Motu FRST Infrastructure Programme: Key Findings & New Questions

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Outline

Key Empirical Findings

a. Transport
b. Telecommunications
c. Water
d. Local social/economic infrastructure

Outline (cont)

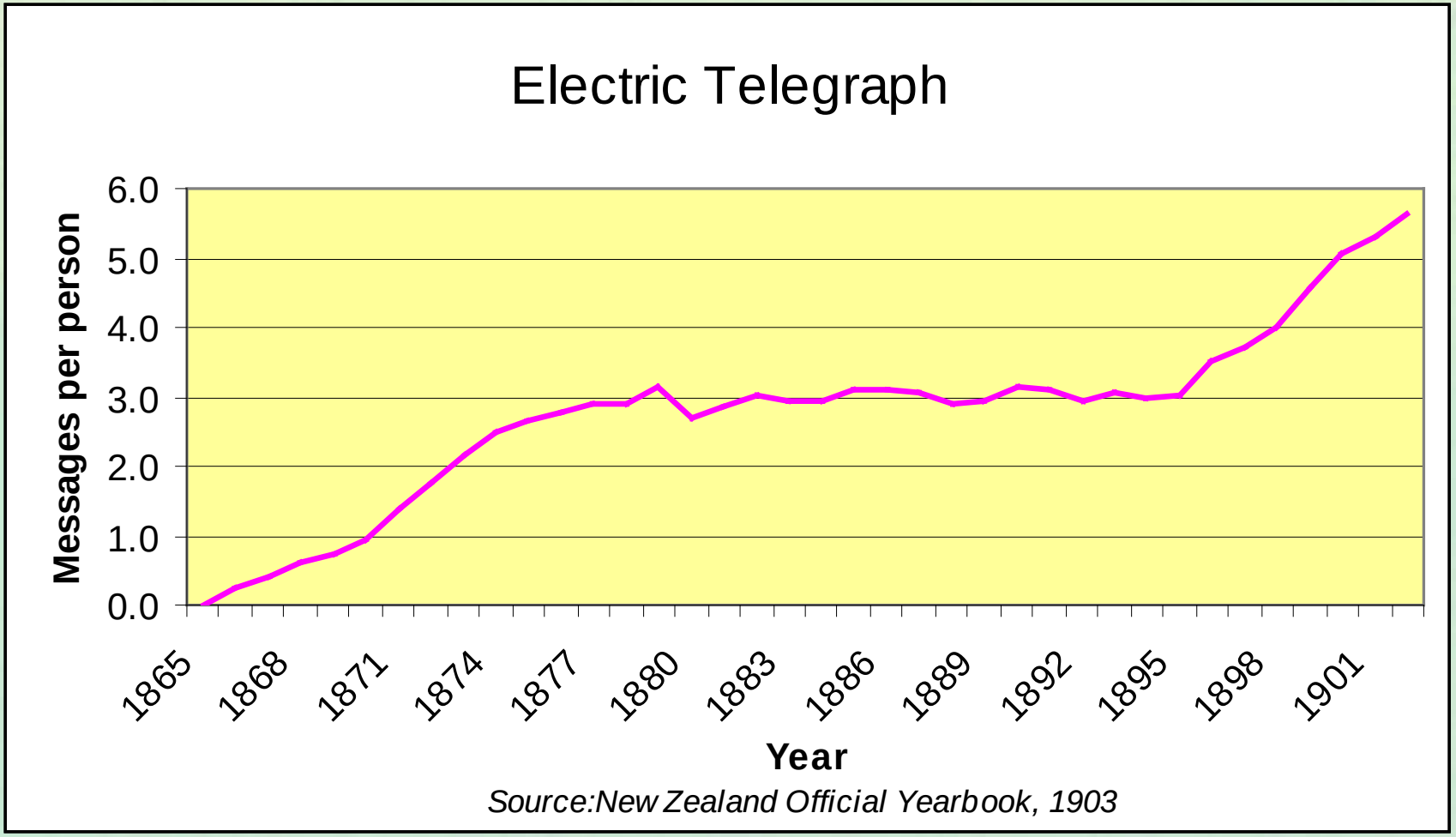
Issues for CBA Infrastructure Assessments

a. Networks & resource availability
b. Options and uncertainty
c. Nature of investments & discount rate
d. Implications for infrastructure policy

