Centre for Transport Studies
STOCKHOLM

How “wide” are the “wider economic impacts”?

On the overlap between standard CBA and agglomeration benefits

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Economic effects may fall outside standard CBA

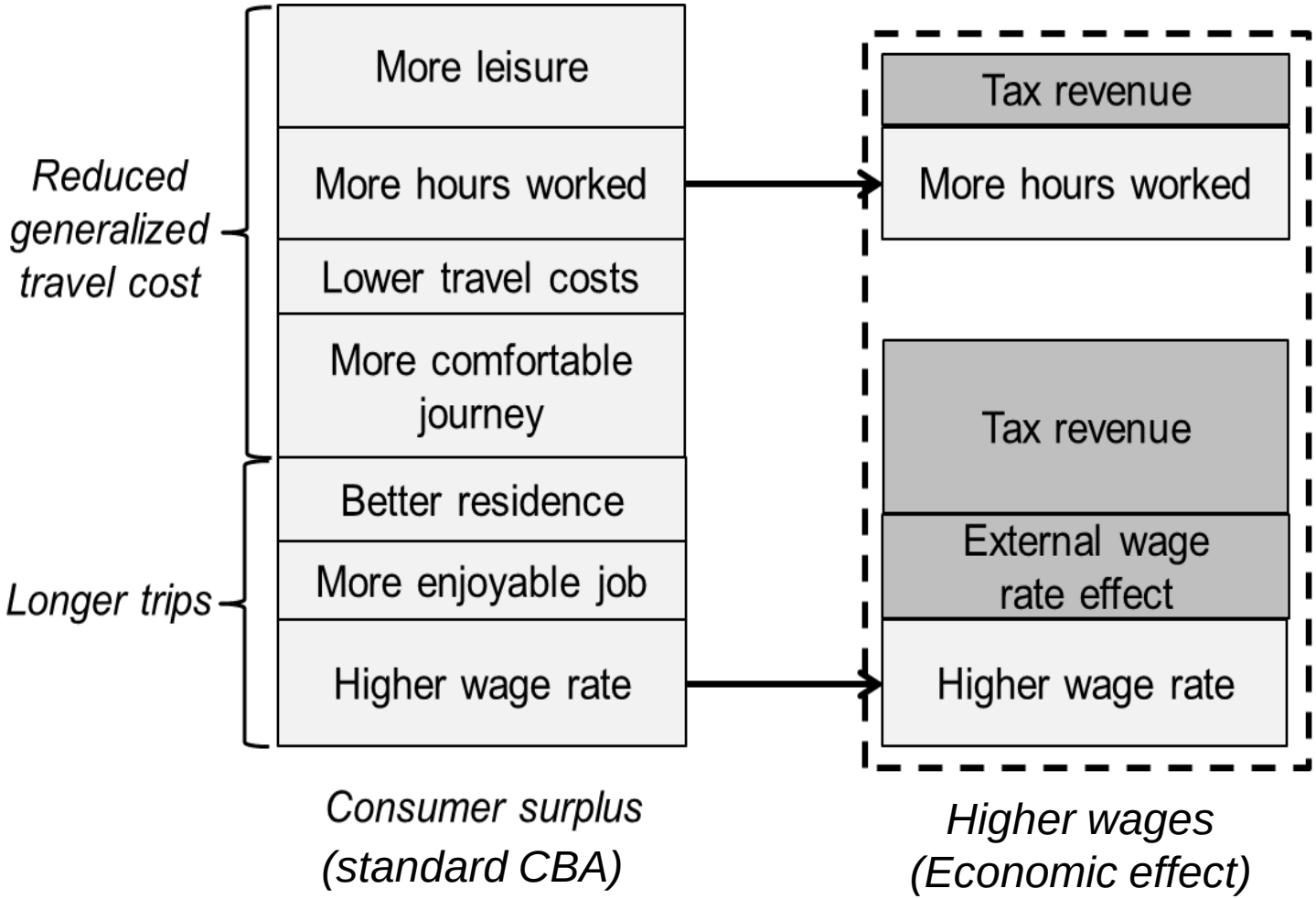
- Labour productivity tends to increase with accessibility
  - And hence with city size
  - Call this ”agglomeration effect”
  - Regional economics is getting better at quantifying this

- Standard transport CBA captures accessibility benefits through the consumer surplus
- External agglomeration effects *or* income taxation => economic benefits outside CBA
  - ”Wider economic impacts”

- The overlap problem:
- Assuming that total economic benefits can be calculated – how much of them should be added to standard CBA?

