Where are the wider benefits?
Transport appraisal and economic geography

Anthony J. Venables, Professor
University of Oxford
United Kingdom

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Overview:

- Introduction and standard approaches

- Sources of 'wider benefit'

- Infrastructure appraisal; inter- and intra-city transport

Introduction and standard approaches

Literature presents very mixed findings:

- Aggregate studies – implausibly weak effects
  Elasticity of output w.r.t. to infrastructure: ~ 0.1-0.2:
  - *'if infrastructure of Norway and UK had stayed the same as they were 100 years ago the resulting per capita GDP losses would be somewhere between a few percentage points and less than 30%.'*......

- Disaggregate data – large effects
  Econometric evaluations of transport infrastructure
  - Transport infrastructure supports market integration (→ factor price convergence)
  - Promotes growth of proximate areas:
  - Eg: Chinese counties: increasing distance from roads 1% ➔ GDP growth 0.12 – 0.28% pa lower (Banerjee, Duflo, Qian):

- Economic geography:
  Proximity raises the efficiency of transactions
  - Cities exist, and are productive.
  - Transport a necessary ingredient

Introduction and standard approaches

Standard approach to transport appraisal:

– Project reduces generalised travel cost by Δp per journey

– Benefit to existing travellers, Q *times* Δp

– Benefit to traffic created ΔQ. *times fraction of* Δp.

- Social savings calculations
    – $Q.\Delta p + \Delta Q.\Delta p/2$
    – Fogel: Impact of 19th century US railroads; upper bound $(Q + \Delta Q).\Delta p$
    – 'level of per capita income achieved by January 1, 1890 would have been reached by March 31, 1890 if railroads had never been invented'

- Social savings a rigorous and well-grounded method:
    – Private gain cannot exceed Δp, or would have travelled anyway.
    – Gains may be transmitted to other people via markets
        - Eg changes in wage, land prices; changes in production, supply
    – But if these markets are efficient, aggregate will be $Q.\Delta p + \Delta Q.\Delta p/2$
        - No free lunch from doing transport projects

- Basis of standard cost-benefit analyses.
- 'Wider benefits' only if some positive interaction with externalities / market failures

Sources of wider benefit

Why might transport improvements generate benefits > their direct cost savings + traffic creation?

- 'Distortions' due to tax wedges
- 'Distortions' due to market imperfections (pecuniary externalities)
- Externalities – eg knowledge spillovers (technological externalities)

- Need to be assessed relative to 'distortions' in rest of economy
- Could, in principle, go either way.

Empirical regularities: productivity gain associated with:
  – Sectoral clusters
  – City size:
- Rosenthal and Strange: survey of studies:
  – Doubling city size raises productivity by 3-8%
- Rice and Venables: (RSUE 2006)

    UK NUTS3 regions: use driving time:
  – Doubling proximity to economic mass raises earnings by 3.5% (controlling for occupation)
  – Falls off rapidly with driving time: weak > 40 mins, disappears > 80 mins
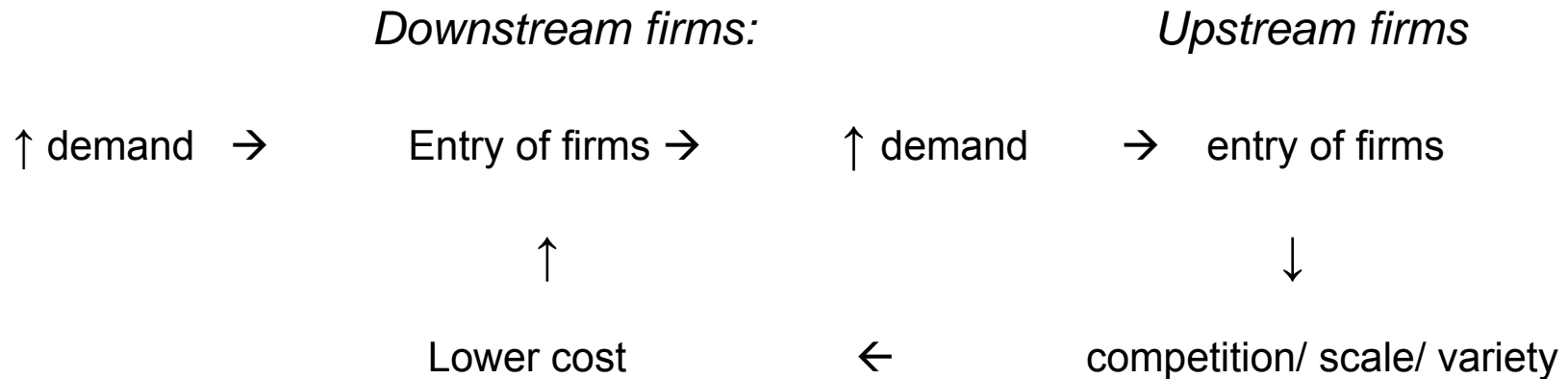
Sources of wider benefit