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

Electric Telegraph
Initial S-shaped diffusion + 2nd uptake wave

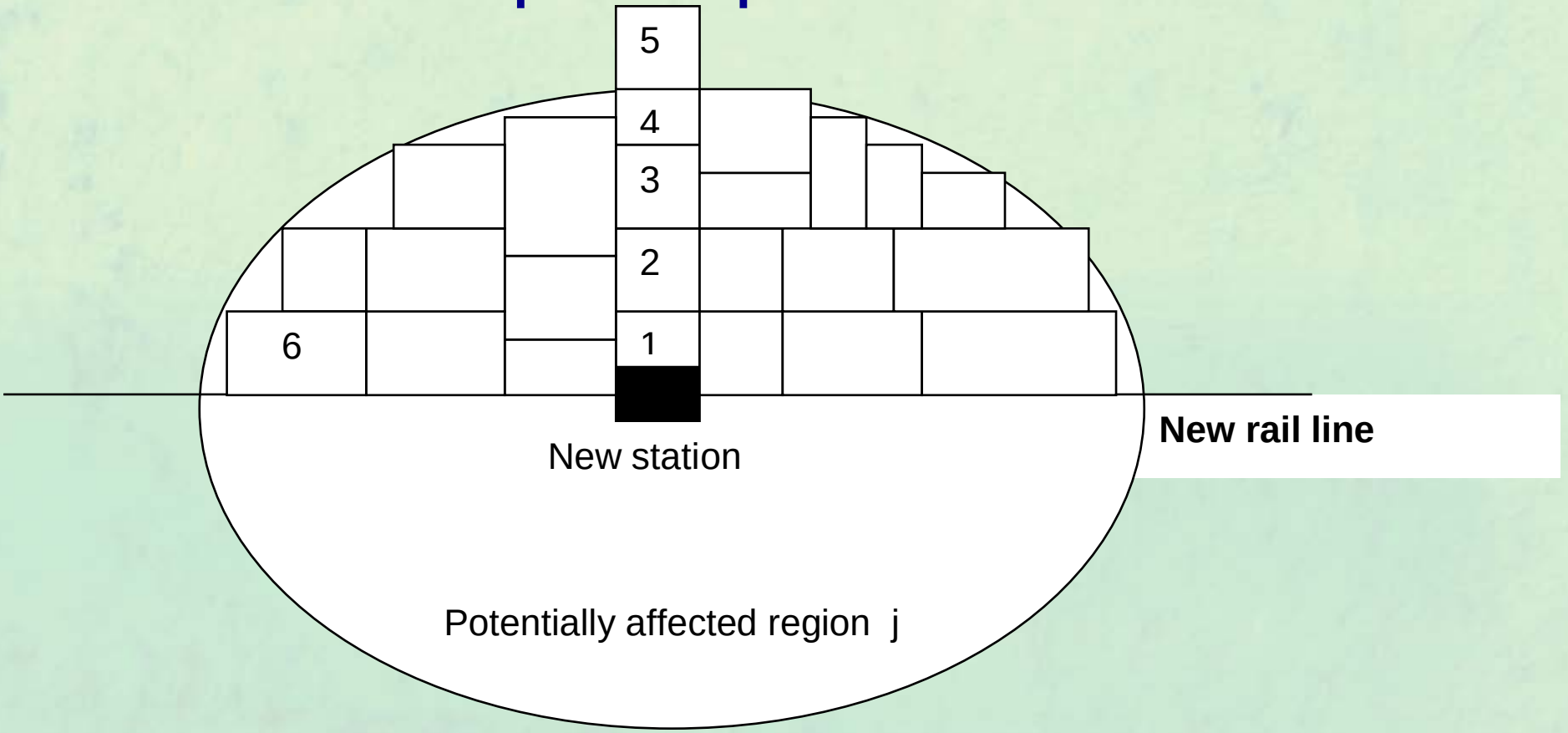


Lessons from History

- Strategic, network approach important
- Benefit scope may be difficult to assess *ex ante*
- Position infrastructure for unknown benefits (options)
- Evaluate benefits *ex post* – lessons for the future