Focus: Increasing workers' accessibility to jobs

Neglect local monopolies etc.



Summary of the paper

- The size of the overlap will depend on what micro-mechanisms generating agglomeration effects
  - Matching or spillovers (in wide sense)
- It's difficult or impossible to distinguish contributions from various micro-mechanisms to agglomeration effects

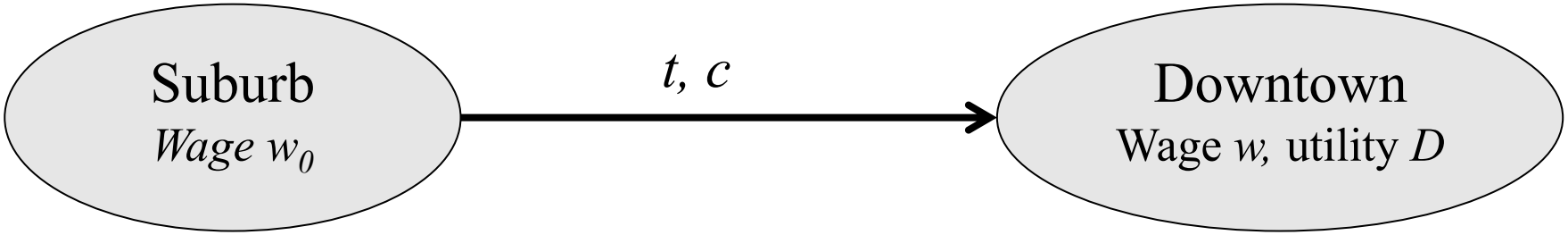
- Hence, the overlap problem is (probably) impossible to solve:
- We can't know how much of economic effects should be added to standard CBA
  - UK practice is wrong
  - Swedish practice is also wrong

Outline

- Two versions of simple two-zone city
- The two city versions are essentially indistinguishable
  - Same elasticities of travel time, travel cost etc.
  - Same relationship accessibility => total wages (=economic output)
  - Standard CBA results of accessibility improvements are identical
- In version 1, all benefits are captured by standard CBA
- In version 2, large benefits fall outside of standard CBA

- ”Micro”-information is needed to distinguish the two versions
- Reality is a mix of the two versions
  - And the ”mix” is likely different across cities and situations

The model



Choose where to work by comparing $u^*(w_0,0,0)$ with $u^*(w,t,c)+D$:

$$u^*(w,t,c) = \max_W u(x,L)$$
such that
$c + x \leq wW + Y$ (budget constraint)
$L + W + t \leq T$ (time constraint)

Wages equal to productivity

w and D are heterogeneous across workers

Distribution of wage rate offers $f(w;N_D)$ depends on number of downtown workers

Three sources of agglomeration effects
(or two)

Decreased travel times =>

- Commuters work more hours => higher total production
  - A.E. due to increased labour supply
- More workers commute => higher average productivity
  - A.E. due to matching effect
- General increase in downtown wages
  - A.E. due to spillover effect

