REGIONAL ECONOMIC IMPACTS OF HIGH SPEED RAIL IN CHINA

Impactos Regionais Econômicos do Trem de Alta Velocidade na China

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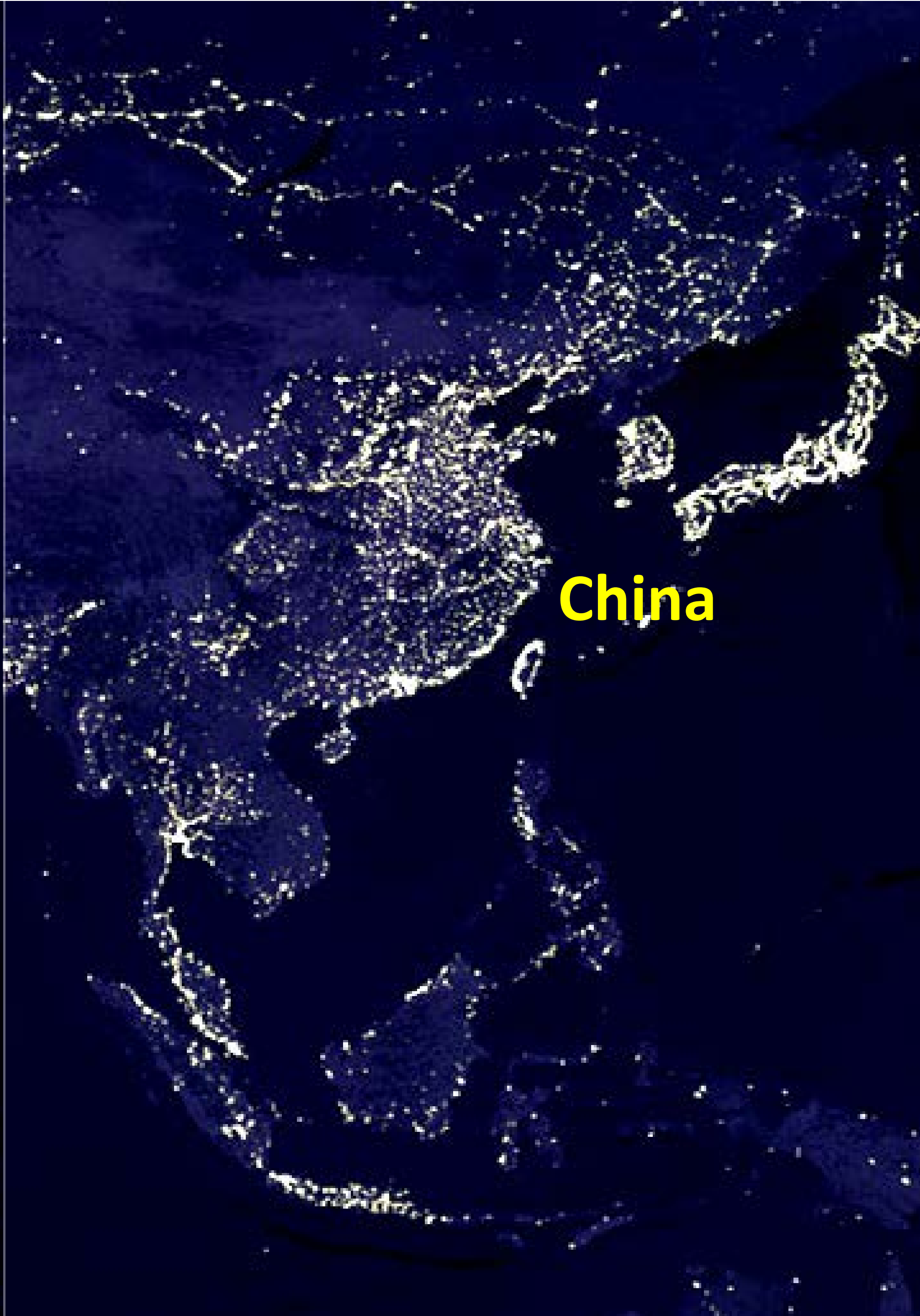