Measuring Infrastructure's Impacts: Empirical spatial approach

Examine land price responses to investment

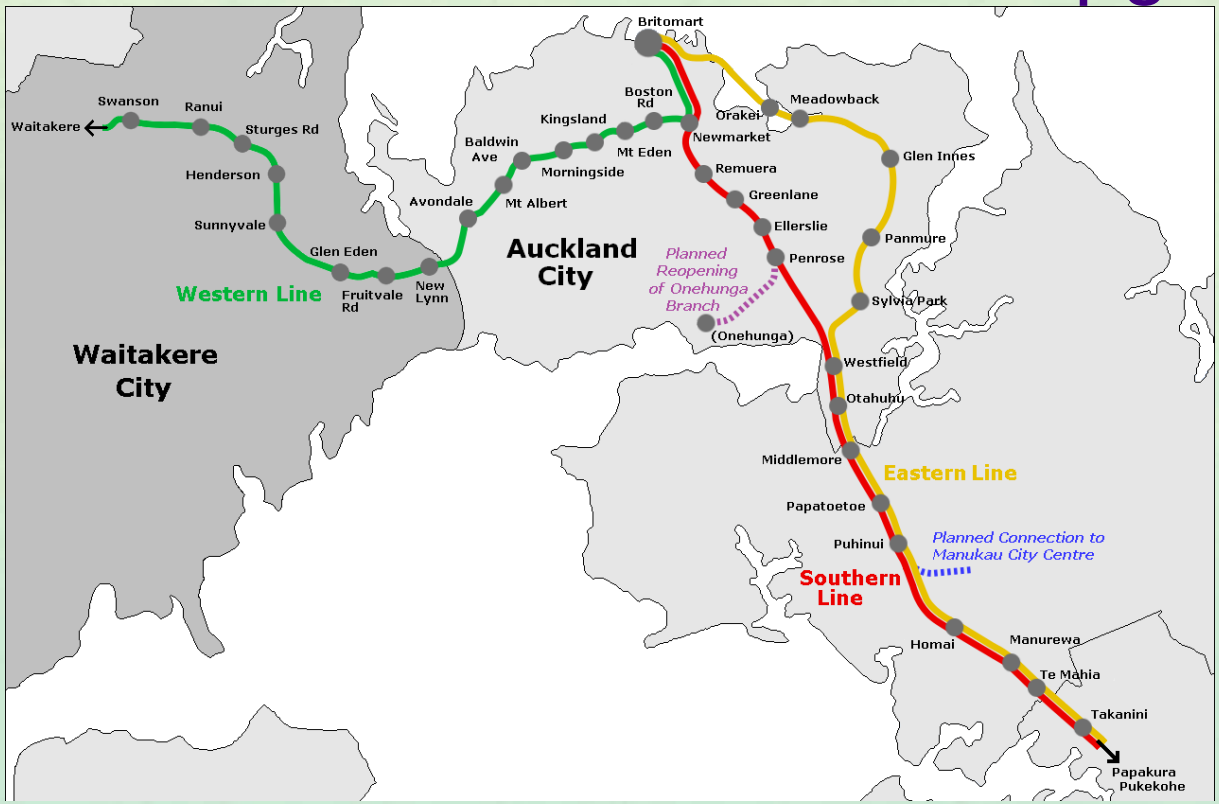


i=1 has greatest price rise, followed by 2,3,4; no effect on 5, price drop in 6

Auckland's Northern Motorway Extensions: Albany to Orewa

- Population, employment & land values rose strongly near new exits
  - within MUL
- Conservative estimate of B:C = 6.2 (after cost over-runs)
  - Some estimates give B:C near 20
  - Higher than standard B:C calculation (= 5.3 before cost over-runs)
- Scale or scope of responses to infrastructure under-estimated?

