Karlsruher Institut für Technologie

ECON

Impact of High Speed Rail Investments on Regional and Urban Development

Werner Rothengatter

Karlsruhe Institute of Technology

- Economic approaches to measure the impacts of HSR
- General lessons from regional economic analysis
- Specific lessons from case studies: impacts on regional and urban development
- Conclusions

Economic approaches to measure the impacts of HSR

ECON

- Micro-economic ex-post analysis
  ➔ unclear evidence of impact
- New geographic economy
  ➔ agglomeration effects
- Endogenous growth theory integrated in system dynamics
  ➔ long-term impact on productivity
- Regional potential analysis
  ➔ impact subject to bottlenecks

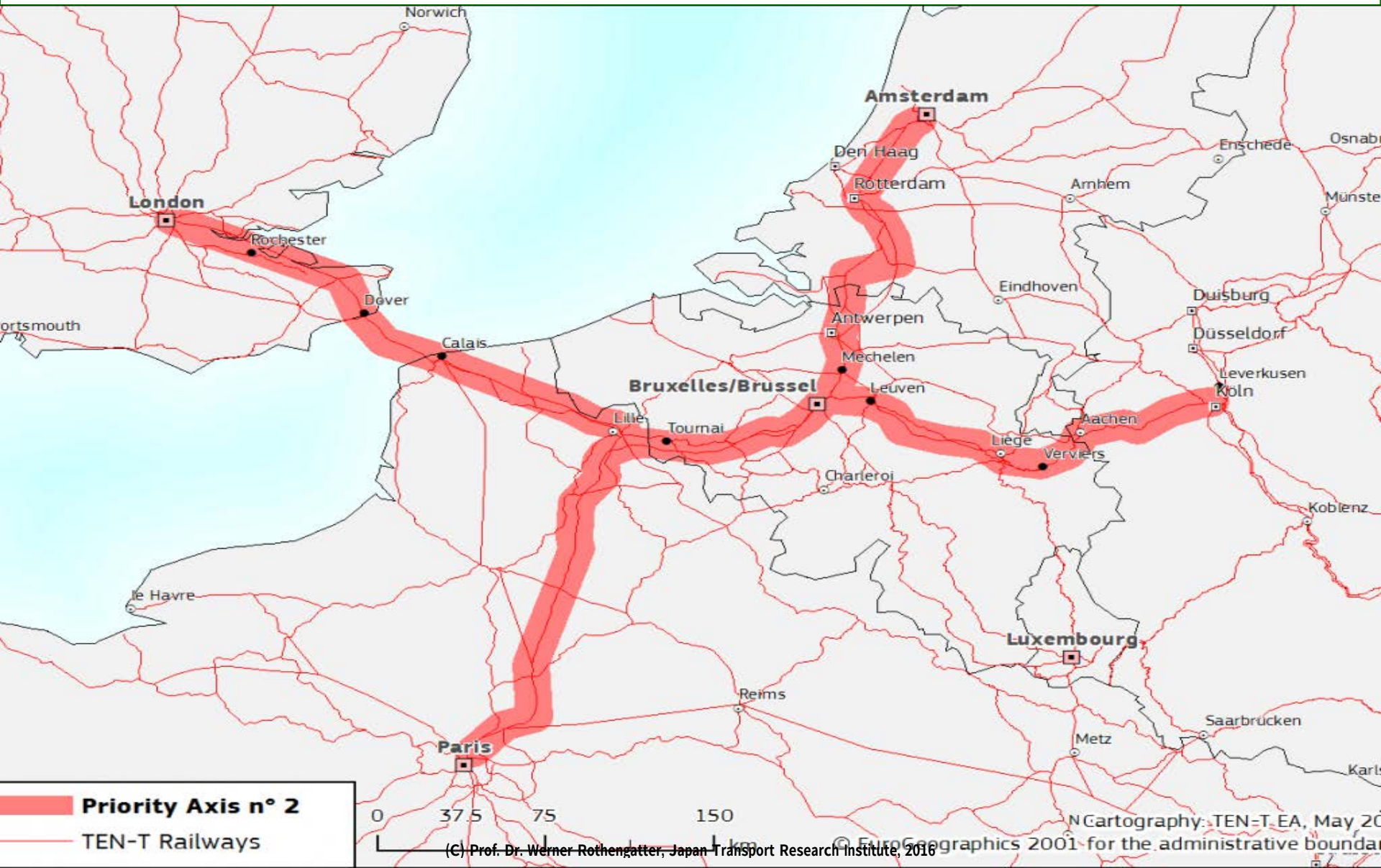
Paul Krugman
Nobel Prize Winner for Economics
2008

ECON

- Paul Krugman, Nobel Prize 2008
- New geographic economy: Impact of increasing returns on spatial activity
- Higher productivity through higher density and/or better accessibility
- Empirical analysis by Venables and Graham; crucial parameter: elasticity of productivity on effective employment density

HSR Paris-Brussels-Cologne-Amsterdam-London

ECON



Operator	1995	2000	2005	2007	2009	2011	2013	Δ95-13
Eurostar	4.9	7.1	7.45	8.26	9.2	9.7	10.1	+106%
Thalys	1.54	5.5	6.19	6.2	6.08	6.65	6.69	+334%
ICE Int.*							3.0	n.a.

* Frankfurt-Amsterdam and Frankfurt-Brussels. national and international passengers

Source: European Commission (2012) and press releases by Thalys and Eurostar

Findings (Vickerman 2015)

- Agglomerations have benefited from HSR: Density impacts in big cities, accessibility impacts in medium sized cities (Lille)
- Little impacts on regions in between HSR stations
- Examples: Nord Pas de Calais (FR), Kent (UK), only positive touristic effects (Disney Land Paris), no reduction of regional disparities

Agglomeration economies: elasticity of productivity with respect to effective employment

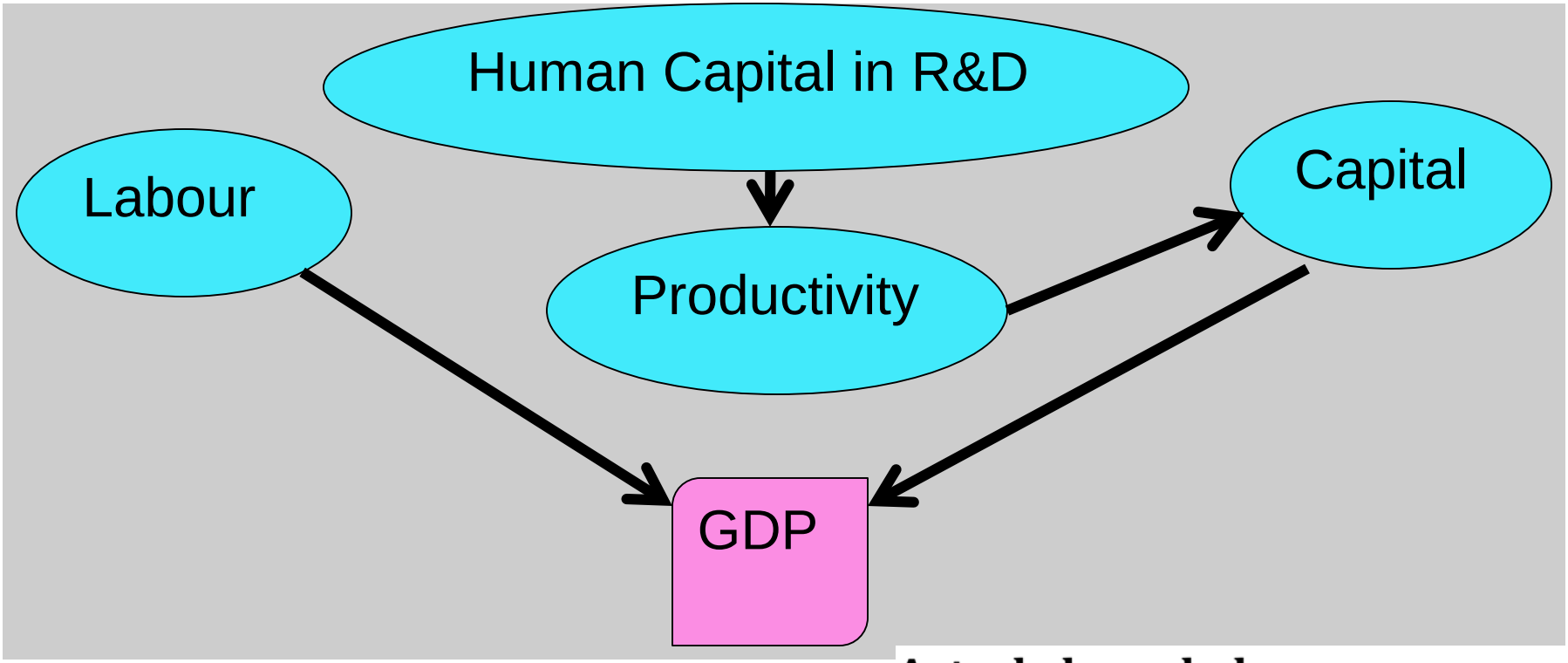
ECON

Industry	Sydney	UK	New Zealand	Melbourne
Retail Trade	0.003	0.042	0.086	0.080
Accommodation, Cafés, Restaurants	-0.003	0.042	0.056	0.09
Electricity, Gas, Water Supply	0.108	0	0.035	0.07

