



POLICY BRIEF

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**Climate change,
infrastructure and the
economics of cities**

By **Gianmarco I.P. Ottaviano**,
Fondazione Eni Enrico Mattei and
Bocconi University



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Fondazione Eni Enrico Mattei
Corso Magenta 63, Milano - Italia
Tel. +39 02.520.36934
Fax. +39.02.520.36946
E-mail: letter@feem.it
www.feem.it

ABSTRACT

Cities promote economic development as they allow agglomeration economies to materialize. These benefits can be seized provided that effective urban infrastructure fosters knowledge spillovers, labour market pooling, input sharing as well as demand and cost linkages. Currently climate change is increasing the costs associated with the geographical concentration of economic activities in cities while urban sprawl is weakening the social and economic interactions through which agglomeration economies work. Urban sprawl is also weakening the economic and social viability of large infrastructural investments that are needed to tackle the twin challenges of climate change and urbanization. In this respect, a crucial prerequisite for climate-proof urban infrastructure is the implementation of integrated land use and transport policies allowing for compact cities to develop.

Policy Challenge

How can cities both bolster economic activities and effectively respond to climate change? In particular, what are the inherent trade-offs and possible synergies between climate protection goals and other goals that are central to urban economic development?

Urbanization and development

Urbanization on the one hand and economic development on the other hand are parallel processes. Indeed, the emergence and dominance of spatially concentrated economic activities is one of the facts that have been traditionally associated with modern economic growth. This strong positive correlation between development and urbanization has been documented by economic historians, in particular in relation to the industrial revolution in Europe during the nineteenth century. Another example is China where the sharp increase in the growth rate of the country during the past twenty years has been accompanied with an increase in the disparity between coastal urban areas and inland rural regions.

How does urbanization contribute to economic development? “Primitive though it may be, every stable society feels the need of providing its members with centers of assembly, or meeting places. Observance of religious rites, maintenance of markets, and political and judicial gatherings necessarily bring about the designation of localities intended for those who wish or who must participate therein”.¹ While religious, political and judicial services may still be important contributions of cities, from an economic point of view their crucial role is to boost productivity by hosting a spatially concentrated mass of suppliers and customers: metropolises are mega-markets and mega-factories.

The competitive advantage of cities

Spatial concentration may help productivity in two ways. First of all, the market size and production cost advantages of cities may simply reflect respectively the relative advantage that a certain location has in terms of local consumption and production amenities deriving from climatic conditions, natural resources and natural means of communication. However,

while places do have different abundance of natural resources, proximity to natural means of communication, and climatic conditions, these features (a.k.a. ‘first nature’) provide only a partial explanation of the pronounced differences in urbanization existing even between areas that are fairly similar in terms of such exogenous characteristics. For this reason it has been argued that urbanization has to be linked also to other additional advantages (a.k.a. ‘second nature’) that are inherent to the functioning of economic interactions and are able to cause uneven development even across ex-ante identical places. In this second perspective, the market size and production advantages of cities are endogenously generated by the scale of economic activities taking place in a certain location.

Through the years a rich list of ‘second nature’ forces have been proposed by geographers, regional scientists and urban economists. These forces are also called ‘agglomeration economies’ and exist as long as the scale of the local environment adds to the performance of local firms. They are ‘external economies’ as long as the benefits of localized interactions are not fully reflected in the prices of market transactions.

An important common implication of agglomeration economies is that they are able to generate self-sustaining clustering insofar as the movements of firms and workers, attracted to places with larger local markets and lower production costs, end up reinforcing these differences and thus spatial imbalances (‘cumulative causation’). In this respect, agglomeration economies give strength to ‘second nature’ against ‘first nature’, detaching the emerging economic landscape from the physical attributes of its underlying geography. Thus, while there is a priori great flexibility on where particular activities locate, once the agglomeration process has started, spatial differences take shape and become quite rigid (‘putty clay geography’).

