

# Urban Scaling

Allometry in Urban Studies and  
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## **32 Bridging scaling with agglomeration economies**

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## 32 Bridging scaling with agglomeration economies

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### 32.1 Identifying agglomeration economies

Despite covering half a percent of the Earth's total terrestrial surface, cities are home to approximately 58% of the global population and generate nearly 80% of the world's gross domestic product (GDP). This concentration of people and economic activities in cities cannot be solely explained by variations in physical geography or the distribution of natural resources, or by the reduction in transportation costs resulting from proximity alone [1,2]. Complementary explanations point at the presence of increasing returns to scale within cities, which benefit individuals and firms by enhancing their wages, productivity, and overall economic performance. These returns are known as agglomeration economies [3,4]. They are external to the firms and individuals located within the urban space and contribute to a cumulative process that drives the gradual concentration of economic activities, accompanied by a pronounced clustering of the population, resulting in significant spatial disparities [5]. One of the main theoretical justifications for implementing place-based policies alongside or instead of people-based policies is the recognition of market failures or spatially driven market processes. In micro-economic terms, these failures or processes entail costs and benefits that arise from various activities conducted by individuals or institutions, which impact the welfare of third parties who are not directly involved [6].

A substantial body of literature provides evidence regarding the positive impact of agglomeration on economic growth, productivity, wages, and other socio-economic dimensions. These benefits encompass a wide range of factors, including a higher propensity for innovation, a reduction in per capita pollution emissions, improved accessibility to amenities, and enhanced energy efficiency [7]. However, once cities surpass certain thresholds in terms of size and population density, the incremental gains from agglomeration benefits become marginal, while the associated costs, both monetary (such as land and housing prices) and non-monetary (such as crime, traffic congestion, or pollution), increase [8]. These costs, known as agglomeration diseconomies, counterbalance the advantages of size and density. In addition to addressing the question of defining the optimal size of cities where the economies and diseconomies of agglomeration are balanced [9], research in the field of urban economics has focused on explaining the impact of agglomeration on

economic performance, with particular attention to the observed increase in productivity. This emphasis is partly driven by the interconnected relationship between urban agglomeration and theories of regional economic growth [10].

The available empirical evidence generally supports the notion that agglomeration has a positive impact on productivity. However, it is important to consider that the magnitude of agglomeration size elasticities is influenced by various contextual factors. Scholars such as Melo et al. [11] emphasize the significance of country-specific effects, the specific industry being analysed, and the choice of model when determining these elasticities. As a result, it is not realistic to expect similar magnitudes across different sectors, cities, or countries. In the United States, productivity gains can be as high as 10% [12], with an average range typically falling between 3–8% [13]. In Europe, agglomeration elasticities usually range between 4–6% on average [14], with larger urban agglomeration dominating (overshadowing) scale-economies of interconnected polycentric settings [15]. A meta-analysis conducted by Donovan et al. [16], which examined the productivity advantages of cities across 54 countries, suggests that while there are variations in productivity due to methodological differences and country-specific effects, it is likely that agglomeration elasticities fall within the range of 3–6%. These findings align with other studies estimating productivity gains of approximately 4–6%, depending on whether labour productivity or total factor productivity is being measured [7,17,18]. It should be noted that the effects of agglomeration on productivity exhibit significant variations in developing or low-income countries. For instance, doubling the size of a city is estimated to lead to productivity improvements of between 6–16% in Latin American nations. In China, the increase can reach up to 19%, while in India it stands at 12%, and in African countries it amounts to 17%. These estimates indicate that the productivity gains in these regions are two to four times higher compared to those observed in developed countries [2]. These findings are not inconsistent with the existing body of literature on urban scaling.

### **32.2 Matching, sharing, and learning as externalities mechanisms**

Agglomeration economies literature has tried to deepen our understanding of these elasticities. In the field of urban economics, three main sources of agglomeration economies that contribute to enhanced urban productivity are recognized: sharing, matching, and learning. Sharing pertains to the indivisibility of certain goods, services, infrastructures, and amenities in cities due to high fixed production costs. It encompasses the benefits derived from shared suppliers of diverse inputs, specialization, and risk mitigation. Matching involves the advantages gained by employers and job seekers, buyers and sellers, and business partners as the size of markets expands, increasing the likelihood of finding suitable matches that meet their needs and quality expectations. Lastly, the learning process refers to the generation, dissemination, and accumulation of knowledge in cities, driven by the development and widespread adoption of new technologies, practices, and processes [19]. Transitioning from the theoretical definition of these three sources of agglomeration

to their empirical estimation poses a challenge due to the intertwined nature of their effects on productivity [4].