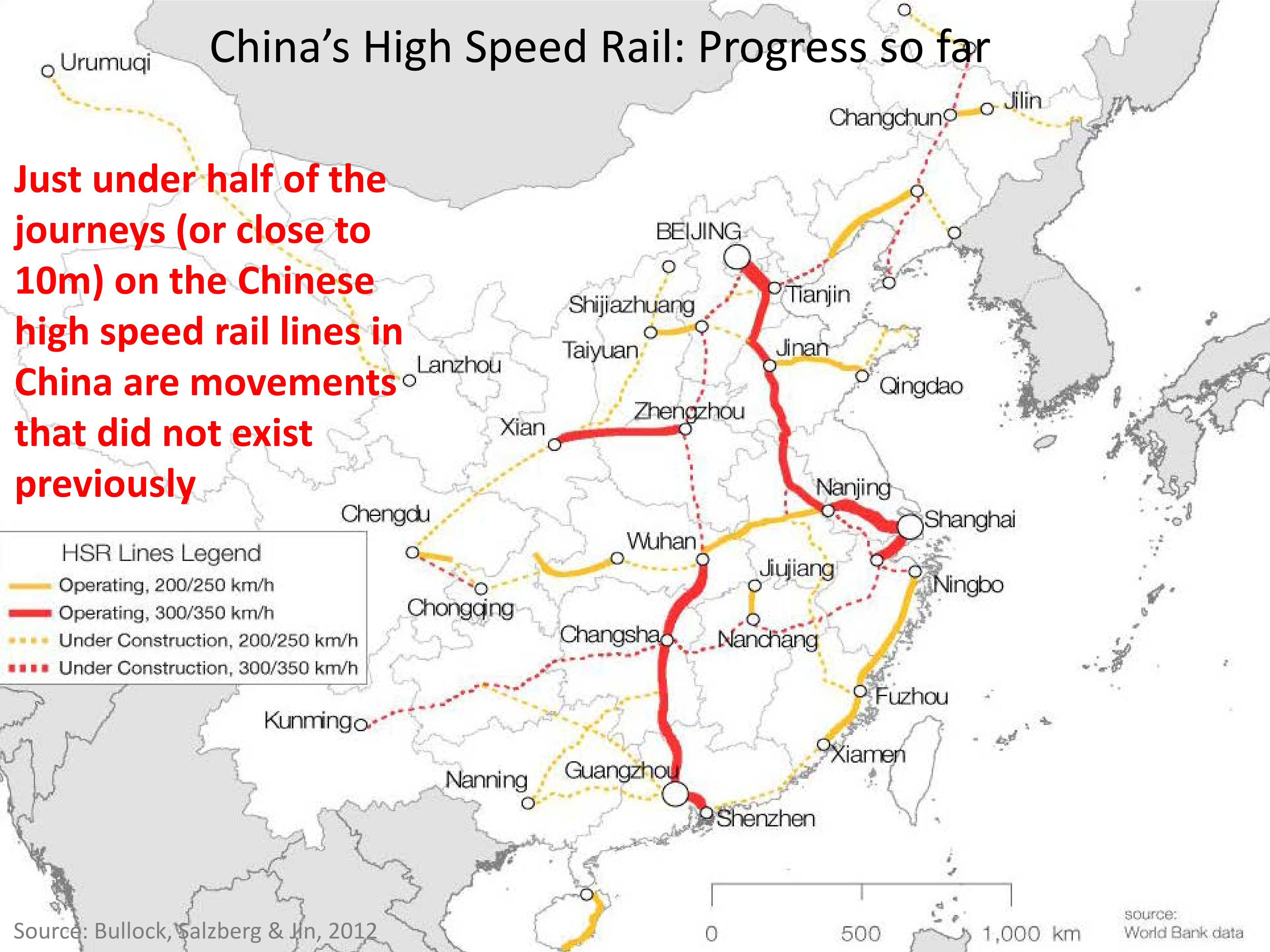
mages: NASA, 2009

In the making: Coastal megalopolises in China

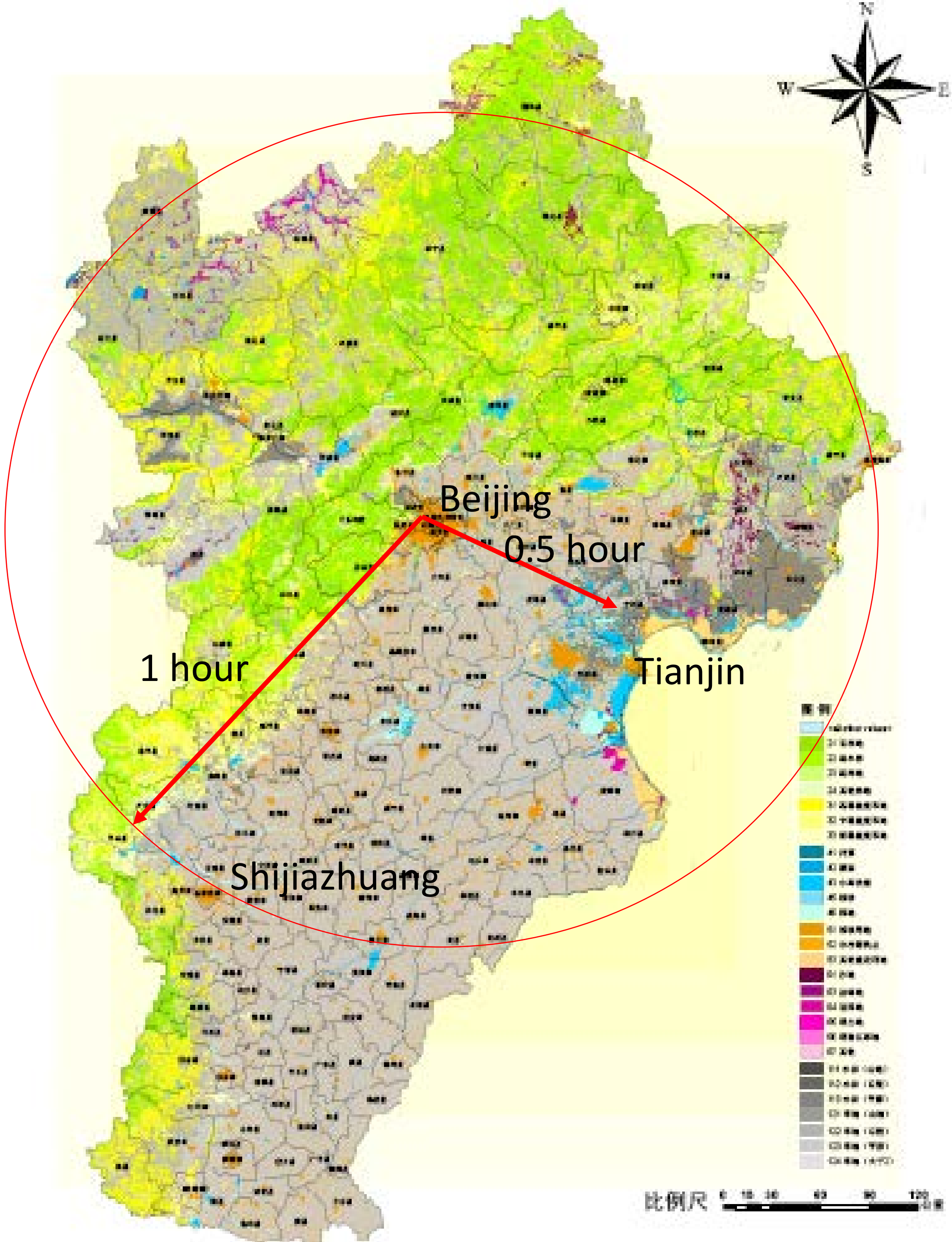
Source: NASA, 200

China’s High Speed Rail: Progress so far

Just under half of the journeys (or close to 10m) on the Chinese high speed rail lines in China are movements that did not exist previously



