The Role of Infrastructure in Developing New Zealand's Economy

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Outline

- Historical infrastructure examples
  (New Zealand Official Yearbook 1903)
- New Zealand's infrastructure record
  (Economic Development Indicators 2007)
- Typical infrastructure responses
- Modern investment frameworks
- Measuring infrastructure effectiveness
  - Example 1: Auckland Northern Motorway
  - Example 2: Auckland's Metropolitan Urban Limit
  - Example 3: Canterbury water (irrigation)
- Lessons for future infrastructure planning

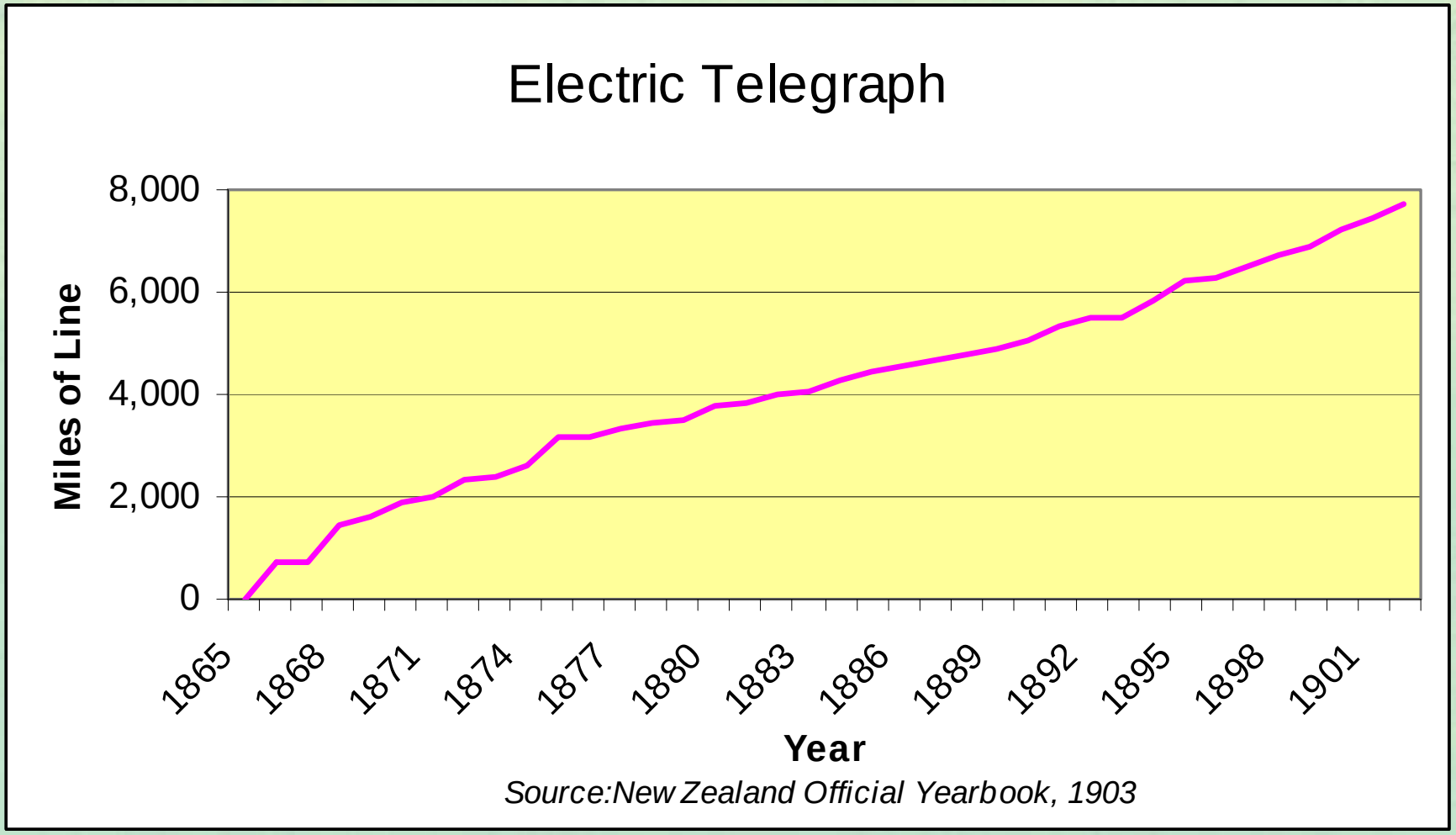
Some History

- Julius Vogel 1870s:
  - 1,600 kms of rail
  - 6,400 kms of telegraph
  - Deep sea cable to Australia
  - Shipping service to San Francisco
- Provinces & industries opened up around rail
  - E.g. Taranaki
    - 97 dairy factories + 1 freezing works by 1903
    - Indicates good inter-regional transport links (dairying worthwhile)
    - But poor intra-regional transport links (plethora of factories)

