Agglomeration Economies: Sources of Productivity and Growth

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Structure of the lecture

Three sections:

1. Relevance of the topic

2. Definition of agglomeraiton economies

3. Existing theories on agglomeration economies as sources of growth and productivity

Relevance of the topic

Stylised facts

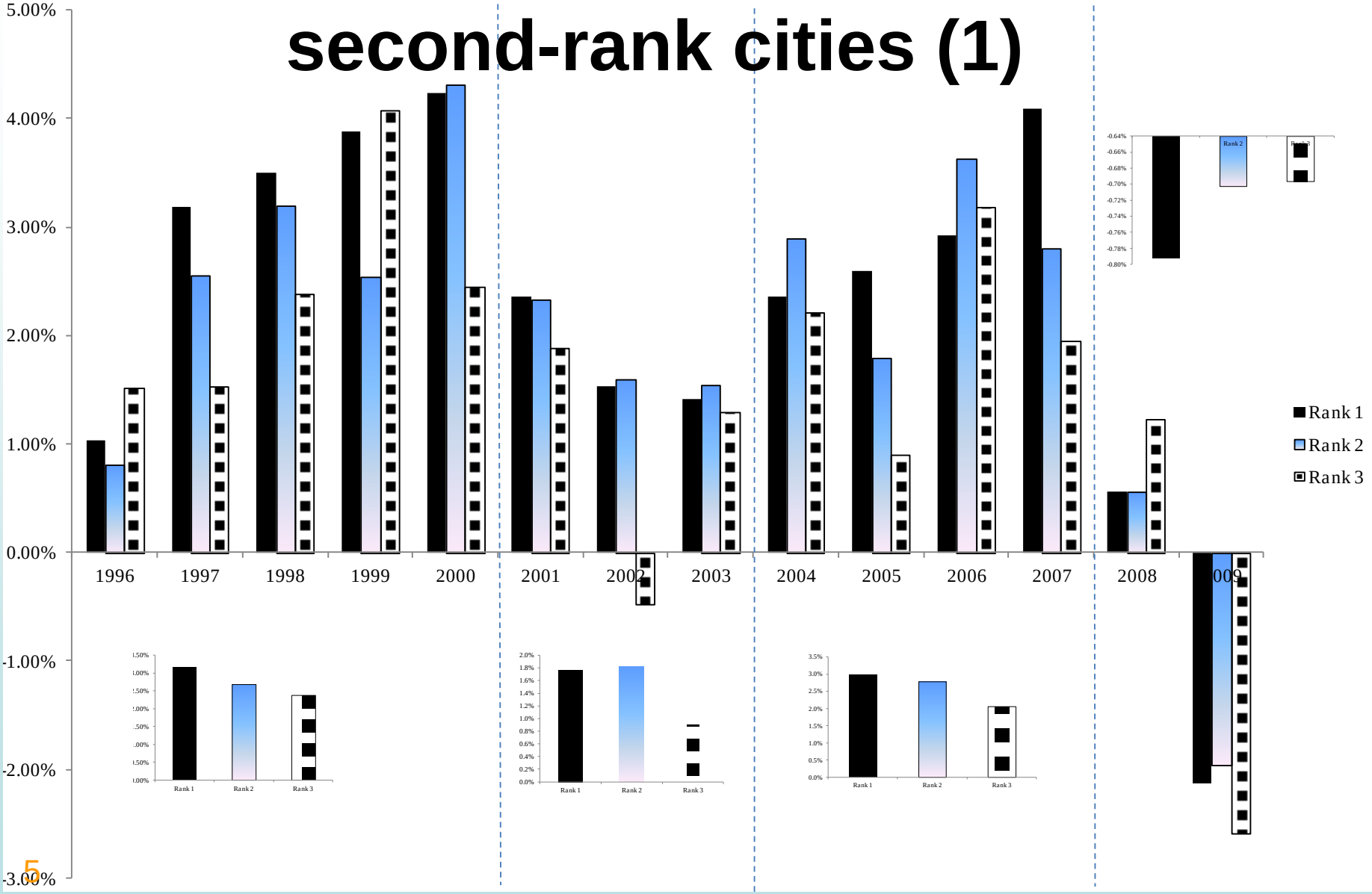
Recently, a resurgence of interest in cities and in their role in national economic performance with empirics focusing mainly on North America (Scott, 1988; Sassen, 2002; Rosenthal and Strange, 2004; Glaeser, 2008).

This revival of interest is not merely driven by an academic fashion (Henderson, 2010), but finds concrete evidence of real changes in the role of large cities in driving national economies (Nijkamp and Kourtit, 2011 and 2012).

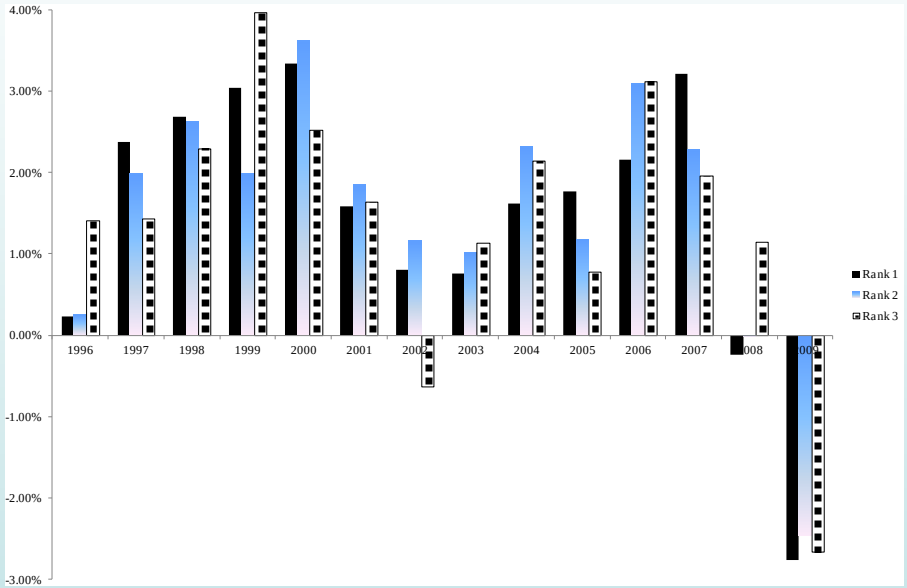
Recently, stylised facts suggest a resurgence of the role of second-rank cities as engines of economic growth.

This result has been underlined in the academic arena (Dijkstra et al., 2013; Parkinson, 2013).

Quantitative evidence: the rise of second-rank cities (1)



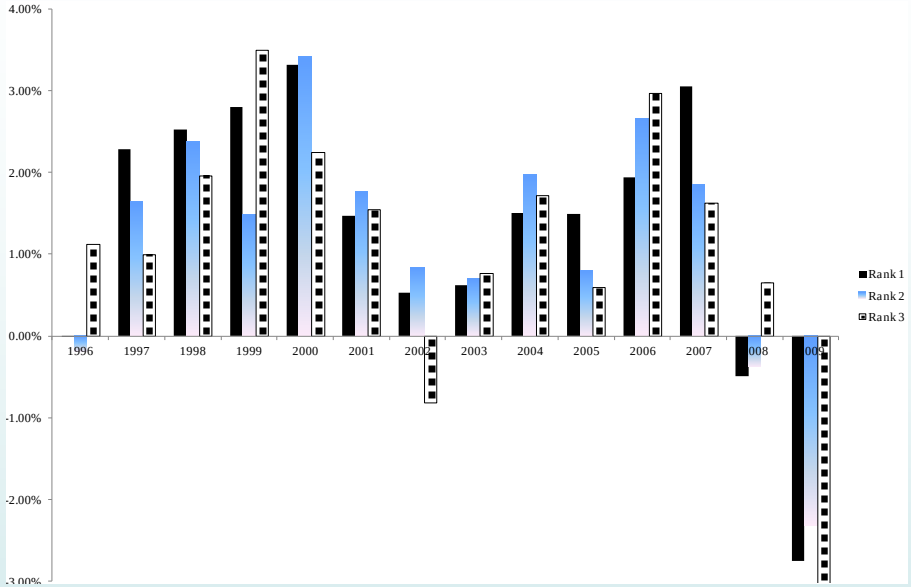
Quantitative evidence: the rise of second-rank cities (2)



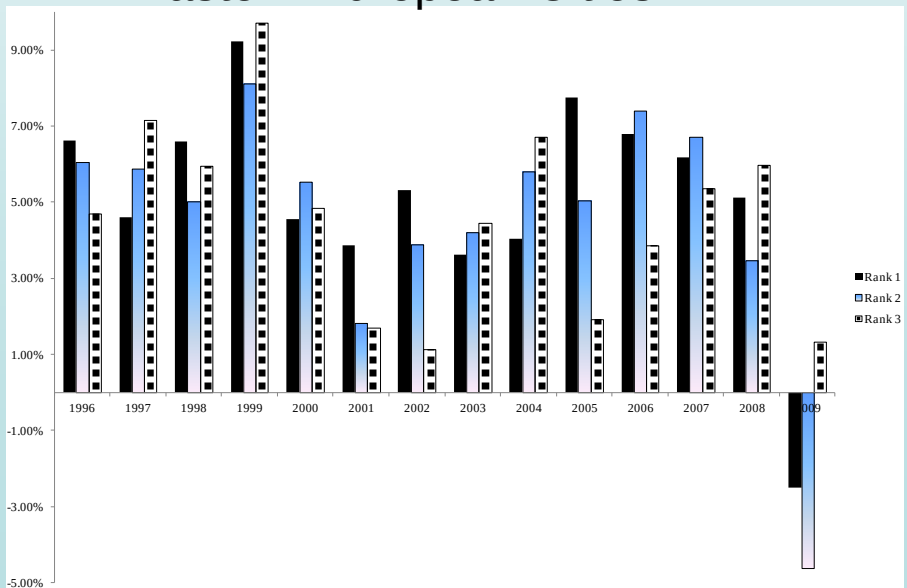
- While this EU-wide trend is relatively visible with plain GDP growth data, the prevalence of rank 2 cities as engines of economic growth in recent periods emerges more clearly from the inspection of per capita GDP data.