Paul Romer
Chief Economist of the World Bank
2016

ECON

The Endogenous Growth Approach
Paul Romer, 1996



$$\dot{A} = \frac{dA}{dt} = \delta * H_A * A$$

A: tech. knowledge

H_A: human capital

δ: productivity of H_A in R&D

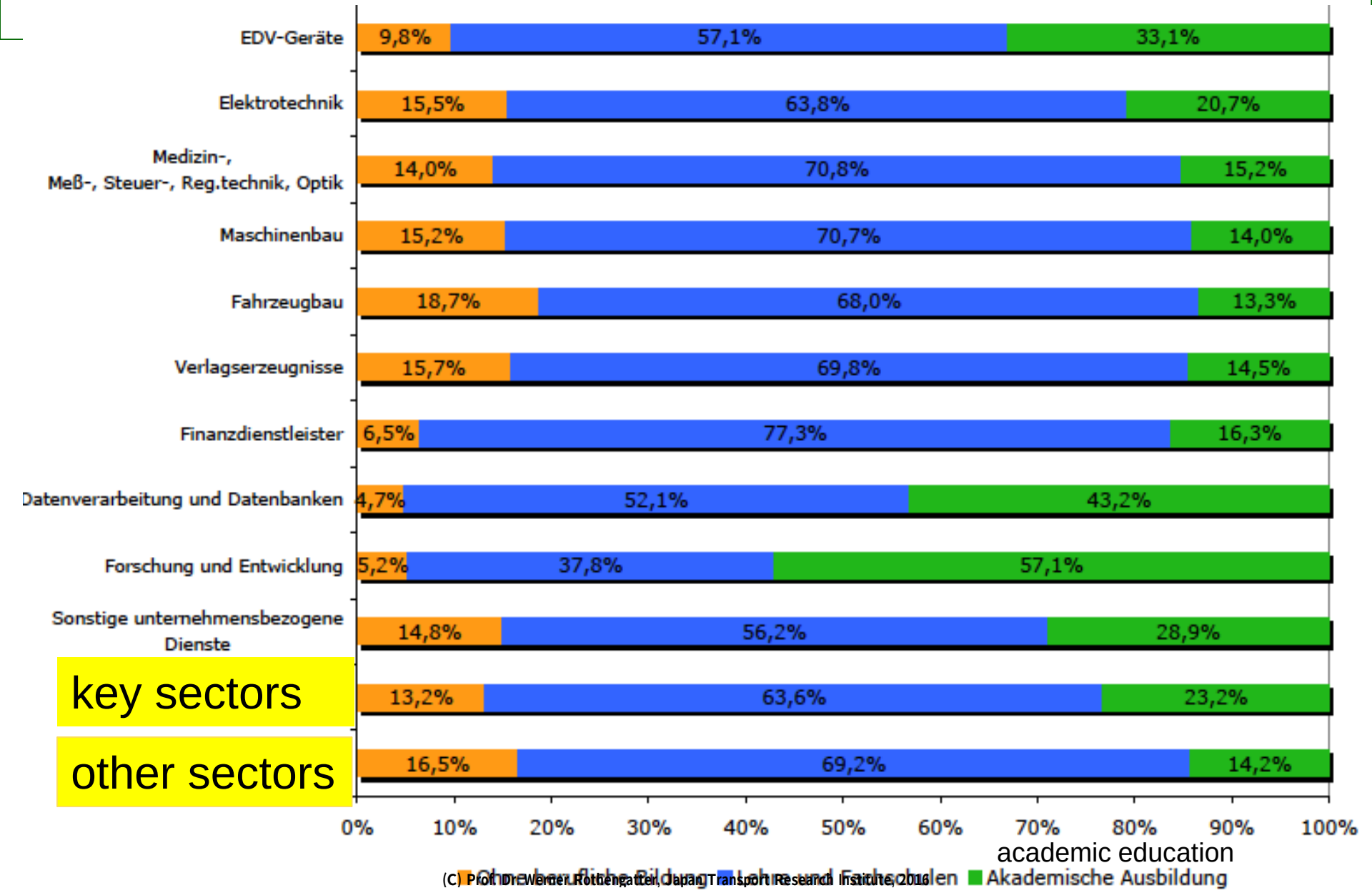
Endogenous Growth Feedback Mechanisms

Freight: HSR ➔ time savings, higher reliability, better synchronization of supply chains ➔ higher productivity ➔ long-term growth

Passengers: HSR ➔ better connections to fast transport modes, attraction of high skilled workers (high qualified workers have higher mobility demand)
➔ higher productivity ➔ long-term growth

Share of academics in key sectors Baden-Württemberg (green)