Auckland's Western Line Rail Upgrade

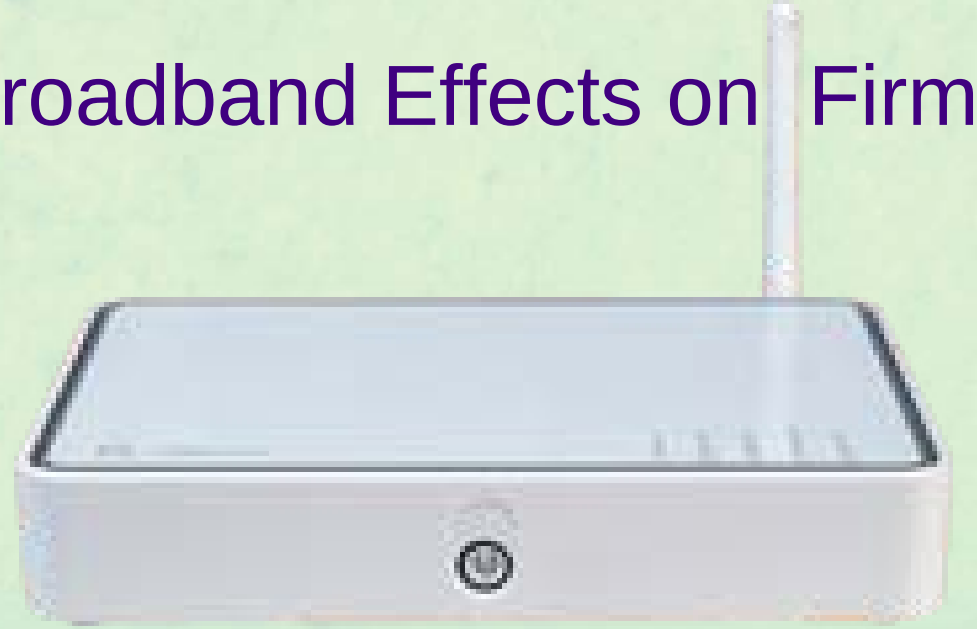


- Land values rose on announcement of upgrades
  - Double tracking, New Lynn, electrification
- Land near stations jumped 5-12% cf land 8 km distant
- May understate full benefits if 'seeing is believing' or benefits elsewhere (e.g. in CBD or for more distant houses with reduced traffic congestion)

Inland Port: Metroport (Southdown)

- Significant number of exporters switch port
- Adds export (shipping) option for firms
- Increases port competition
- Implies benefits for exporters

Broadband Effects on Firm Productivity



- Broadband raises firm productivity on average
  - After controlling for other observable factors across matched firms
- Export-oriented firms more likely to use fibre/cable
  - But no evidence of productivity difference between cable & other (ADSL)
- Investment decisions need to use options thinking

Irrigation in Mackenzie District (South Canterbury)

- Large benefits of irrigated water
- Benefits depend on:
  - Rainfall, slope, soil
  - Location (near town)
- Importance of water access/storage
- Water allocation/trading issues

Local Authority Economic Infrastructure

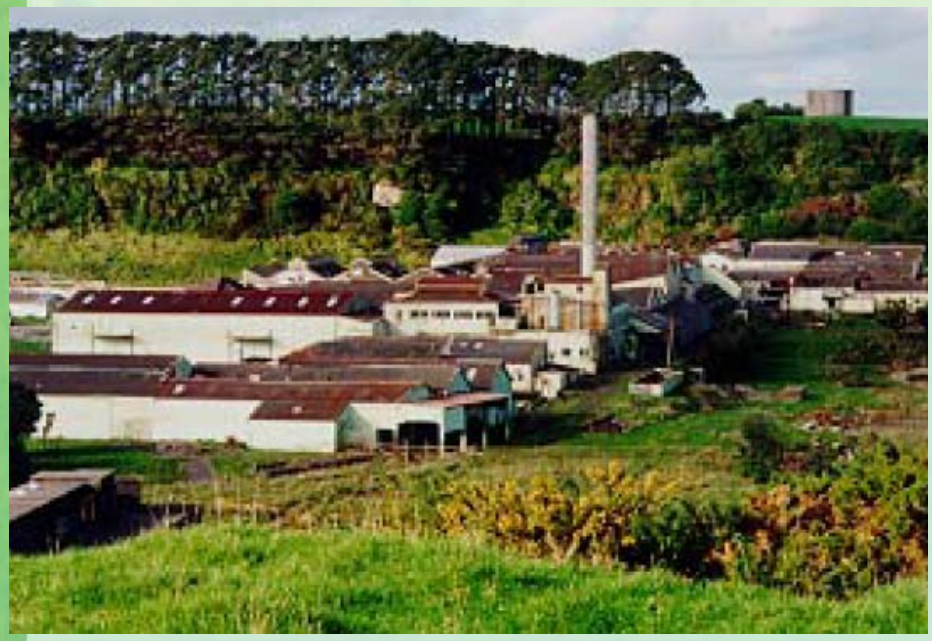
- Includes roads, ports, etc

- After controlling for local factors, extra investment increases:
  - Population
  - Land values

- ‘Build it and they will come’

- Resources endogenous to region

Primary Processing Infrastructure: Closure of Patea & Whakatu



- Resources leave the region
  - working age population
- Houses remain

  → increased elderly population
- Whakatu (Hastings) much less affected long-term than Patea
- Risk-sharing agglomeration benefits

Agglomeration Studies

- Areas with higher employment density have higher productivity
  - 10%↑ emp density → 0.5% ↑ in prod^{y}
  - Good infrastructure required for high density cities
- Highest agglomeration benefits:
  - Finance & insurance
  - Wholesale & retail trade
  - Health & community services
- Implies supporting infrastructure especially important for Akld
  - & other “larger” cities

Local Authority Investments in Social Capital

- Includes community facilities
- Increased investment increases community participation
  - Of those who participate
- But reduces no. of participants
  - I.e. free rider effect
- Demonstrates complexities of public investments