United we win

While sharing this common characteristic of making the spatial concentration of economic activities self-sustaining, agglomeration economies nonetheless differ substantially from one another in terms of their ‘source’.

This refers to a microeconomic explanation of the existence of agglomeration economies. Four explanations have attracted special attention:

¹ Pirenne H. (1925) *Medieval Cities*, Princeton University Press, Princeton

‘knowledge spillovers’, ‘labour market pooling’, ‘input sharing’, ‘demand and cost linkages’.

‘Knowledge spillovers’ arise when knowledge is transferred between agents thanks to sheer physical proximity irrespective of market transactions between them. Knowledge, ideas and, above all, tacit information, can be considered as impure public goods that generate spillover effects from one firm or institution to another. Consequently, if economic agents possess different pieces of information, pooling them through informal communication channels can benefit everyone, hence the importance of proximity. In this perspective, agents co-locate to take advantage of knowledge that is somehow ‘in the air’, which makes them more efficient. Accordingly, the cost advantage of a location becomes an increasing function of the relative number of its resident agents.

‘Labour market pooling’ refers to two related phenomena that arise when firms and workers face search and matching frictions. On the one side, the spatial concentration of workers with different skills and firms with different needs increases the likelihood of good matches. On the other side, if matches face an idiosyncratic risk of destruction, spatial concentration reduces the duration of unemployment spells and unfilled vacancies. Co-location allows firms and workers to benefit from both opportunities. Through these channels, both the cost production advantage and the market size advantage of a location become increasing functions of the relative number of its resident agents.

‘Input sharing’ generates agglomeration economies when the production of intermediate inputs faces increasing returns to scale and their transportability is limited. When this is the case, the input producing sector is able to reach an efficient scale of production only when its local market is large enough, which requires the spatial concentration of downstream customers. Accordingly, the cost advantage of a location becomes an increasing function of the relative number of its resident agents.

‘Urban consumption opportunities’ are sometimes considered an additional explanation of urban primacy. They are, however, partly a variation on the theme of input sharing and partly a variation on the theme of knowledge spillovers. On the one hand, when the supply of final goods and services faces increasing returns to scale and their transportability is limited, large local demand associated with the spatial concentration of people allows final production to achieve an efficient scale. On the other hand,

the spatial concentration of people fosters social interactions that may be valuable per se even in the absence of knowledge transmission. A similar argument is readily applied to the provision of all sorts of goods and facilities characterized by some relevant degree of indivisibility (road, schools, etc.). As long as some of these are publicly provided through local funds, the spatial concentration of economic activities generates the tax base needed to finance them (‘fiscal externality’). Once more, the market size advantage of a location becomes an increasing function of the relative number of its resident agents.

Turning to ‘demand and cost linkages’, three scenarios have received particular attention. All stress the impact of firms’ locations decisions on other firms profits. The first scenario considers the effect of firm relocation when matched by labour migration (‘demand linkage’). In this case, as the firm moves, it reduces demand in the place of origin while increasing it in the place of destination. In so doing, as profits rise with demand, the firm harms competitors in the former place and benefits competitors in the latter. Hence, the market size advantage of a location becomes an increasing function of the relative number of agents residing there. In the second scenario, firms are linked by input-output linkages: what is output for a firm is input for the others and vice versa (‘cost linkage’). Here, when a firm relocates, it depresses both final demand and intermediate supply in the location of origin, whereas it reinforces them in the location of destination. Accordingly, other firms’ profits suffer in the former country and thrive in the latter. The production cost advantage of a location becomes an increasing function of the relative number of its resident agents.

The fact that all these are external economies implies that market forces generate a geographical distribution of economic activities that is generally inefficient from a social point of view.

What role for infrastructure?

The empirical relevance of infrastructure for global and local economic development can be hardly overstated. In particular, its role has been stressed along two main dimensions: its effects on economic growth and its effects on income inequality. Along the first dimension, most studies focus on the impact of infrastructure on aggregate output finding it positive. In

particular, they identify positive and significant impacts on output of three types of infrastructures (telecommunications, transport and energy) and show that such impacts are significantly higher than those of non-infrastructure capital.