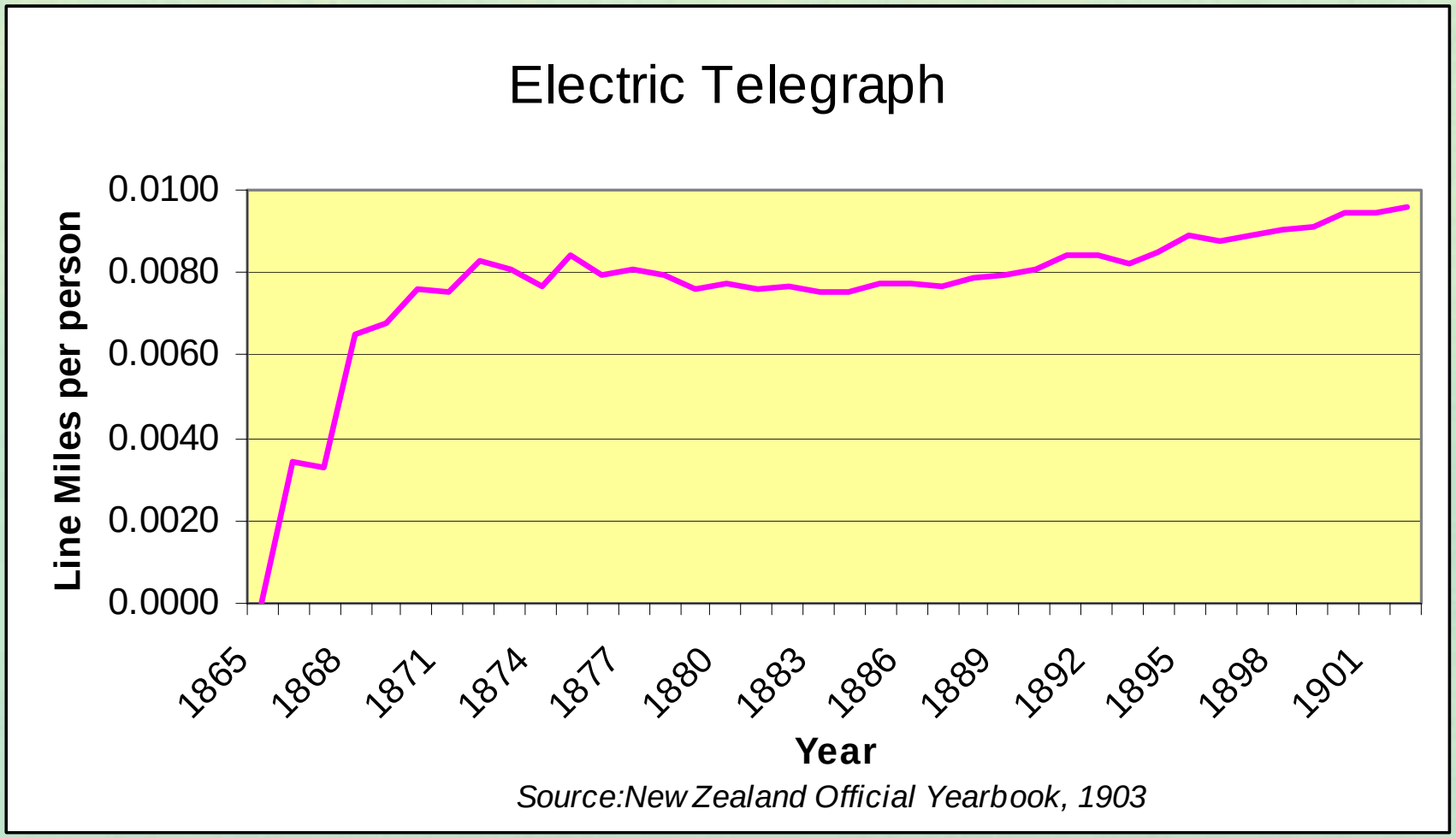
Responses to New Infrastructure

- S-shaped diffusion curve common for new technologies
- Learning is a major feature (Atkeson & Kehoe)
- General purpose technologies (GPTs) have feature of subsequent delayed responses
  - e.g. computing in response to electricity
- These features are observed for Vogel's investments

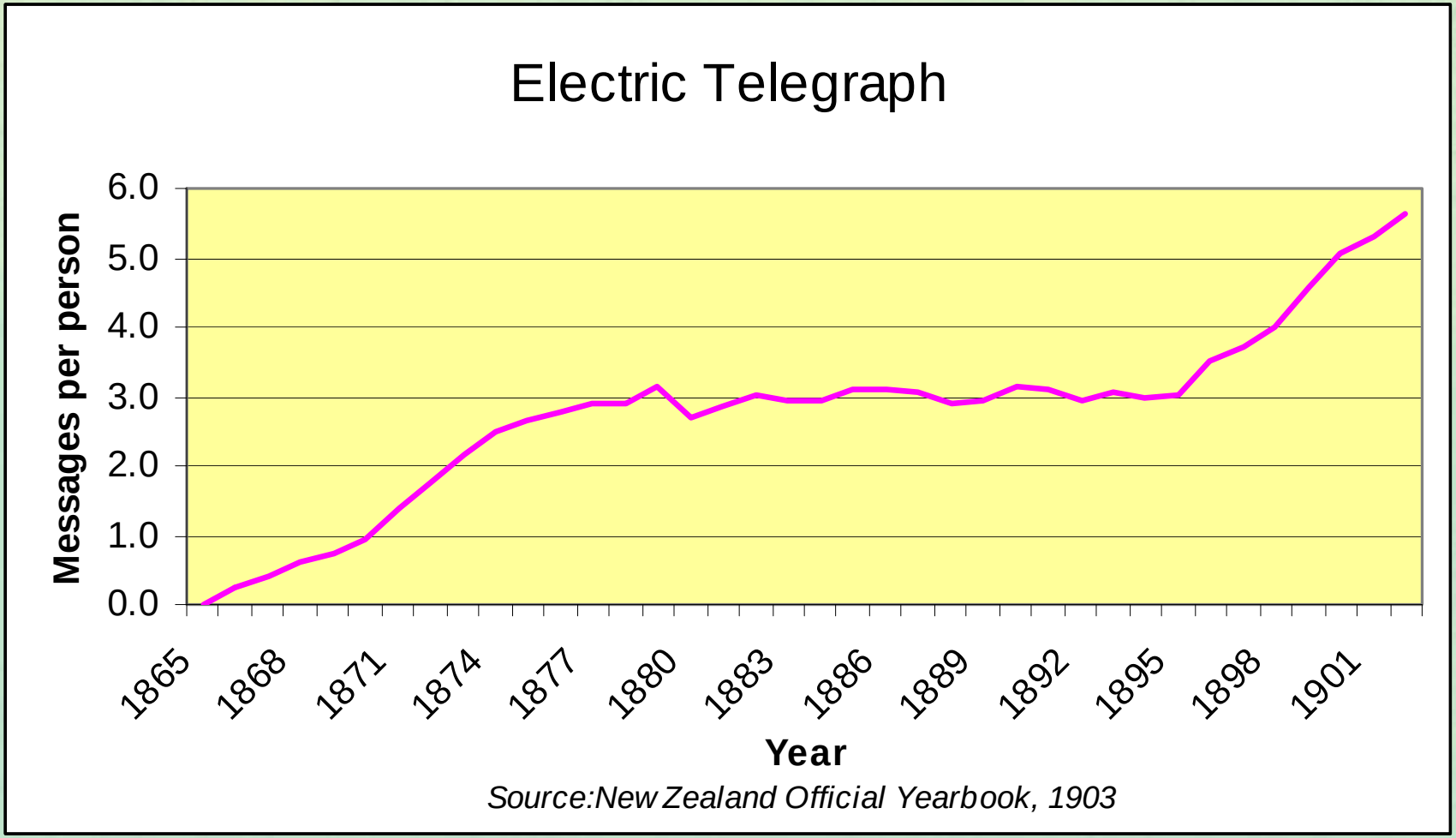
Long Time Horizons: to build



Long Time Horizons: to keep up with population



Long Time Horizons: to use fully (S-shape) & GPT(?)



