

# Transport Investment, Economic Performance and Regional Development

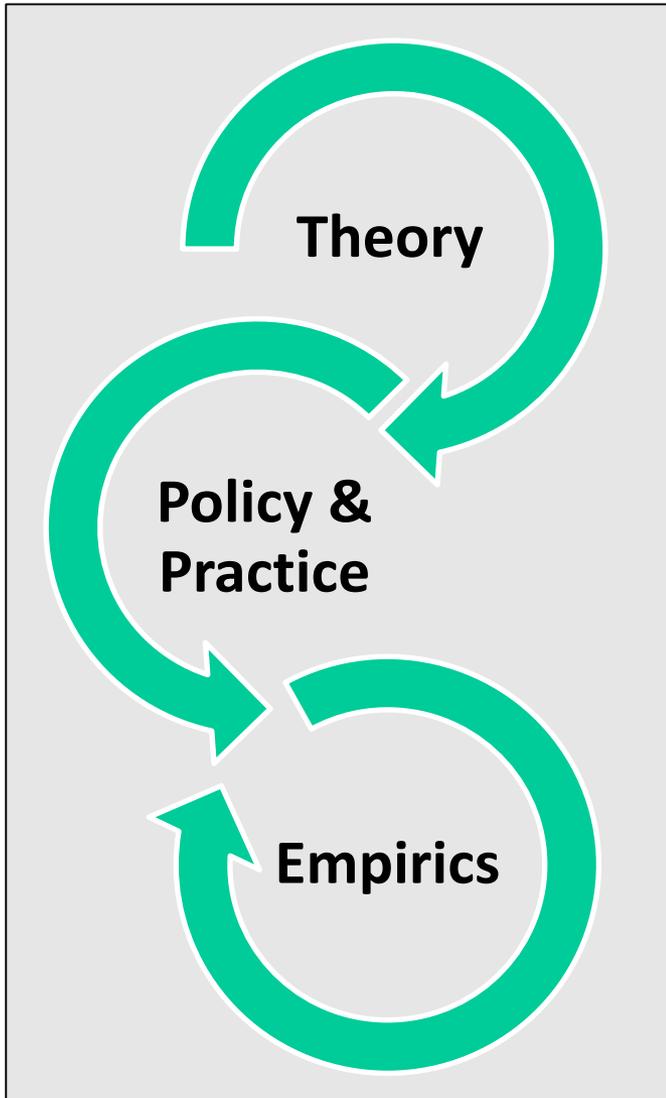
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**2nd ERSA-REGIO Academic Lecture 2019**  
**DG REGIO, 20 June 2019, Brussels**

# This talk



- Theoretical rationale(s) for transport infrastructure investment – from double dividend to conflict between efficiency and equity
- State of empirical evidence and main challenges
- Implications for policy and practice – EU cohesion policy, transport appraisal
- Some tentative recommendations and conclusions



**I -  
Economic theory, transport & cohesion policy**

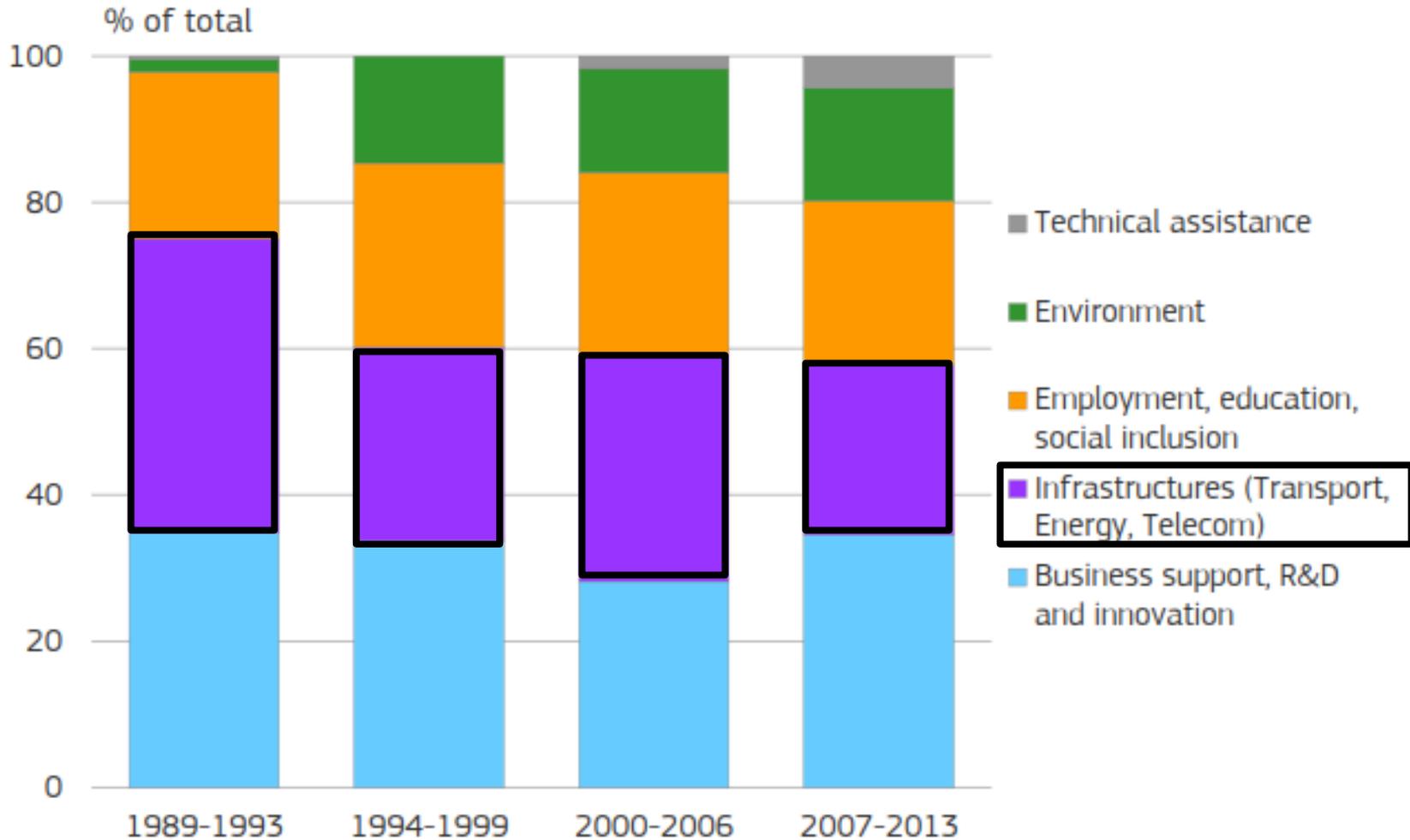
# Transport as efficiency & equity

- Endogenous growth models provide theoretical foundation for transport infrastructure's special place in the regional growth process: *as shifter of factor productivity and driver of technical progress; as public capital stock*

$$Y = g(\mathbf{T}).f(K, L, \mathbf{T})$$

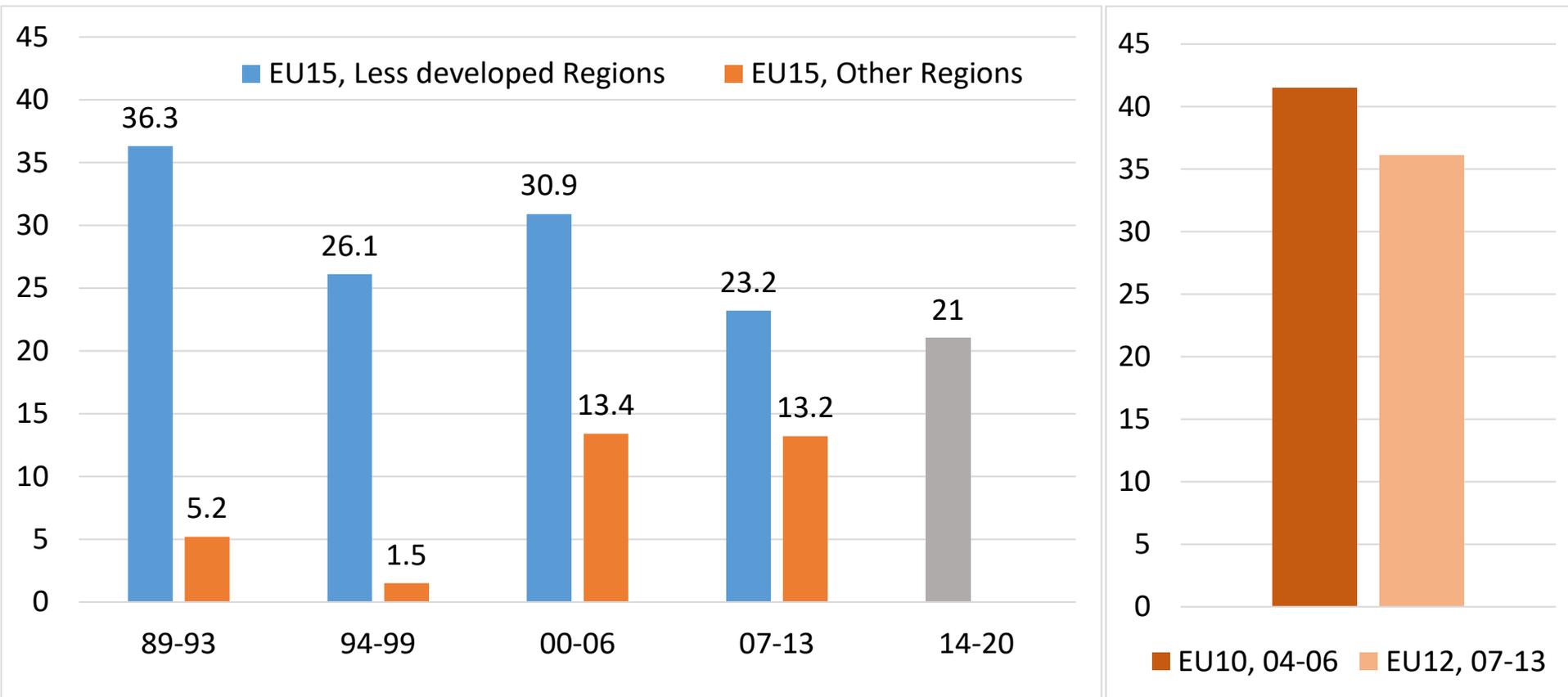
- Similarly to education and innovation, transport infrastructure is viewed as a public good generating positive externalities capable of sustaining long-term technical progress by avoiding diminishing returns to capital (e.g. Barro and Sala-i-Martin, 1995)
- By contributing to increased productivity and permitting conditional convergence, endogenous growth models promised both efficiency and equity