Quantitative evidence: the rise of second-rank cities (3)

Western European Cities



Eastern European Cities



- This evidence can be further decomposed by macroarea, i.e. between EU15 and NMS.
- Because of the large portion of EU27 GDP produced by Western Countries, the EU15 behaves quite similarly to the EU27 trend.
- In NMS, instead, in most observed years rank 1 cities overperform w.r.t. rank 2 ones, with no clear trend of a rank 2 cities' reprise.
- For this reason, in the empirical analysis rank 2 cities will only be analyzed in EU15 countries.

Aim of the lecture (1)

The explanations given for the relative better performance of second-rank cities are not so convincing:

- econonomists speak about agglomeration economies / diseconomies (Dijkstra et al., 2013);
- political scientists: urban governance quality (Parkinson, 2013).

Structural breaks are used to explain cyclical economic phenomena, with no explanation of why they take place exactly at a specific moment and in a particular place.

Why should large cities suddenly start suffering from diseconomies of agglomeration?

Why should small cities start getting advantages from their small size?

Aim of the lecture (2)

The aim of the lecture is to explain such an apparent contradiction by highlighting the crucial distinction between a static and a dynamic definition of urban advantage / productivity.

- **Static productivity advantages:** higher productivity of large cities w.r.t. small ones at any given point in time.

- **Dynamic productivity advantages:** productivity increases over time for each city size.

Definition of Agglomeration Economies

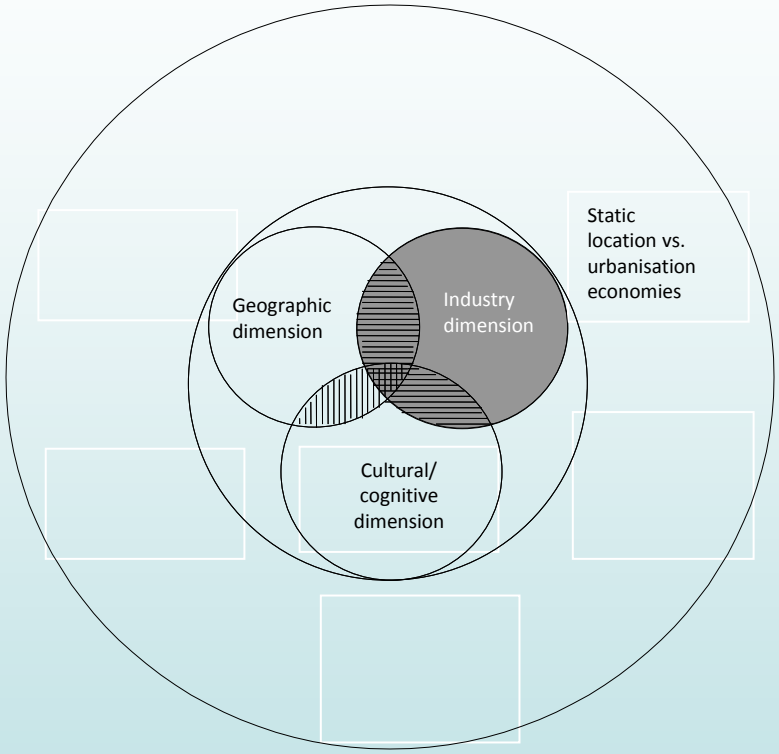
Microfoundations of agglomeration economies

- **Indivisibilities**: agglomeration activities add to productivity by causing shifts in a firm's production or cost curve, i.e. more output for a given input, or lower input costs for a given output (industrial dimension);

- **synergies:** agglomeration activities add to productivity because they allow to increase the intensity of local cooperation and market interactions (socio-cultural/cognitive dimension);

- **proximity:** agglomeration activities adds to productivity since it facilitates interactions, exchange of ideas: if interaction costs were nil, there would be no reason to concentrate activities, because doing so would not produce 'economies'. In this sense, agglomeration economies are 'proximity economies' (geographic dimension).

The early 1970s



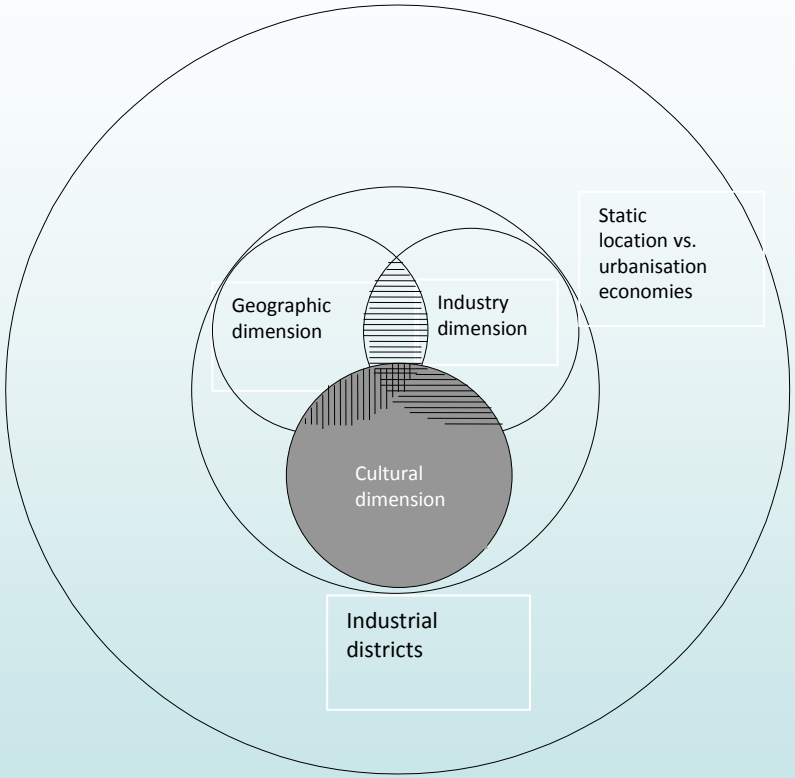
References: Segal, 1976; Henderson, 1985; Shefer, 1973; Carlino, 1980; Sveiskauskas, 1975; Moomaw, 1983; Hoch, 1972; Mera, 1973; Mills, 1970, Jacobs, 1969 to cite only some authors

The Early 1970s: Indivisibilities and the Industrial Dimension

Studies on agglomeration economies characterised by:

- their empirical nature;
- their interest in highlighting the source of indivisibilities (intra-sectoral or inter-sectoral; e.g. Jacobs, 1969);
- their simple idea of space:
  - dichotomous -> dispersed vs. concentrated space, or specialised vs. diversified areas;
  - absolute -> no interactions with other areas; industrail specificities.

The mid 1970s



References: Becattini, 1975, 1979, Bagnasco 1977, 1983; Brusco, 1982; Paci, 1973; Bagnasco and Trigilia ,1984; Trigilia, 1985; to cite only some authors

The Mid-1970s: Synergies, Local Networks and the Socio-Cultural Dimension

Agglomeration economies studied as:

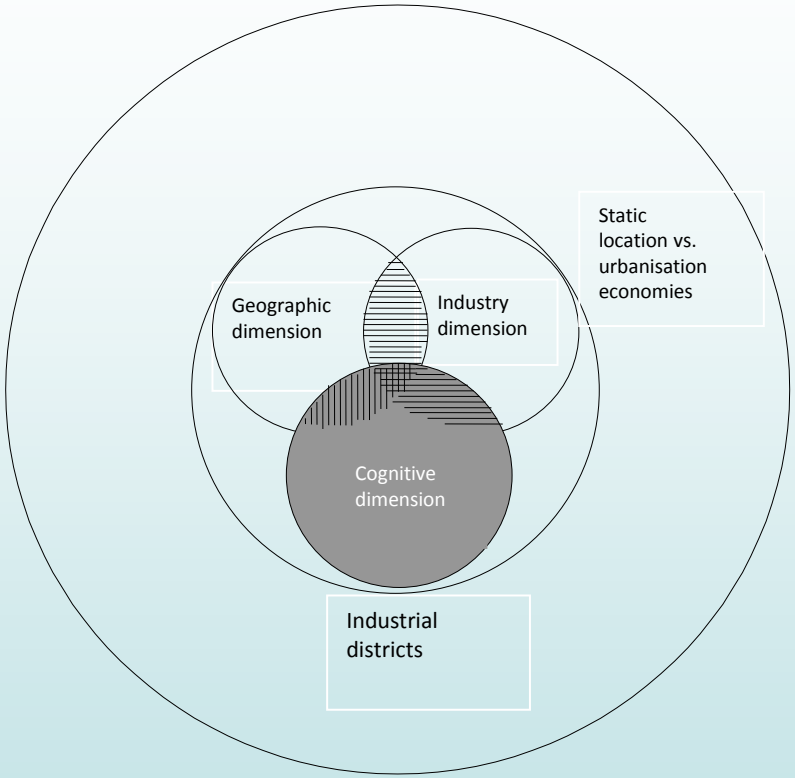
- advantages generating and reinforcing *market interaction and synergies among economic agents,* that produce increases in firms' productivity;

According to this approach, the capacity of economic actors to cooperate is rooted in the *socio-cultural environment* in which firms operate, and it generates increasing returns – or more precisely, localization economies, or again 'district economies' (Becattini 1979).