Underlying mechanisms that create these 'externalities':

1) *Market size, increasing returns and competition*

- Standard approach – based on textbook model of perfect competition
- What happens in environment with imperfect competition, increasing returns to scale and product differentiation?

- Transport improvements are like an increase the size of the market.

➜ entry of new firms

Shifts the competition-scale tradeoff: more intense competition *and* larger firms
- More competition, so price closer to marginal cost
- Larger firm scale, so reduction in average cost
- More varieties

➜ Productivity and variety benefits that are additional to direct transport cost savings

Sources of wider benefit

2) *Forward and backward linkages:* (Hollywood, City of London)

Downstream firms: *Upstream firms*

↑ demand →   Entry of firms →   ↑ demand   →   entry of firms

↑   ↓

Lower cost   ←   competition/ scale/ variety

- Cumulative causation process – possible agglomeration
- Real income gains will accrue to the fixed factor:
    - Land (urban context)
    - Labour (international context)
- Externality if these are not the key decision takers.
- Can a 'large developer' internalise the benefit? (science parks, retail malls)

Sources of wider benefit

3) Labour market effects

- Better matching in a thick market:
  - Firms with specific skill requirements
  - Workers with specific skills
  - Returns to scale in matching functions

- Incentives to undertake training:
  - If single prospective employer there is no incentive to get specific training
    - 'Hold-up'
    - Monopsony power

- Risk sharing:
  - Firms have independent shocks
  - Hire workers from same labour market
  - Larger labour market reduces variance

Sources of wider benefit

4) *Knowledge spillovers and demonstration effects*

- Best practise observed by others and knowledge spills-over:
  - *'.. secrets of trade... in the air'*

- Mechanisms?
  - Labour market turnover

  - 'Buzz'
    - F2F
    - Networks and information

  - Demonstration effects
    - Best practise can be copied:

Infrastructure appraisal: inter-city

Improved inter-city communications:

- Equivalent to city enlargement
  - Gains from overall city scale
  - Bergen – Stavanger?

- Facilitates city specialisation
  - London, Manchester and HS2.
  - Production of (financial?) services involves numerous 'tasks':
  - Some tasks *receive* more benefits from cluster spillovers
  - Some tasks *creat*e more cluster spillovers
  - Transport improvement brings down costs of coordination London/ Manchester
  - Allows some tasks to move to Manchester, creating space for others to expand in London
  - Real income gains in both cities >> direct benefit of time-saving
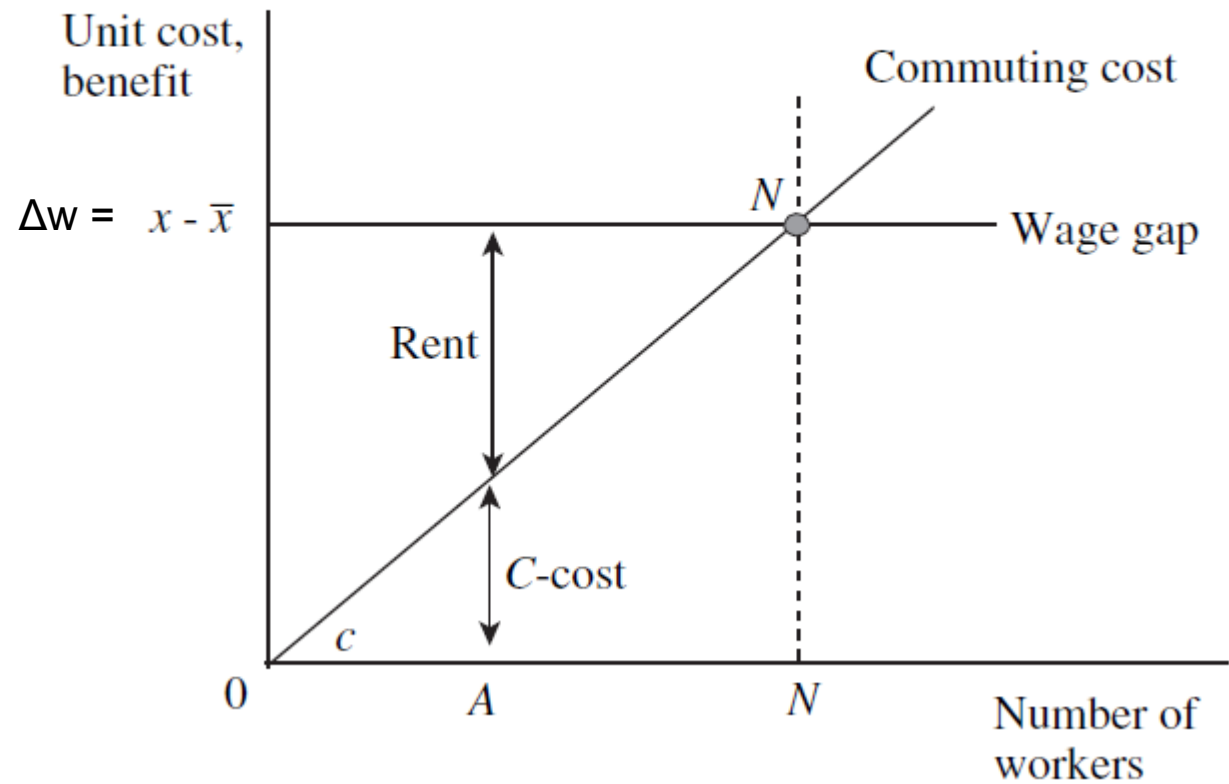
Infrastructure appraisal: intra-city