**Figure 3 Composition of Cohesion Policy investment in less developed regions, 1989-2013**



Source: DG REGIO

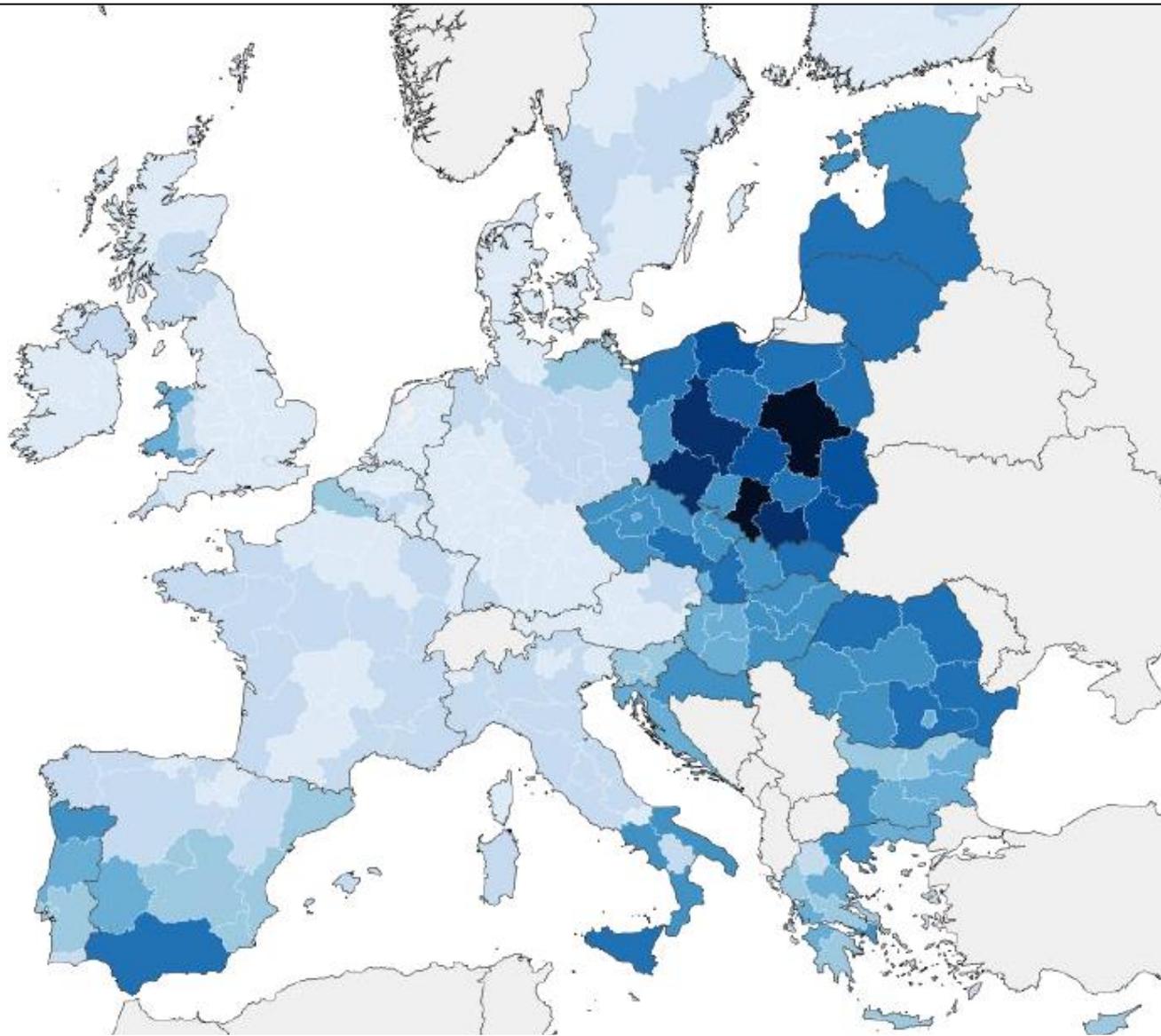
# % Cohesion policy spending in infrastructure (transport, energy, telecoms, social infrastructure)



- And Connecting Europe Facility (CEF) for investment in TEN, with TEN-T receiving nearly 80% of total CEF & 2% of total EU budget for 2014-2020



## Transport infrastructure investment in the CP 2014-2020 (M.Eur)

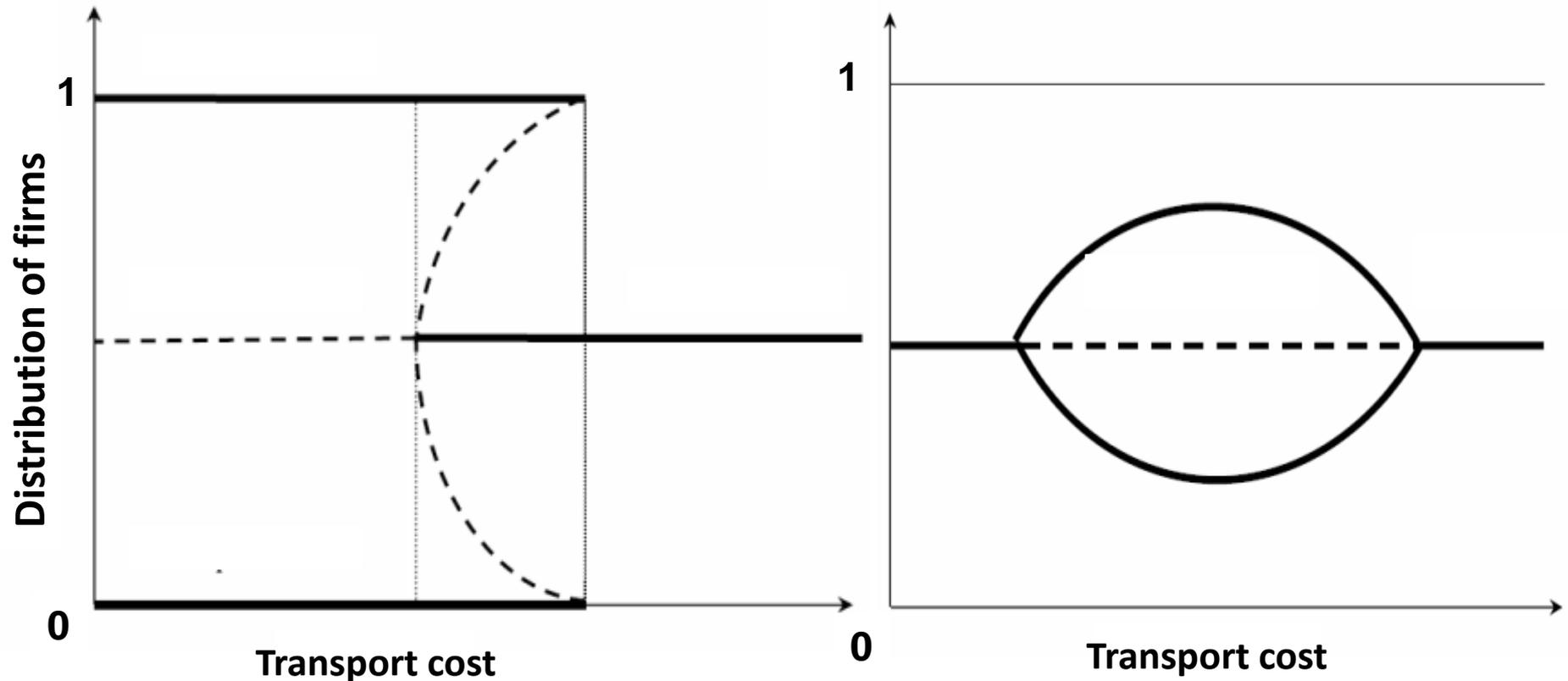


Source: Damiaan Persyn & Jorge Diaz-Lanchas & Javier Barbero, 2019. "Estimating road transport costs between EU regions," JRC Working Papers on Territorial Modelling and Analysis 2019-04, Joint Research Centre (Seville site).