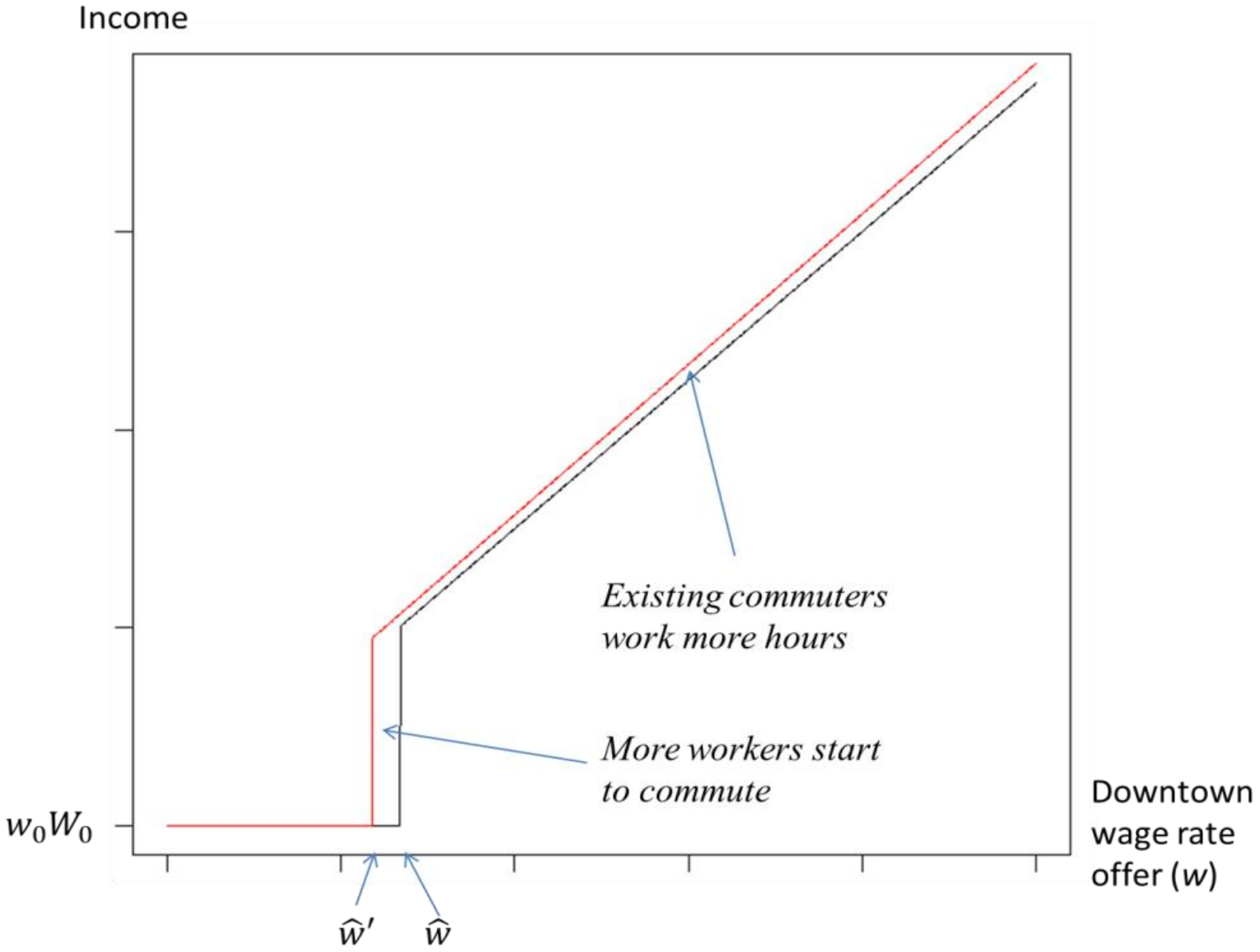
- Hence, better accessibility => higher average productivity

Two versions

- 1: No spillovers
  - A.E. are caused only by matching (+ working hours)
- 2: No heterogeneity in wage rates
  - A.E. are caused only by local spillovers (+ working hours)
  - *D* heterogeneity causes some workers to commute, some not
  - *(could interpret D as space heterogeneity instead)*

- Reality is continuous, not two zones…
- Hence we can't divide workers neatly into "commuters" and "suburbians", and can only observe average wages, commuting distances etc.
- Here, the modeler can't observe "commuters" and "suburbians" separately – only aggregate numbers (average wage, VMT etc)