ECON



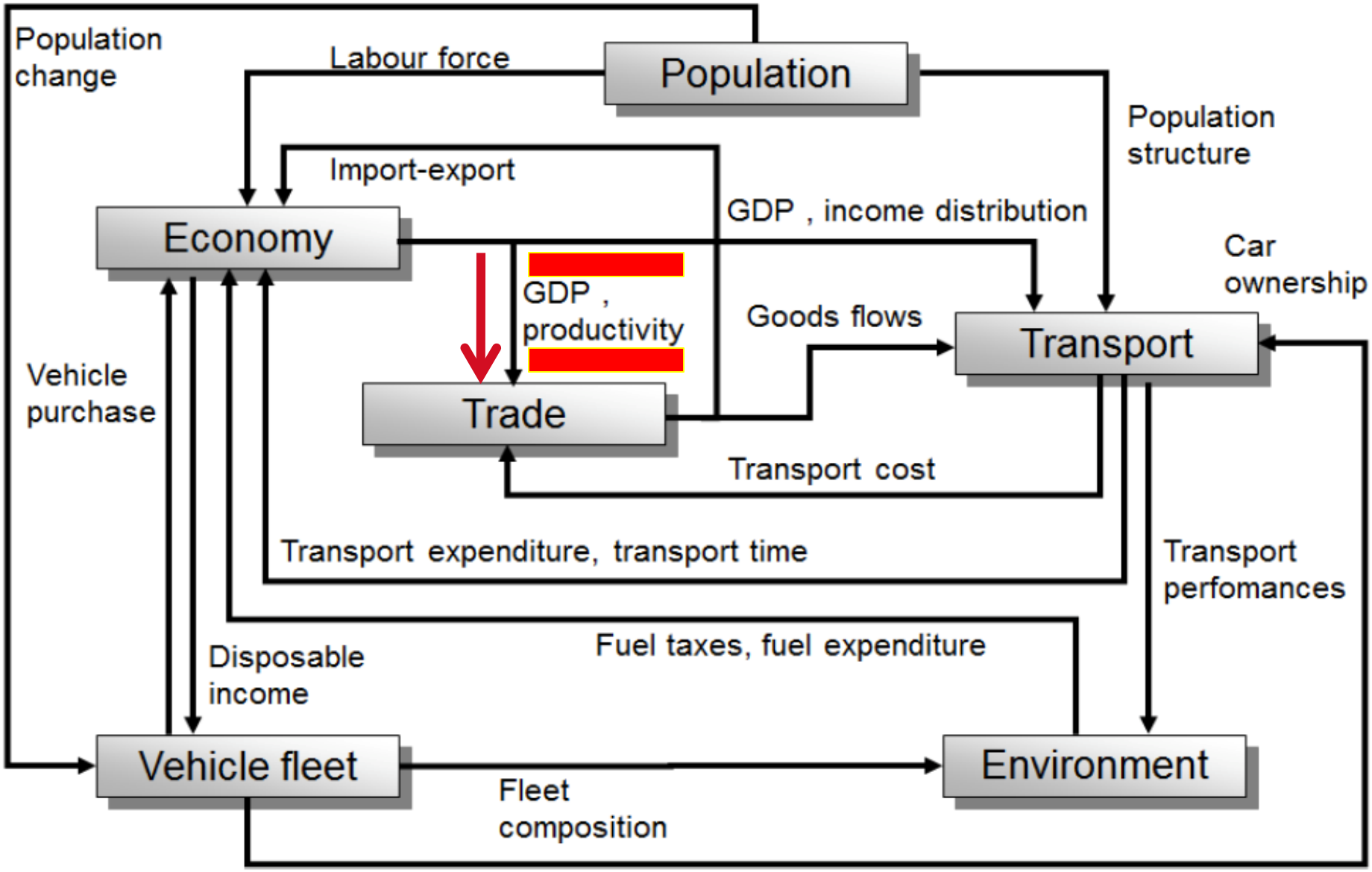
key sectors

other sectors

academic education

System Dynamics Approach
The ASTRA Model

ECON

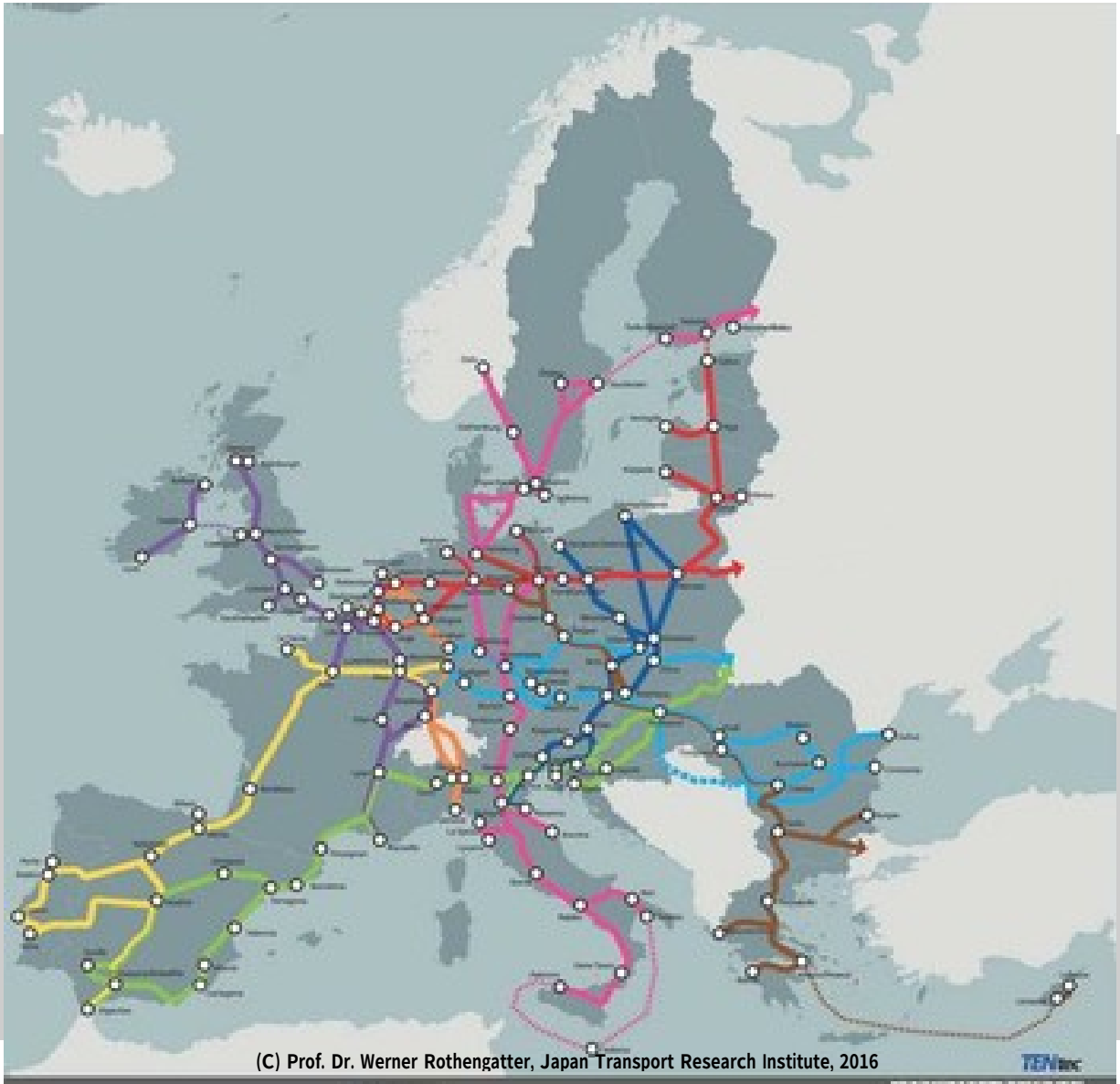


Source: *TRT - Fraunhofer-ISI*

TEN-T and the status of CNC Infrastructure planning

ECON

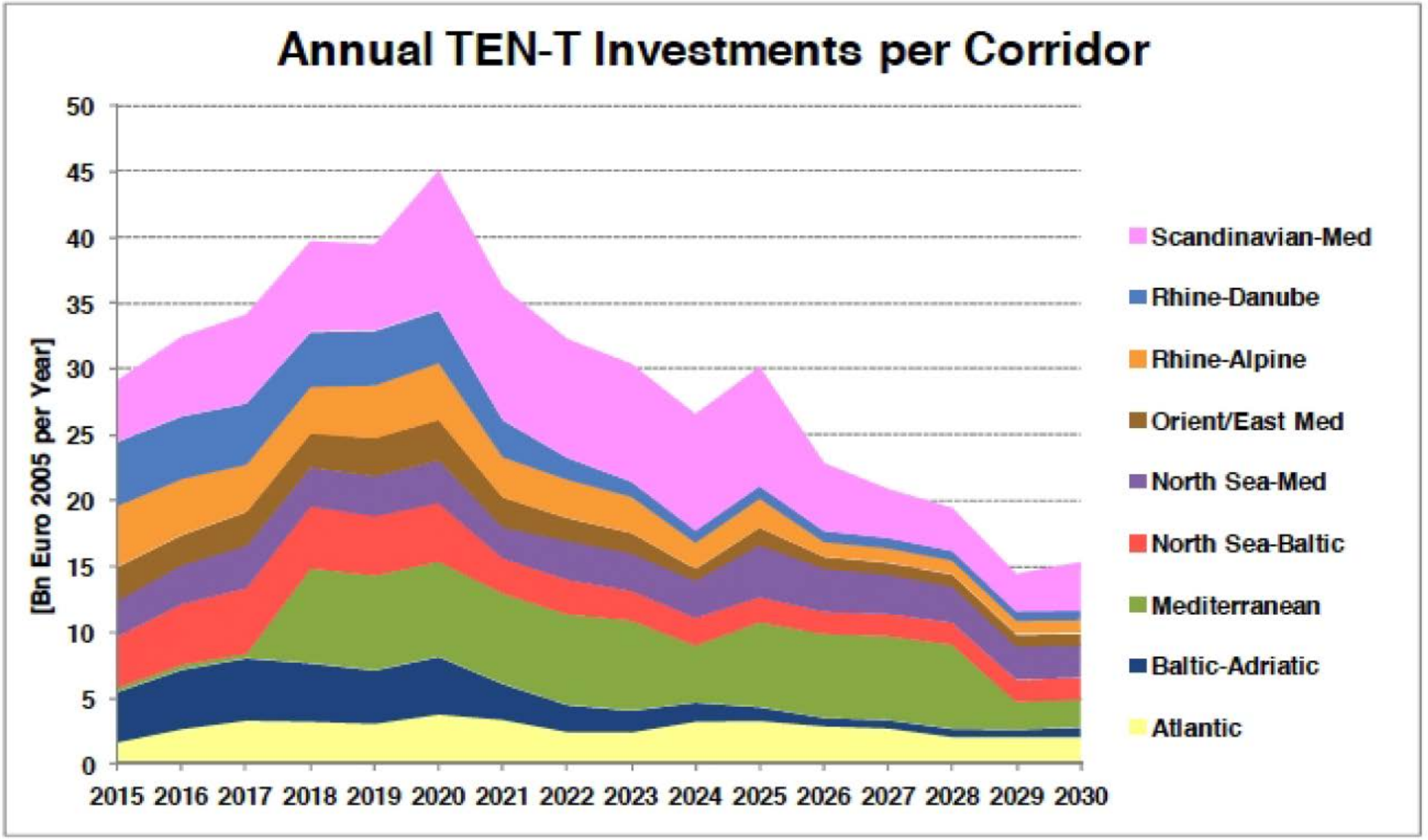
TEN-T CNC