# Transport as efficiency, but maybe not equity

- Neither neoclassical nor endogenous growth models can explain persistence of disparities in regional development, let alone even divergence
- Alternative economic models based on the New Economic Geography (NEG) appear to have a more fitting predictive value of EU-wide (and nation-wide) regional economic disparities
- NEG models predict that for low transport costs, and in the presence of inter-regional labour mobility, cumulative causation self-reinforcing mechanisms (e.g. demand and cost linkages) lead to a core-periphery spatial economic landscape dominated by greater concentration

# Transport cost and industry share with labour mobility (left) and imperfect labour mobility (right)



# What are the economic policy implications from NEG?

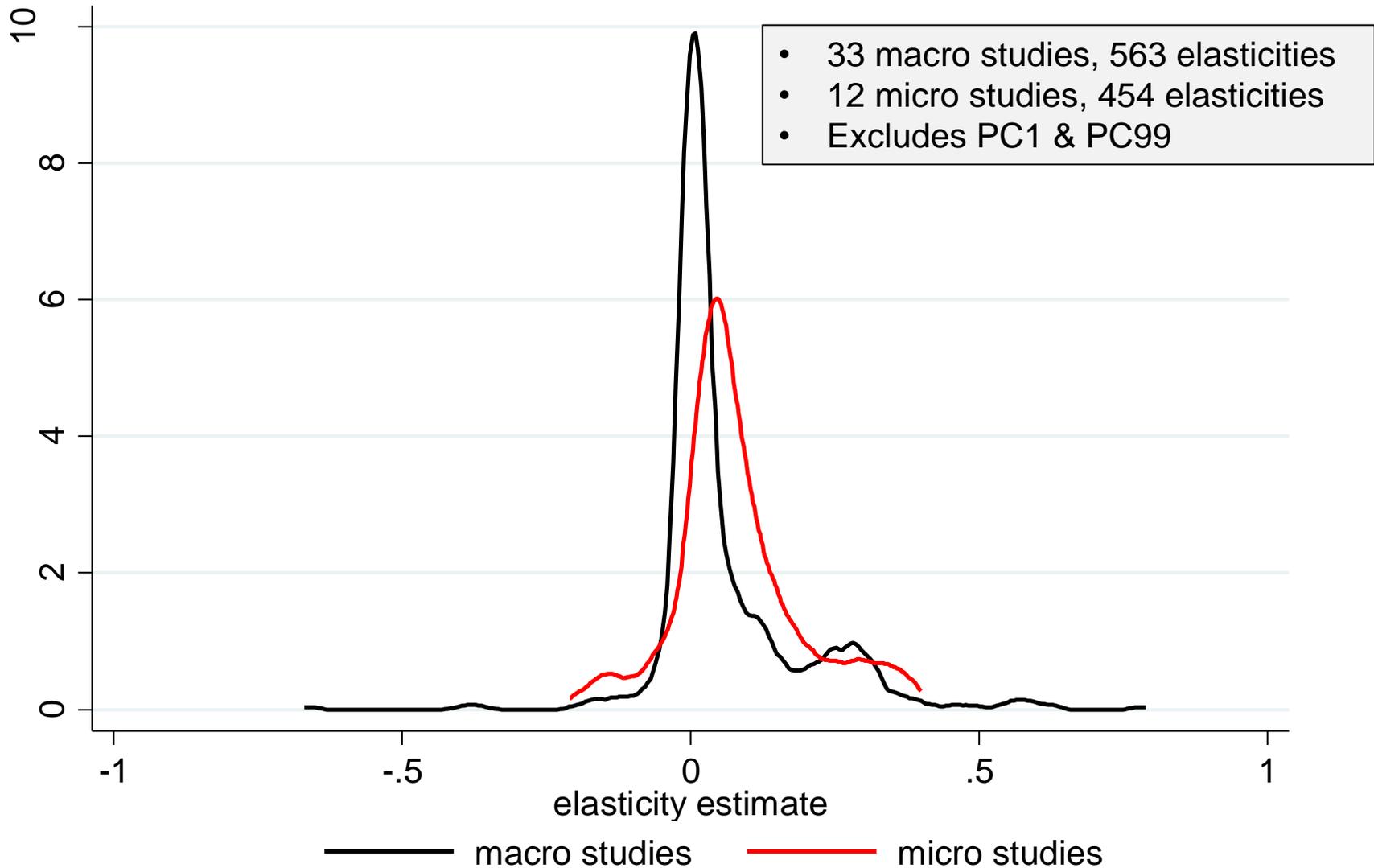
- Location of economic activity results from the interaction between agglomeration and dispersion forces, and the balance between the two forces is affected by the level of transport cost
- **Transport infrastructure can have an ambiguous effect, promoting both agglomeration and dispersion of economic activity as transport cost declines**
- **More efficient transport networks may reinforce regional disparities, and regional context and history may affect the spatial economic outcome**
- The inter-regional nature of models makes them relevant for major transport projects, e.g. motorways, HSR, and more generally TEN-T



**II -**

**What does empirical evidence show?**

# Output elasticity of transport: macro- vs. micro-level studies

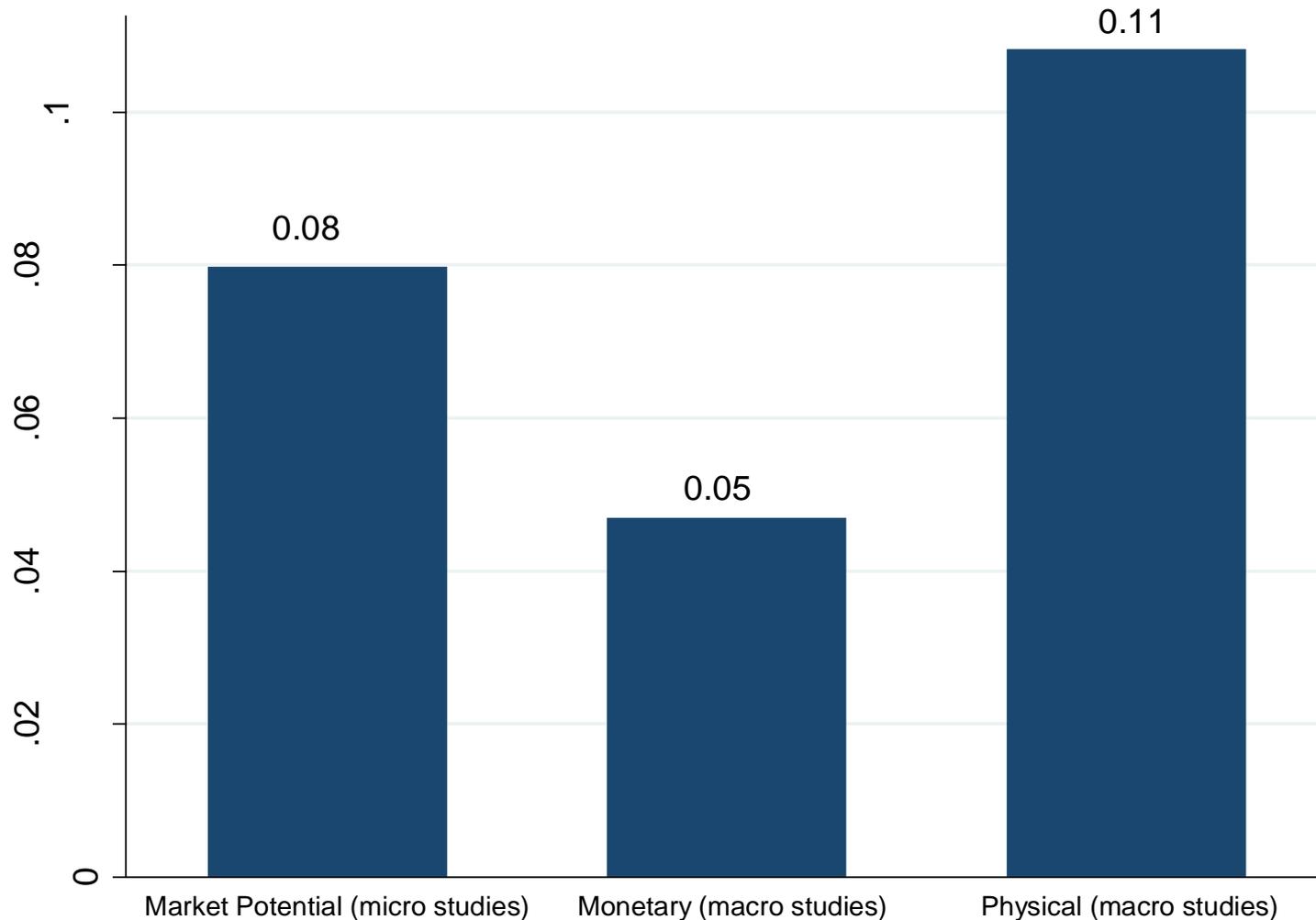


\* Elasticity estimates of firm output with relation to distance to nearest motorway were excluded from micro-level studies

Source: Melo, P. and Graham, D.J., and Brage-Ardao, R. 2013. The productivity of transport infrastructure investment: A meta-analysis of empirical evidence. *Regional Science and Urban Economics* Vol.43, pp. 695-706.