Features of this approach

- The geographic dimension was still left aside – space was again considered to be dichotomous and absolute;
- the industrial dimension was also taken for granted: conceptual reflections in fact concentrated on highly specialised areas called “industrial districts”;
- the interest of this branch of literature was mainly directed at the socio-cultural dimension in agglomeration economies.

The mid 1980s



References: Aydalot, 1986; Lundvall, 1992; Asheim, 1996; Aydalot and Keeble, 1988; Camagni, 1991, to quote some.

The mid-1980s: the cognitive approach

First step forward: *the cognitive approach*.

Like the approach based on the socio-cultural dimension, this one took the industrial and the geographic dimensions of agglomeration economies for granted.

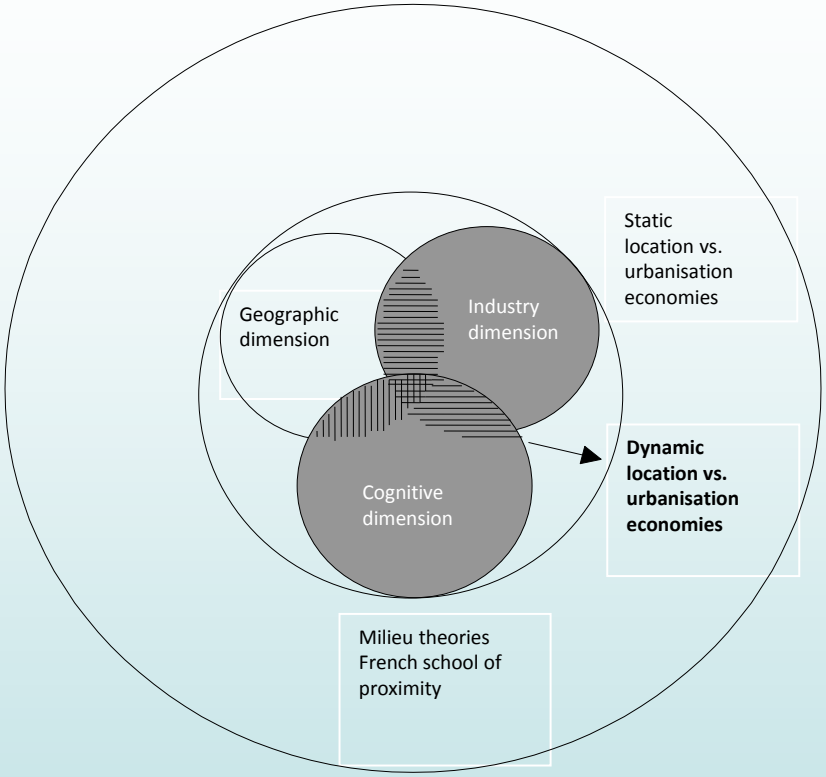
Territories were diversified in terms of the “cognitive capability” of actors, by which was meant the ability to manage information in order to identify and solve problems (Lundvall, 1992; Asheim, 1996). This cognitive capability increases in highly specialised and more densely populated environments (Aydalot and Keeble, 1988; Camagni, 1991).

Features of this approach

In this approach, agglomeration economies:

- were dynamic in nature;
- they stemmed from processes of collective learning, from tacit knowledge continuously created, exchanged and utilised, and from the ability to organise local knowledge into continuously innovative production processes and products;
- they were no longer sources of increased efficiency; rather, they became sources of increased innovation capability.

The late 1980s



References: Camagni, 1989; Capello, 1999; Cappellin, 2003;

The late 1980s - A First Multidimensional Approach: the Industrial/Cognitive Approach

- the cognitive approach merged with the industrial approach;

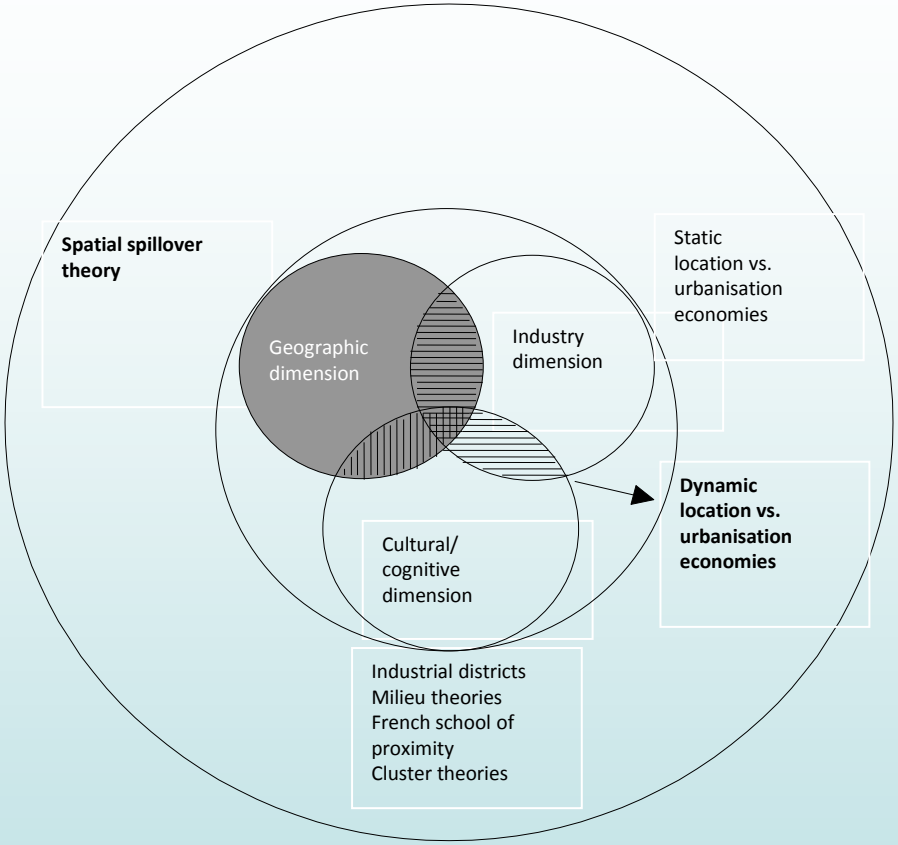
- empirical studies mainly sought to understand whether collective learning mechanisms are more intense in specialised or diversified areas, in milieus or/and in cities;

Features of this approach

- Like the socio-cultural approach, space is dichotomous (densely vs. non-densely populated) and absolute, with no relations being assumed among different geographical areas.

- Geographical areas differ in terms of social structures and industrial composition, and these differences explain the scope of agglomeration advantages.

The early 1990s



References: Acs et al., 1994; Audretsch and Feldman, 1996 and Feldman and Audretsch, 1999; Anselin et al., 1997.

The 1990s: the Geographic Dimension

The interest in agglomeration advantages shifted from the industrial and cognitive dimension to the geographic one, as a result of advances in statistical, and especially econometric, techniques.

A first application of this concept of space to agglomeration economies was made by the spatial spillover theory (e.g. Acs et al., 1994; Audretsch and Feldman, 1996 and Feldman and Audretsch, 1999; Anselin et al., 1997).

Features of this approach

Space becomes a continuous space.

The other two dimensions given for granted:

- the presence of advanced sectors and advanced functions like R&D and higher education – not interpreted but taken for granted – guaranteed knowledge spillovers,

- the capacity to absorb knowledge was assumed to be homogenously distributed over space and based on pure probability contacts.

Explicit criticism

- A step forward was achieved in measuring geographical proximity by moving away from the simplistic assumption of a postulated concentration of economic activities in a point in space,

- A step backward: a pure geographic approach imposed synergy elements to be left to pure probability contacts that increased as distance decreased.

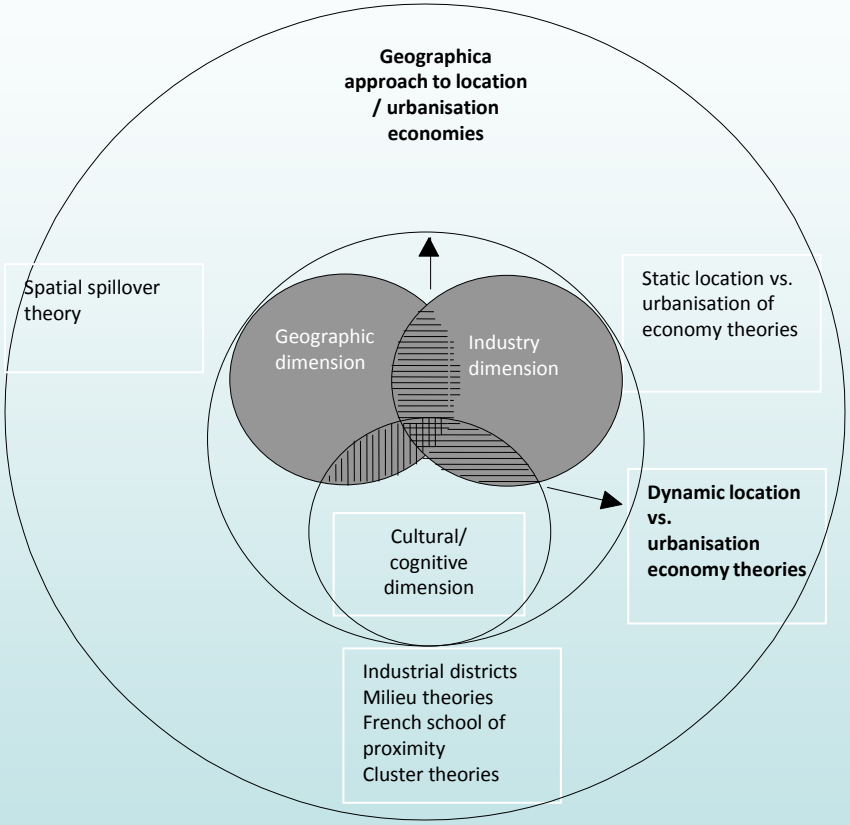
Early 2000s: Geographic/ Industrial Interaction

- Do agglomeration economies attenuate rapidly across space?