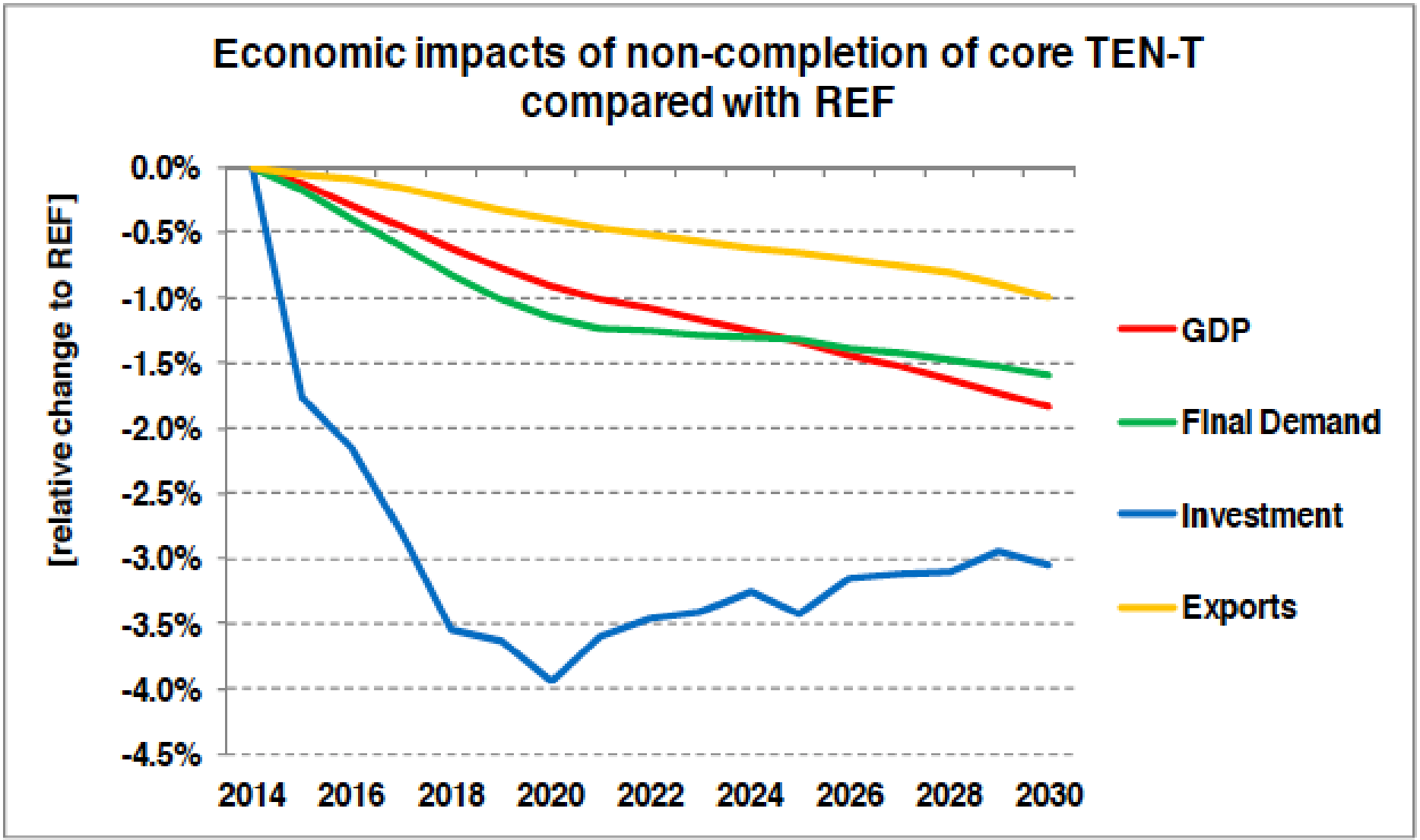
Corri-dors

TEN-T and the status of CNC Infrastructure planning

ECON



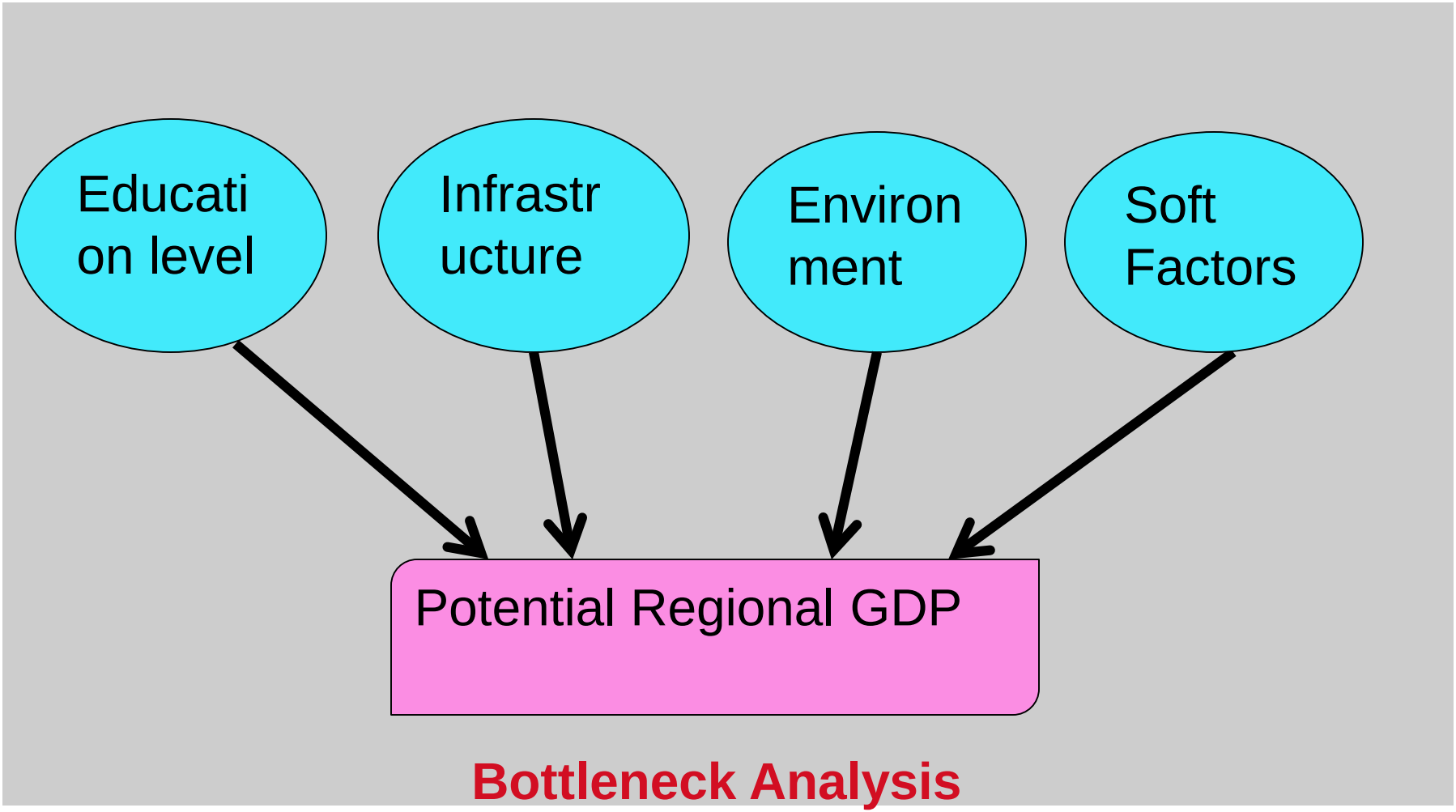
Source: EC/Fraunhofer-ISI



Source: Fraunhofer-ISI

Regional Potential Approach

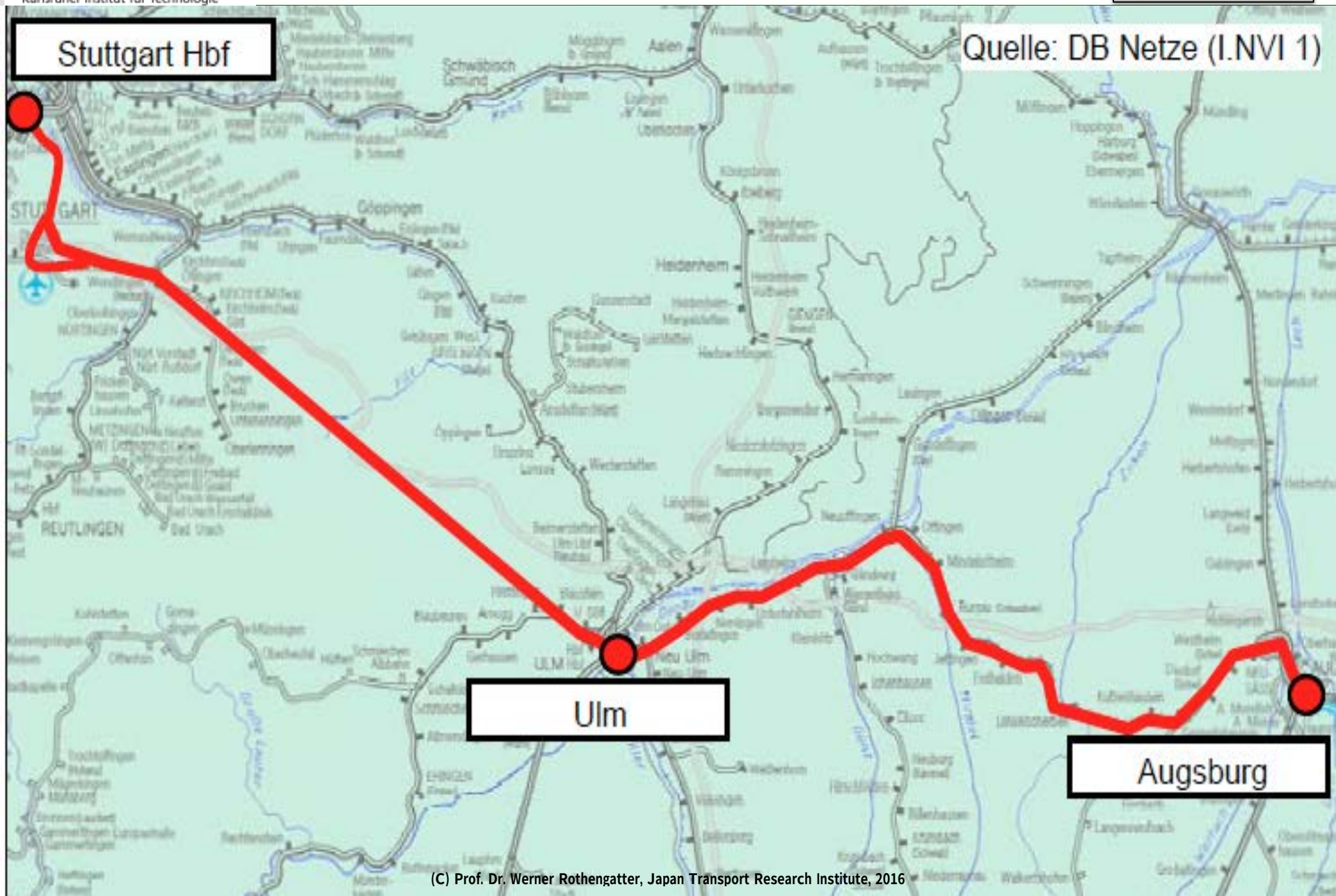
Factors immobile, indivisible, non-substitutable, polyvalent



Bottleneck Analysis

