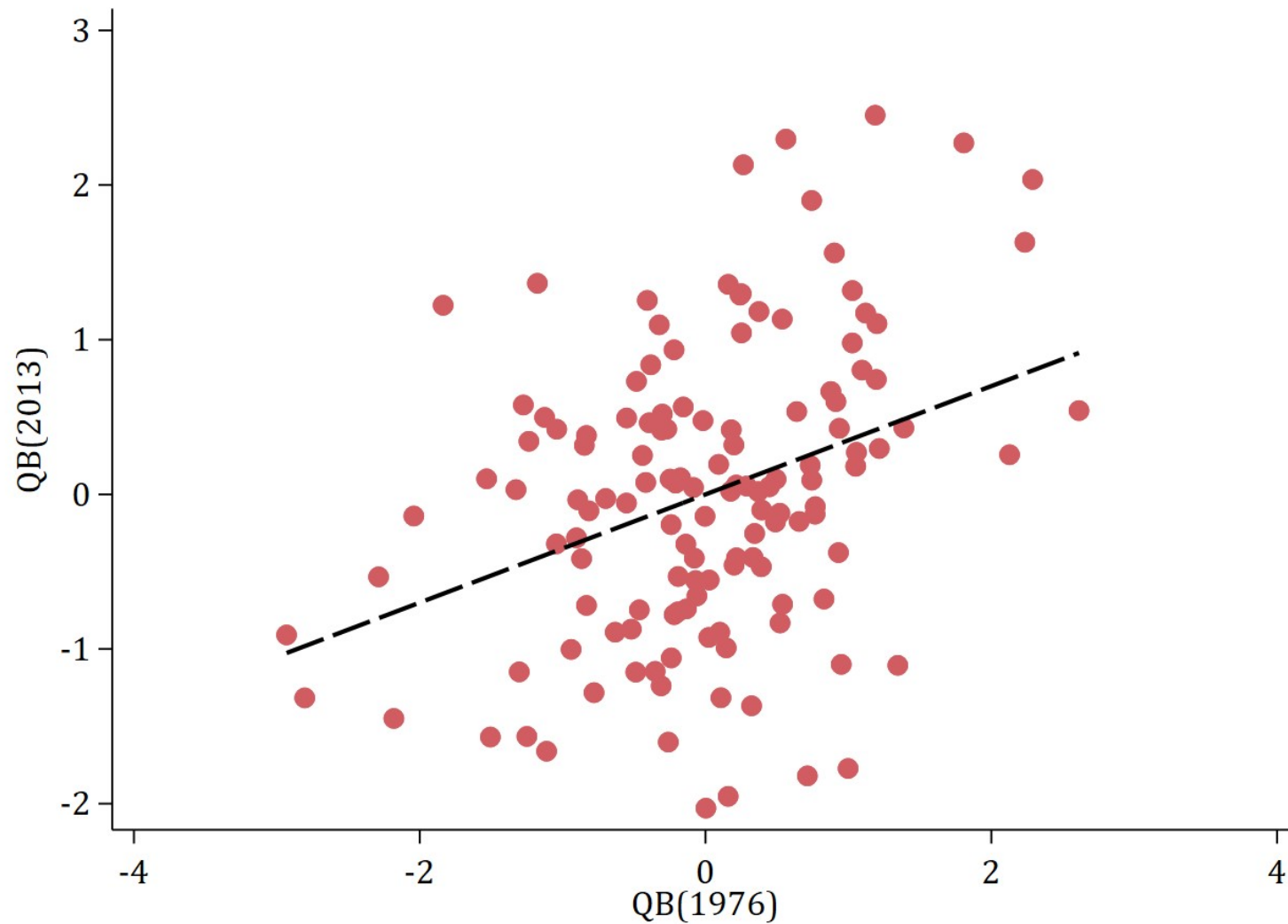
Relationship between QL in 1976 and 2013

- persistence apparent (as per other countries)



Relationship between QB in 1976 and 2013

- persistence apparent (as per other countries)



Relationship between QL and natural features plus population (1976 and 2013)

QL regressed on amenity variables and ln(Pop) - weighted							
	temp	rainfall	sunhours	wind	coastal	lake	lnpop
1976							
...							
2013	-0.071	-0.007 ***	0.011 ***	-0.063 **	0.637 ***	0.617 **	-0.077 *

Relationship between QB and natural features plus population (1976 and 2013)

QB regressed on amenity variables and ln(Pop) - weighted							
	temp	rainfall	sunhours	wind	coastal	lake	lnpop
1976							
...							
2013	-0.015	0.006 **	0.001	0.008	-0.498 ***	-0.268	0.225 ***

Do QB & QL affect subsequent population growth?