Improved intra-city communications:

Standard urban model
with exogenous wage
gap, Δw

- Central business
district
- Commuting cost
- Land rent

- City expands until real
wages equalised

Figure 1a
Urban Equilibrium

Unit cost, benefit

Commuting cost

$\Delta w = x - \bar{x}$

N

Wage gap

Rent

C-cost

c

0

A

N

Number of
workers

Infrastructure appraisal: intra-city

Transport improvement reduces commuting costs

α: direct cost saving (Δp) ⎤
β: value of extra trips (Δp.ΔQ/2) ⎦ Welfare gain

β + η: GDP increment (η is not a welfare gain)

Figure 1b
Net Gains from Transport Improvement

Figure 1b. Net Gains from Transport Improvement
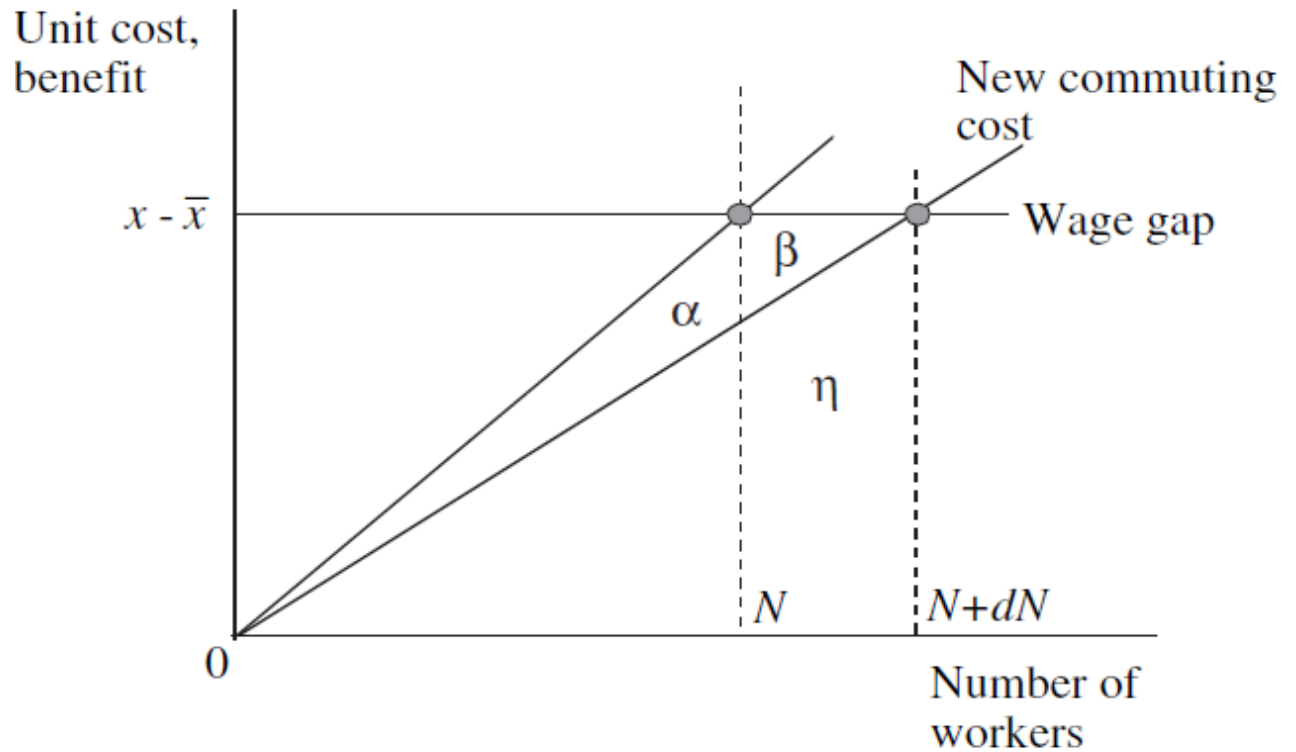
Infrastructure appraisal: intra-city + endogenous wage