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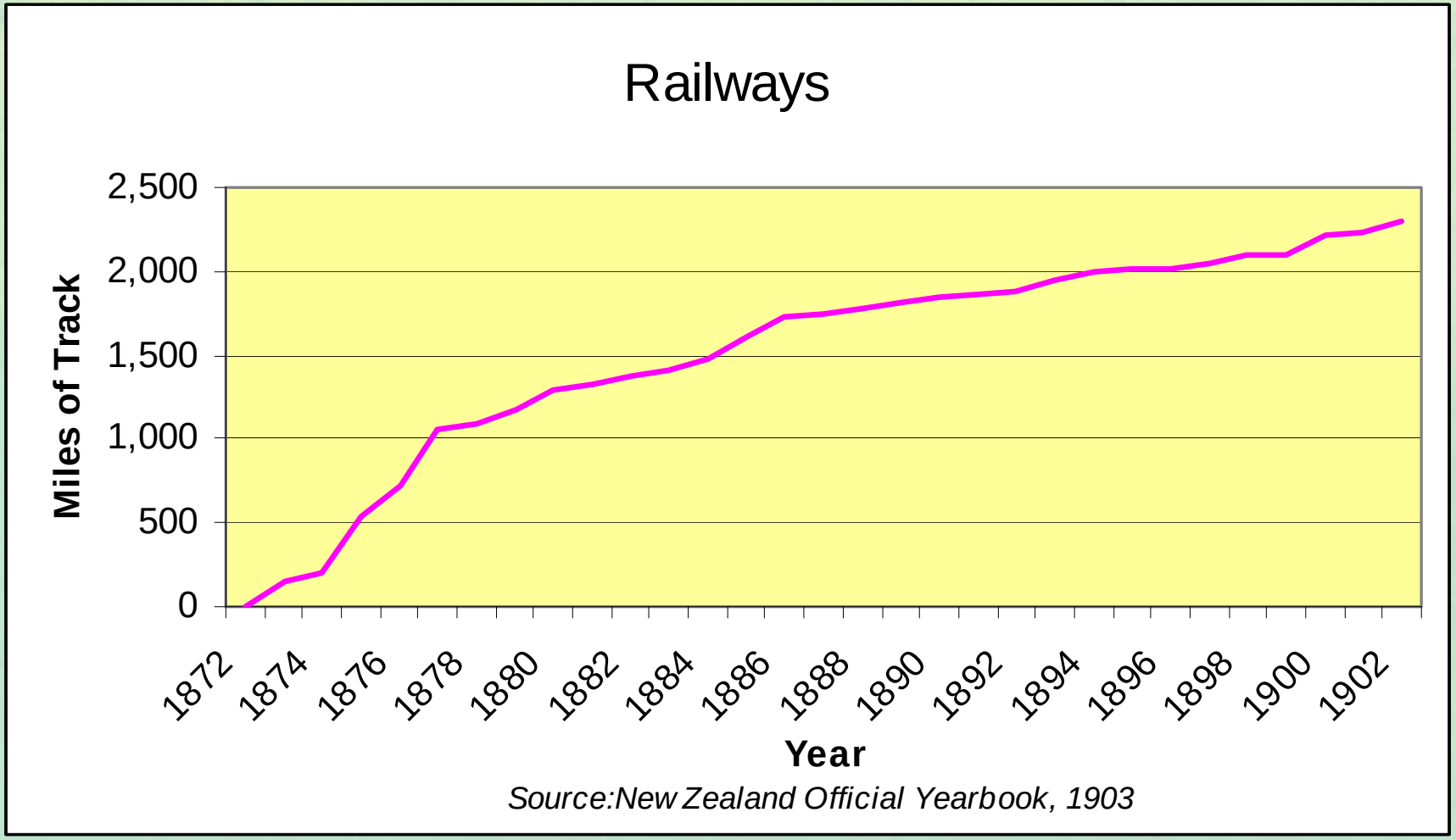

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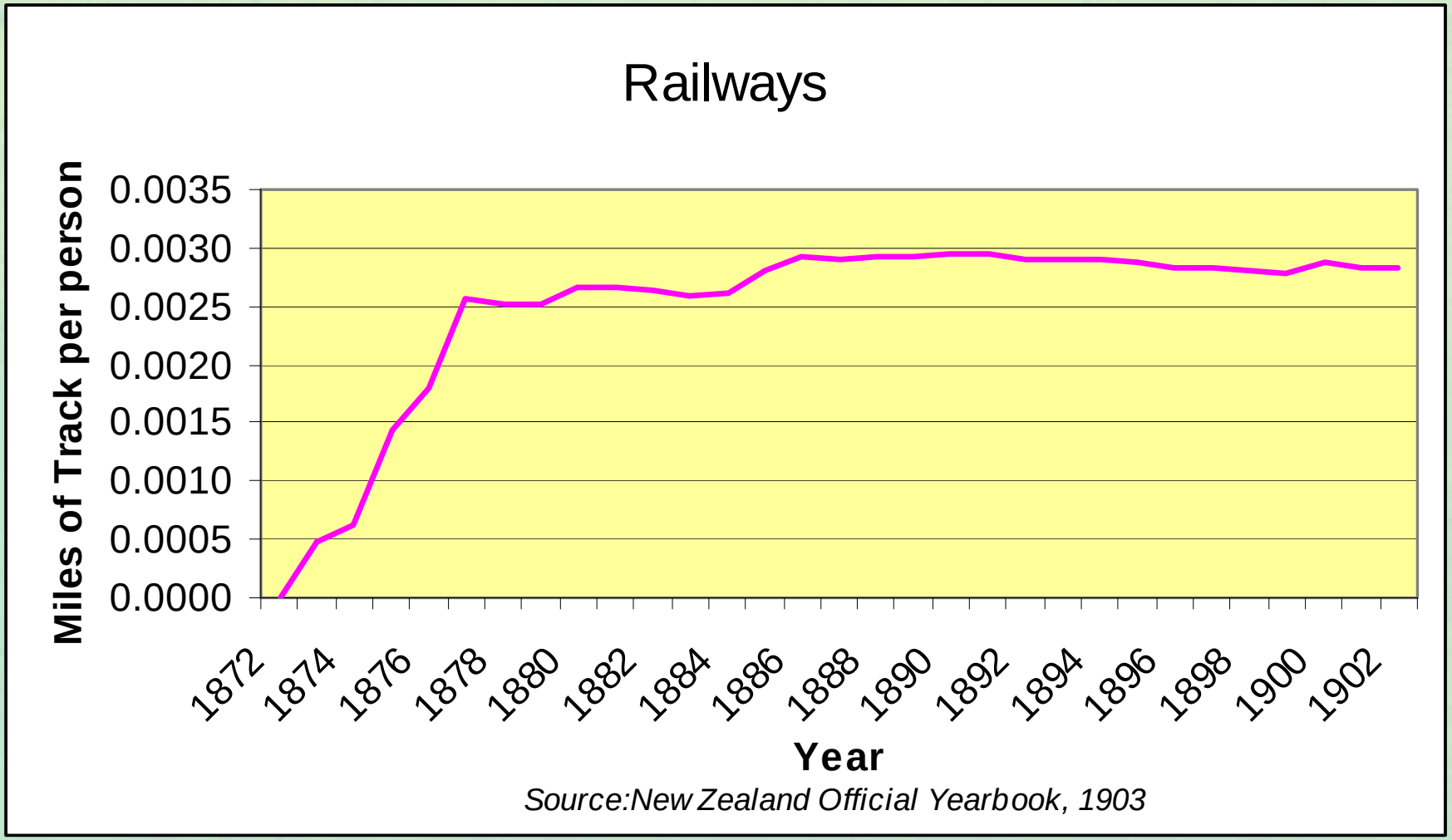