- does this occur more among establishments operating in the same or in different sectors?

New and sophisticated techniques in the spatial econometric sphere.

Early 2000s



References: Acs et al., 1994; Audretsch and Feldman, 1996 and Feldman and Audretsch, 1999; Anselin et al., 1997, to quote some of the authors.

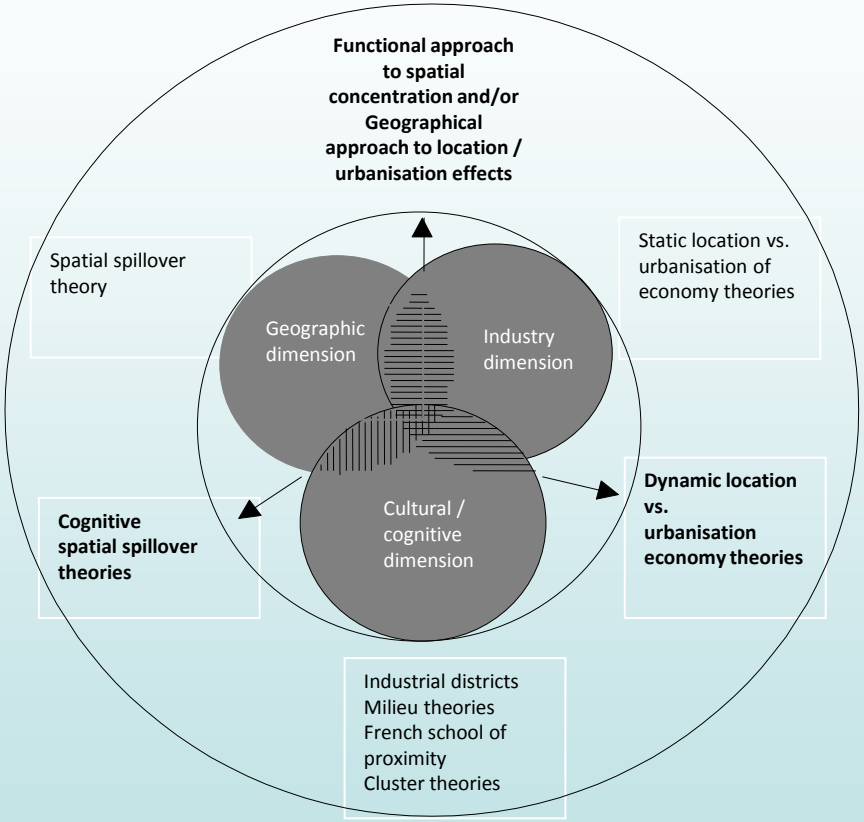
Future Challenges: Towards an Integrated Approach

An integrated approach concerning all three dimensions is necessary and represents the challenge in front of us.

Especially a step forward in interpreting agglomeration economies would be to reposition the socio-cultural/cognitive dimension in the debate on agglomeration economies.

Step forward with the integrated approach: to avoid the deterministic assumption of the geographic and industrial approaches in which proximity means agglomeration advantages.

The Future Challenge



It would enable…

… explanation of why, with the same physical distance between two establishments in the same industry (at micro-territorial level) or between regions (at the macro-territorial level), agglomeration economies may emerge in some cases and not in others!

Limits to an integrated approach

- data availability on non-material elements (some attempts in this respect with the EVS);

- Development of quantitative methodologies with both spatial and social proximities taken into consideration at the same time (from a “spatial”to a “territorial econometrics”);

- Mainstream approaches sensitive to the role of non-tangible elements (some example in the literature on trust, social capital, sense of belonging).

-> I remain optimistic that future steps will be made in this direction.

Theories of Agglomeration Economies

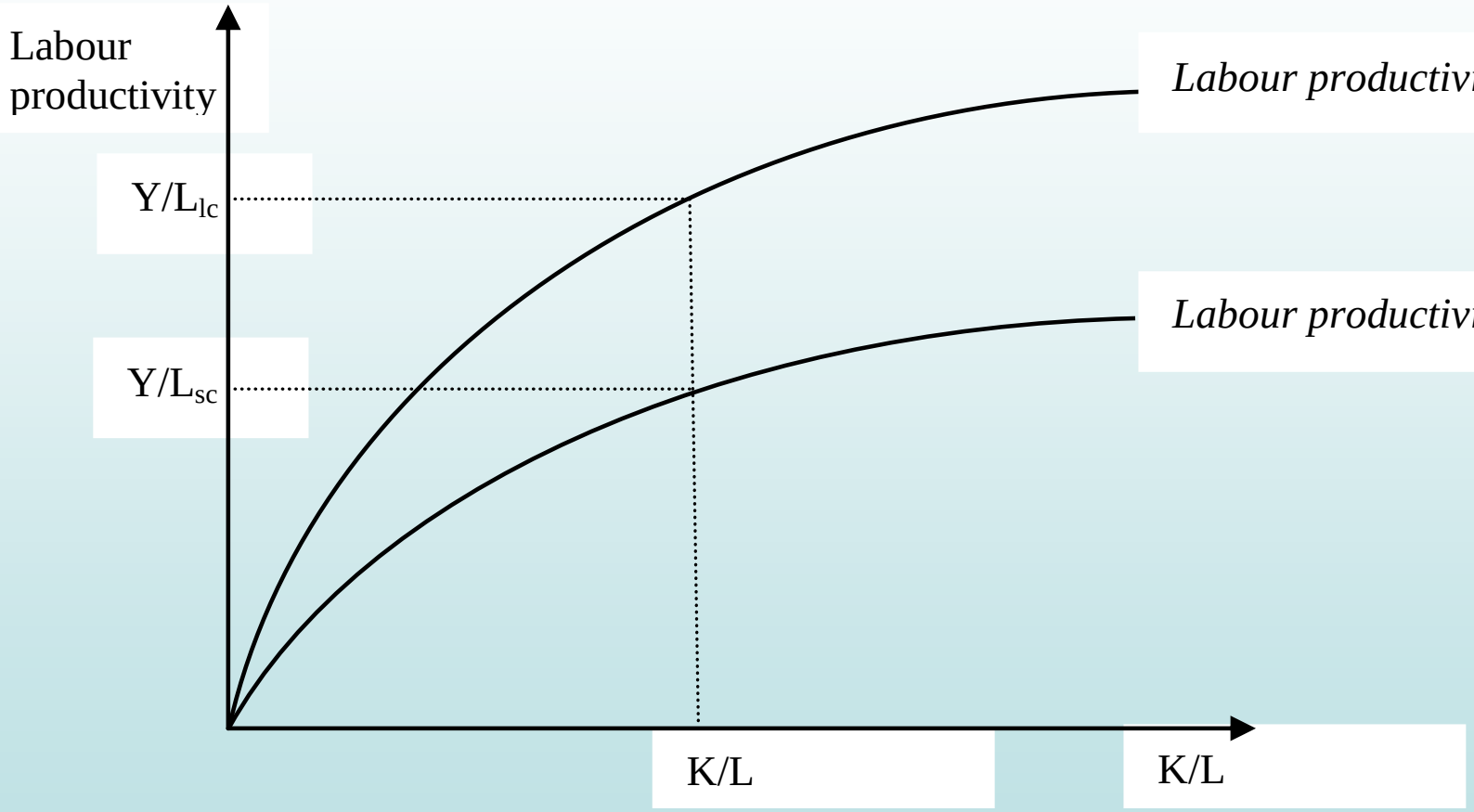
Three shortcuts in the existing literature

1. A direct link is established between static agglomeration economies and urban growth. The presence of increasing returns to urban scale only points out a superior efficiency/productivity of large cities, not a trend towards increasing urban size, automatically implying a growth in productivity.

2. Smaller cities also present a positive size-derivative of average urban benefits and the potential efficiency increases eventually attained would also be beneficial to the entire urban system.

3. Production factors determining urban productivity other than size are not perfectly malleable. Some of them are characterized by high indivisibilities and time discontinuities in their development path. Therefore, they may hamper urban growth.

The existing literature: the micro-industrial approach



The existing literature: the micro-industrial approach

This approach has some limits:

It interprets urban dynamics in an indirect way:

- large cities are more efficient;
- therefore, they are more attractive;
- therefore, they grow.