Source: Bullock, Salzberg & Jin, 2012


N
W
E
S
Beijing
0.5 hour
Tianjin
1 hour
Shijiazhuang
比例尺

Source: NASA, 2010

Arthur Wellesley
1st Duke of Wellington

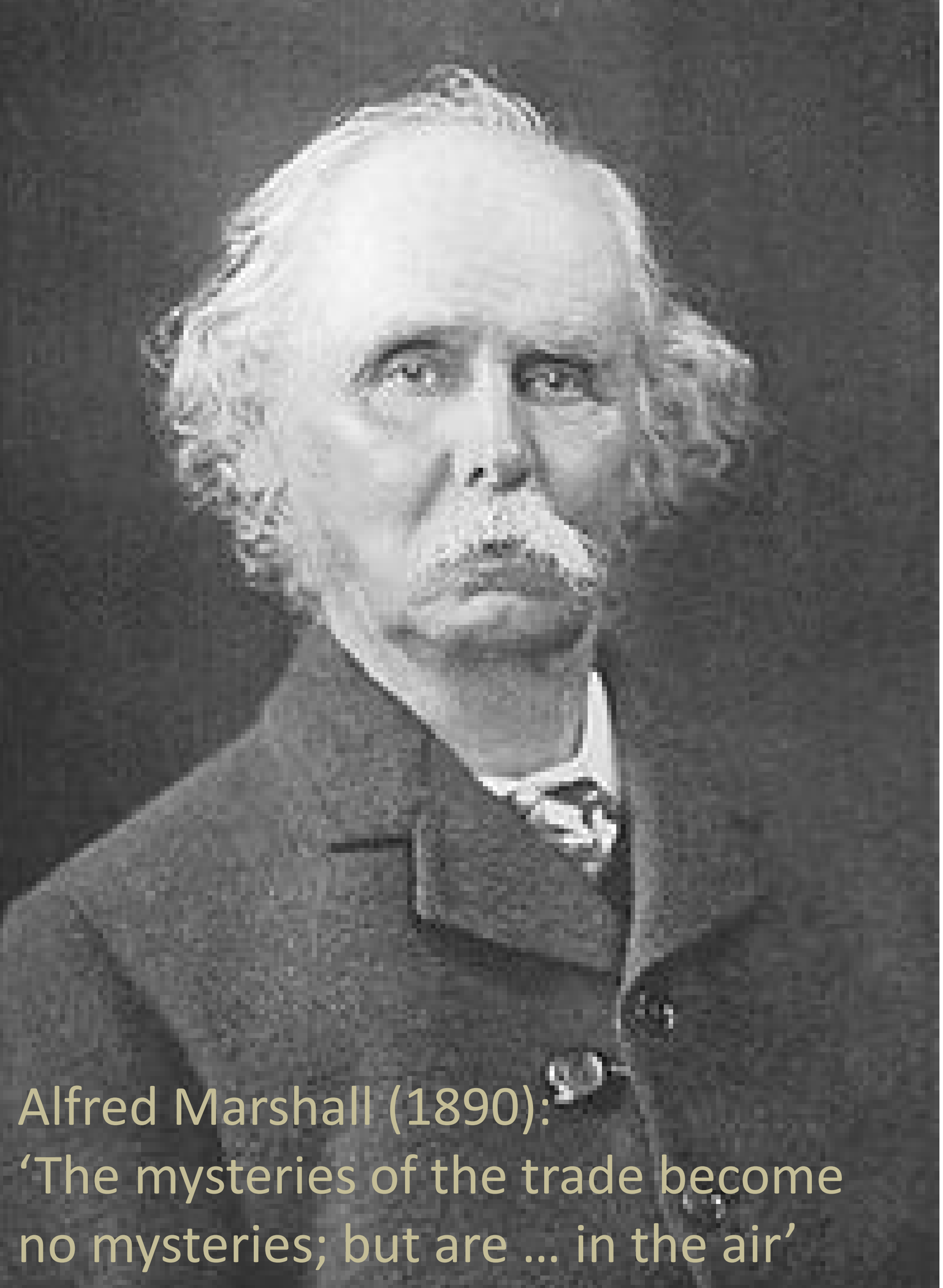
‘Common people travelling needlessly by train’?

Competition with other modes?

China: spatial proximity not to be taken for granted

Source of image: Beijing Urban Planning Museum

- Suburbanisation - China’s urban population rose by 97% while built-up area rose by 176% during 1990-2007 (Zhang, 2008)
- Promoting development in peripheral areas may lead to dispersal of activity relative to the current trend of coastal concentration – it needs efficient transport for face-face contact



Alfred Marshall (1890):
'The mysteries of the trade become no mysteries; but are … in the air'

Why is **spatial proximity** is attractive?