Curve gives urban productivity (relative to non urban)

α: direct cost saving (Δp)
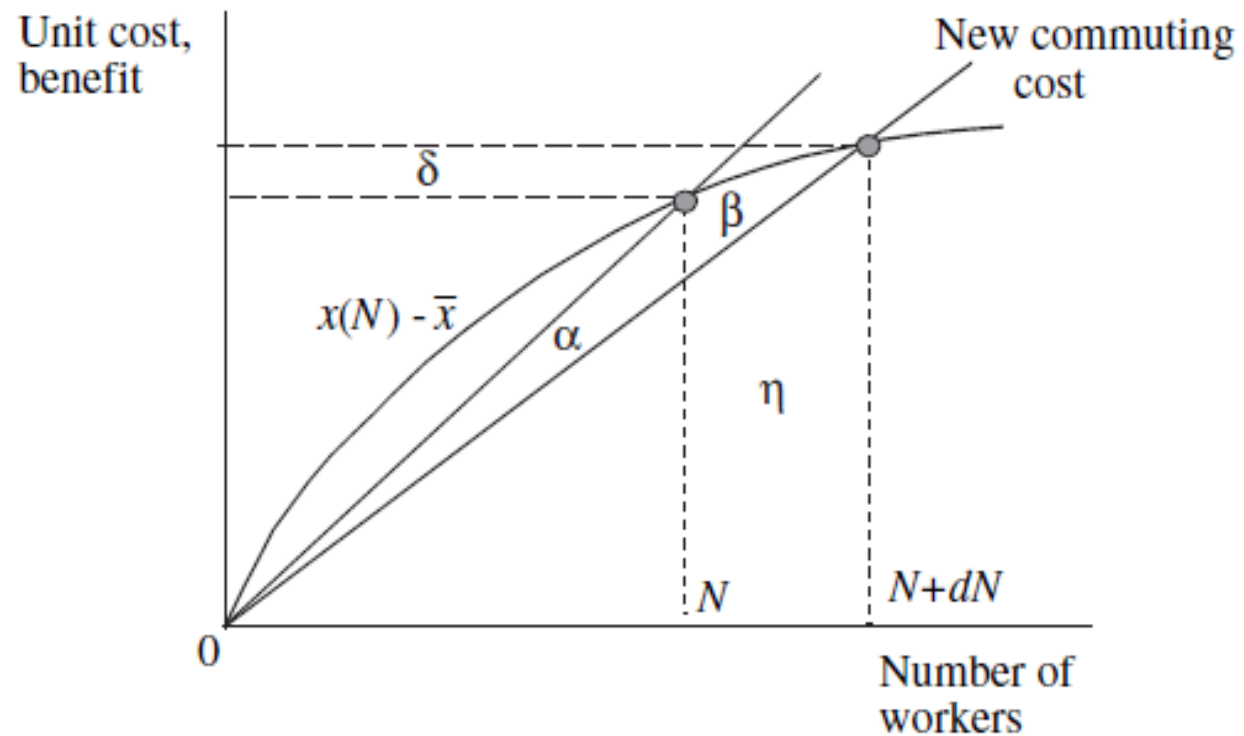
β: value of extra trips ($\Delta p.\Delta Q/2$)