Version 1


Income
Existing commuters work more hours
More workers start to commute
w_0W_0
$\hat{w}'$
$\hat{w}$
Downtown wage rate offer (w)

Comparison CBA – exact benefits (version 1)

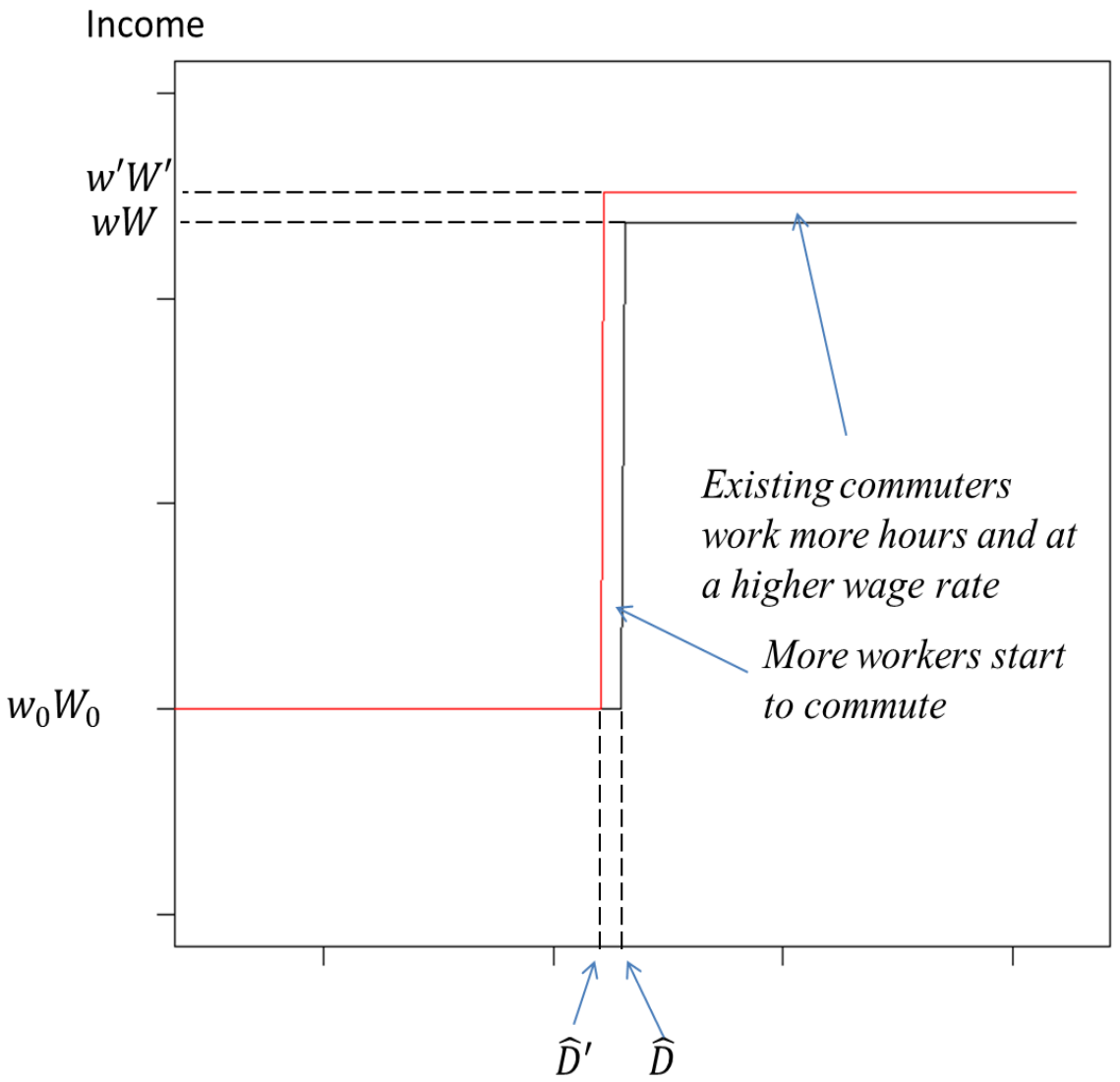
$$TB = \int_{\widehat{w}'}^{\infty} \frac{1}{\lambda} u^*(w, t - dt, c) f(w) dw - \int_{\widehat{w}}^{\infty} \frac{1}{\lambda} u^*(w, t, c) f(w) dw =$$