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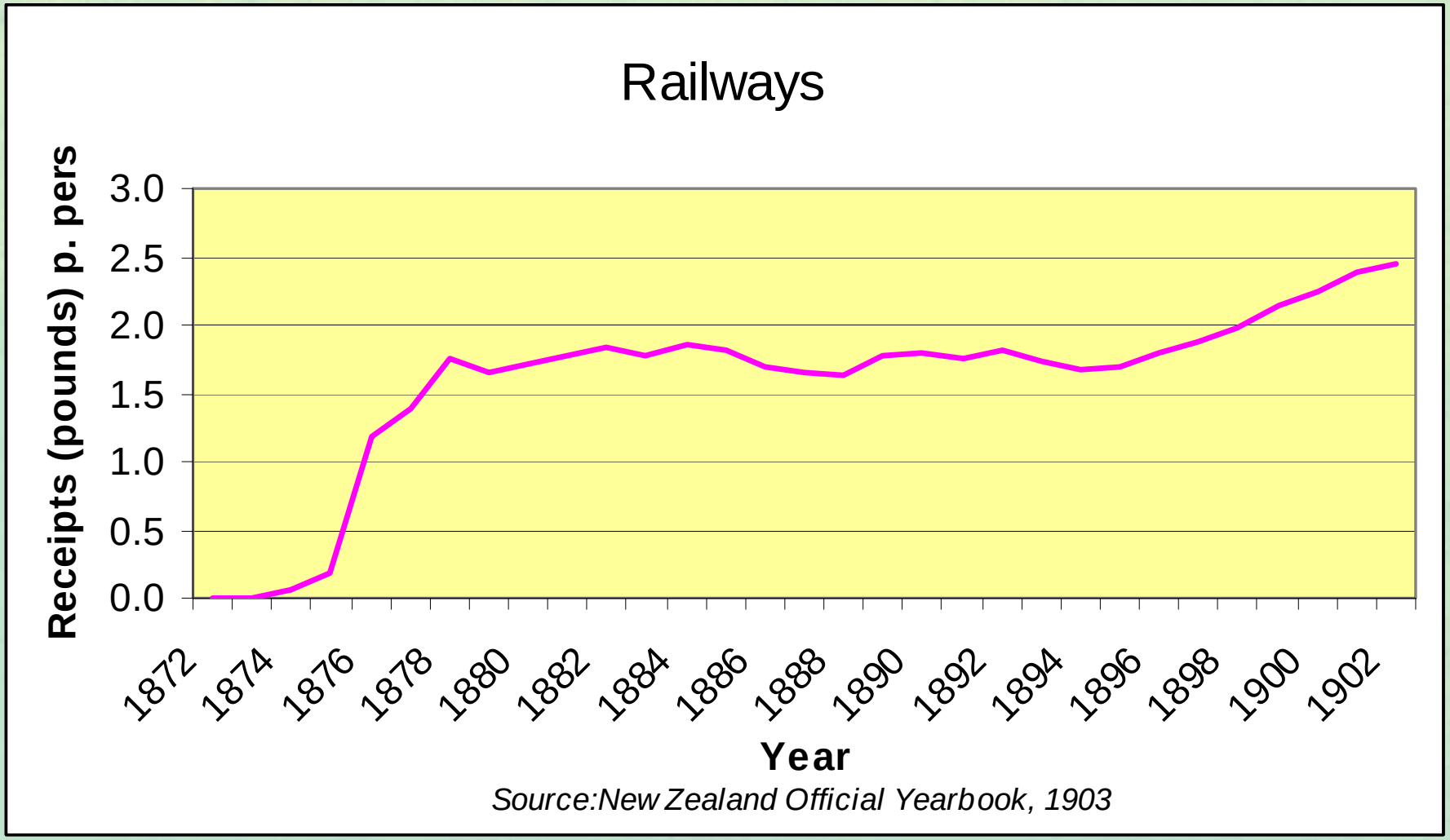


Source:New Zealand Official Yearbook, 1903

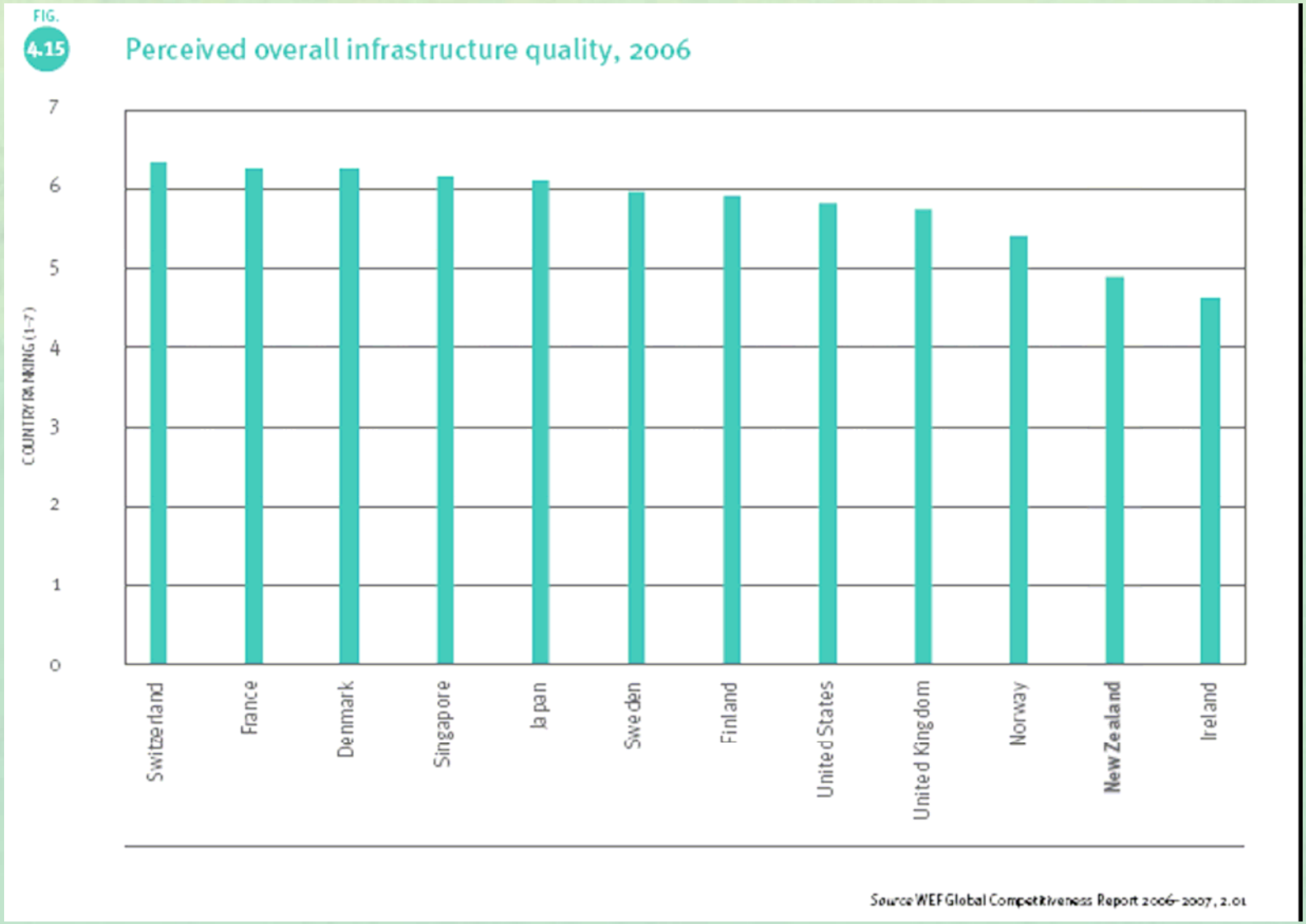
Why focus on infrastructure?