Melo, P. 2019. Transport infrastructure effects on economic output: the micro-economic approach (forthcoming).

# Output elasticity of transport: macro- vs. micro-level studies



Source: Melo, P.C., Graham, D.J., and Brage-Ardao, R. 2013. The productivity of transport infrastructure investment: A meta-analysis of empirical evidence. *Regional Science and Urban Economics* Vol.43, pp. 695-706.

Melo, P. 2019. Transport infrastructure effects on economic output: the micro-economic approach (forthcoming).

# Evidence for European regions (I)

- **Main approaches commonly used:**

- 1) Assesses regional disparities by relating changes in accessibility to market potential indicators using GIS-based methods
- 2) Examines through regression analysis how the expansion of transport affected the spatial distribution of economic activity (e.g. population, employment)
- 3) Examines through regression analysis the relation between regional economic growth (e.g. GDP pc) and transport infrastructure

- **I will focus on 3) - some main features of these studies:**

- Typically at NUTS1- and NUTS2-level
- Measurement of transport:
  - commonly based on kms of roads, particularly motorways
  - some studies also use Euros invested in transport infrastructure
  - very little attention given to rail transport
- Limited consideration of potential for spatial spillover effects
- Very limited focus on specificities of cross-border regions

# Evidence for European regions (II)

- Crescenzi and Rodríguez-Pose (2012) test the effect of motorways on GDP pc using a pool of NUTS1 & NUTS2 data for 11 EU15 countries over 1990-2004

***No systematic relation: transport infrastructure as a factor that complements the process of regional development rather than one of its drivers***

Y= Delta ln(GDP pc)	Controls for socio-economic, educational and innovation context?			Statistical estimator
	No	Yes	Yes + Migration rate	
(MTW kms/1000 pop)	0.0175			Fixed-effects
(MTW kms/1000 pop)	-0.0037	0.0082	0.0005	
Spatial weighted av of (MTW kms/1000 pop)	0.0616**	0.0917***	0.0678***	
(MTW kms/1000 pop)	0.0398*			GMM-Diff, all suitable lags as instruments
(MTW kms/1000 pop)	0.0267	0.0131	0.0252	
Spatial weighted av of (MTW kms/1000 pop)	0.0275	0.0374	0.0301	
(MTW kms/1000 pop)	0.0774*			GMM-Diff, 2nd order lags as instruments
(MTW kms/1000 pop)	0.0870	-0.00289	0.0287	
Spatial weighted av of (MTW kms/1000 pop)	-0.0230	0.0547	0.0349	

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# Evidence for European regions (III)

- Crescenzi, Di Cataldo and Rodríguez-Pose (2016) extend the analysis by Crescenzi and Rodríguez-Pose (2012) to test the moderating effect of Quality of Government (QoG) on the economic returns of transport endowment
  - Data: pool of 166 EU regions (NUTS1 for BG, DE, & UK and NUTS2 for 12 countries) over 1995-2009
  - Transport & QoG: 1) kms of motorway per 1000 people; 2) kms of other roads; + interaction with QoG index
  - Empirical strategy: 1) fixed-effects estimator (and dynamic GMM as robustness testing); 2) Spatial weight of motorway (in neighbouring regions); 3) controls for socio-economic, educational and innovation factors affecting GDP pc growth

# Evidence for European regions (IV)

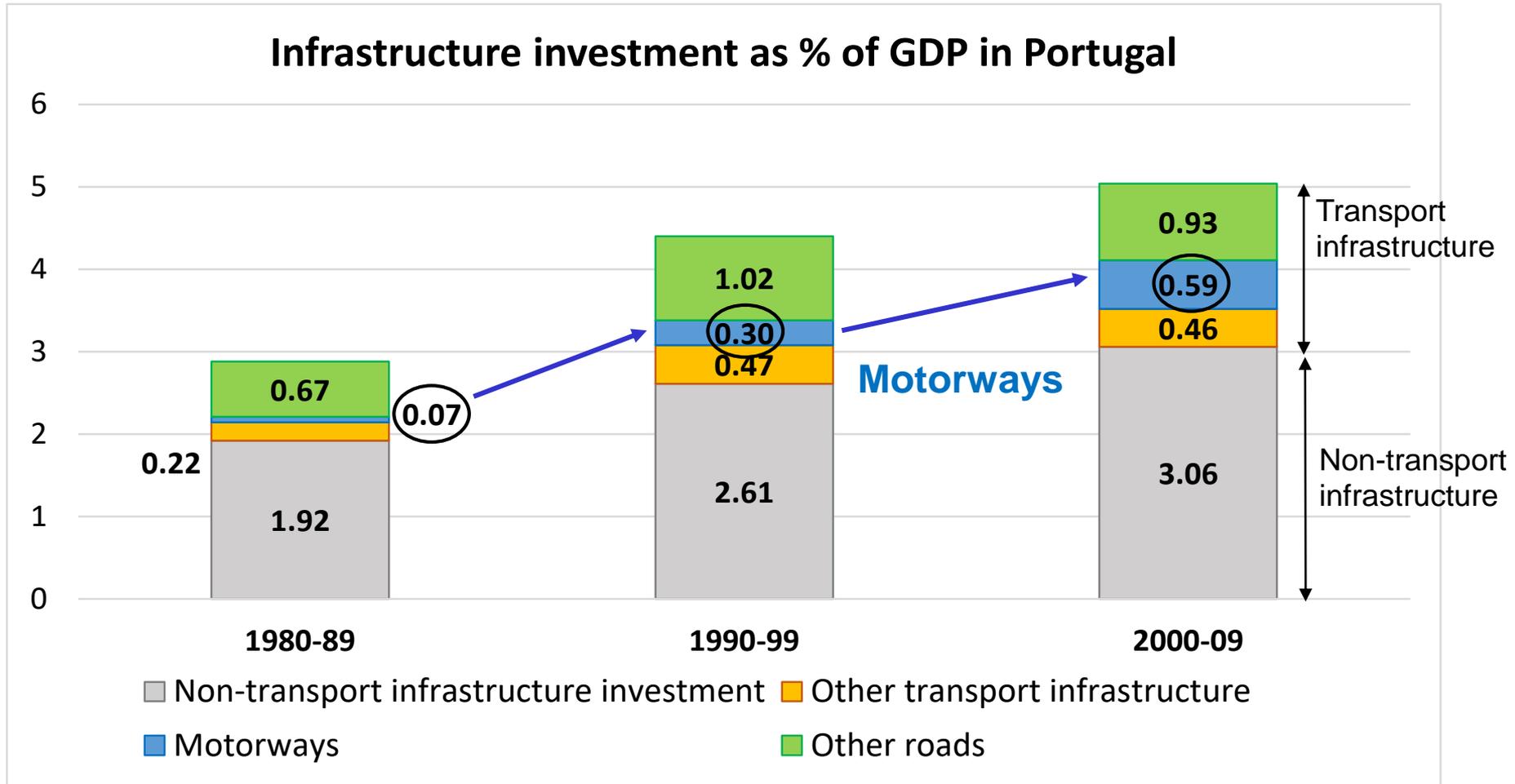
Y= Delta ln(GDP pc)	Controls for socio-economic, educational and innovation context?		Sample
	No	Yes	
(MTW kms/1000 pop)	0.126**	0.0847	All regions
QoG	0.0318***	0.0346***	
QoG*(MTW kms/1000 pop)	-0.118	-0.0663	
Spatial weighted av of (MTW kms/1000 pop)		0.784***	
(MTW kms/1000 pop)	-0.0286	-0.0478	Less developed regions
QoG	0.0636***	0.0603***	
QoG*(MTW kms/1000 pop)	-0.184	-0.110	
Spatial weighted av of (MTW kms/1000 pop)		0.409**	