- Roback approach is an equilibrium relationship
 - i.e. firms & workers are indifferent between locations

⇒ QB & QL should not affect future location choices

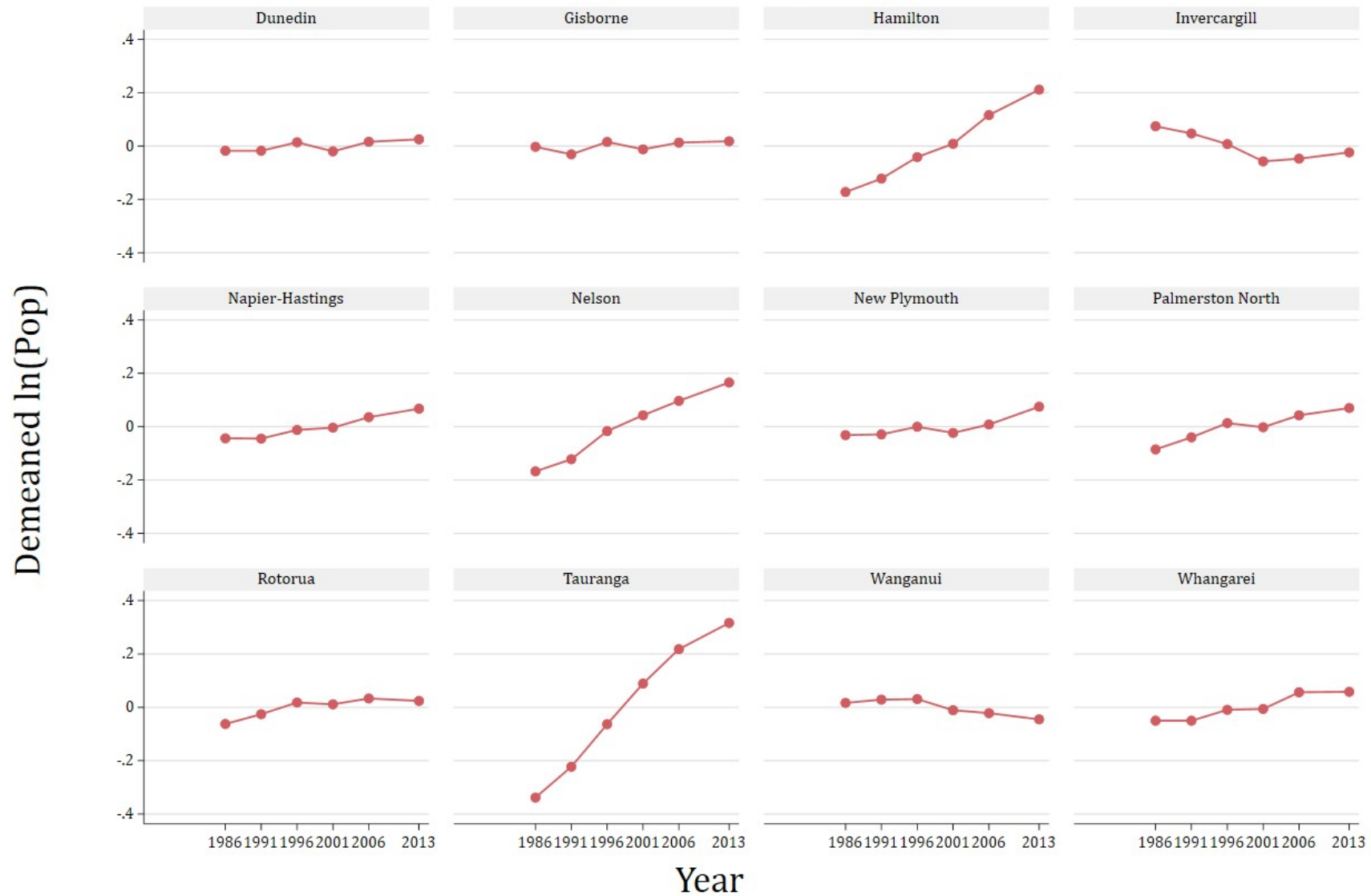
- But empirical work indicates dynamics are important
- ‘Time-to-build’ implies that shocks take time to have their full effect on housing (and hence population) due to construction lags (Grimes & Aitken, 2010; Glaeser et al, 2014)