- One of few ways govt exp may raise productivity

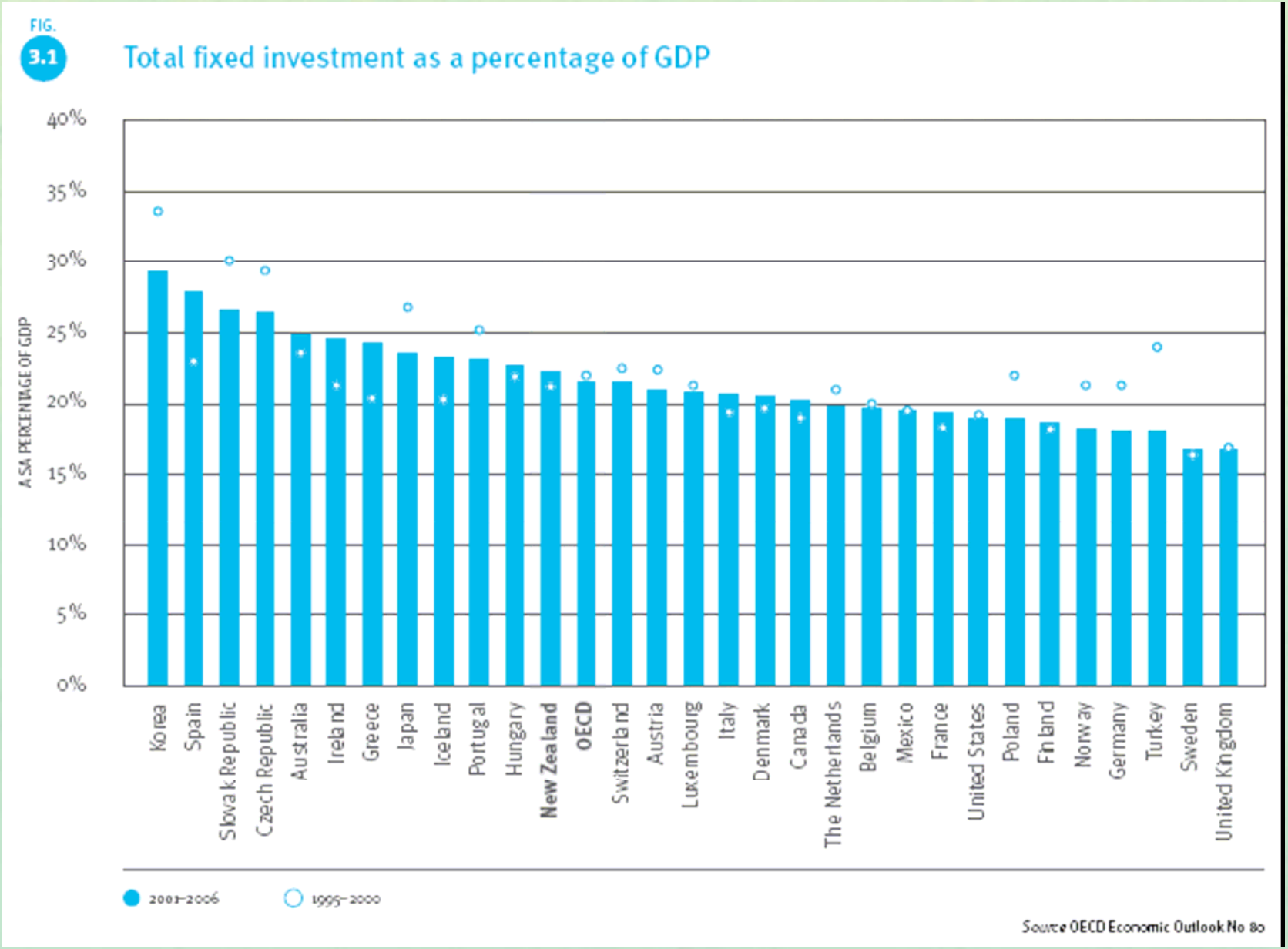
  (Nijkamp & Poot, 2004; Bassanini, 2001)
- NZ spends relatively little on infrastructure

  (Grimes, 2003; Sanderson 2004)
- OECD concerned about NZ infrastructure deficit
  - Land transport, telecommunications, electricity
- Policies now focused on infrastructure
  - But expensive
  - Are the right things being built, & in the right order?

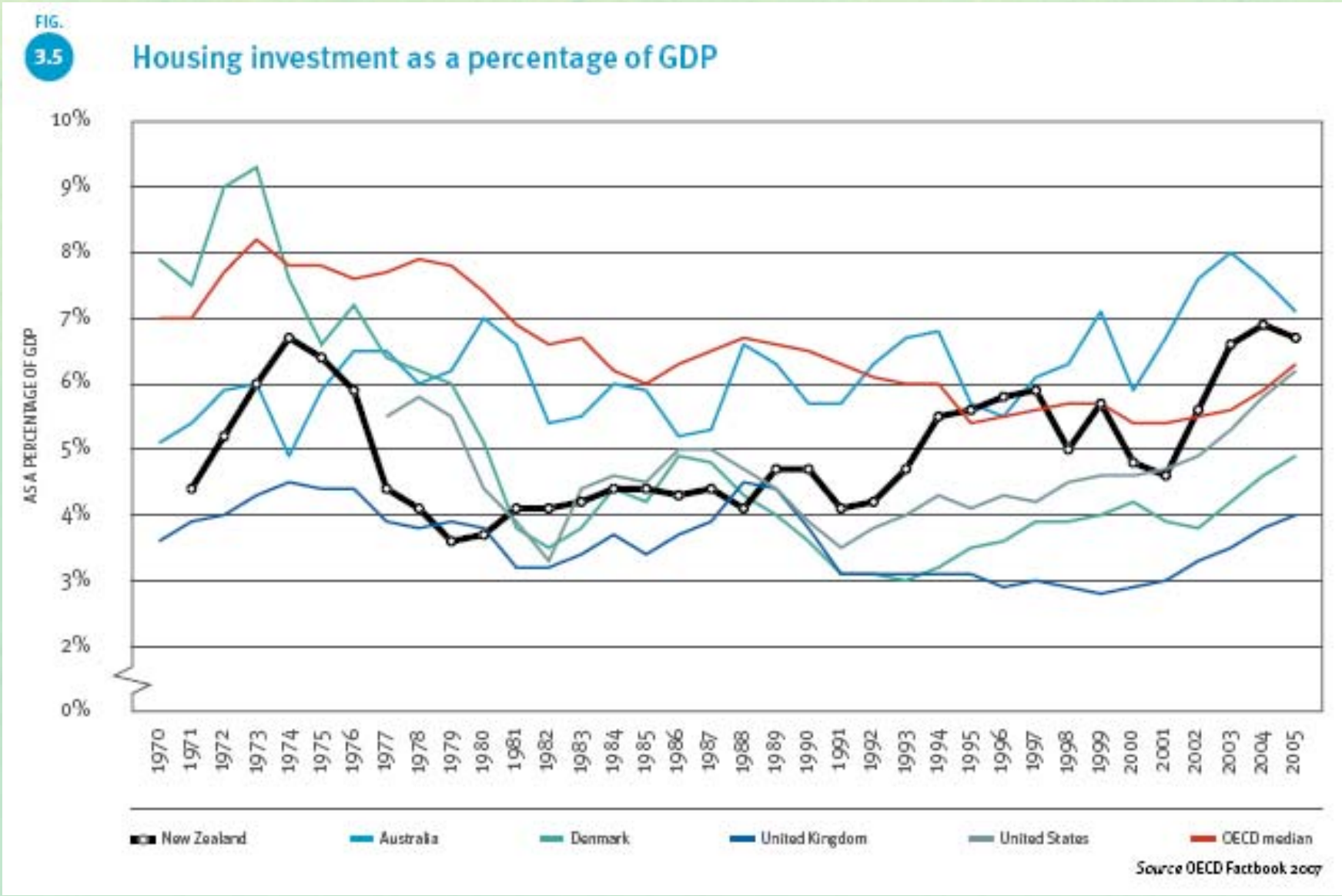
Infrastructure Quality Ranked 34th in world