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

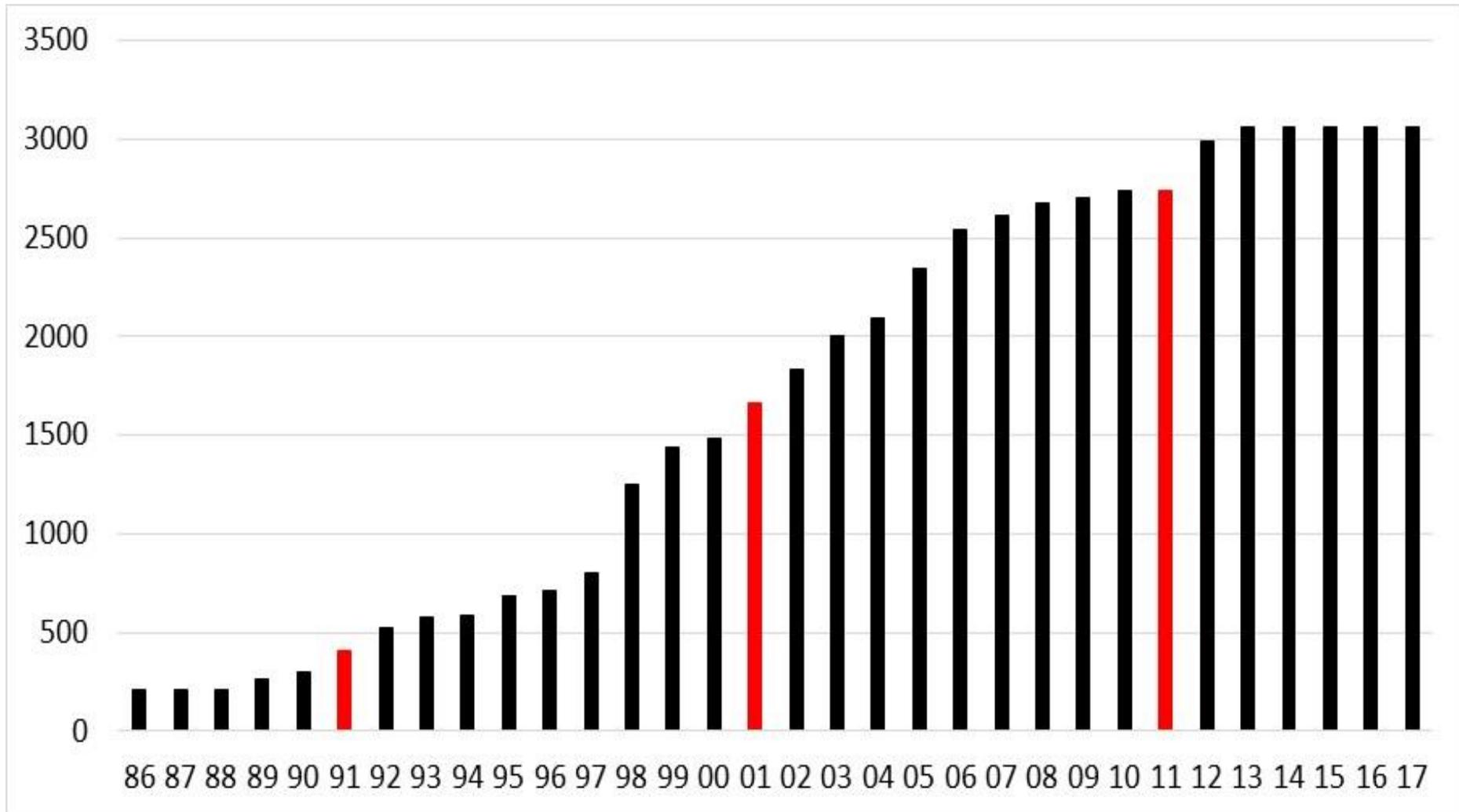
- Expansion of transport (i.e. motorways) in lagging regions (Objective 1 in 2000-06 ESIF) not associated with regional GDP pc growth
- QoG +ve linked to GDP pc growth, but no moderation on transport's effect
- Human capital and innovation were found to play a stronger positive effect for less developed regions

# Evidence for European regions (V)

- Country-specific evidence, especially for some of the main beneficiaries of EU's regional policy ESIF for transport infrastructure (e.g. Portugal)

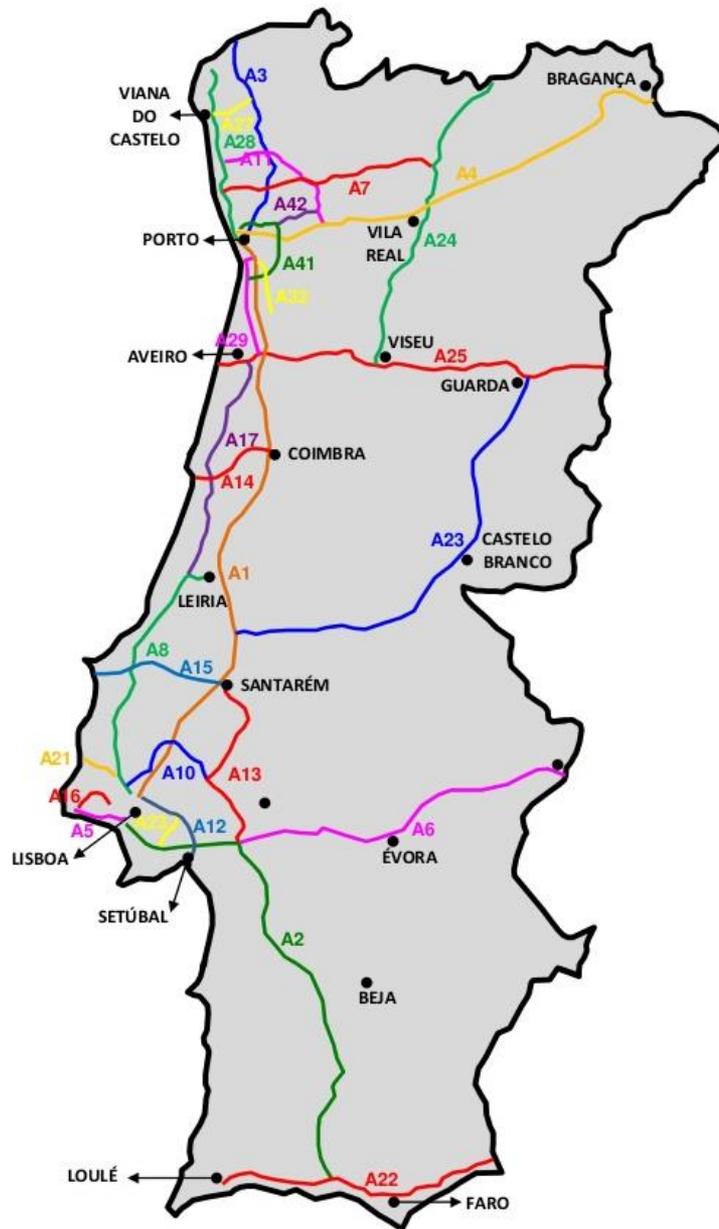


# Kms of motorways in Portugal, 1986-2017



Source: Author, based on INE statistics

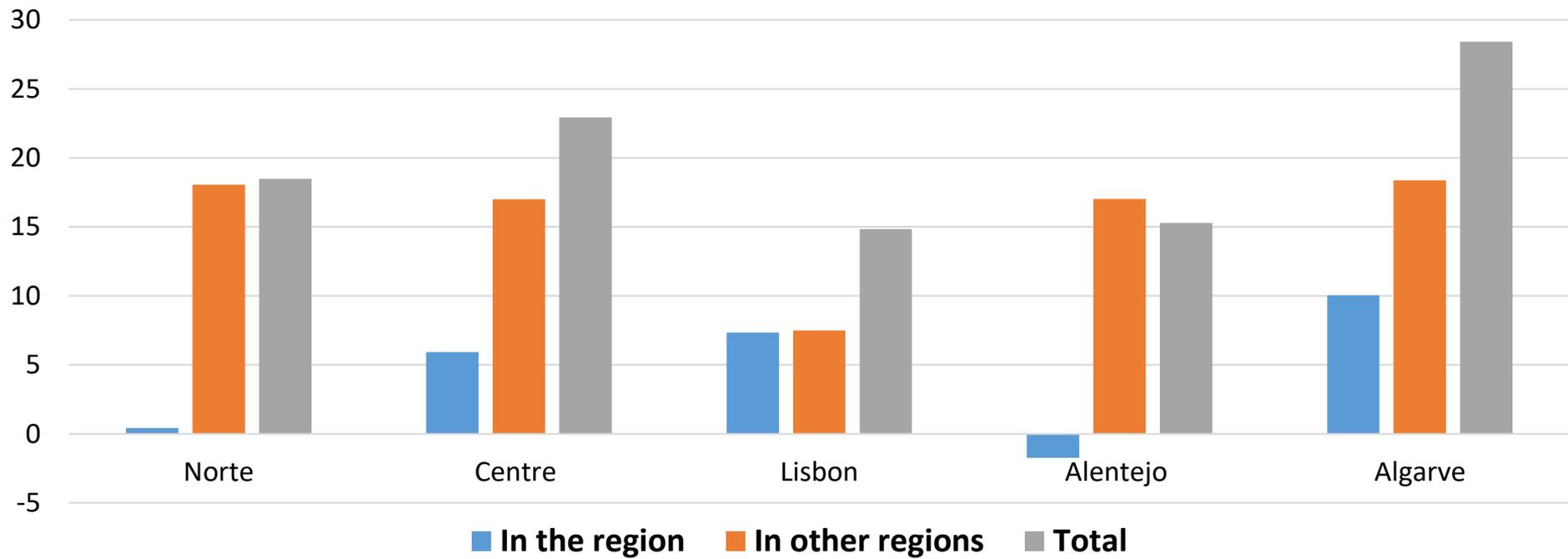
# Motorway network in Portugal: efficiency first