This means that it explains urban dynamics through static efficiency

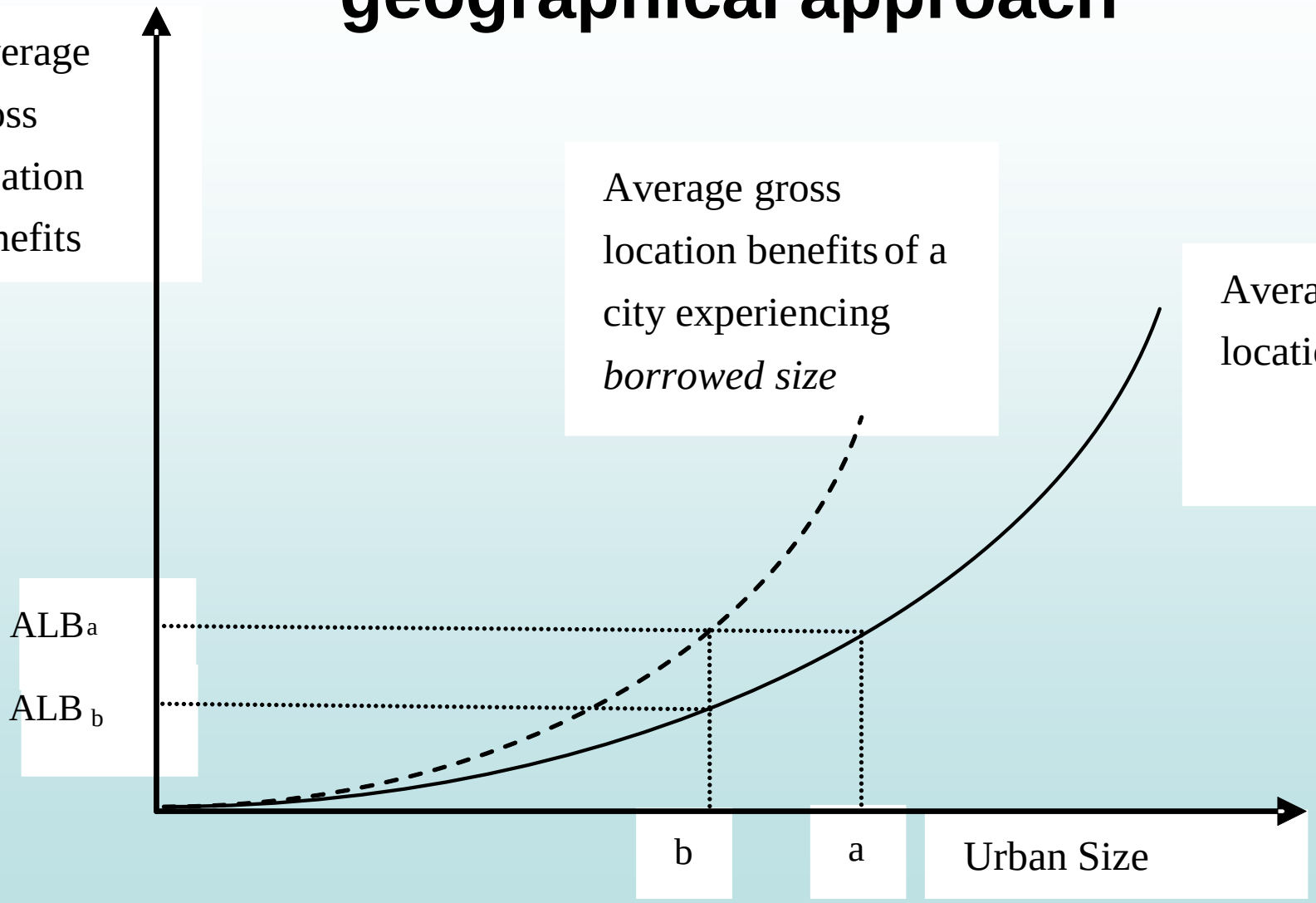
It explains productivity advantages with pecuniary externalities. This implies that agglomeration is associated to clusters of small firms, rather than to cities; and, that leaves totally aside the costs of urban agglomeration.

The existing literature: the geographical approach

- The geographical approach was included as a way to overcome the contradiction that small cities may grow more than large ones.

- The concept used is that of ‘borrowed size’ developed by Alonso (1973); “… a small city or a metropolitan area exhibits some of the characteristics of a larger one if it is near other population concentrations” (Alonso, 1973, p. 200).

The existing literature: the geographical approach



Limits of the geographical approach

This theory:

- assumes no threshold in urban growth;
- describes static agglomeration economies for urban growth;
- interprets urban dynamics in an indirect way:
  - small cities cannot afford the functions played by large ones;
  - some of them are located close to population concentrations and borrow their functions;
  - therefore, they are more efficient and attractive;
  - therefore, they grow.

New reflections on the geographical approach (1)

- In order to fully understand the role of borrowed size, we suggest:

1. A separation between a market (demand) effect and a function (supply) effect:

    - **Market effect (borrowed size)**: advantages coming from a pooled and diversified labor supply, from a larger market of final goods and also from population spillovers from larger cities

    - **Function effect (borrowed functions)**: advantages coming from a wider labor demand, from a larger accessibility to services and also from physical spatial spillovers of functions from larger cities

- This separation allows to distinguish between the 'borrowed size' and 'borrowed functions' concepts. The two effects may have different intensities and different directions (signs) for different city sizes.

New reflections on the geographical approach (2)

2. A separation between spatial and a-spatial networks.

Functions can be ‘borrowed’ also thanks to relationships and flows of a mainly horizontal and non-hierarchical nature among cities of similar size, even if located far from each other (city network theory: Camagni 1993; Boix and Trullen, 2007; Camagni and Capello, 2004).

The existing literature: the dynamic macro-territorial approach

Two major steps forward:

1.If agglomeration economies are assumed as the driving forces for the attractiveness of new activities and population, they have to be conceived as net and not gross urban benefits, at a macro-urban and not a micro-pecuniary level;

2.other factors contribute, together with pure size, to explaining urban efficiency levels, and changes in the intensity of these factors influence increases in agglomeration economies, irrespective of the size of the city.

The existing literature: the dynamic macro-territorial approach (2)

- With respect to previous approaches, two different perspectives are adopted:

- the risk of entering decreasing returns for cities irrespective of their size class;

- the identification of a direct link between dynamic agglomeration economies and urban growth.

Research questions (1)

- Two groups of research questions

- **Static agglomeration economies:**

1. whether large cities are more productive, at increasing or decreasing rates;
2. whether urban productivity is influenced by factors other than urban size, namely urban functions, ‘borrowed size’, ‘borrowed functions’, and urban network externalities;
3. whether these effects are mediated by city size.

Research questions (2)

Dynamic agglomeration economies:

1. whether urban productivity increases in time are related to urban size;

2. whether productivity increases in time are related to the increase in the quality of functions hosted, to the increase of city networks, to the increase in ‘borrowed size’ or in ‘borrowed functions’;

3. previous relationships hold differently for increasing city sizes

The estimated models

Formally, this translates into the following testable reduced forms.

A: Model for the static approach:

$$urban\_productivity_{c,t} = \alpha + \beta_1 population_{c,t-1} + \beta_2 population^2_{c,t-1} + \beta_3 urban\_functions_{c,t-1} +$$
$$+ \beta_4 borrowed\_size_{c,t-1} + \beta_5 borrowed\_functions_{c,t-1} + \beta_6 network\_externalities_{c,t-1} + \varepsilon_{c,t}$$

B: Model for the dynamic approach:

$$\Delta urban\_productivity_{c,T-t} = \alpha + \beta_1 population_{c,t} + \beta_2 \Delta urban\_functions_{c,t-\vartheta} +$$
$$+ \beta_3 \Delta borrowed\_size_{c,t-\vartheta} + \beta_4 \Delta borrowed\_functions_{c,t-\vartheta} + \varepsilon_{c,t}$$

The indicator of urban productivity (net location benefits) and the sample

- Urban rent is used to measure urban productivity, i.e. net location benefits.

- This indicator is based on a crucial underlying hypothesis:
  - the differences in house prices between large and small cities measure their relative attractiveness (and thus their net localisation advantage), since they are the result of an evaluation made by the market of the ‘value’ of these locations;
  - for the same reason, the dynamics of urban house prices captures the changes in attractiveness of each location, and thus the dynamics of urban productivity advantages.
- The empirical analysis is run on 136 European cities, of all size, located all across Europe

The data base for the empirical analyses (1)

Variable	Indicator	Source of raw data	Years available
Urban productivity	Urban rent per square meter (prices in constant 2005 Euros)	EUROSTAT + National sources	2004 and 2011
High-level urban functions	Share of high-level occupations over total workforce	Labour Force Survey	Average 1998–2002 and 2002–2006
Urban size	Population of the metropolitan area	EUROSTAT metropolitan areas data base	Average 1998–2002 and 2002–2006
Metropolitan location – critical mass (borrowed size)	Spatial lags of population in cities discounted by geographical distance	EUROSTAT metropolitan areas data base, Authors' elaborations	Average 1998–2002 and 2002–2006
Metropolitan location – access to nearby functions (borrowed functions)	Spatial lags of share of high-level occupations in cities discounted by geographical distance	Camagni et al. (2014a), Authors' elaborations	Average 1998–2002 and 2002–2006
Cooperation networks (network externalities)	High-level urban functions in other cities, discounted by the intensity of FP5 and FP6 collaborations between city couples	CORDIS	1998–2002 (FP5) 2002–2006 (FP6)

The data base for the empirical analyses (2)

A measure of borrowed size:

$$borrowed\_size_c = \sum_{j=1}^{n} \frac{pop_j}{w_{geo_{c,j}}}, \forall c \neq j$$

A measure of borrowed functions:

$$borrowed\_functions_c = \sum_{j=1}^{n} \frac{functions_j}{w_{geo_{c,j}}}, \forall c \neq j$$

A measure of urban network externalities:

$$city\_network\_externalities_c = \sum_{j=1}^{n} \frac{functions_j}{w_{coop_{c,j}}}, \forall c \neq j$$