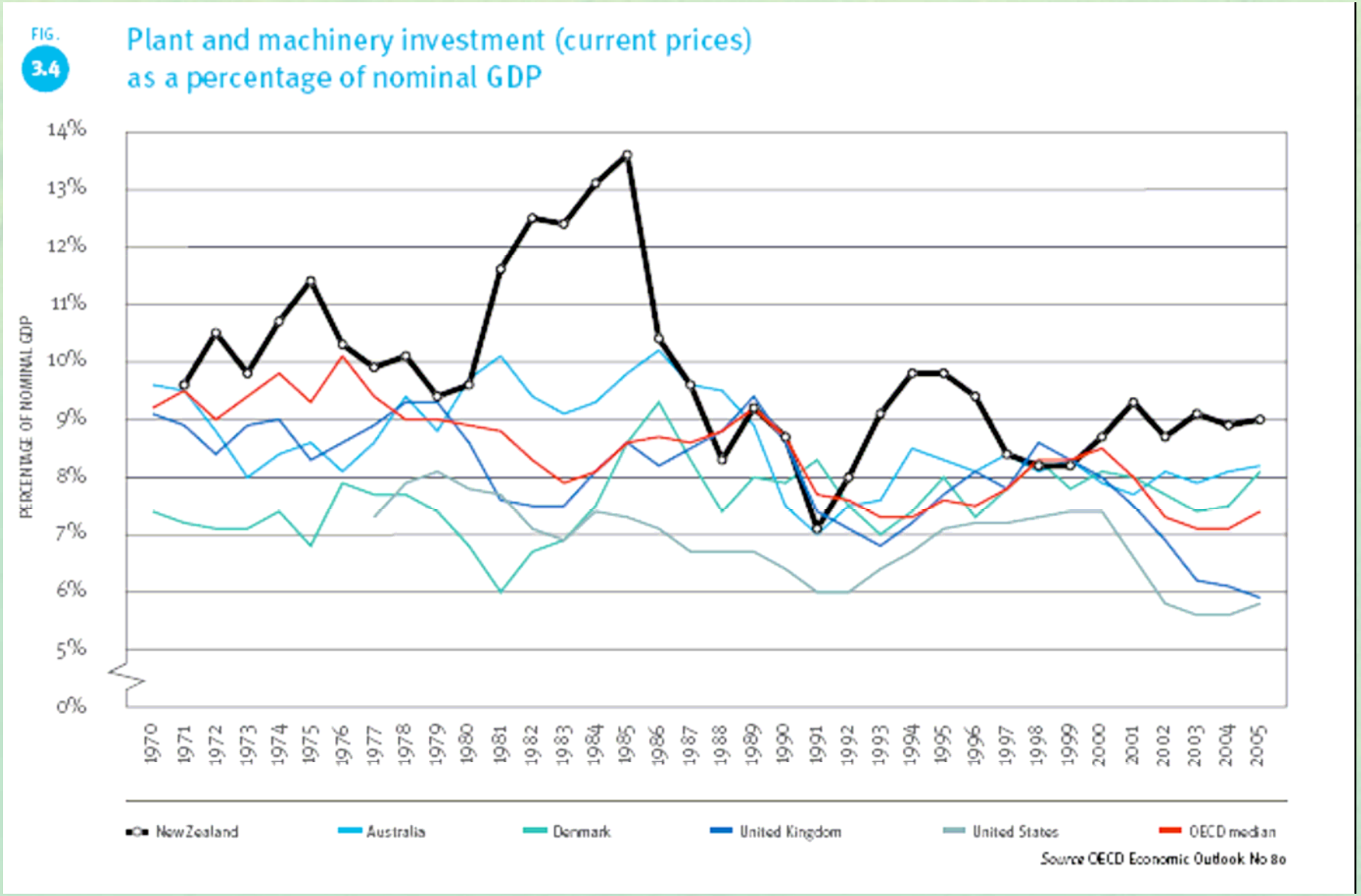
Total investment at OECD average



Housing investment about average



Plant & machinery investment very high



Government investment plunged post-1986

FIG. 3.3

Investment as a percentage of nominal GDP

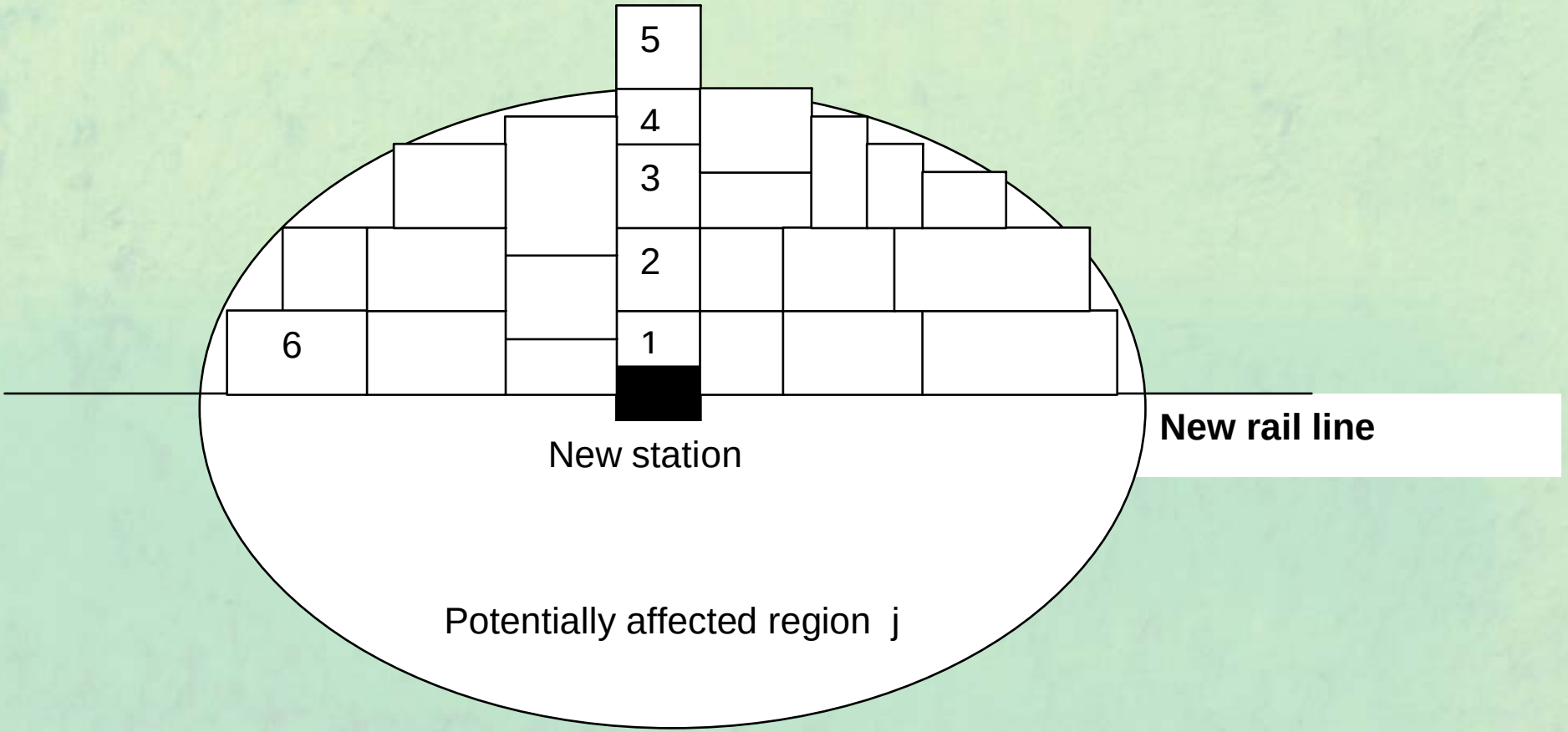
Source OECD Economic Outlook No 80

Measuring effectiveness

- Productive infrastructure increases local productivity
  - Also affects 'amenity' values
- Land prices reflect local productivity & amenities
  - Expected infrastructure benefits reflected in land prices (Ricardo)
- Examine prices (or rents) before & after infrastructure
  - Difference (after controls) reflects value of infrastructure
- Also examine effects on:
  - wages, employment, population, economic activity, productivity

NB: Many developments may not be foreseeable ex ante

Illustration



i=1 has greatest price rise, followed by 2,3,4; no effect on 5, price drop in 6

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Example 1:
Bridge to Somewhere

Auckland Northern Motorway

- Estimate benefits of Auckland's Northern Motorway extensions post-1990 to Orewa
- Use change in land values (after controlling for other factors) as summary indicator of value
- Also examine pop^{n}, employment, income Δs
- 3 waves: 1992, 1998, 2004
- Compare estimated benefits with project costs to measure net benefit (& B:C)

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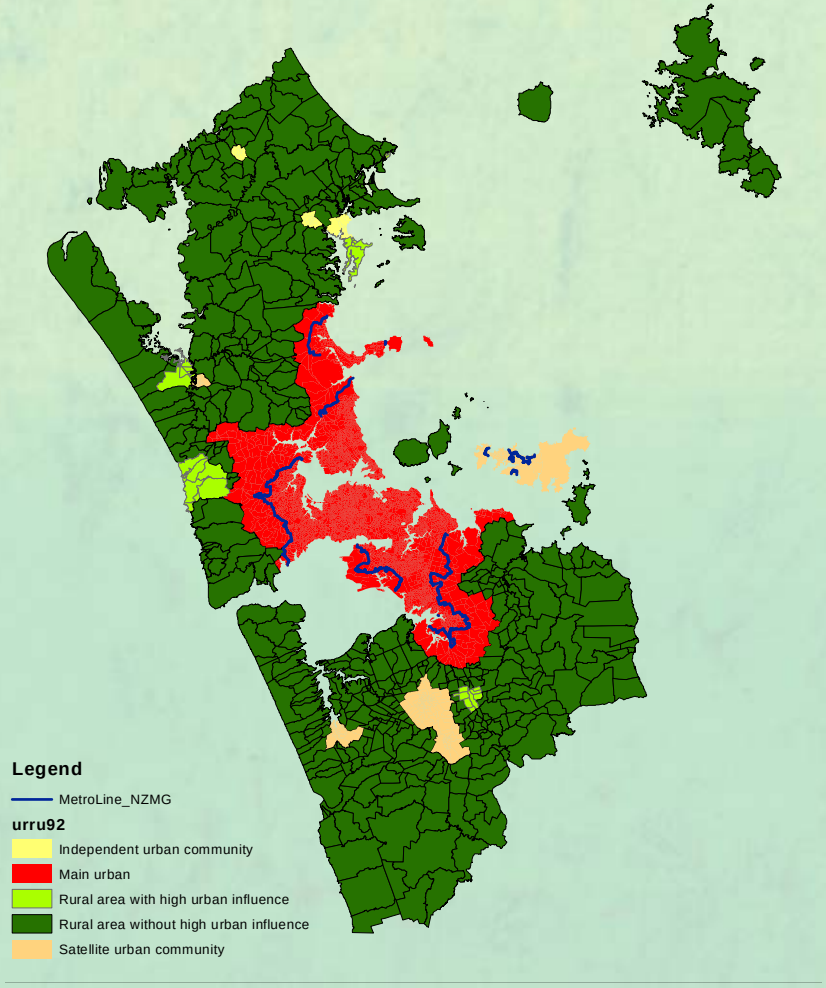
Results

- Population & employment rose strongly near new exits & around Warkworth
  - Growth strongly exceeded Auckland region growth
- Land values grew strongly near new exits, tailing off
- Most conservative calculation gives a benefit of $2.3 billion (in 2004 $'s)
  - cf estimated discounted costs of $0.37 billion
- Implies B:C = 6.2 (even after large cost over-runs)
- Some estimates give B:C near 20
  - Much higher than standard B:C calculation (5.3)
  - Range or degree of responses to infrastructure under-estimated(?)