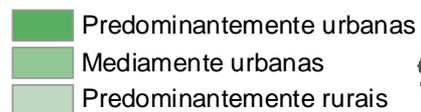
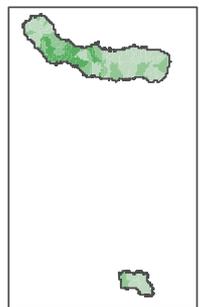
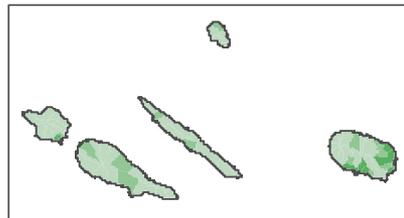
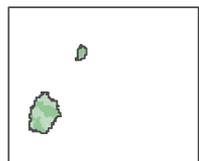


# Evidence for European regions (VI)

- Pereira and Andr az (2011) implement VAR models to test the effect of road investment (in Euros) on Portugal's NUTS2-level output for the period 1980-98
- They find considerable spatial spillover effects across regions (orange)

Long-run marginal effect of 1 million Euros of road investment in each region

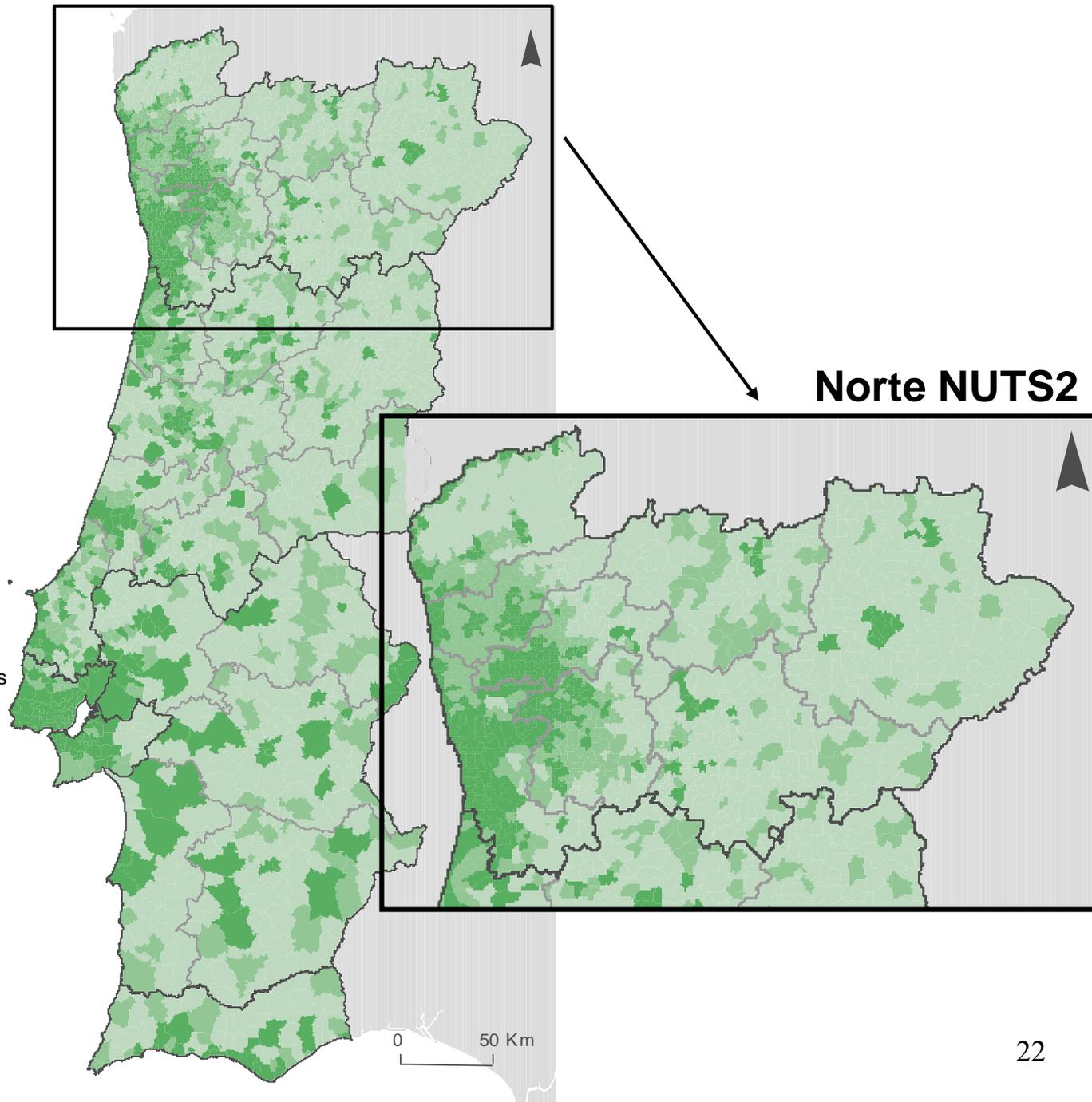
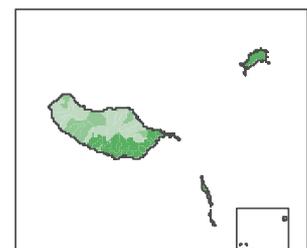




Limites territoriais

NUTS III

NUTS II





# **III - Main challenges facing empirical research**

# Endogeneity of transport investment

- Identification of causal effects of transport infrastructure investment as - possibly - the major empirical challenge:
  - Simultaneity bias between economic outcome and transport investment, which can work on both directions
  - Non-random allocation of transport investment across locations
  - Self-selection or spatial sorting of firms/workers across locations
- Popular solutions used in recent studies:
  - Use of IV methods based on instruments for the assignment of transport infrastructure: planned routes, historical routes, least-cost routes
  - Inconsequential units approach, by assuming that allocation of transport to locations along the corridor may be unrelated to economic performance
  - Other counterfactual-based methods, e.g. Propensity score techniques, synthetic control techniques
  - Natural experiments (very difficult)

# Need to distinguish growth from spatial reorganization

- A lot less discussed and studied, but crucial for policy: Do changes in transport infrastructure create new economic activity or reshuffle existing activity geographically? We know very little about the relative importance of growth vs. displacement on economic performance
- Evidence from studies of the relation between transport accessibility and the location of economic activity suggests that:
  - within metropolitan regions and large urban areas, relocation is likely as important as new activity creation
  - for inter-city and inter-regional transport infrastructure, displacement of activities from peripheral regions to more central ones is more likely
  - local context and transport project specificity also likely to influence economic outcomes

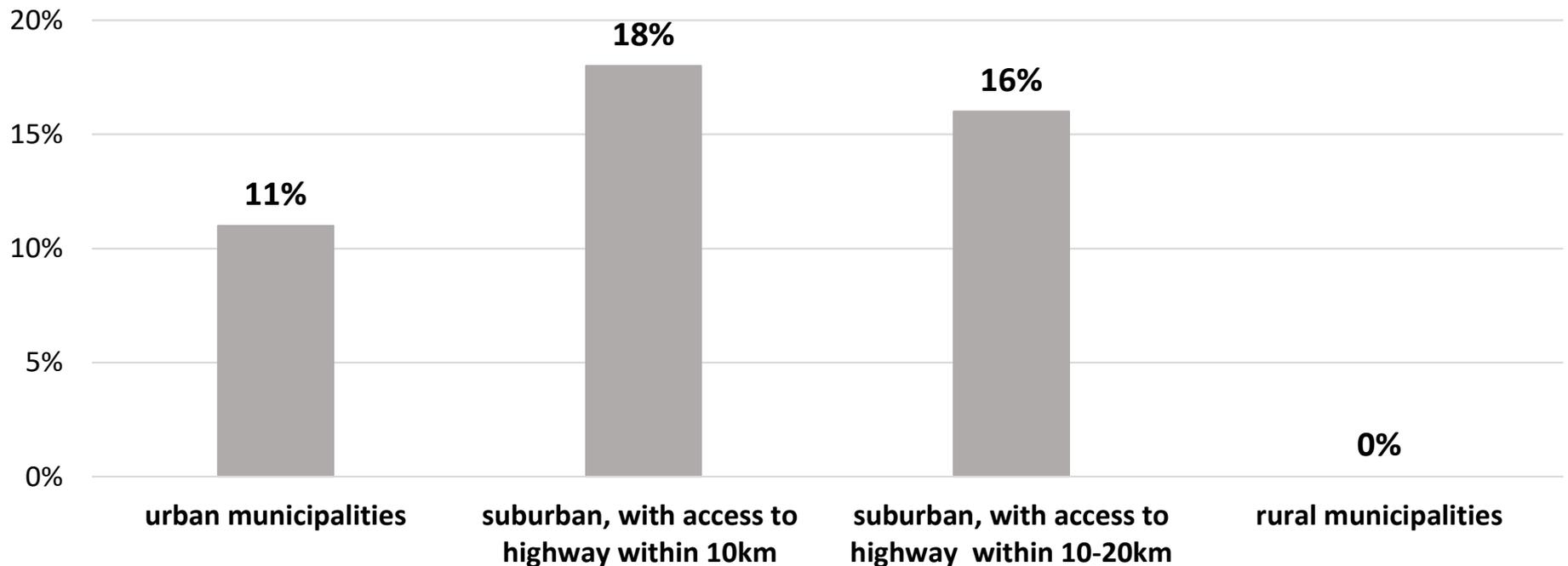
# Growth vs. relocation, and the scope for spatial spillovers