The link between infrastructure and long-run growth is much less explored. Some studies find that public expenditures in transport and communications foster growth. This finding is also confirmed in the case of physical infrastructure and in the case of communications (telephone density). On the other hand, it is argued that sometimes the inefficiency of infrastructure provision can curb and even reverse the sign of its impact on long-run growth.

Turning to the effects on income inequality, the issue is whether infrastructure has a disproportionate impact on the income and welfare of the poor. The presence of a disproportionately positive impact finds some support in the existing evidence. Several studies point at the effects of infrastructure on human capital accumulation: better transportation and safer roads promote school attendance; electricity allows more time for study and the use of computers; access to water and sanitation reduces child and maternal mortality. Infrastructure also connects poor people in underdeveloped areas to core economic activities, thus expanding their employment opportunities. Finally, better infrastructure in poorer regions reduces production and transaction costs.

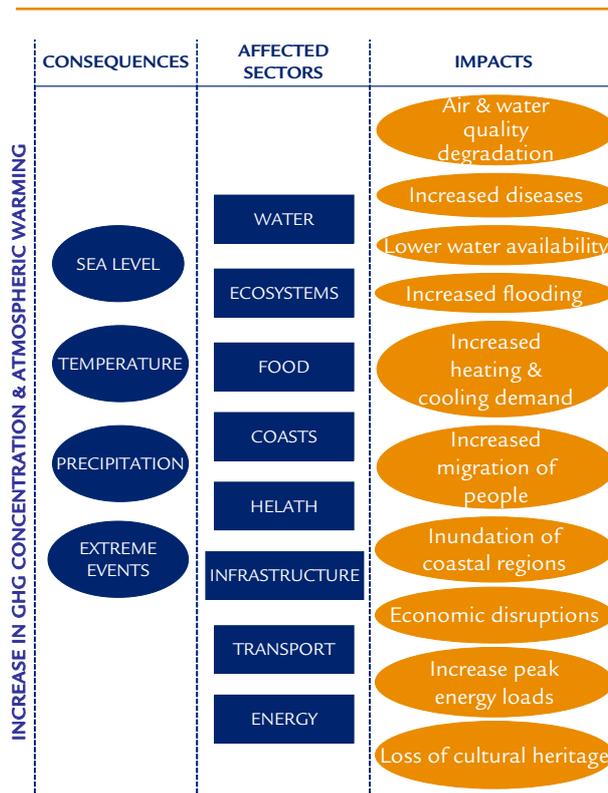
Sprawling cities

Cities foster economic development because the geographical concentration of economic activities enhances productivity and consumption opportunities. This is due to 'first nature' and 'second nature' advantages. The former derive from climatic conditions, natural resources and natural means of communication. The latter are inherent to the functioning of economic interactions. Infrastructure shapes 'second nature' by altering the 'market potentials' of cities.

Infrastructure also affects the impact of 'first nature'. On the one hand, it promotes cities' access to natural resources and means of communication, thus relaxing the constraint of physical proximity on economic development. On the other hand, it can reduce the dependency of economic activities on climatic conditions and

natural disasters. However, due to human induced climate change, this has become an increasingly difficult task as increasing heat in the atmosphere is affecting weather patterns, temperatures, sea levels, and storm frequencies with disruptive impacts on economic activities (Figure 1).