McCann and Van Oort [10] and Steijn et al. [20] differentiate various agglomeration scenarios that provide a deeper understanding of the processes involved in transferring knowledge, input–output relationships, and labour skills. These concepts partly overlap with the matching, sharing, and learning distinction. Whether attributable to a company’s size or a considerable initial number of local enterprises, a notable level of local factor employment can nurture the emergence of external economies within the cluster of local firms within a specific sector. These phenomena are commonly known as localization economies. The strength of these local externalities is presumed to vary, with some sectors experiencing stronger effects while others exhibit weaker ones [21]. The associated economies of scale encompass elements that decrease the average production cost within the particular region. To enhance the understanding of localization economies, it is beneficial to explicitly consider the market structure [22]. Furthermore, externalities characterized by knowledge spillovers among firms in a geographically concentrated industry are commonly referred to as Marshall–Arrow–Romer (MAR) externalities. In a dynamic context, the MAR theory predicts that local monopoly fosters growth more effectively than local competition by constraining the dissemination of ideas to external entities, enabling innovators to internalize them. Porter [23] supports the importance of localization economies and argues that knowledge spillovers in specialized, geographically concentrated industries stimulate growth. Conversely, urbanization economies materialize as external economies experienced by enterprises, resulting from cost savings derived from the large-scale operation of the agglomeration or the city as a whole, irrespective of the industry structure. The density of institutions, encompassing not only economic aspects but also social, political, and cultural dimensions, facilitates the generation and assimilation of know-how, stimulating innovative behaviour and influencing varying rates of interregional growth. The diverse blend of industries within an urbanized area enhances opportunities for interaction, the adoption and adaptation of practices, and innovative behaviour within the same or related sectors. In her theory of urban growth, Jane Jacobs [24] identifies diversity as a fundamental source of agglomeration economies and, in contrast to the MAR theory, suggests that the most substantial knowledge transfers originate from outside one’s own industry. The interplay of specialization, diversity, and competition represents one of the extensively researched themes in the field of agglomeration economies, given its significant implications for economic policies and urban planning [25].

Each of these elements pertaining to agglomeration economies also presents a potential explanation for why regions characterized by agglomeration generally experience higher levels of growth compared to regions lacking such characteristics. Moreover, cities possess additional attributes that contribute to the growth potential of a city-region [10]. One way to perceive the structure of a regional or urban economy is through an analogy to corporate diversification in product portfolios. Regional diversity can be viewed as a portfolio strategy aimed at safeguarding regional income against sudden asymmetric shocks specific to specific sectors.

This strategy is particularly effective in protecting labour markets and preventing persistent unemployment. Consequently, an increase in regional industrial diversity would reduce regional unemployment rates and foster regional economic growth, while specialization would elevate the risk of unemployment and lead to a slow-down in growth. Similarly, for firms, a fundamental question arises regarding the most rewarding approach to diversification – whether it should be related or unrelated. Scholars such as Baldwin and Brown [26] explore whether related industries, more frequently than not (although not as an absolute rule), experience correlated demand shocks. Therefore, from a portfolio strategy perspective, diversifying risk across unrelated sectors is generally preferable. However, it is crucial to consider the potential benefits derived from related diversification as well. Comparable to economies of scope at the firm level, one can anticipate that knowledge spillovers within a region primarily occur among sectors that are related, and to a limited extent among unrelated sectors. In the realm of agglomeration theory, it is expected that Jacobs' externalities would be more pronounced in regions characterized by a related variety or cognitive relatedness of sectors compared to regions with an unrelated assortment of sectors [27,28]. Additionally, technological development and the diffusion of knowledge and innovation are regarded as central to the modern concept of regional growth. A large literature argues that there is an urban product cycle notion in that new products are more easily developed in large diverse metro areas with a diversified industrial structure and skill base, whereas mature products eventually are decentralized to hinterland or peripheral areas [29,20].

### **32.3 Beyond scaling: bridging disciplines**

The scaling literature and the economic agglomeration literature share many common features: both observe a 5–10% premium in economic outcomes for larger cities (when doubling in size or moving along a logarithmic scale). These economic outcomes include productivity, employment, and other positive factors, as well as related problematic issues like crime, congestion, and segregation (for recent urban economic applications, see Refs. [30,31]). However, despite these similarities, these two literatures do not integrate much as to date, although an interdisciplinary approach offers clear learning advantages. The agglomeration literature suggests that scaling outcomes depend on a delicate balance between agglomeration advantages and disadvantages. The advantages can be divided into two types: first-nature (natural) and second-nature (man-made) advantages. The latter are influenced by micro-based sorting of talented people and entrepreneurs, accompanied by meso-based local matching, sharing, and learning externalities related to specialization, diversity, and competition. Understanding the complexity of this build-up forms a starting point for a common research agenda. To gain a deeper understanding of the building blocks of scaling premiums, it is crucial to advance the joint discussion on urban (dis)advantages. This also has implications for policymaking. People-based policies might focus on attracting talent and entrepreneurs. However, these individuals are mobile and may move away from

areas once they have improved their personal abilities and skills, which are often fuelled by policies. Therefore, it is equally important to introduce place-based policies that support the development of cities and regions that are not targeted by the most talented workforce [32,33]. Ultimately, people and entrepreneurs in cities and regions are those who drive, benefit from, and bear the consequences of scaling effects. Thus, local policies and governance structures play a critical role in shaping significant economic and social developments, as well as addressing societal challenges, as both literatures suggest [34,35]. More research is needed from both disciplines to identify the impacts of policies and guide effective governance. Understanding the mechanisms and determinants of agglomeration and sorting effects is crucial. This includes gaining insights into labour mobility as carriers of knowledge, dependencies on trade networks, and the factors that attract people to local qualities of life, sustainability, and inclusive prosperity. Finally, the concept of polycentricity, as an alternative to urban concentration, has been a subject of fierce debate. For effective planning purposes, it is also essential to pay more attention to polycentricity, especially ensuring that medium-sized and smaller urban nodes are well-connected through infrastructure and functional (complementary) relations [15].

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