δ: value of extra productivity from reciprocal externalities

Welfare gain

β + δ +η: GDP increment

Figure 1c

Net Gains from Transport Improvement with Endogenous Productivity

Infrastructure: intra-city + endogenous wage + tax wedge

Lower curve is net of tax wage increment

α: direct cost saving (Δp)

β: private value of extra trips (Δp.ΔQ/2)

δ: value of extra productivity from reciprocal externalities

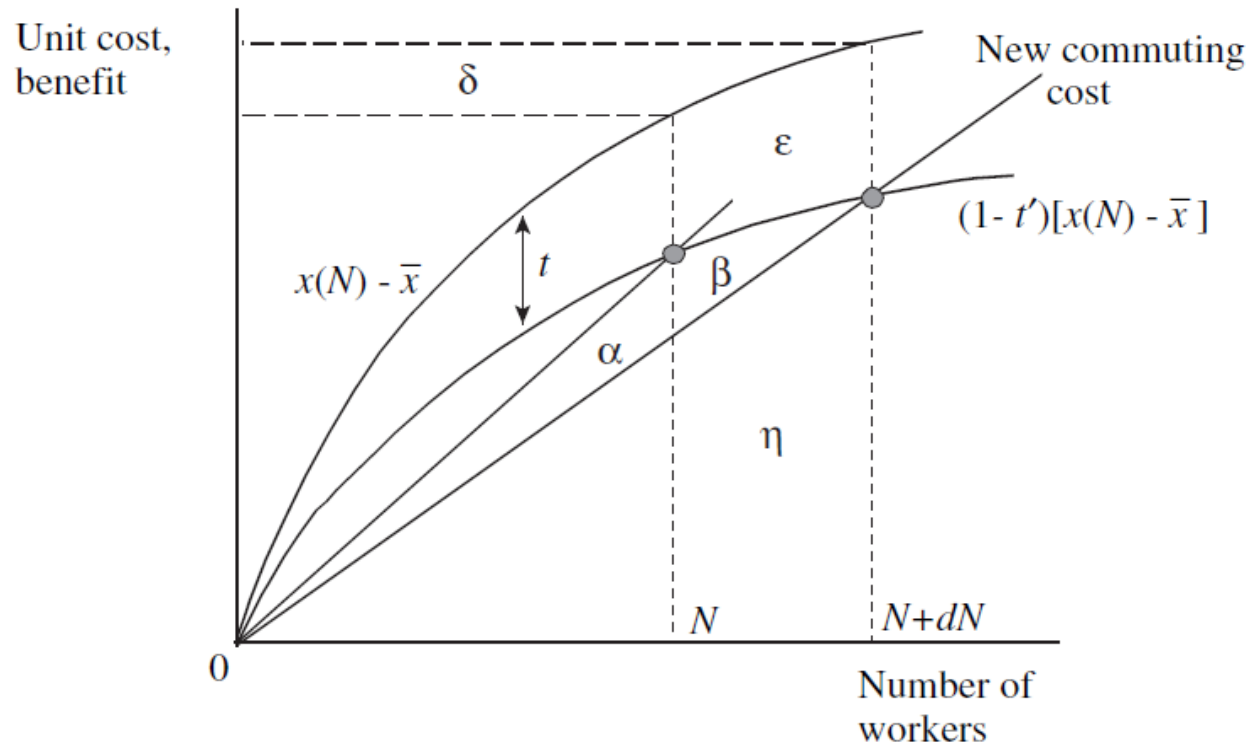ε: tax revenue on incremental journeys

β + δ + η + ε :   GDP increment

Welfare gain

Figure 1d
Net Gains from Transport Improvement with Endogenous Productivity and Tax Wedge (t)