Figure 1. Impact of climate change on cities



SOURCE: WORLD BANK (2008)

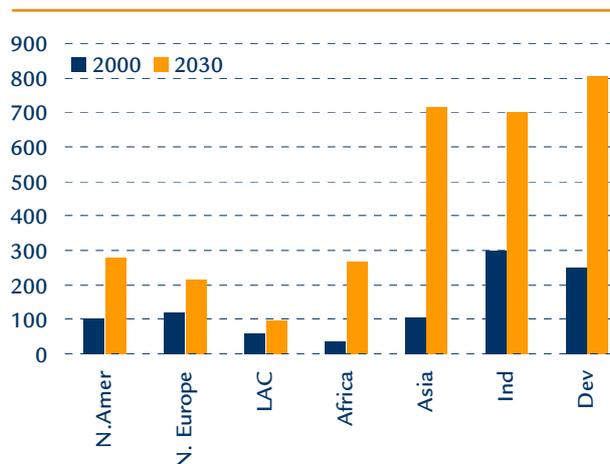
Against this background the economic benefits of agglomeration enjoyed in cities have to be weighed against mounting costs.

On the cost side, the most adverse impacts of climate change are likely to be in urban areas where people and economic activities are concentrated. Urban concentration is currently on the rise as developing countries grow. By 2030 at least 61 percent of the world's population will be living in cities up from 50 percent today. With 95 percent of all urban growth happening in developing countries, their cities will become home to almost 4 billion people, roughly 80 percent of the global urban population. The concentration of people and firms in cities increases the vulnerability of economic activities to climate change impacts.

On the benefit side, urbanization fosters economic development thanks to agglomeration economies. However, all the sources of such

economies - especially knowledge spillovers, labor market pooling and input sharing - crucially depend on high levels of urban density. Current projections for the next decades suggest that rising urbanization will map into a staggering expansion of built up areas across the world (Figure 2). The projections are particularly impressive for developing countries, where the doubling of urban population by 2030 will result in a tripling of their built up areas, thus leading to lower urban density ('urban sprawl').

Figure 2. Build up area projections



SOURCE: WORLD BANK (2005)

Though still partly debated, the problems deriving from 'urban sprawl' are well known. Sparse urban communities are associated with more frequent and longer driving spells generating higher pollution, more time lost in traffic and more traffic-related fatalities. In sparse communities limited social interactions undermine social capital and hamper knowledge spillovers.

In addition, low density due to urban sprawl puts an extra strain on the development of the infrastructures needed to serve ongoing urbanization. The reason is that several types of urban infrastructure typically entail large indivisible investments that may end up being economically not viable in sparse communities as these do not allow to reap the corresponding economies of scale. Examples of such investments are mass transit, communication networks, water supplies, power facilities, social services, shelters and services in the case of extreme events. Moreover, in the presence of such large indivisible investments coordination failures may arise whenever the private return is much lower than the social return. When this is the case, high urban density may act as a

coordination device by revealing common interests as well as identifying shared objectives and strategies.

Policy lessons

Cities promote economic development by allowing agglomeration economies to materialize. These benefits can be seized provided that effective urban infrastructure fosters knowledge spillovers, labour market pooling, input sharing, demand and cost linkages.

1. Recently urban economies are increasingly under strain. On the cost side, climate change is raising the costs of the clustering of economic activities in cities. On the benefit side, urban sprawl is weakening the social and economic interactions through which agglomeration economies work.

2. Urban sprawl is also weakening the economic and social viability of the large infrastructural investments that are needed to tackle the twin challenges of climate change and urbanization.

In this respect, a crucial prerequisite for the creation of climate-proof urban infrastructure is the implementation of "integrated land use and transport policies that allow for compact cities to develop with clusters of high density nodes that can support mass transit options and efficient grouping of residential developments, commercial services, and centers of employment. This would create lower transit emissions, less energy-intensive development, and proximity to shelters and services in the case of emergencies".²

This Policy Brief builds upon the work by Gianmarco I.P. Ottaviano, *Infrastructure and economic geography* (European Investment Bank Papers 2008), and his expert presentation prepared for the *2nd Annual Meeting of the OECD Roundtable Strategy for Urban Development "Competitive Cities and Climate Change"*, 9-10 October 2008, Milan, Italy

² World Bank (2008) *Climate Resilient Cities*. Washington DC: The World Bank