A. Empirical results on the static approach

Dependent variable: urban productivity						
Model	(1)	(2)	(3)	(4)	(5)	(6)
Constant term	21.20***	25.17***	-8.10	-9.48	-11.70	-6.81
	(7.74)	(7.58)	(7.43)	(7.43)	(7.53)	(7.56)
City population	-2.22**	-2.41**	-2.30**	-2.70**	-2.51**	-2.18**
	(1.09)	(1.04)	(1.06)	(1.14)	(1.09)	(1.08)
Square city population	0.09**	0.09**	0.09**	0.10***	0.10**	0.09**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
High level urban functions	-	0.24***	0.24***	0.24***	0.24***	0.25***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Borrowed size	-	0.06	0.06	0.08	0.06	0.06
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Borrowed functions	-	0.99***	1.07***	1.03***	1.00***	1.04***
		(0.24)	(0.24)	(0.27)	(0.27)	(0.26)
Network externalities	-	0.001	0.001	0.001	0.001	0.001*
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High-level urban functions* City population	-	-	-0.01	-	-	-
			(0.06)			
Borrowed size * City population				0.16**		
Borrowed functions * City population						
Network externalities * City population						**
						(0.00)
Dummy UK	-	-	-0.07	-0.07	-0.07	-0.07
			(0.07)	(0.06)	(0.06)	(0.06)
Number of obs.	272	272	272	272	272	272
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes
Method of estimation	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS
R^2	0.14	0.43	0.43	0.44	0.44	0.44
Joint F-test	32.46**	35.77***	29.06***	25.72***	28.29***	26.78***

Increasing returns at increasing rates characterize productivity levels.

A. Empirical results on the static approach

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High level urban functions	-	0.24***	0.24***	0.24***	0.24***	0.25***
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Network externalities	-	0.001	0.001	0.001	0.001	0.001*
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High-level urban functions* City population	-	-	-0.01	-	-	-
			(0.06)			
Borrowed size * City population				0.16**		
Borrowed functions * City population						
Network externalities * City population						**
						(0.00)
Dummy UK	-	-	-0.07	-0.07	-0.07	-0.07
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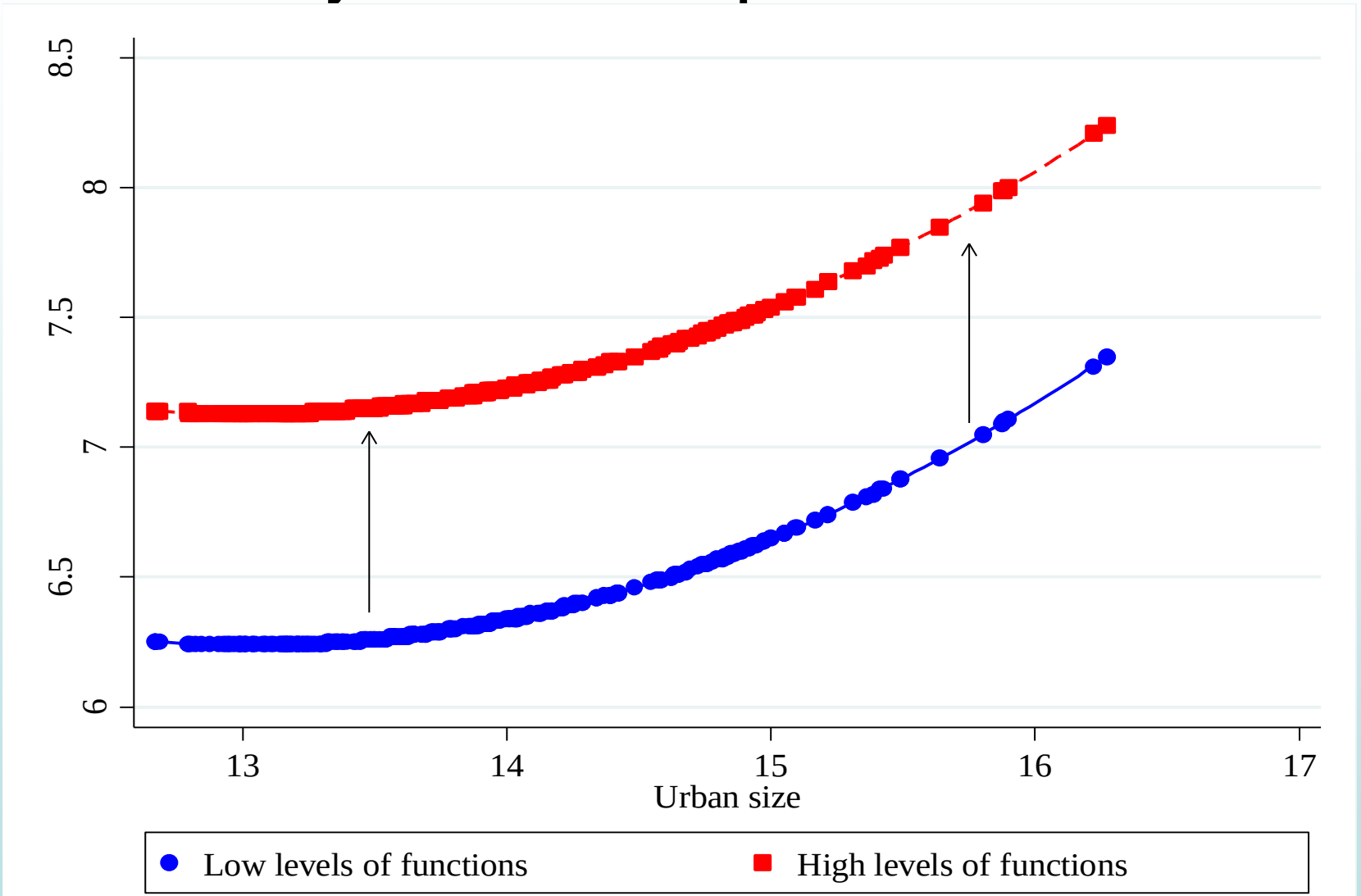
Joint F-test	32.46**	35.77***	29.06***	25.72***	28.29***	26.78***

High-level functions and borrowed functions explain productivity levels.

A. The role of functions on agglomeration economies by urban size: empirical results



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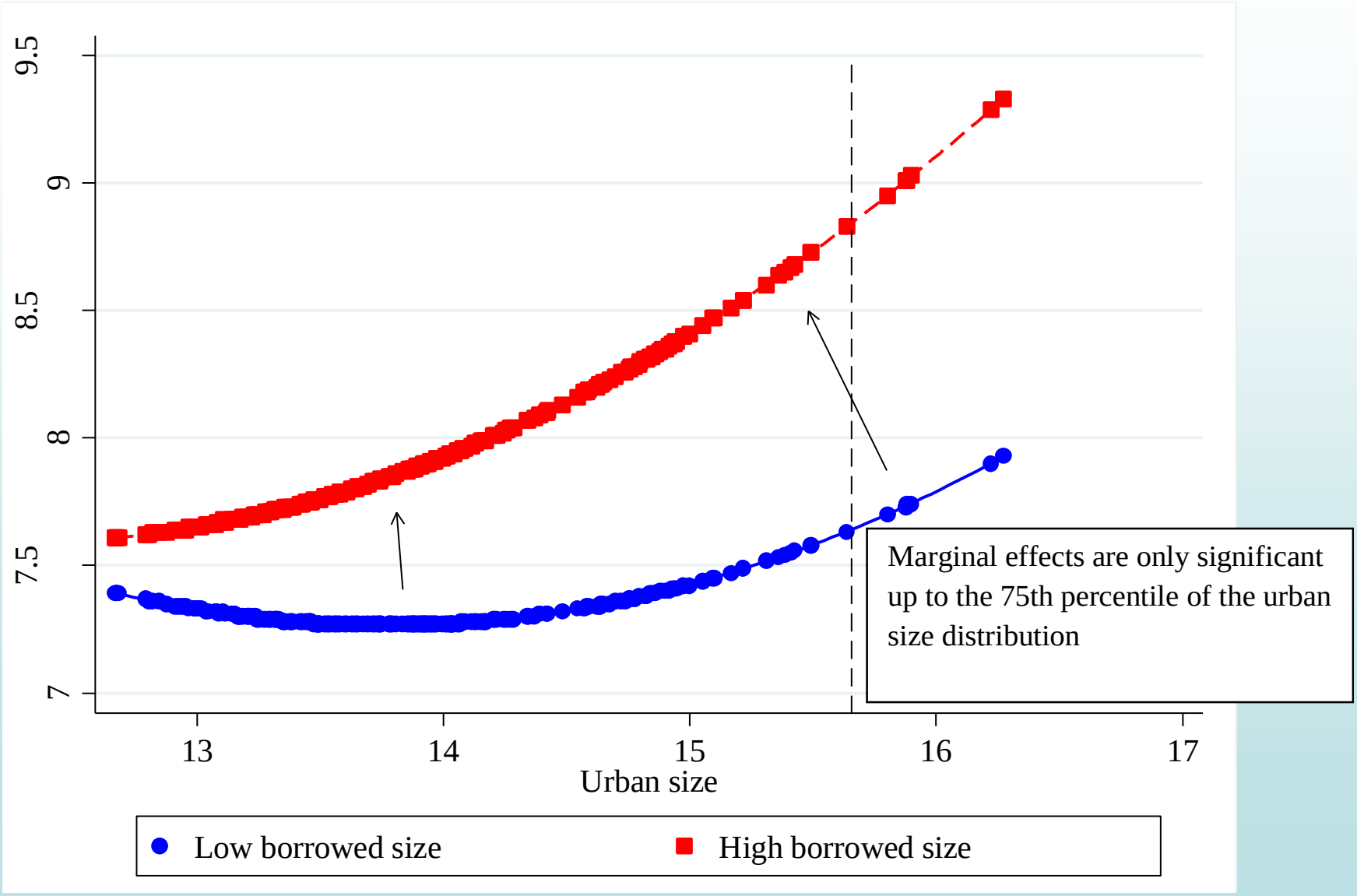
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
High level urban functions	-	0.24***	0.24***	0.24***	0.24***	0.25***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Borrowed size	-	0.06	0.06	0.08	0.06	0.06
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Borrowed functions	-	0.99***	1.07***	1.03***	1.00***	1.04***
		(0.24)	(0.24)	(0.27)	(0.27)	(0.26)
Network externalities	-	0.001	0.001	0.001	0.001	0.001*
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High-level urban functions* City population	-	-	-0.01	-	-	-
			(0.06)			
Borrowed size * City population				0.16**		
Borrowed functions * City population						
Network externalities * City population						
Dummy UK						
Number of obs.	27					
Robust standard errors	Ye					
Method of estimation	Poole					
R^2	0.14	0.43	0.43	0.44	0.44	0.44
Joint F-test	32.46**	35.77***	29.06***	25.72***	28.29***	26.78***