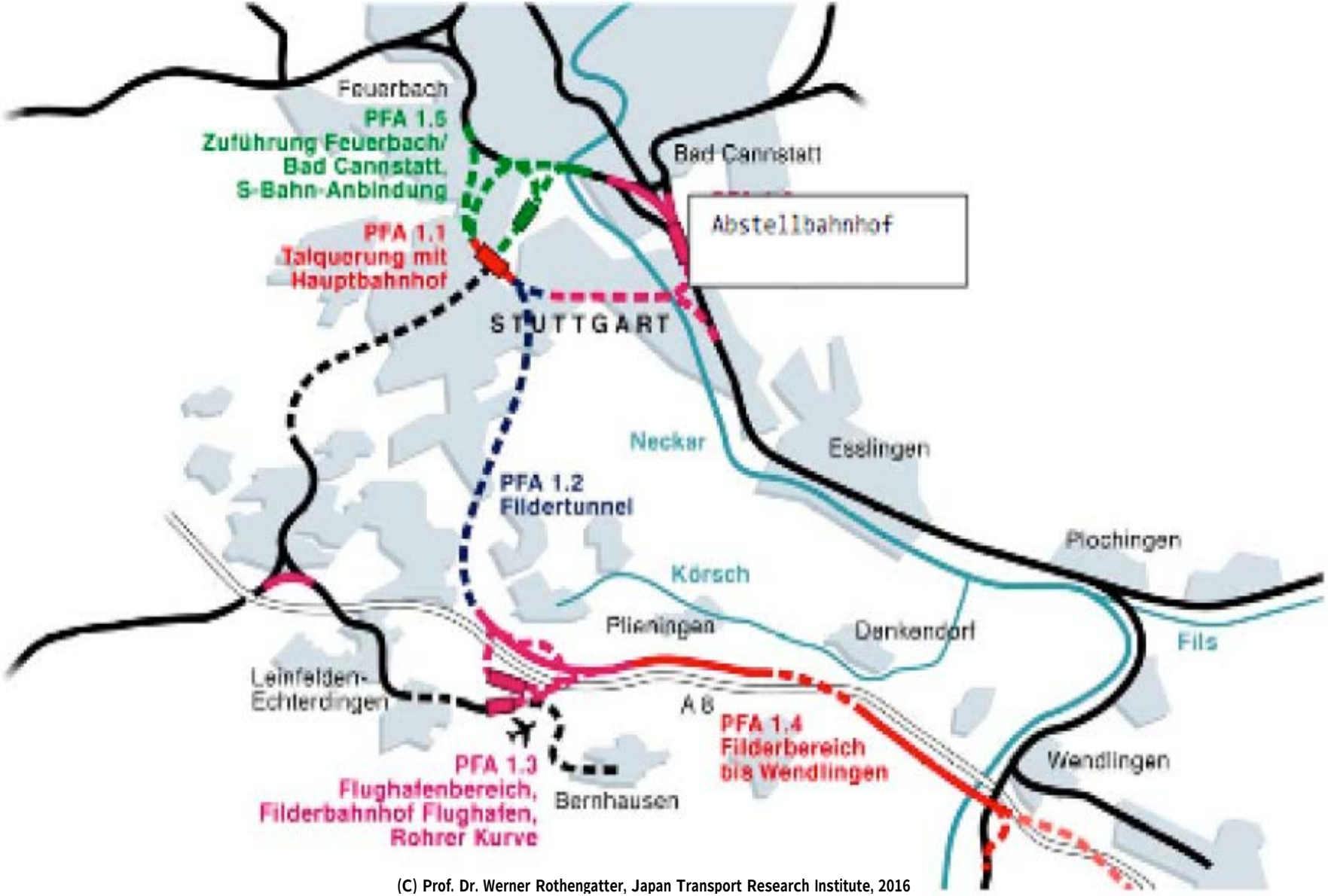
HSR project Stuttgart-Ulm

ECON



S21: Stations and airport links

ECON



Example of Stuttgart 21 (part of HSR Stuttgart-Ulm)

- Replacement of rail freight station
- New alignments for regional rail transport
- New urban S-Bahn station
- Gain of 106 ha of land for park area and new business/ residential district