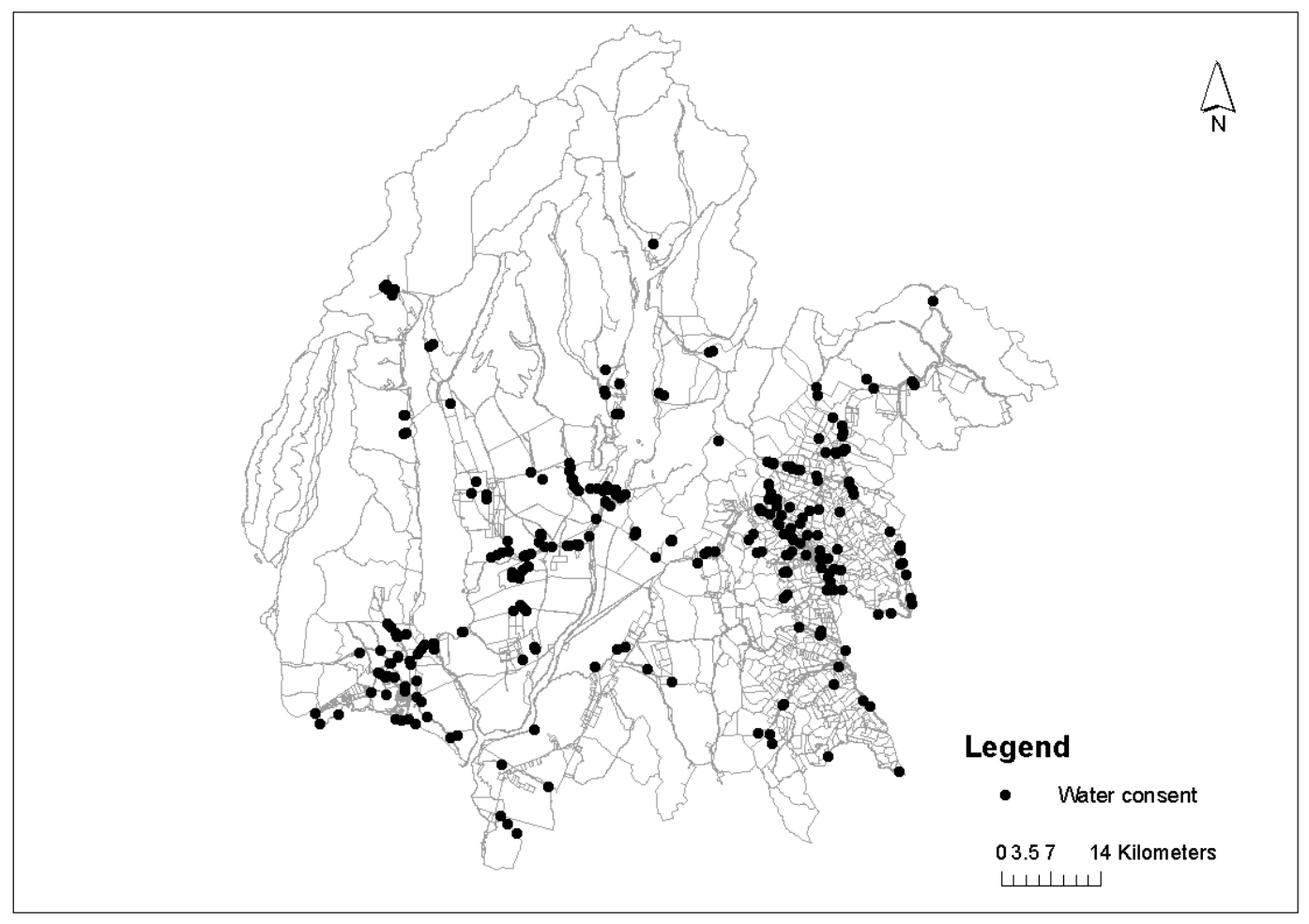
Example 2: Auckland's Metropolitan Urban Limit



- Land values vary by factor of 10 across MUL border
- I.e. zoning has huge impact on land use (incl to m'way)
- Affects payoffs to infrastructure investment
- Little attention given to measuring whether costs outweigh MUL's benefits

Example 3:
Water, Water Somewhere

Location of Irrigation Consents: Mackenzie District



Source: Environment Canterbury

Mackenzie District Water Consents

- Estimate benefits of water consents for farms
- Change in land values indicate water's value
  - after controlling for other factors
- Annual data: 1988-2006 for every farm in district
  - Sales price data & valuation data
  - Individual farm water consent data (incl flow-rates etc)
  - Individual farm data on area, location, rainfall, slope, soil type
- Examine interactions of characteristics & consents

Key Findings

- On average, significant positive benefits of water
- But benefits differ enormously depending on:
  - Location (more valuable near towns)
  - Farm rainfall, slope & soil
- Raises issues of water allocation & trading
  - Water given away free to farmers
  - Not easy to sell to someone who has higher use-value
- Water's value to the farm is reflected in farm price
  - But this may be less than its full economic value

Infrastructure & Modern Investment Theory (1)

- Investment under uncertainty implies projects may have high hurdle rates - to learn about the future
  - Uncertainty creates a valuable option for delay
- What if uncertainty relates to types of opportunities in response to new infrastructure project?
  - May create rationale to bring forward some infrastructure expenditure

Infrastructure & Modern Investment Theory (2)

- Must pay up front to be in with chance to exercise options for other investments when they arrive
  - Multi-stage investment process (possibly with increasing returns)
  - Payoffs to different parties; not to infrastructure provider
- May be like a GPT in some cases, but not others; e.g.
  - Rural road-straightening, vs
  - Broadband or urban passenger transport

Lessons & Conclusions (1)

- New infrastructure is costly
  - Benefits firm productivity &/or consumption
  - Constraints will delay what can be built in near term
  - Not all infrastructure is worthwhile (Japan)
- New infrastructure can lead to major effects
  - Endogenous changes in sectors, employment, population
  - Major wealth transfers
  - Subject to S-shaped diffusion
  - GPTs will also see subsequent waves of uptake
- 19th & 20th century examples show positive benefits to new infrastructure

Lessons & Conclusions (2)

- Decide on value of short-run vs long-run benefits
  - Discount rate impacts on priorities as well as absolute B:C
  - Consider lower discount rate where wide range of new opportunities are opened up
    - e.g. rural road straightening vs broadband roll-out
- Consider who benefits & who should pay
  - And whether to borrow or pay out of current income
- Regulations may have major effect on returns to infrastructure investment
  - NZ still has work to do in this field (e.g. water, planning reg's)

Motu's current & proposed research on infrastructure effectiveness

- Highways: Auckland Northern Motorway
- Planning rules: Auckland MUL
- Irrigation: South Canterbury
- Broadband: Effect on NZ firm productivity
- Urban accessibility: Effects on Auckland firms
- Rural: Emergency services; processors
- Urban rail: Auckland upgrades
- Export infrastructure: Port/airport impacts on exporters
- Local amenities: E.g. Waitakere