- People are more productive when having easier access to one another's ideas
- Pioneers of New Economic Geography: Fujita, Krugman and Venables (1999)
- 'Triumph of the city': Glaeser (2010)
- Recent empirical evidence
- Significance: to guide strategies for growth

Measuring spatial proximity

'Hansen's accessibility' (1959), or economic mass: sum of accessible economic activity weighted by transport cost, e.g.

$$M_i = \sum_j \left(\frac{E_j}{g_{ij}^{\alpha}} \right)$$

Including effects of transport

$$M_{Cambridge} = \frac{Employment_{Cambridge}}{Travel\_time_{Inside\_Cambridge}} + \frac{Employment_{South\_Cambs}}{Travel\_time_{S\_Cambs\_to\_Cambridge}} + \frac{Employment_{London}}{Travel\_time_{London\_to\_Cambridge}} + \ldots$$

– This is effective 'city size' incorporating compactness for business interactions

– There can be alternative functional forms, e.g. Rice, Venables and Patacchini (2006) use

$$M_i = \sum_j E_j e^{(-1.37(T_{ij} - 30)/30)}$$

Econometrics

$$y_i = \beta^0 \bullet M_i^{\beta^M} \bullet X1_i^{\beta^1} \bullet X2_i^{\beta^2} \bullet X3_i^{\beta^3} \bullet \ldots$$

$$\ln(y_i) = \beta^0 + \beta^M \ln(M_i) + \beta^1 \ln(X1_i) + \beta^2 \ln(X2_i) + \beta^3 \ln(X3_i) + \ldots$$

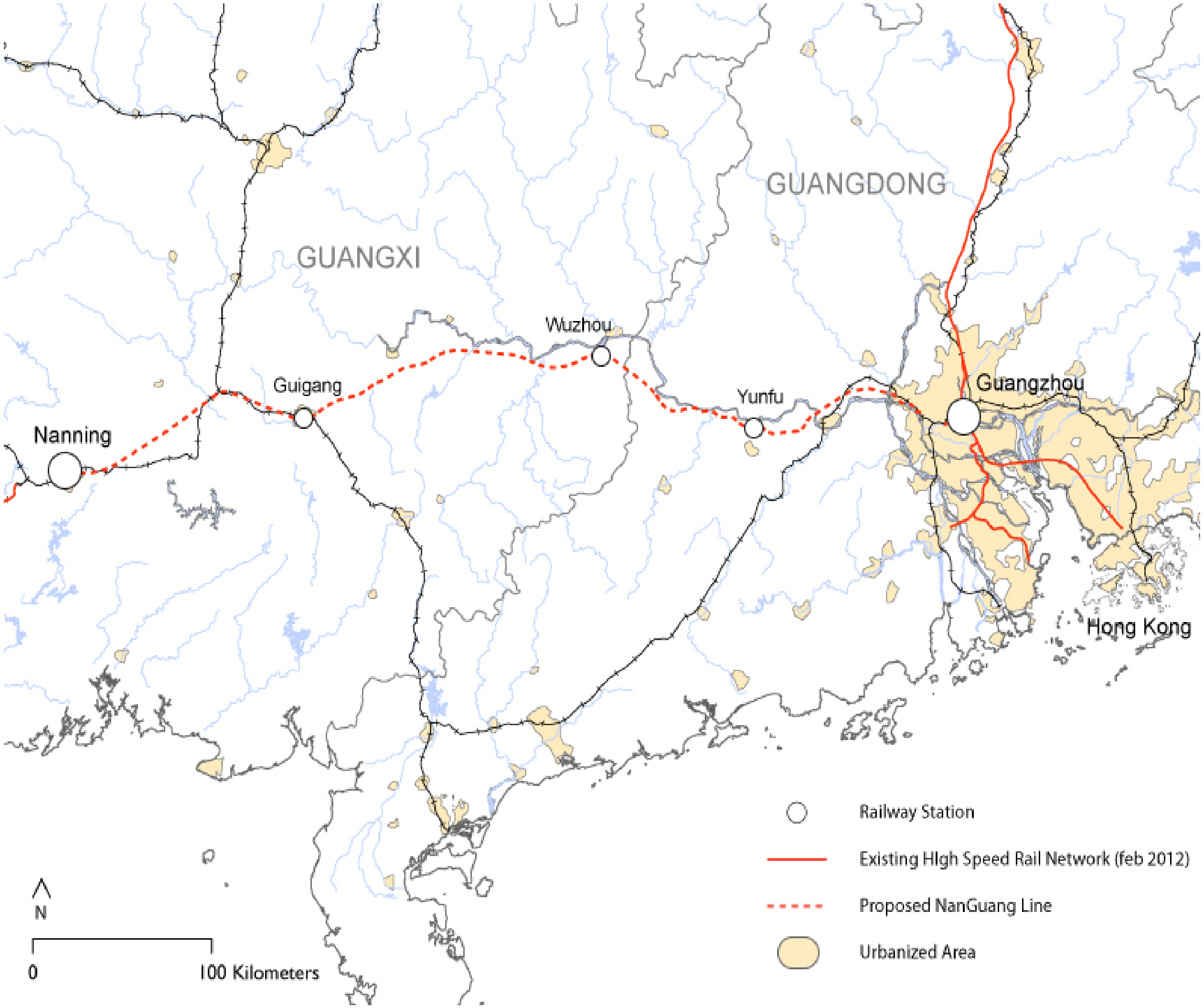
- y_i Nominal income per employee
- M_i Economic mass
- $X1_i$ Labour skills index
- $X2_i$ Capital stock per employee
- $X3_i$ Location quotient for R&D industry

- Economic mass shown to be statistically significant, after controlling for skills, capital and industry composition – productivity effects

Productivity effects of proximity

- A difficult area of econometric work
- Some see an emerging consensus (Vickerman, 2007):
  - Across developed countries: ‘Doubling city size seems to increase productivity by an amount that ranges from… roughly 5-8%’ (Rosenthal and Strange, 2004)
  - In the UK: ‘doubling the economic mass to which an area has access raises its productivity by 3.5%’ (Rice et al, 2006)
  - Considering spatial sorting typically reduces the elasticity by half (P-Ph Combes et al, 2008)
  - Accounting for learning effects raises the magnitude of the effects to about double (Puga, 2011)
- Very little empirical evidence for the emerging economies; Jin et al (2011) suggest 9% for Guangdong, China, and Glaeser (2011) suggest higher for India

The case study estimates the agglomeration benefits accruing from the construction of the Nanguang medium-speed line



KEY STATISTICS

- Distance – 471 km
- Speed – 200km/h (pax), 120km/h (frt)
- Cost - Rmb 37 bn (Rmb 2008) – about $US 5 bn
- Four main centres served by line: Wuzhou, Guigang, Nanning and Kunming