Simple (and preliminary) empirical tests

- Estimate two-way fixed effects equations for effects of **QB** and **QL** on subsequent **total settlement population** and for different population age-groups
- Panel with $N=127$, $T=8$
- But are the variables (non-)stationary?
 - Graphs & (low-powered) tests \Rightarrow QB & QL stationary
 - $\ln \text{Pop}$ could be $I(1)$, or $I(0)$ about a linear trend
 - Modelled below assuming $\ln \text{Pop}$ is $I(0)$ about a linear trend
 - But results are sensitive to this assumption

Example of $\ln(\text{Pop})$: I(1) or I(0) about a trend?

Demeaned $\ln(\text{Pop})$



**Log Population and (significant) sub-populations
- two-way FEs & time trends (1986 onwards – weighted)**

	ln(Pop)	ln(Pop 0-14)	ln(Pop 65+)
QB(t-1)	0.006	0.055***	-0.043***
DQB(t-1)	0.006	-0.016*	0.018**
QL(t-1)	0.011	0.045***	-0.058***
DQL(t-1)	-0.000	-0.018**	0.025***
Obs.	762	762	762
No. settlements	127	127	127
R-sq	0.952	0.903	0.975

Next stages

- Extend tests of determinants of QL & QB to other potential amenities
- In estimating effects on population, control for other variables (e.g. Bartik industry index)
- Test relationships for different sub-populations
 - E.g. by education, ethnicity, ...
- Extend theory of dynamic effects of amenity changes on population to different 'types'
- Examine how QL and QB have influenced:
 - choice by Christchurch 'refugees' of where to live after earthquakes
 - choice by tertiary students of where to live after graduation



A simple dynamic model

(all variables subscripted _{it} unless indicated otherwise)

Production (Y) a function of labour (N), labour-augmenting productive amenities (b) & land (L):

$$Y = (1 + b)N + L$$

$$L = \gamma N$$

$$\Rightarrow Y = (1 + b + \gamma)N$$

Zero profit condition (with $P=1$):

$$Y - WN - RL = 0$$

$$\Rightarrow W = 1 + b + \gamma - \gamma R$$

Consumption amenities (assuming congestion effects):

$$A = a - \alpha N$$

Time to build

Marginal cost of construction (C) where $I = \Delta N$:

$$C = c_0 + c_1 I + c_2 N$$

Landlords will construct (or ship in) new homes if $R > C$. In equilibrium, therefore:

$$R = c_0 + c_1 I + c_2 N$$

$$\Rightarrow I = \frac{1}{c_1} R - \frac{c_2}{c_1} N - \frac{c_0}{c_1}$$

$$\Rightarrow N_{t+1} = \left(1 - \frac{c_2}{c_1}\right) N + \frac{1}{c_1} R - \frac{c_0}{c_1}$$

Indirect utility

Indirect utility (V) is given by [where \tilde{V} is reference location utility]:

$$V = W + A - R = \tilde{V}$$

substituting in for W :

$$\Rightarrow R = (1 + \gamma)^{-1} [1 + a + b + \gamma - \tilde{V} - \alpha N]$$

Three equations for R, W & dynamics of N

(given initial N)

$$N_{t+1} = [c_1(1 + \gamma)]^{-1} \{[(c_1 - c_2)(1 + \gamma) - a]N + [1 + a + b + \gamma - \tilde{V} - c_0(1 + \gamma)]\}$$

$$R = (1 + \gamma)^{-1} [1 + a + b + \gamma - \tilde{V} - \alpha N]$$

$$W = 1 + b + \gamma - \gamma R$$

Also:

$$QB = W + \gamma R - 1 - \gamma \quad (= b)$$

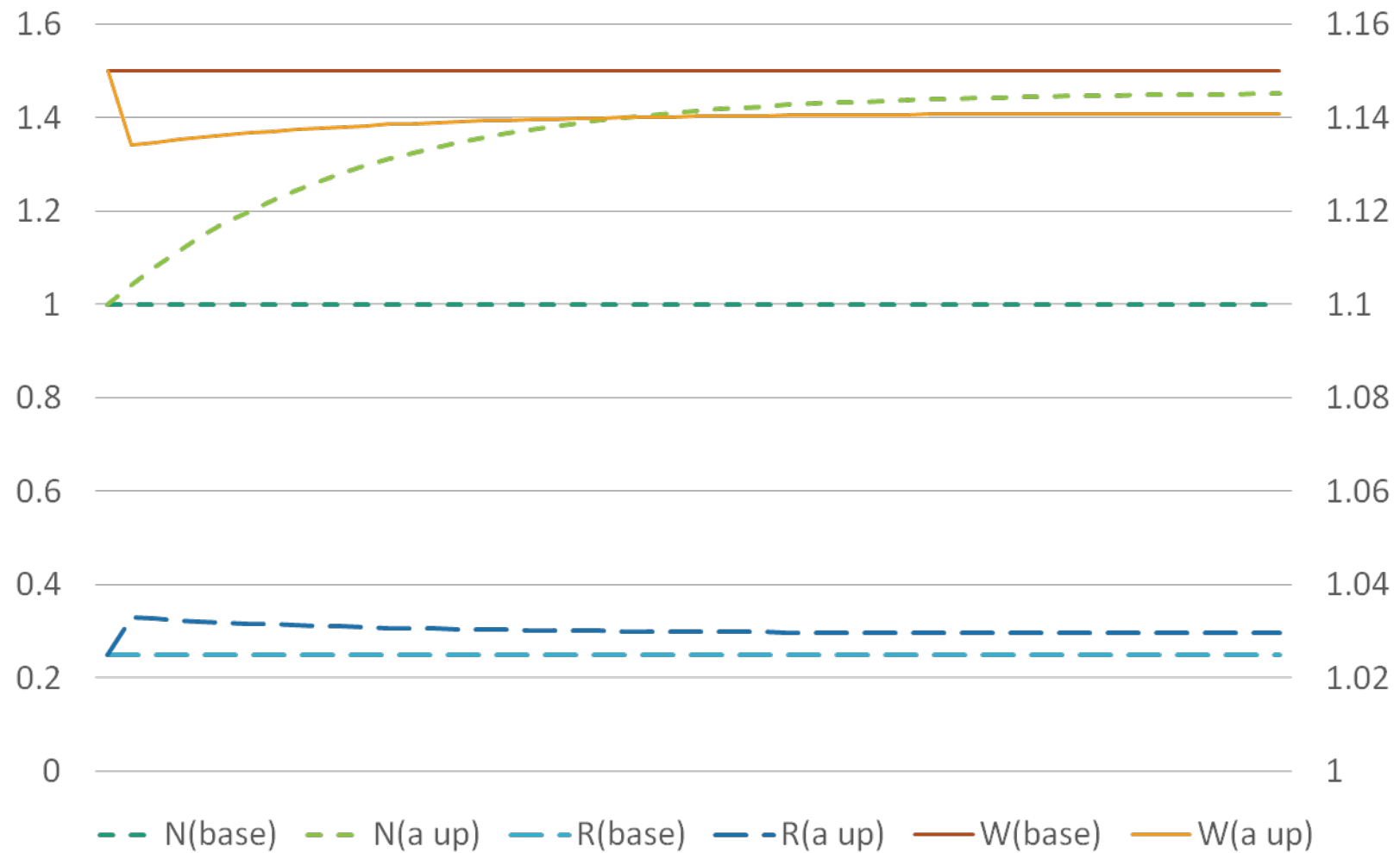
$$QL = R - W + \tilde{V} \quad (= A)$$

Long-run value for N (\hat{N}) given by: $\hat{N} = \theta(1 - \phi)^{-1}$

$$\text{where: } \phi = [c_1(1 + \gamma)]^{-1} [(c_1 - c_2)(1 + \gamma) - a]$$

$$\text{and: } \theta = 1 + a + b + \gamma - \tilde{V} - c_0(1 + \gamma)$$

Dynamics with consumption amenity (a) rise (wages on right axis)



Dynamics with productive amenity (b) rise (wages on right axis)