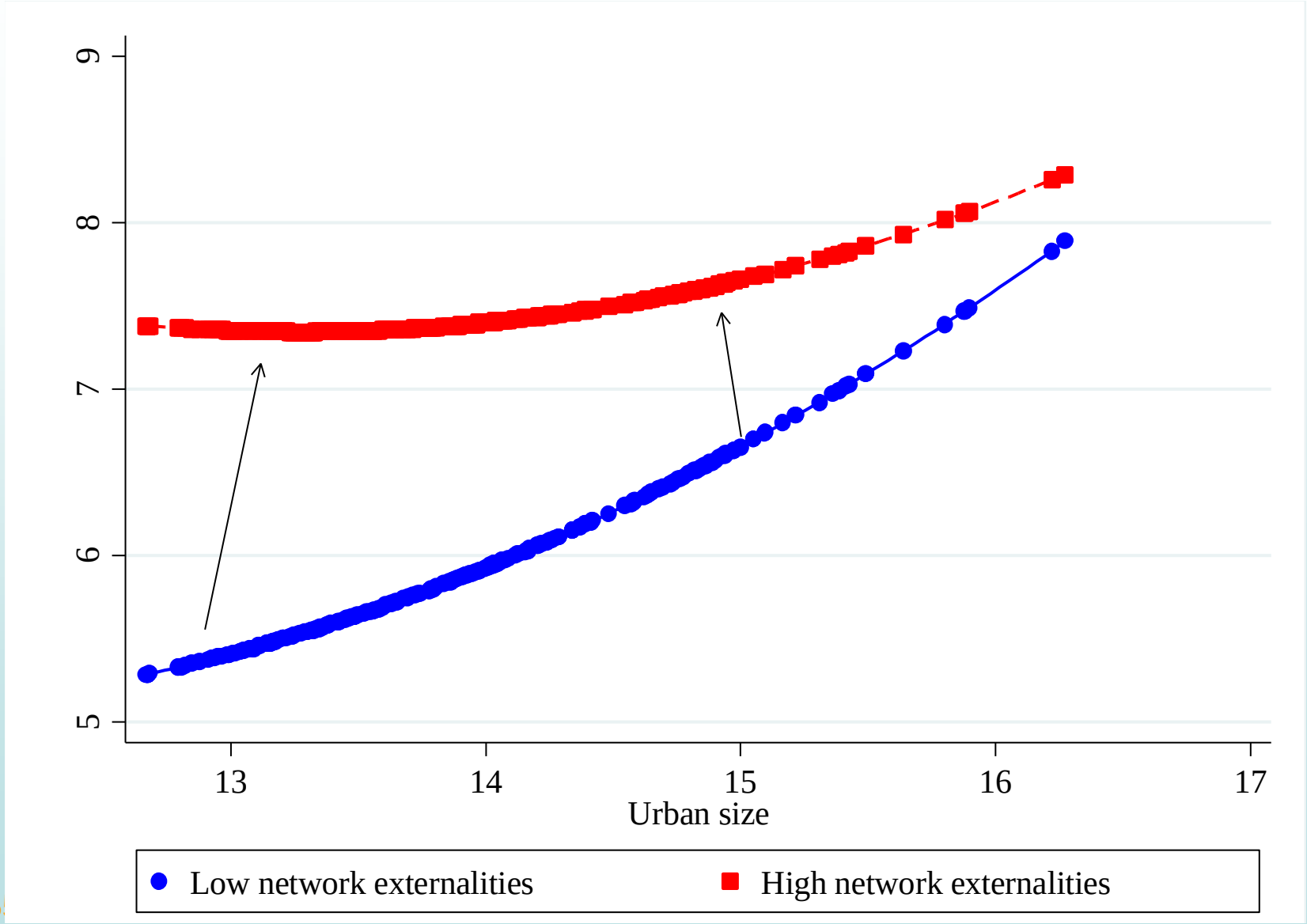
Borrowed size increases with city size but it is significant only for small and medium cities.

City networks effects decrease with urban size.

A. The role of borrowed size on agglomeration economies by urban size: empirical results



A. The role of network externalities on agglomeration economies by urban size: empirical results



B. Empirical results on the dynamic approach

Dependent variable: urban productivity increases

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant term	-0.36	-0.53	-0.10	-0.04	-0.10*	-0.10*	-0.06	-0.14**
	(0.51)	(0.52)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)
City population	0.02	0.03	0.04	0.04	0.02	0.04	0.03	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Growth of high level urban functions	0.17***	0.15***	0.15**	0.15**	0.14***	0.15***	0.16***	0.16***
	(0.06)	(0.06)	(0.06)	(0.07)	(0.03)	(0.05)	(0.06)	(0.06)
Growth of borrowed size	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.001)	(0.00)	(0.00)	(0.00)
Growth of borrowed functions	-	0.43**	0.46**	0.49**	0.45*	0.46**	0.43*	0.45*
		(0.23)	(0.23)	(0.23)	(0.24)	(0.24)	(0.24)	(0.24)
Growth of networks	-	-	-0.31**	-0.28	-0.00	-0.00	-0.00	-0.00
			(0.19)	(0.19)	(0.00)	(0.00)	(0.00)	(0.00)
Urban networks	-	-	-	0.19*	-	-	-	-
				(0.11)				
Growth of high level urban functions * City population	-	-	-	-	-	-	-	-
Growth of borrowed size * City population	-	-	-	-	-	-	-	-
Growth of borrowed functions * City population	-	-	-	-	-	-	.07 (0.31)	-
Growth of networks* City population	-	-	-	-	-	-	-	-0.00 (0.00)
Number of obs.	136	136	136	136	136	136	136	136
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method of estimation	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Pseudo-R^2	0.09	0.12	0.14	0.16	0.15	0.15	0.12	0.12
Joint F-test test	3.01**	3.35**	3.09**	2.97***	14.50***	5.52***	2.46**	2.33**

Population is never significantly associated to dynamic agglomeration economies.

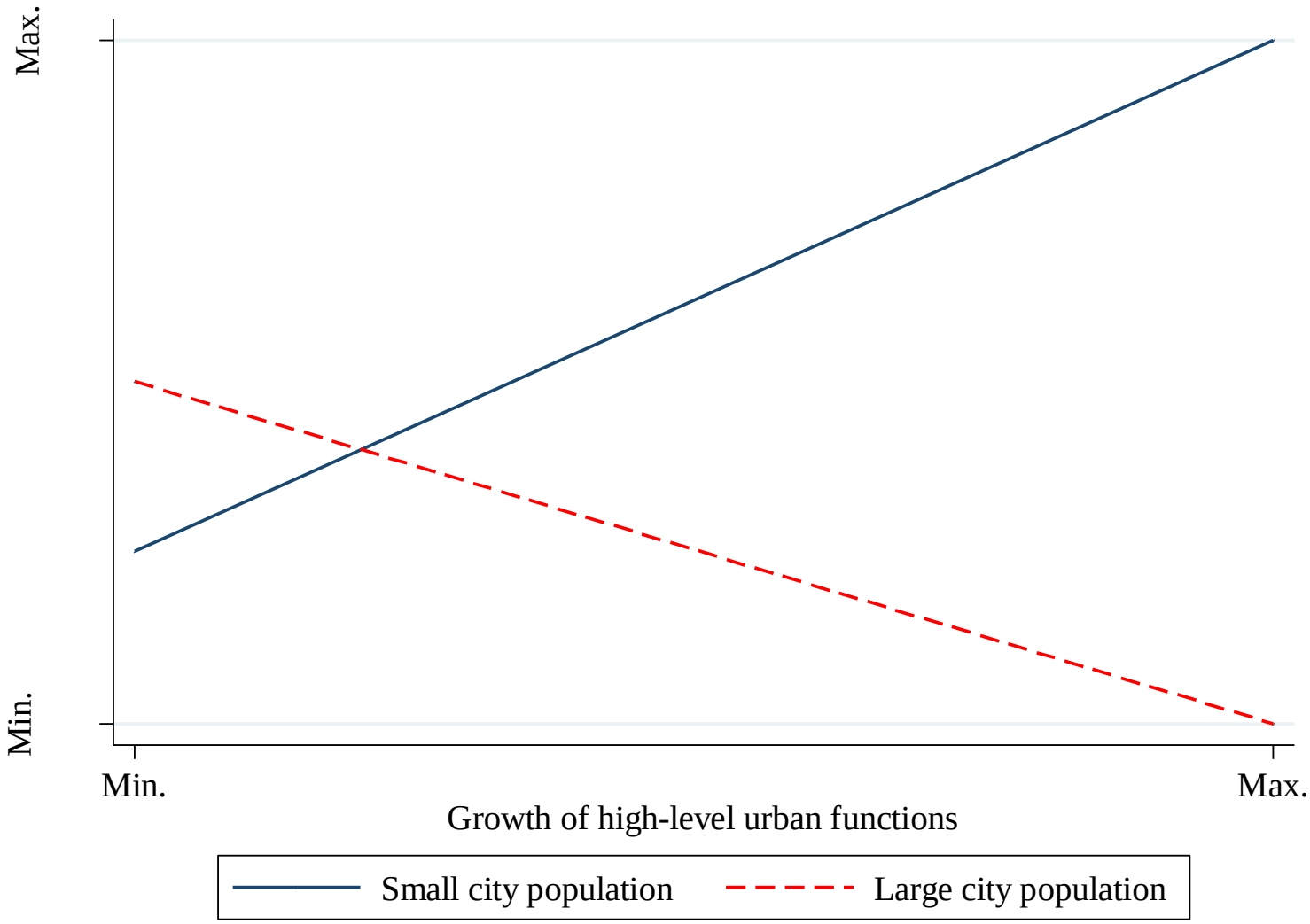
B. Empirical results on the dynamic approach