- Intra-regional or intra-city transport infrastructure
  - Tends to favour urban core primacy at national level, i.e. pro-agglomeration
  - But can have negative effects if infrastructure investment promotes dispersed urbanisation and sprawling (i.e. urban congestion externalities)
- Inter-regional transport infrastructure
  - Greater scope for more ambiguous effects
  - Spatial concentration effects may be accentuated due to nodal and hub effect advantages of more central cities experiencing higher increases in relative accessibility and market size compared to peripheral locations
  - Special cases of cross-border transport projects, more subject to coordination failures, making under-investment more likely

# Firm-level studies focusing on inter-regional transport infrastructure: e.g. motorway expansion in Spain (I)

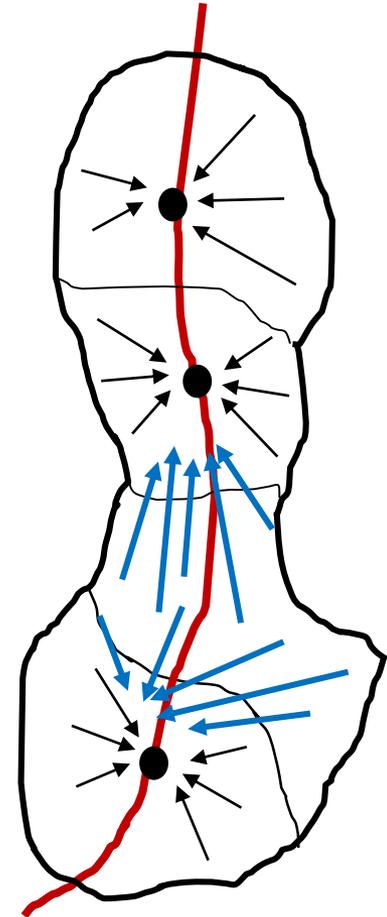
- Holl (2016) tested if firm-level productivity gains from improved highway access between 1997-2007 differed across Spanish municipalities by proximity to mtw

**Difference in firm TFP in relation to firms located in municipalities more than 20 km from the nearest new highway**



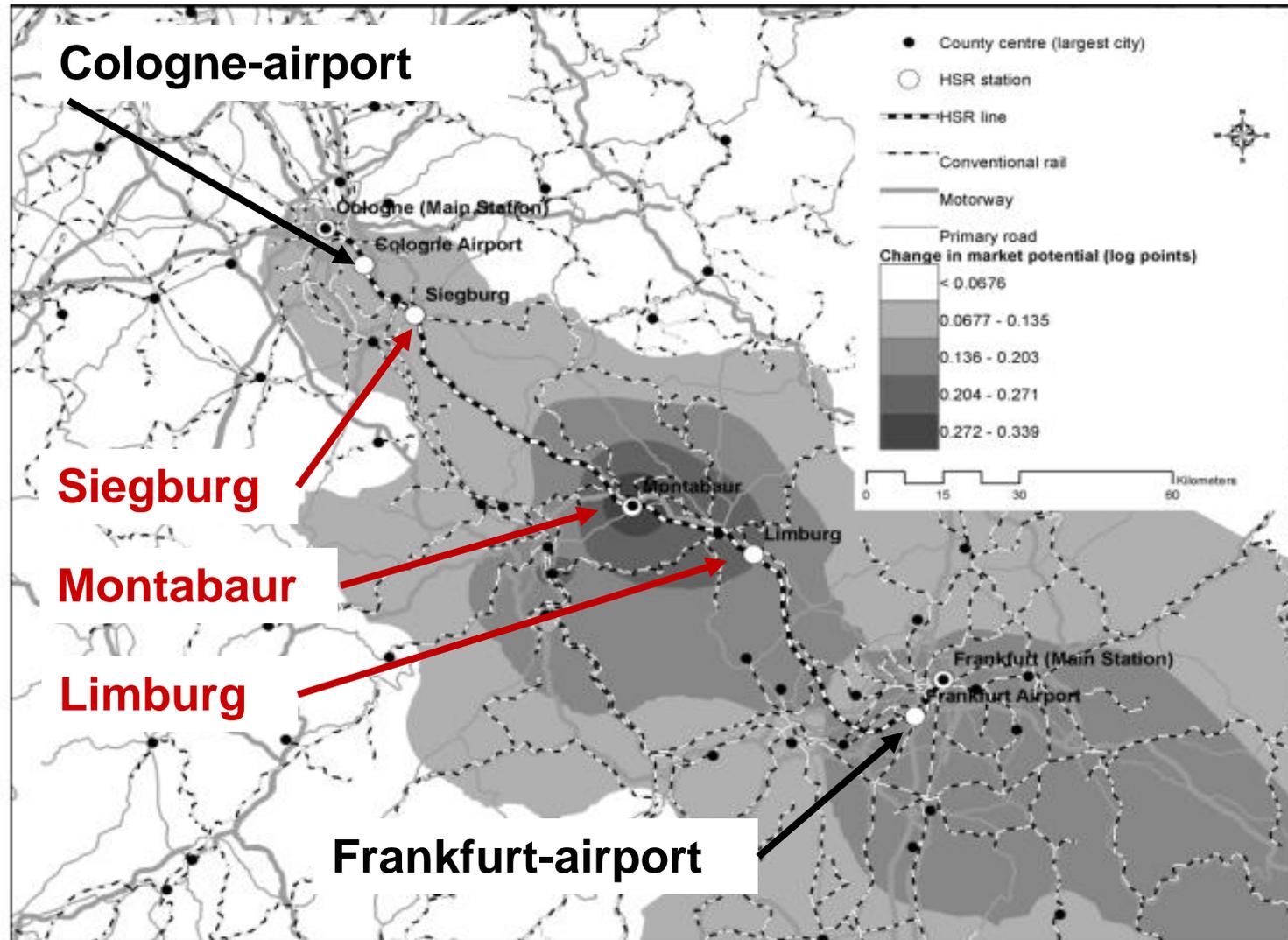
# Firm-level studies focusing on inter-regional transport infrastructure: e.g. motorway expansion in Spain (II)

- Holl (2004a, 2004b) using firm-level data for Spain and Portugal, respectively, finds that firms prefer municipalities in close proximity to new motorways at the cost of more distant ones; this is indicative of negative spillover effects
- Contrary results by Montalvo and Garcia (2013), who tested the effect of access to major roads on business location using PSM techniques for treated/untreated groups of firms (within 10 km and 20 km from major road); they find no effect of proximity to new major roads and new firm location in Spain



Sources: Holl, A. 2004a. Manufacturing location and impacts of road transport infrastructure: empirical evidence from Spain. *Regional Science and Urban Economics* 34(3):341-363. Holl, A. 2004b. Transport infrastructure, agglomeration economies, and firm birth: Empirical evidence from Portugal. *Journal of Regional Science* 44(4):693-712. Garcia-Milà, T. and Montalvo., J.G. 2007. A new approach to measure the impact of highways on business location with an application to Spain. WP754, Barcelona Graduate School of Economics.

# Economic effects of inter-regional transport: Cologne-Frankfurt high-speed rail corridor



Source: Ahlfeldt, G. M. and Feddersen, A. 2017. From periphery to core: measuring agglomeration effects using high-speed rail. *Journal of Economic Geography* 18, 355–390.