Source: Jin et al, 2012

The application drew upon the UK DfT approach

$$W^{A/B} = \left[\left(\frac{d^{A}}{d^{B_0}} \right)^{\gamma} - \left(\frac{d^{B}}{d^{B_0}} \right)^{\gamma} \right] \times h \times E^{A}$$

$W^{A/B}$	Agglomeration benefits for the Alternative Case (A) vs the Base Case (B)
d^{A}, d^{B}	Economic masses of location for A and B respectively
d^{B_0}	Economic mass for the Base Year (e.g. the Year 2006)
γ	Productivity elasticity parameter with respect to economic mass, to be empirically estimated
h	GDP per worker
E^{A}	Size of employment in the Alternative Case A

Although the statistical analysis gave an estimate of the elasticity with respect to economic mass in Guangdong of 0.124, a lower, more conservative value of 0.075 was used in this project.

Source: Jin et al, 2012

The starting point is the difference between the costs and travel times without and with the project

	Travel time (hrs)(1)					Tariff (Rmb)				
	Gzhou	Shanghai	Chengdu	Beijing	Nanning	Gzhou	Shanghai	Chengdu	Beijing	Nanning
Air										
Nanning	2.5	4.5	3.0	5.0		780	1440	1080	2100	
Kunming	3.5	5.0	2.5	5.0		1310	1950	750	1860	
Rail (conv)										
Nanning	11.1	9.0	7.9	11.0		113	515	440	640	
Kunming	21.5	11.4	5.3	13.1		229	669	275	779	
Guigang	8.8				1.6	88				39
Wuzhou	7.3				7.7	75				88
Rail (HSL)										
Nanning	3.5					125				
Kunming	6.4					260				
Guigang	2.6					101				
Wuzhou	1.9				2.3	55				85
Road										
Nanning	8.8	25.9	19.5	24.0		213	676	504	813	
Kunming	18.9	32.7	12.6	35.5		229	669	275	779	
Guigang	7.5				2.8	176				50
Wuzhou	4.2				5.5	88				123

Source: Jin et al, 2012

The changes in travel time and cost create changes in mode choice on the relevant routes

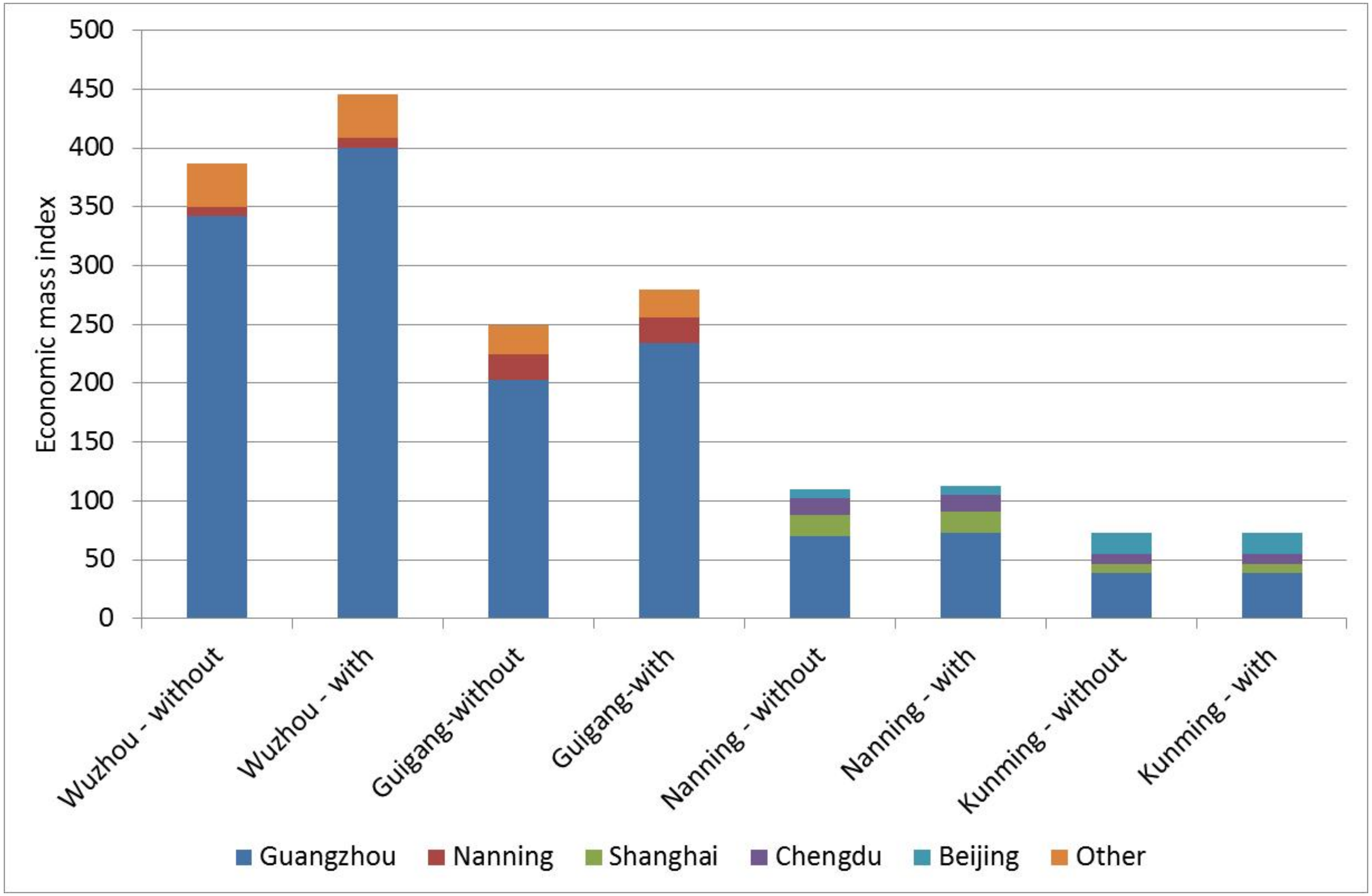
		Modal share without project (%)			Modal share with project (%)			Composite utility[1]	
From	To	Air	Rail	Road	Air	Rail	Road	Without	With
Wuzhou	Guangzhou	0	2	98	0	37	63	18.3	15.3
	Nanning	0	2	98	0	21	79	23.3	21.9
Guigang	Guangzhou	0	43	57	0	71	29	30.3	26.3
	Nanning	0	61	39				8.8	
Nanning	Guangzhou	8	37	55	5	60	35	87.4	84.
	Shanghai	6	85	9				155.1	
	Chengdu	7	85	8				114.9	
	Beijing	13	68	20				243.0	
Kunming	Guangzhou	31	46	23	24	58	18	159.3	155.9
	Shanghai	45	49	5				407.6	
	Chengdu	25	59	16				91.2	
	Beijing	47	48	5				230.2	