→ new urban development perspectives

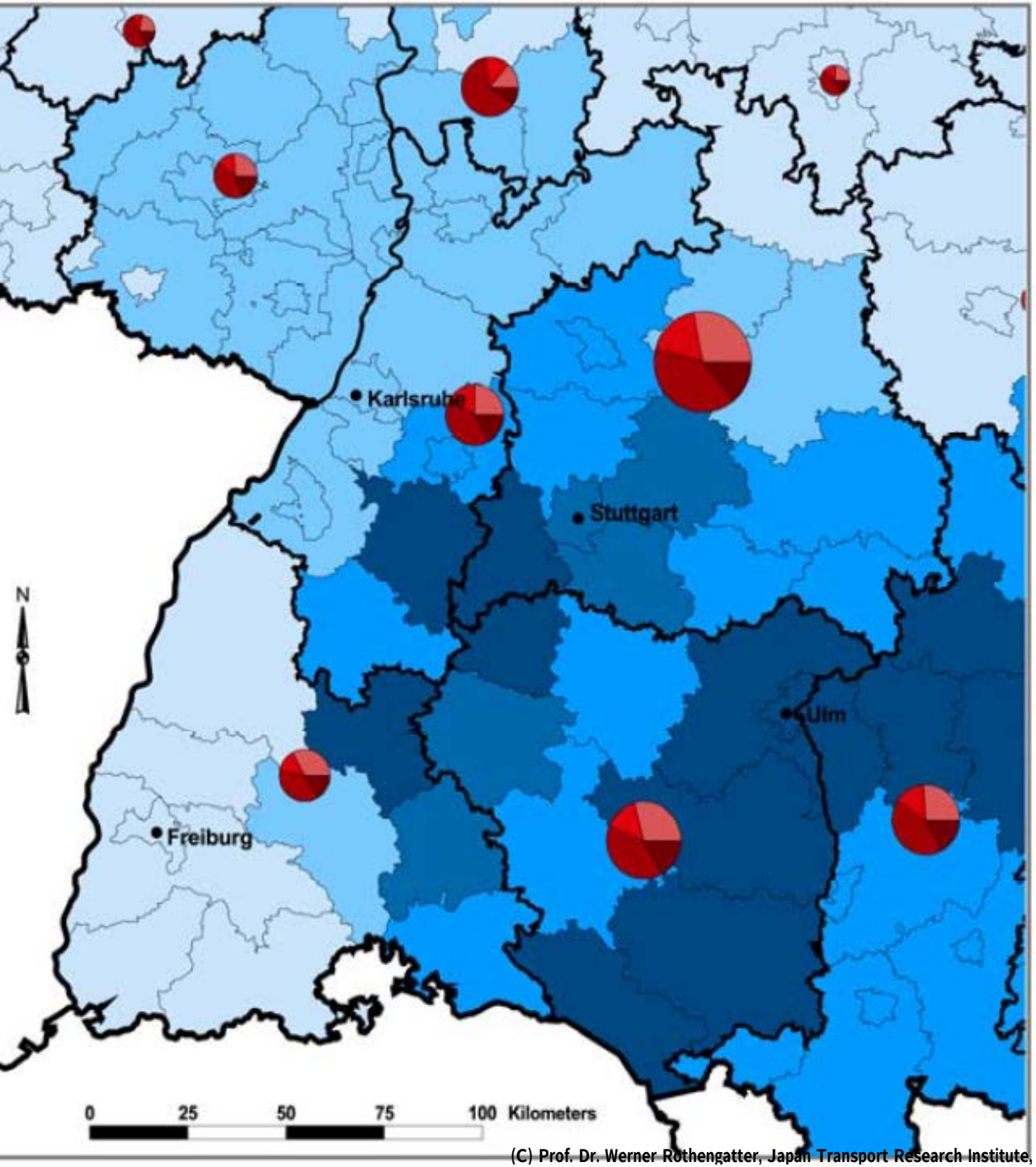
→ better environment

→ new attractive underground station

→ new airport station/connection

New Underground Station


Gained Central City Area: 106 ha
Rosensteinviertel
Europaviertel



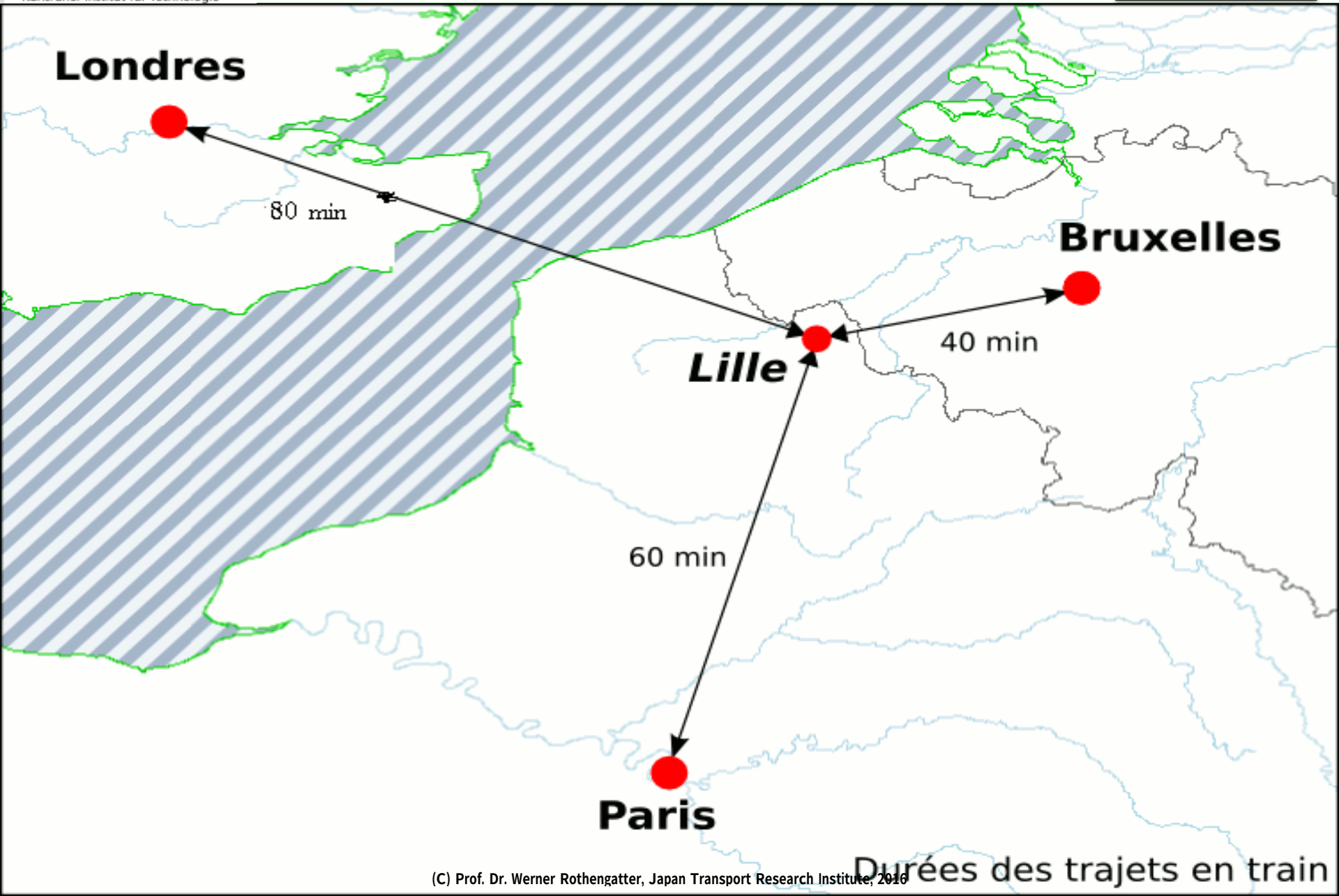
Impact of HSR Stuttgart-Ulm

<u>regional impacts:</u>
dark blue: high
Light blue: low
(in % of GDP)

<u>sector impacts:</u>
areas of red circles
light.: industry
light-med: trade, transport, tourism
med-dark: commer-cial services
dark: public services