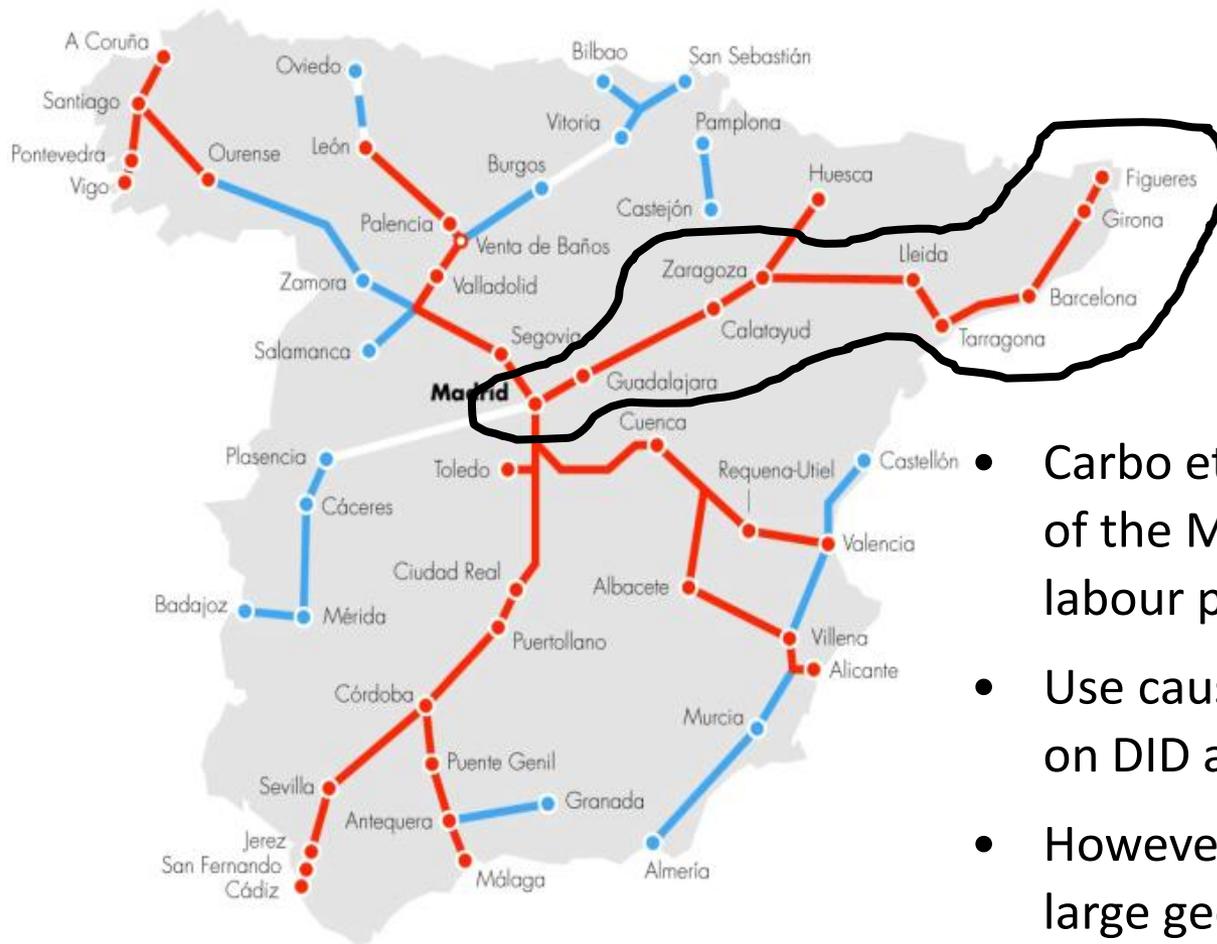
# HSR effect on treated county GDP (vs. synthetic control)

ATE from DID of ln(GDP) between synthetic control vs treated county	Treated counties (pooled)	Limburg	Montabaur	Siegburd
short run	0.046*	0.033**	0.049	0.057**
cumulated effect after 3 years	0.066*	0.050***	0.073*	0.074**
cumulated effect after 6 years	0.084*	0.067***	0.097*	0.089**

Note: Cologne and Frankfurt are excluded from the analysis. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

- Identifying assumption: “...the routing and the timing of the connection of Limburg, Montabaur, and Siegburg ... are exogenous to the levels and trends of economic output.” *inconsequential units approach*
- Using SCM they create a comparison group of counties for each of the treated counties - Limburg, Montabaur, and Siegburg – and estimate DID models to measure the ATE of the HSR on county-level GDP:
  - short-run GDP gain of 5%
  - longer term GDP gain between 6.6%-8.4%
  - with some variation between counties

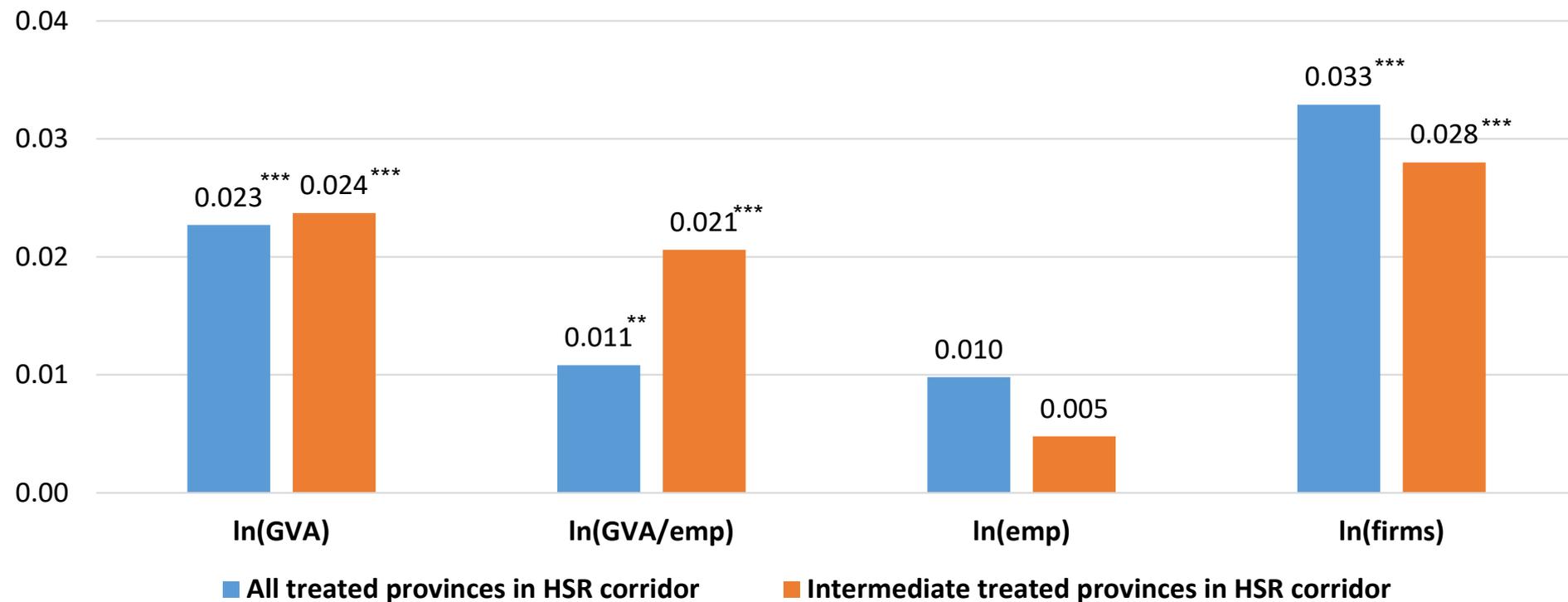
# Economic effects of inter-regional transport : Madrid-Barcelona high-speed rail corridor



Province	HSR Implementation
Madrid	Late 2003, enhanced in late 2006
Guadalajara	Late 2003, enhanced in late 2006
Zaragoza	Late 2003, enhanced in late 2006
Lleida	Late 2003, enhanced in late 2006
Huesca	2005
Tarragona	Late 2006
Barcelona	Early 2008
Girona	Early 2013

- Carbo et al. (2019) estimate the effect of the Madrid-Barcelona HSR on GVA, labour productivity, emp., and firms
- Use causal inference techniques based on DID and SCM for Lleida & Tarragona
- However, the analysis is based on fairly large geographies, i.e. Provinces

## Average Treatment Effect (ATE) from DID for Madrid-Barcelona HSR



\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

- The greater increase in labour productivity in provinces with HSR stations, compared to control provinces, is attributed to the expansion in GVA and in the number of companies due to HSR
- Not possible to examine intra-province effects of HSR



**IV -  
Some tentative conclusions and policy  
implications**

# The political economy of transport investment

- Transport on its own is likely to achieve very little in terms of improving regional economic development and, consequently, contribute to the reduction of regional disparities
- Political economy issues affecting decision-making wrt project selection and allocation, and lack of appropriate transport appraisal, may also have reduced potential socio-economic benefits
- EU's regional development policy likely to have been *unbalanced* favouring transport infrastructure and *disconnected* from the main drivers of development (as per recent studies: Crescenzi and Rodríguez-Pose, 2012; Crescenzi et al., 2016) – this calls for a more integrated regional development policy

# Making evidence more relevant for policy

- Main ongoing empirical challenges for empirical research with direct policy implications:
  - Pay more attention to the potential for spatial spillover effects, and their relation to local context and type of transport project;
  - Separate the overall economic impact of transport infrastructure into growth vs. relocation effects of economic activity;
  - Use more realistic measures of transport: 1) commonly used physical endowment cannot capture changes in relative accessibility across locations; 2) studies overly focused on road, especially motorways;
  - Continue addressing the key identification issues, but without getting (too) distracted away from the real question.

# Implications for transport appraisal

- Transport appraisal to take greater account of context and transport project specificities, and how its outcomes may (not) contribute to regional development - *in which ways does the project link to the regional development strategy?*
- Some countries – notably, UK’s DfT – assess the potential for Wider Economic Impacts (WEIs) of transport investments, especially due to agglomeration economies
- However, the evaluation of the potential local and regional economic impacts needs to consider scope for actual additionality and displacement effects within and between regions
- Importance of doing ex-post analysis and comparing its outcomes with ex-ante estimates

# Thank you

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