Measured in hours of generalized time (i.e. travel time plus cost converted to time using appropriate value of time)

The ‘composite utility’ is a standard output of choice models which use a logit formulation (as almost all do in practice) – it is also known as the logsum. For a single-mode model, it is identical to conventional generalised cost.

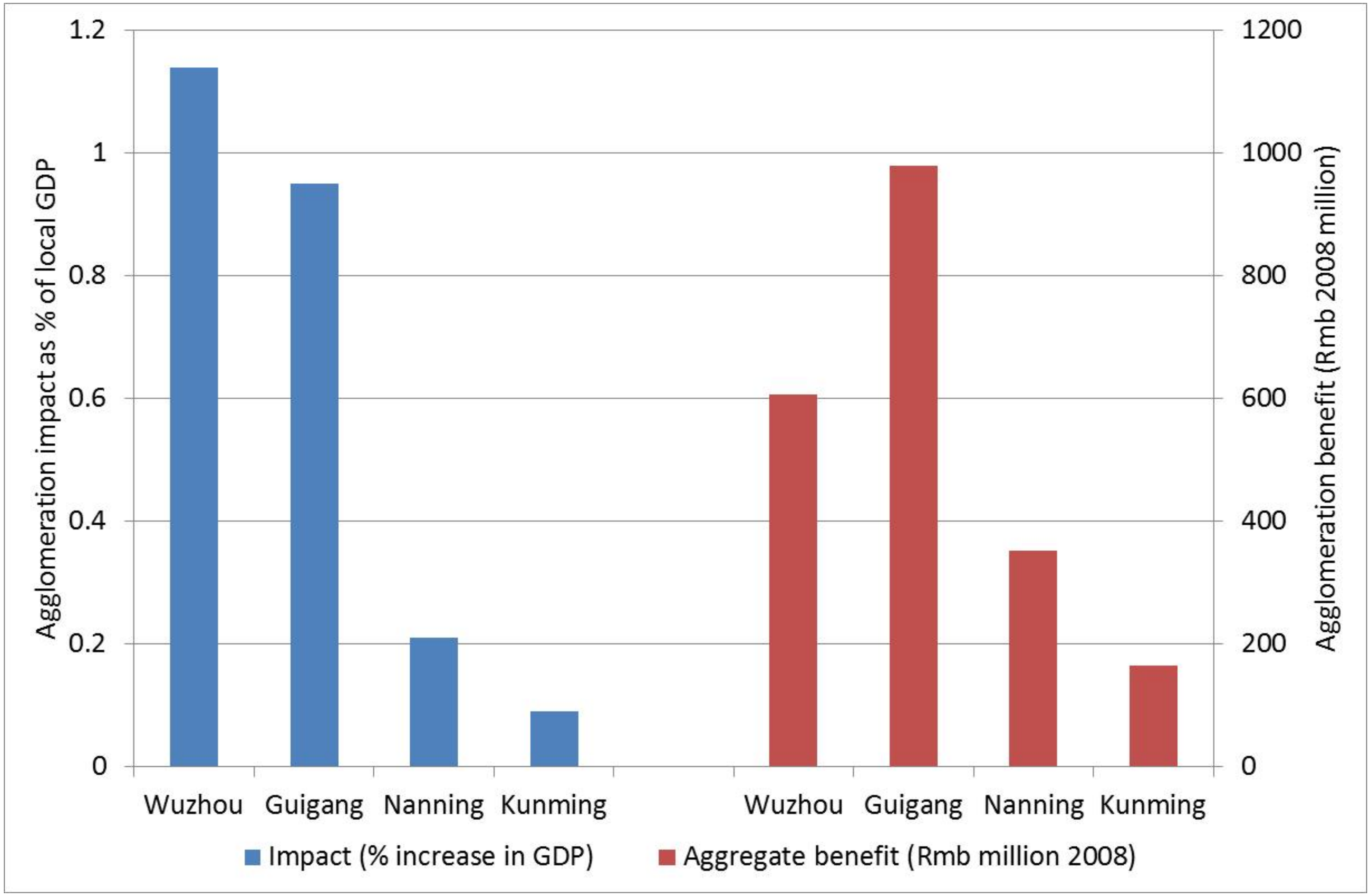
Source: Jin et al, 2012

Accessibility can then be derived from the composite utility - in this case the improved accessibility to Guangzhou dominates the changes in economic mass