Dependent variable: urban productivity increases

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant term	-0.36 (0.51)	-0.53 (0.52)	-0.10 (0.06)	-0.04 (0.06)	-0.10* (0.06)	-0.10* (0.06)	-0.06 (0.05)	-0.14** (0.06)
City population	0.02 (0.03)	0.03 (0.03)	0.04 (0.03)	0.04 (0.03)	0.02 (0.03)	0.04 (0.04)	0.03 (0.04)	0.04 (0.04)
Growth of high level urban functions	0.17*** (0.06)	0.15*** (0.06)	0.15** (0.06)	0.15** (0.07)	0.14*** (0.03)	0.15*** (0.05)	0.16*** (0.06)	0.16*** (0.06)
Growth of borrowed size	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)	0.002 (0.001)	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)
Growth of borrowed functions	-	0.43** (0.23)	0.46** (0.23)	0.49** (0.23)	0.45* (0.24)	0.46** (0.24)	0.43* (0.24)	0.45* (0.24)
Growth of networks	-	-	-0.31** (0.19)	-0.28 (0.19)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Urban networks	-	-	-	0.19* (0.11)	-	-	-	-
Growth of high level urban functions * City population	-	-	-	-	-0.15*** (0.05)	-	-	-
Growth of borrowed size * City population	-	-	-	-	-	0.003** (0.001)	-	-
Growth functio popula						-	-0.07 (0.31)	-
Growth City po						-	-	-0.00 (0.00)
Numbe						136	136	136
Robus						Yes	Yes	Yes
Metho						OLS	OLS	OLS
Pseudo-R^2	0.09	0.12	0.14	0.16	0.15	0.15	0.12	0.12
Joint F-test test	3.01**	3.35**	3.09**	2.97***	14.50***	5.52***	2.46**	2.33**

The growth of urban functions is always positively associated to dynamic agglomeration economies; these effects decrease with city size.

B. The role of functions on dynamic agglomeration economies by urban size: empirical results

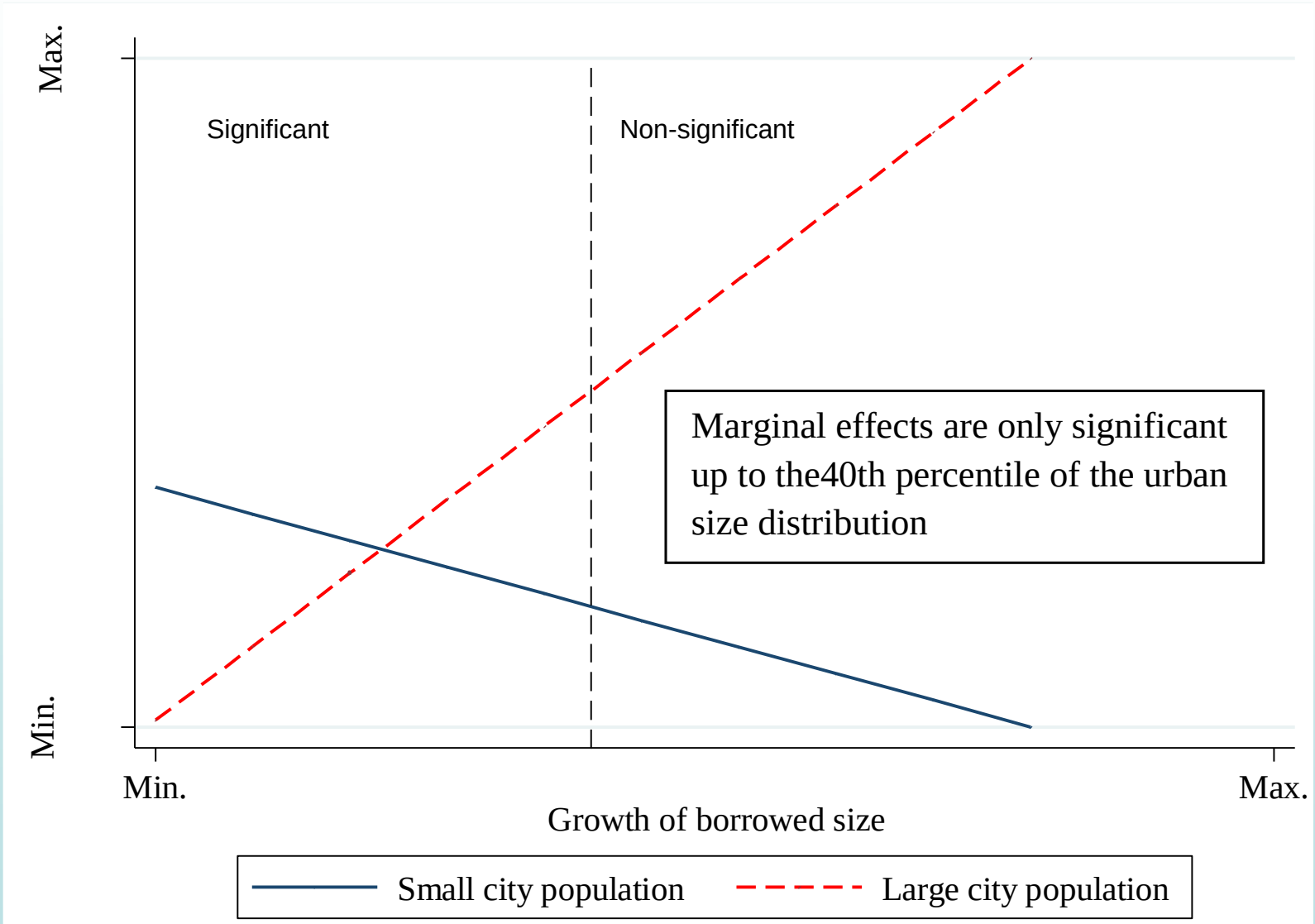


B. Empirical results on the dynamic approach

The effects of the growth of borrowed size increase with size but they are significant only up to the 40th percentile of the city size distribution.

Dependent variable: urban productivity increases

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant term							-0.06	-0.14**
							(0.05)	(0.06)
City population							0.03	0.04
							(0.04)	(0.04)
Growth of high level urban functions							0.16***	0.16***
							(0.06)	(0.06)
Growth of borrowed size							0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.001)	(0.00)	(0.00)	(0.00)
Growth of borrowed functions	-	0.43**	0.46**	0.49**	0.45*	0.46**	0.43*	0.45*
		(0.23)	(0.23)	(0.23)	(0.24)	(0.24)	(0.24)	(0.24)
Growth of networks	-	-	-0.31**	-0.28	-0.00	-0.00	-0.00	-0.00
			(0.19)	(0.19)	(0.00)	(0.00)	(0.00)	(0.00)
Urban networks	-	-	-	0.19*	-	-	-	-
				(0.11)				
Growth of high level urban functions * City population	-	-	-	-	-0.15***	-	-	-
					(0.05)			
Growth of borrowed size * City population	-	-	-	-	-	0.003**	-	-
						(0.001)		
Growth of borrowed functions * City population	-	-	-	-	-	-	-0.07	-
							(0.31)	
Growth of networks* City population	-	-	-	-	-	-	-	-0.00
								(0.00)
Number of obs.	136	136	136	136	136	136	136	136
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method of estimation	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Pseudo-R^2	0.09	0.12	0.14	0.16	0.15	0.15	0.12	0.12
Joint F-test test	3.01**	3.35**	3.09**	2.97***	14.50***	5.52***	2.46**	2.33**


Max.
Min.
Significant
Non-significant
Marginal effects are only significant up to the40th percentile of the urban size distribution
Min.
Max.
Growth of borrowed size
Small city population
Large city population

Conclusions and policy implications

- Especially for the dynamic part of the analysis, the paper highlights that the ways to increase urban performance are of a high number, all distinct from an increase in size; there is therefore still much that can be done in order for our cities to grow without being obliged to increase their size.

- Even in a period of crisis like the present one, policy makers should concentrate their limited resources in those cities able to develop an evolutionary and innovation-oriented strategy, by investing in renovating their functions and their way of cooperation. This holds for both large as well as small cities.

And, for your attention,

Thank you!

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