Empirical Studies: Common Findings & Issues

- Infrastructure investments mostly found to raise productivity &/or amenity values

- Estimated benefits are often diffuse
  - Need methods that can evaluate these diffuse benefits
    - Ex ante; &
    - Ex post

- Ex post benefits may differ considerably from ex ante benefits
  - Suggests a range of conceptual factors to explore

Conceptual Issues: Standard Cost benefit analysis (CBA)

- *Treasury CBA Primer* notes key distinction:
  - CBA vs financial analysis
- CBA includes all tangible & intangible benefits
  - incl. wider economic benefits
- To compare projects, must compare like CBAs
- Discount rate used for intertemporal comparisons
- Conceptually simple, but sometimes too simple

Network Benefits

- Networks exhibit IRS (increasing returns to scale); e.g.
  - Complementary investments (schools, health clinics, roads)
  - Multiple road upgrades
  - Rail and inland port investment
- Individual project CBA inappropriate with IRS
  - ‘think networks & systems, not projects”

Resource Availability

- Over what scale do resources flow?
  - Resources flow across Australasia to their best use
  - Think of NZ as a “small” region of Australasia
- Can NZ attract (or keep) productive resources by investing in quality infrastructure servicing tradables?
  - E.g. head office personnel

Uncertainty, Real Options & Modern Investment Theory

- CBA typically undertaken using "certainty equivalents"

- Inappropriate where there is both:
  - uncertainty; and
  - choice of investment timing

- Uncertainty typically → projects having high hurdle rates
  - Uncertainty creates a valuable option for delay
    - In order to see whether things evolve favourably or not

Uncertainty & types of opportunity

- What if uncertainty relates to types of opportunities in response to new infrastructure?
- And if we learn more about these opportunities after initial infrastructure is built
- May create rationale to bring forward expenditure

Option Value with 2 Stages:

CBAs say don't proceed with either stage 1 or stage 1 & 2

Sequential Investment Projects (no discounting)

	Period		
	1	2	3
	All values in $ million		
Cost: Project A	100		
Cost: Project B		100	
Benefit: Project A (by itself)			50
Benefit: Combined projects (poor outcome)			50
Benefit: Combined projects (good outcome)			300
Expected value of combined projects (p=0.5)	175		
NPV: Project A only (without option value)	-50		
NPV: Combined projects (without option value)	-25		
NPV: Programme (with option value)	25		

BUT with learning:

NPV programme = -50x0.5 + 100x0.5 = 25

so optimal policy is to invest in stage 1

Implications of Modern Investment Theory

- 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 may be to different parties, not to infrastructure provider
- Applicable in some cases but not others, eg:
  - Urban transport or fibre-optic broadband; vs
  - Rural road-straightening

Production vs Consumption: 1

- CBA treats productive & consumption benefits equally
- Assume alternative investments exist that yield 8% real
- To be as productive, a project costing $1 now must return:
  - $1.08 in one year's time; or
  - $6.85 in 25 years' time ($=1.08^{25}$).
- Implies indifference between $1 now and $6.85 in 25 yrs

Production vs Consumption: 2

- Intangible consumption benefits can't be reinvested
  - Indifference result no longer holds
  - Especially for different generations (future generation can't choose)
- A "social rate of time preference" (SRTP) is required
  - to compare intangible benefits across generations
  - SRTP is entirely different concept from cost of capital

# Hip op's in 25 yrs for 10 hip op's today						
SRTP	0%	2%	4%	6%	8%	10%
# op's	10	16	27	43	68	108

Discount Rates in an International Context

- What if NZ's 'optimal' discount rate = 8% (real)
  - but Australia used 6%?
- Aust will have lower near-term consumption cf NZ
  - But higher long-term capital & incomes (per person)
  - Next NZ generation migrates to better opportunities
- Are policy-makers comfortable with this?

Funding Options

- Empirical work shows land values rise for many infrastructure investments
- Provides an ideal mechanism to raise funds
  - Through land-value uplift
  - Targets those who benefit most
  - All remain better off provided B:C > 1
  - Commonly used historically & in US (TIF districts)
- Could replace council FCs & DCs

Implications for Policy

- CBA useful for standard small projects
- But inadequate for more complex &/or strategic projects
- Need to consider:
  - Network effects & appropriate scale for effects
  - Option values
  - Discounting and types of benefits
- Consider value uplift as form of infrastructure funding
- Also ensure infrastructure usage is priced correctly!
- Conduct & learn from ex post evaluations of investments
  - Still in its infancy in NZ