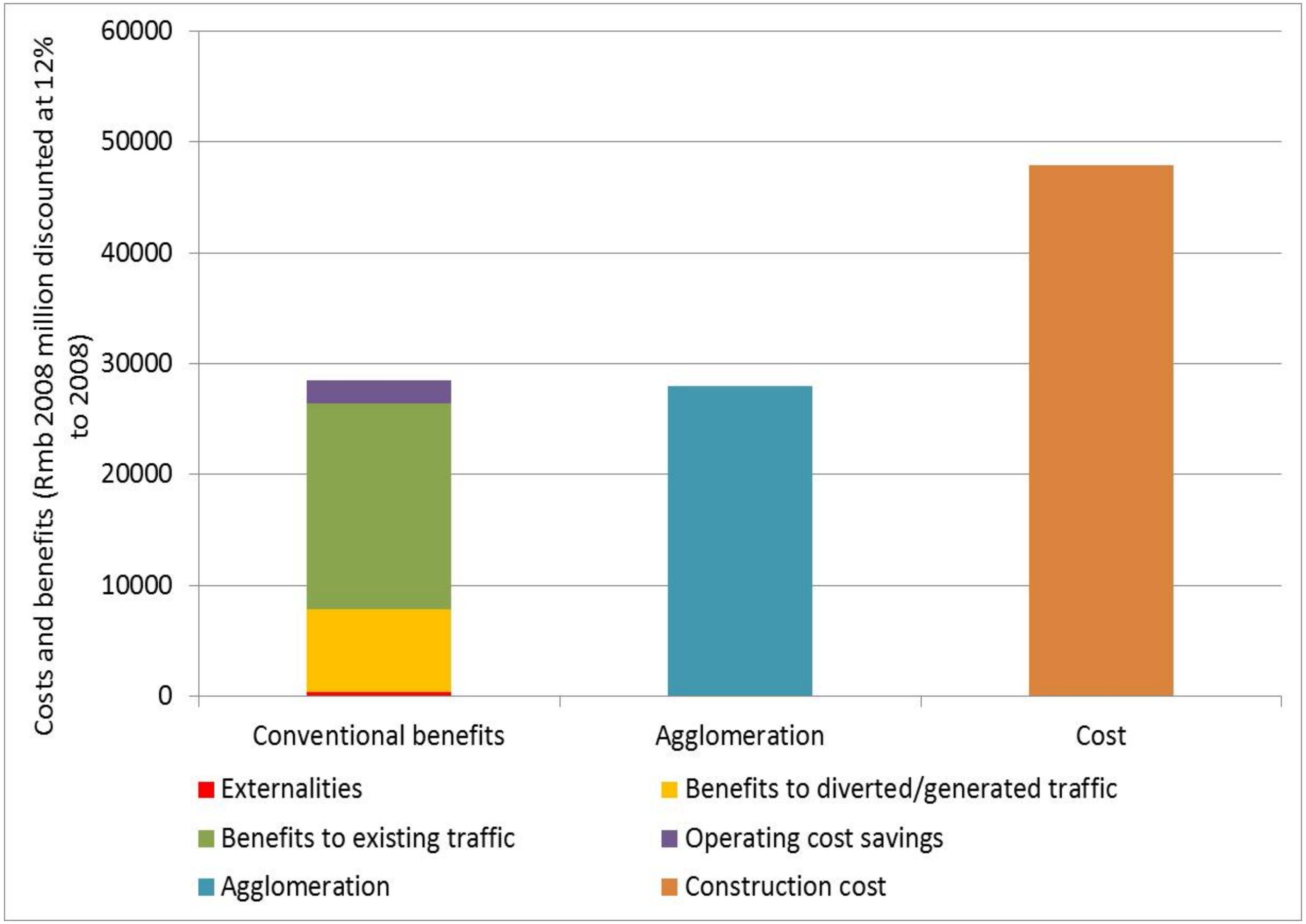
Source: Jin et al, 2012

The changes in economic mass are then factored by the agglomeration elasticity - the largest percentage impact is in Wuzhou but the largest absolute impact is in Guigang



Source: Jin et al, 2012

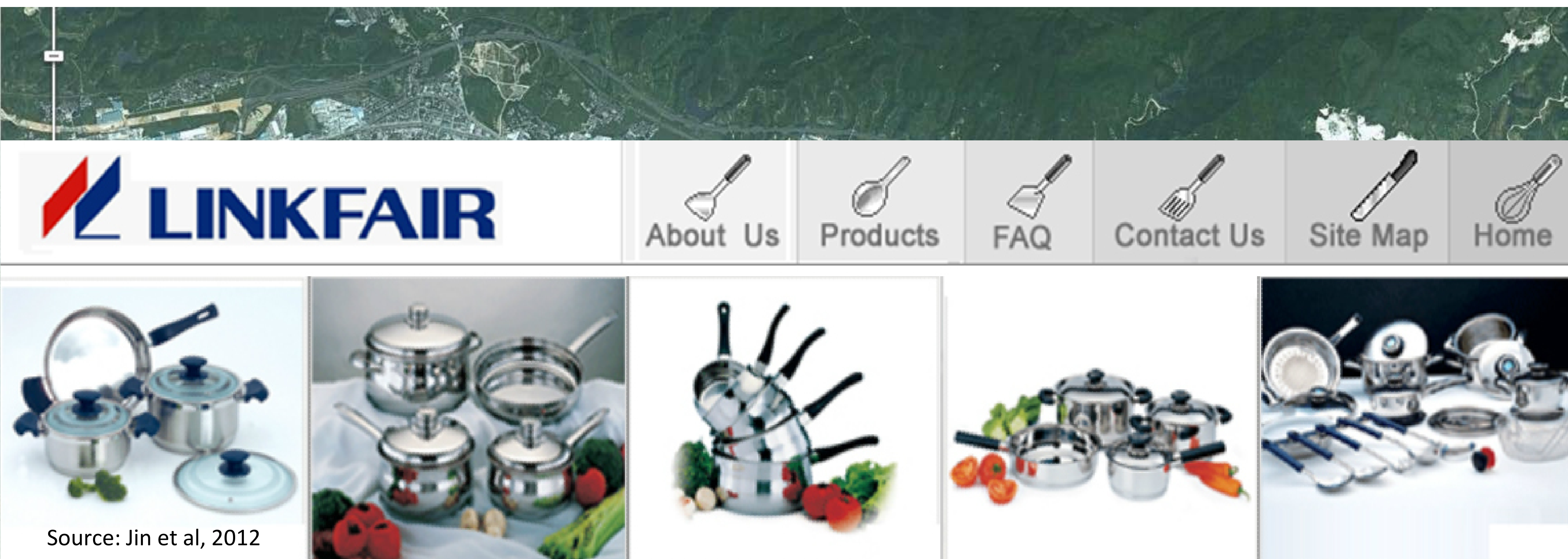
The Nanguang project had an EIRR of 13% when agglomeration benefits are included and 9% when they are excluded