Lille

ECON



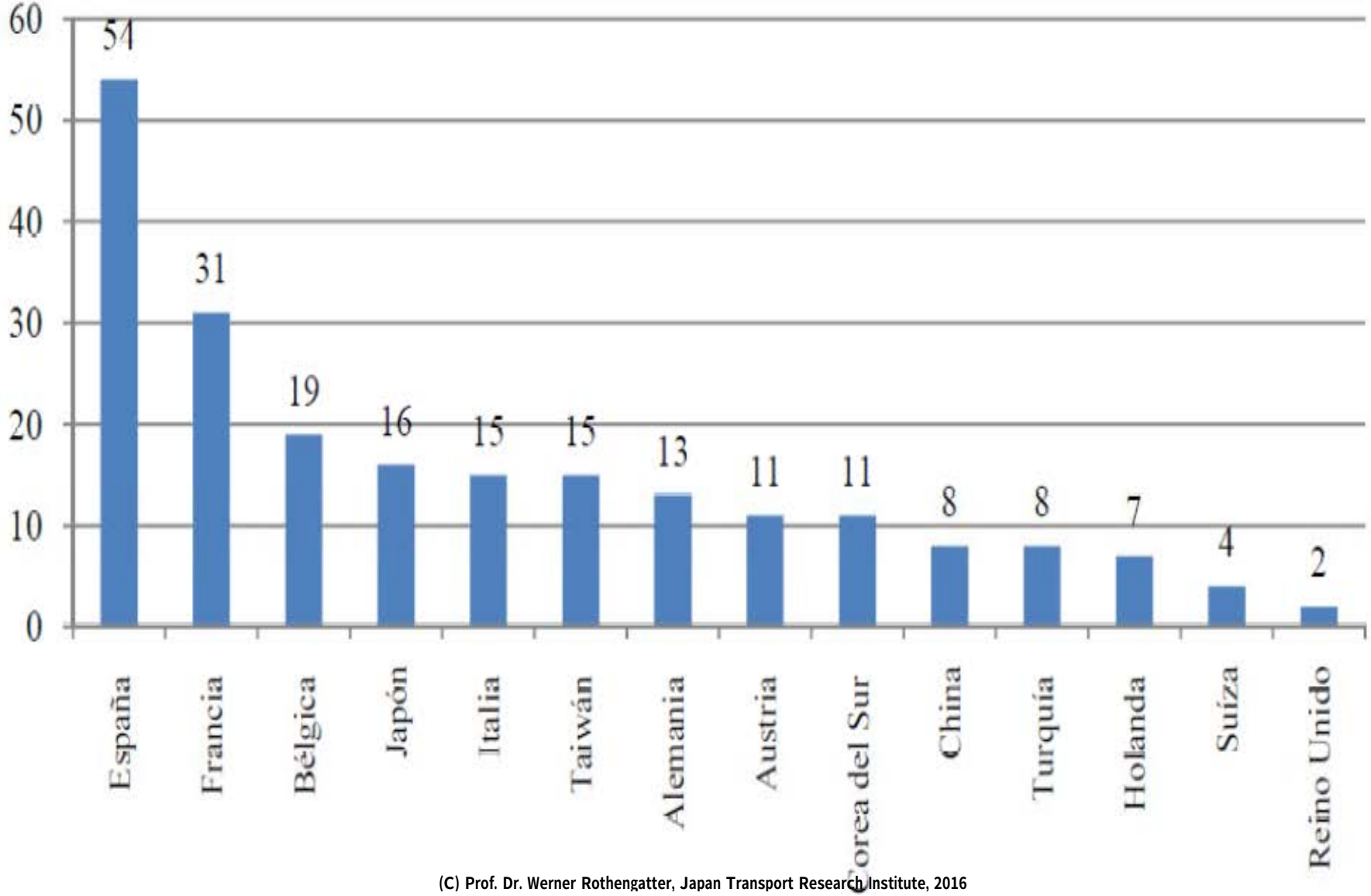
Indicators of urban development in Lille, France

HSR station opened in 1993

- population 172,000 (1990) to 232,000 (2013)
- Euralille 3rd biggest business center of French cities
- share of industry 10% (incl. Toyota)
- four universities in the area (110,000 students)
- center of services, trade and transport
- conferences and fairs

Spanish High Speed Network

HSR Network Length per 1 mill. Inhabitants



Planned bridge over the strait of Messina

Opinions on the Messina Bridge

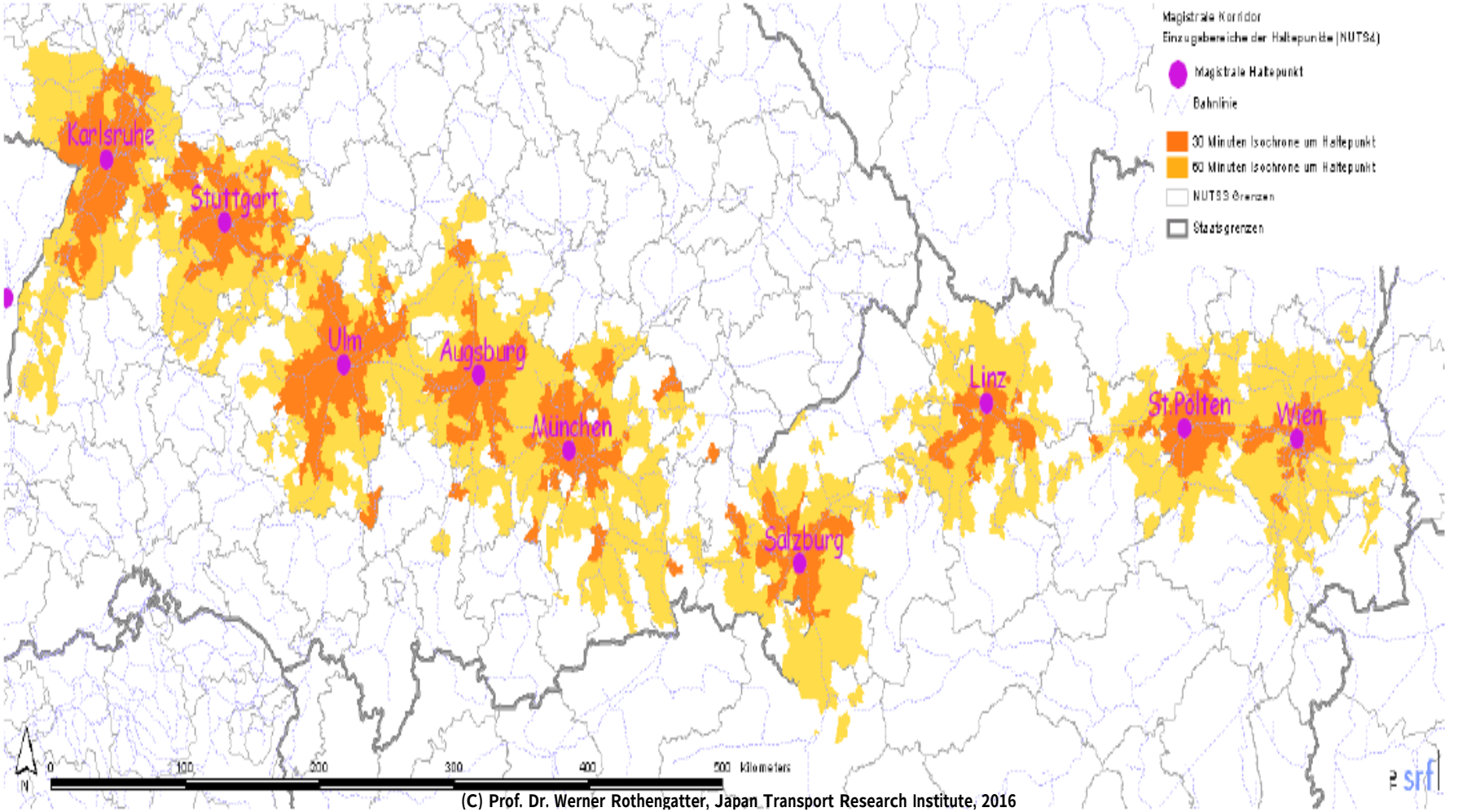
Political positions: **strongly pro (Berlusconi government: instrument of regional development policy); strongly contra (Prodi, Monti governments)**

Position of regional scientists: **regional development policy to come first; bridge and HSR access links only economically viable after a strong economic upturn in southern Italy and Sicily**

Example for Removal of Physical Bottlenecks: Gotthard&Ceneri Tunnels

Stuttgart-Ulm as Part of a European West-East Axis Paris-Budapest

Bringing the Benefits to the Regions: Optimizing Regional Transit Networks



Bringing the Benefits to Regions and Small Cities: Karlsruhe Model

Karlsruher Institut für Technologie

ECON

Conclusions

- HSR needs high passenger volumes; in this case it is environmentally advantagous to aviation and car travel.
- HSR brings economic stimuli to station areas.
- HSR brings regional economic benefits if physical bottlenecks are removed.
- Efficient regional transit systems can transfer HSR benefits to the regions around HSR stations.
- Integrated planning of HSR, urban and regional development brings synergy effects. It is often hard to implement because of complexity and costs.

Thank you.