$$\int_{\widehat{w}}^{\infty} w dt f(w) dw + \int_{\widehat{w}'}^{\widehat{w}} \frac{1}{\lambda} u^*(w, t - dt, c) f(w) dw = N_D * \bar{w} dt + ½ dN * \hat{w} dt$$

$$TB_{CBA} = N_D * \bar{w} dt + ½ dN * \bar{w} dt$$

- **All benefits captured by standard CBA**
- … but slight approximation in the value of time savings

Version 2


Income
$w'W'$
wW
w_0W_0
Existing commuters work more hours and at a higher wage rate
More workers start to commute
$\hat{D}'$
$\hat{D}$
Idiosyncratic commuting utility (D)

Comparison CBA – exact benefits (version 2)

$$TB = \int_{\widehat{D}'}^{\infty} \frac{1}{\lambda} u^*(w', t - dt, c) f(w) dw - \int_{\widehat{D}}^{\infty} \frac{1}{\lambda} u^*(w, t, c) f(w) dw =$$

$$= (W dw + w dt) N_D + \tfrac{1}{2} dN * \tilde{w} dt = TB_{CBA} + (W N_D + \tfrac{1}{2} dN dt) dw$$

$$TB_{CBA} = N_D * \bar{w} dt + \tfrac{1}{2} dN * \bar{w} dt$$

- CBA misses the term with *dw* – the wage increase for existing commuters

Numerical simulations

- $u(x, L) = 0.5 \log(x) + 0.5 \log(L)$
- T=16 hours, t=1 hour, c=5$ and w_0=5$/h
- 1: $f(w)$ uniform 5 to 10$/h
- 2: wage increase elasticity 0.25
- 3: $g(D)$ uniform -2.7 to 0.3 (*used to calibrate model*)

Numerical simulations

- The two versions ”behave” in the same way on an aggregate level:

	Model 1	Model 2
Mean wage rate ($/h)	7.32	5.42
Mean working hours (h)	7.86	7.97
Mean income ($/day)	57.41	43.12
Elasticity of travel wrt. time	-0.22	-0.23
Elasticity of mean wage rate wrt. accessibility	-0.044	-0.047

- BUT:

Wider economics impacts: Benefits outside CBA relative to standard CBA benefits	-1%	+42%

Part 2:
The slipperiness of the generalized cost

Generalized travel cost

- Sum of travel time, travel costs, trip comfort etc.
- Cornerstone of standard CBA
- … and of accessibility measures used to calculate agglomeration

However…

- The size of agglomeration benefits depends on which *component* of the generalized travel cost that is affected by a transport project.
- A change in generalized travel costs of a given size gives rise to different agglomeration benefits depending on which component of the generalized travel cost that changes
- Hence, impossible to establish a fixed relationship between standard CBA benefits and WEIs
  - Since CBA benefits *only* depend on change in generalized cost, not its components

Equivalent reductions of GC may give very different effects (model 2)

Reduction of:	Travel time (t)	Travel disutility (γ)	Travel cost (c)
Elasticity of travel	-0.37	-0.37	-0.17
Elasticity of mean wage rate	-0.064	-0.063	-0.061
Wider economics benefits: benefits outside CBA relative to standard CBA benefits	128%	110%	81%
Wider benefits IF tax revenues are included in the CBA	30%	34%	37%

Conclusions

- Difficult (impossible??) to know the ”overlap” between standard CBA and total economic benefits
- Standard CBA may capture more of benefits than is usually assumed
  - Venables, Graham, UK…
- Important to add change in tax revenues
- Generalized cost is too coarse a measure when studying economic effects of changed accessibility