Source: Jin et al, 2012

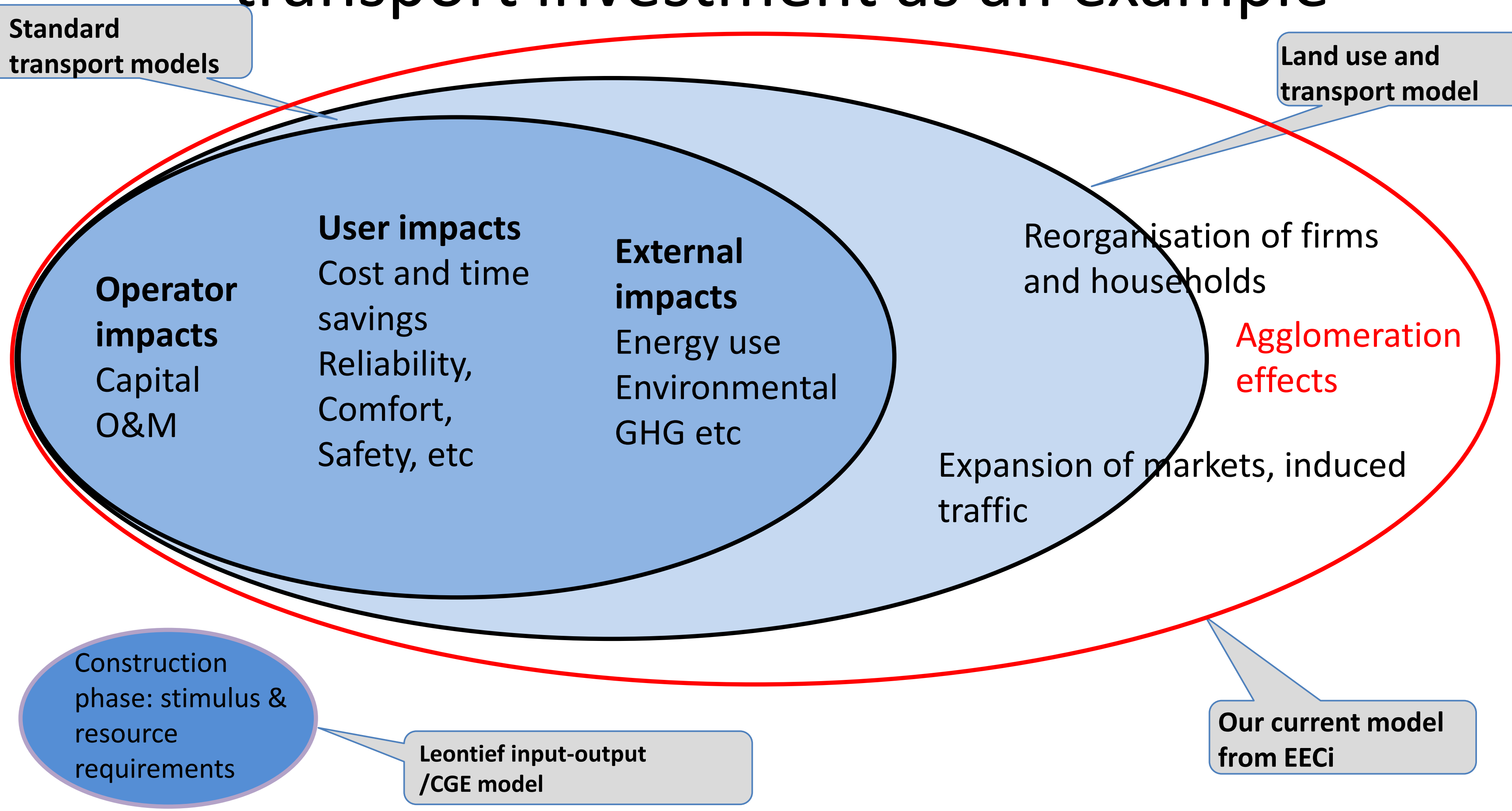
At the micro-level field work uncovered specific examples where improved accessibility would improve productivity

- Urbanisation economies: Linkfair Group Co (cookware).



Source: Jin et al, 2012

Measuring the effects: transport investment as an example



Models used to examine the direction of urban growth, its performance, and what more can be done: ReVisions (£4m), Energy Efficient Cities EECi (£3m), Centre for Smart Infrastructure (£17m), Low Carbon Urban Design in China (US$0.2m seed fund).

The key to the success of the High Speed Rail is urban planning

- Transport improvements is a necessary rather a sufficient condition for growth
  - Interactions between productivity growth, job growth, external direct investment, and governance
  - The elasticity parameters may change over time, according to the level of development (data shows that they are higher in the emerging economies)
- A wider pool of evidence from the emerging economies is important

High Speed Rail Station in Wuhan, Central China

Sources: http://www.map3.net/en/wuhan.html; http://chinaholisticenglish.org/wp-content/uploads/2010/04/Station.jpg

Conclusions

- Modern cities grow – more for reasons of agglomeration than natural advantages
- This offers opportunities to guide the direction and intensity of urban growth
- Huge investment needed for infrastructure and governance – increased per person productivity provides the only sustainable funding stream over time
- High speed rail is one of the essential instruments for shaping the mega-city regions in China in the next 20-30 years