Werner Rothengatter
Karlsruhe Institute of Technology

rothengatter@kit.edu

Supplementary slides

$$Y^{pot} = aI^{\alpha_1} Q^{\alpha_2} S^{\alpha_3} U^{\alpha_4},$$ for every region i (index omitted)

a	(total) factor productivity
I	Indicator for infrastructure capital
Q	Indicator for human capital
S	Indicator for soft location factors (e.g.: cultural assets)
U	Indicator for environmental quality
$\alpha_1,\ldots,\alpha_4$	production elasticities

Bottleneck analysis based on single regression

Agglomeration economies, WB1

(3.1) $$WB1 = \sum_{i,j} \left[\left(\varepsilon_{i,j} \times \frac{\Delta ED_j}{ED_j} \right) \times GDP_{i,j} \times E_{i,j} \right]$$

where

i: industries j: locations ED: effective employment density

ε: elasticity of productivity with respect to effective employment density

GDP: output per employed person E: number of jobs

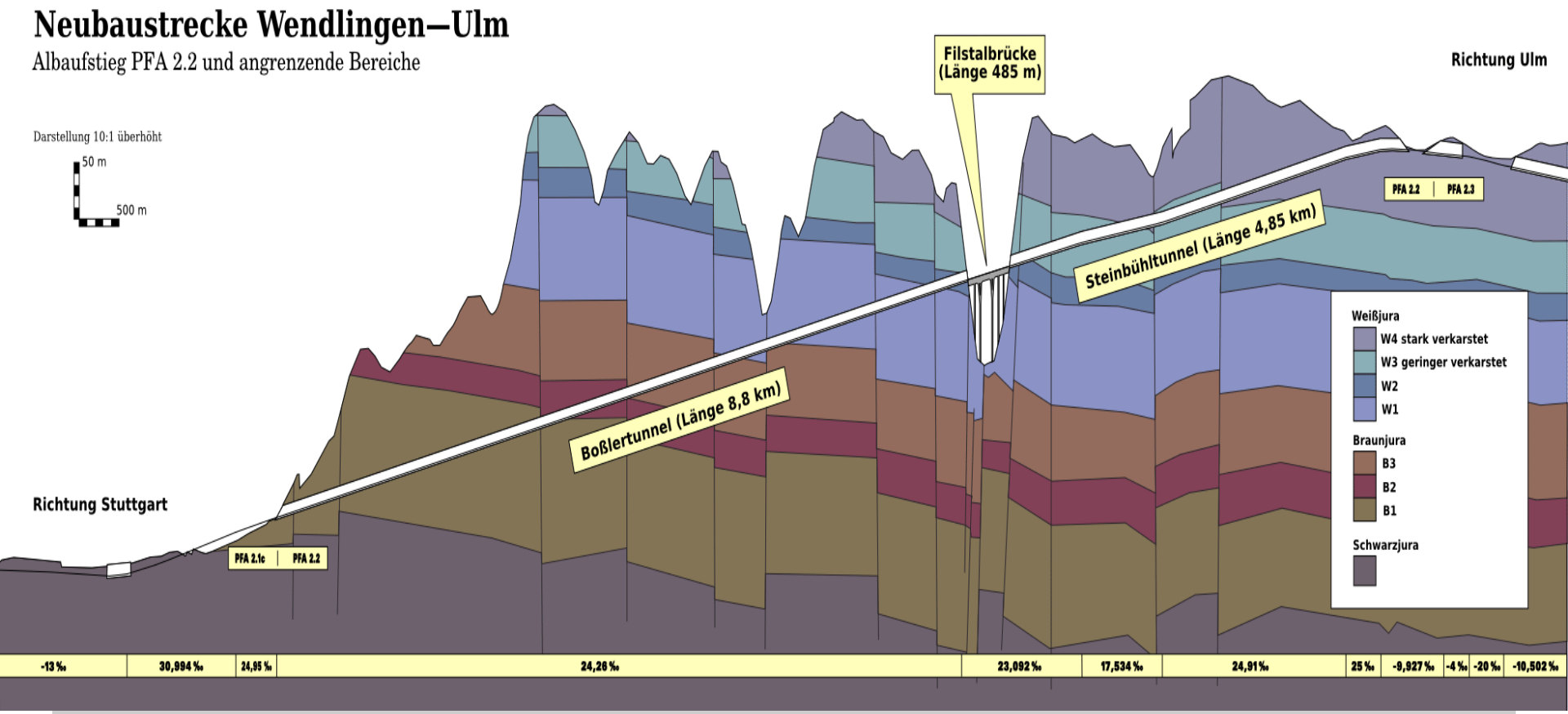

43
Repère
S
Sortie
44
46
eurostar

HSR Stuttgart – Ulm, some facts

⊙ Chronology

- First plans 1988
- Start of legal planning 1996
- Process of legal approval 2001-2006
- Signature of financial agreement, 6 partners, 2009
- Cost estimate Jan. 2009: 5.1 bill. €
- Revision of cost estimate Dec. 2009: 6.6 bill. €
- Start of construction work Jan. 2010
- Interruption 2010, 2011, arbitration process, voting of population of Baden-Württemberg
- Revision of cost estimate Dec. 2012: 9.7 bill.€
- Construction continuing since 2011

Alignment of tunnels/bridges in the hilly area Stuttgart-Ulm with various geological rock formations

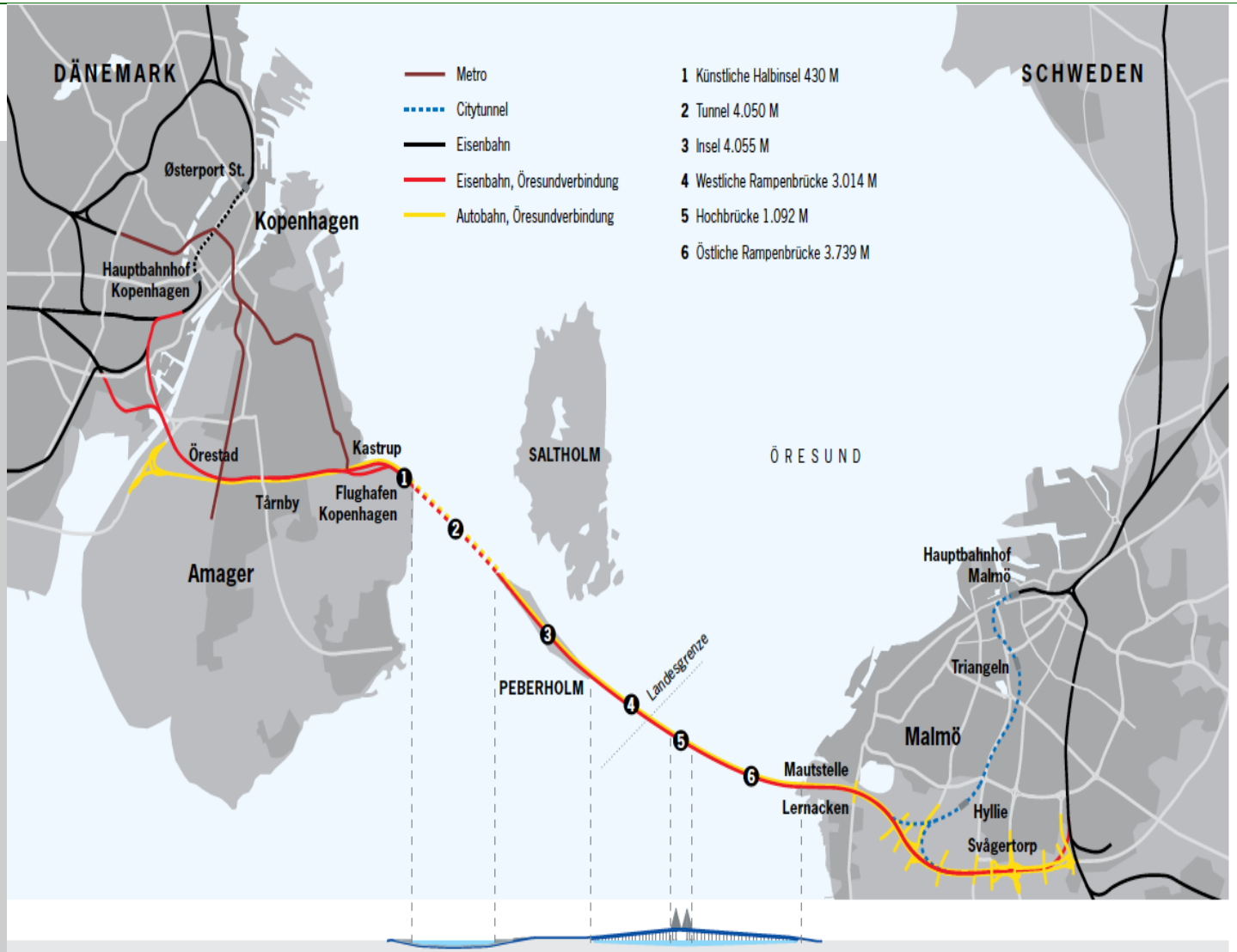


Spanish Highspeed Network

- Ca 3000 km, second largest HSR network after China
- In terms of km/inhabitant most dense network of the world
- Plans to extend the network to 5000 km
- Planning base: PEIT, environmental issues and regional accessibility dominating
- Increasing doubts in economic viability
- Most lines operated by short trains (400 pass.)
- Several land use planning failures (Mega Project Sesena/Madrid)

Example for the removal of physical Bottlenecks: Oeresund fixed link

Oeresund Fixed Link



Gotthard Tunnel (57 km)
Ceneri Tunnel (15 km)