Unit cost, benefit

δ

New commuting cost

ε

$(1- t')[x(N) - \bar{x}]$

$x(N) - \bar{x}$

t

β

α

η

N

N+dN

0

Number of workers

Infrastructure: intra-city: eg Cross-rail
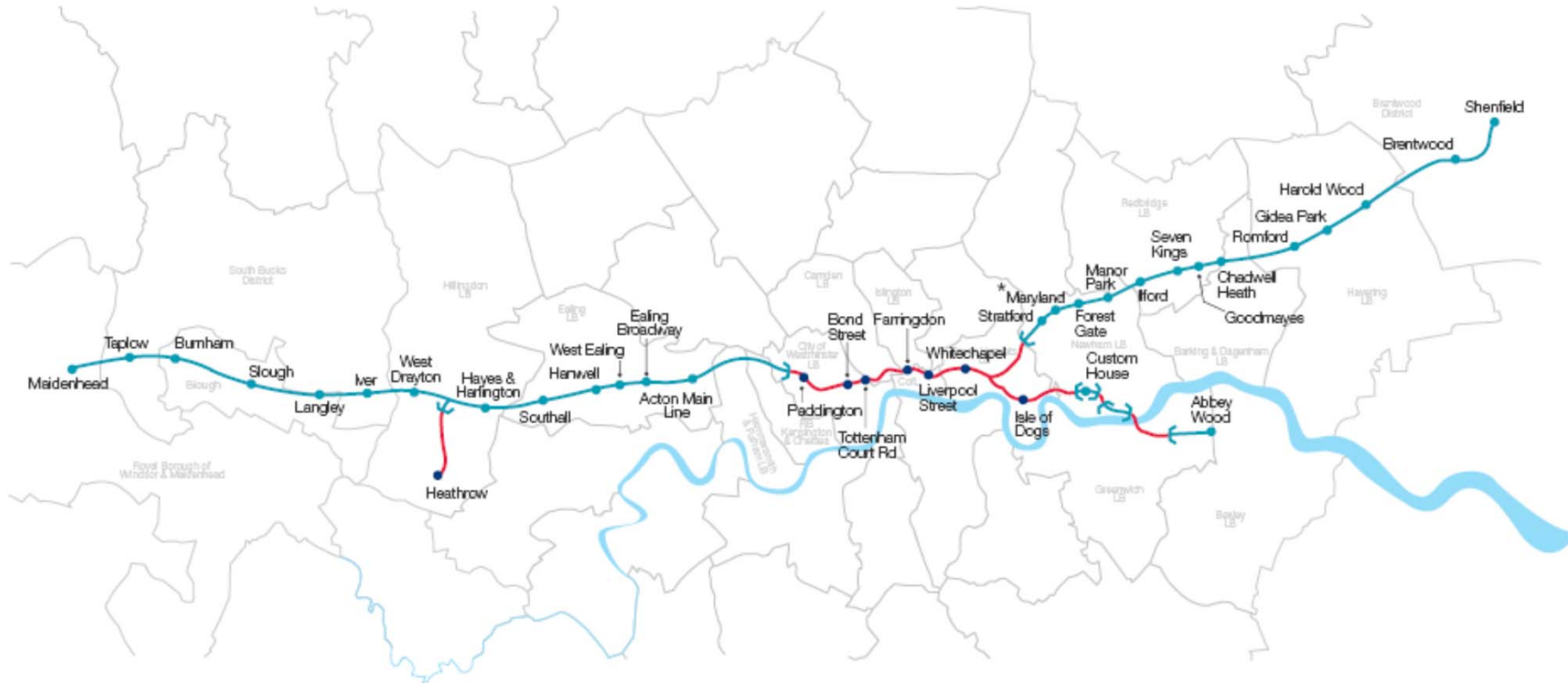
Infrastructure: Crossrail

Table 5: Welfare and GDP impacts of Crossrail (£m)

	Welfare	GDP
Business time savings	4,847	4,847
Commuting time savings	4,152	
Leisure time savings	3,833	
Conventional appraisal	*12,832*	
Labour-market effects	$\eta + \varepsilon =$	11,644
Agglomeration benefits	3,094	3,094
Imperfect competition	485	485
Exchequer revenues	3,580	
Addition to conventional appraisal	*7,159*	
Total	*19,991*	*20,069*

$\alpha + \beta$ brackets the Business/Commuting/Leisure time savings and Conventional appraisal.

δ brackets Agglomeration benefits and Imperfect competition.

ε marks Exchequer revenues.

Note: Environmental impacts not included.

Source: Department for Transport (2006a).

Concluding comments

- Have set out some arguments and applications

- There is enough evidence of the benefits of proximity / scale to make inclusion of 'wider benefits' necessary and feasible.

- BUT:
  - Inherently difficult to value projects that have a 'transformative' effect on the location and efficiency of economic activity.

  - Need to build research and evidence base

  - Risks in moving away from the tightly structured framework of social savings: anything goes?