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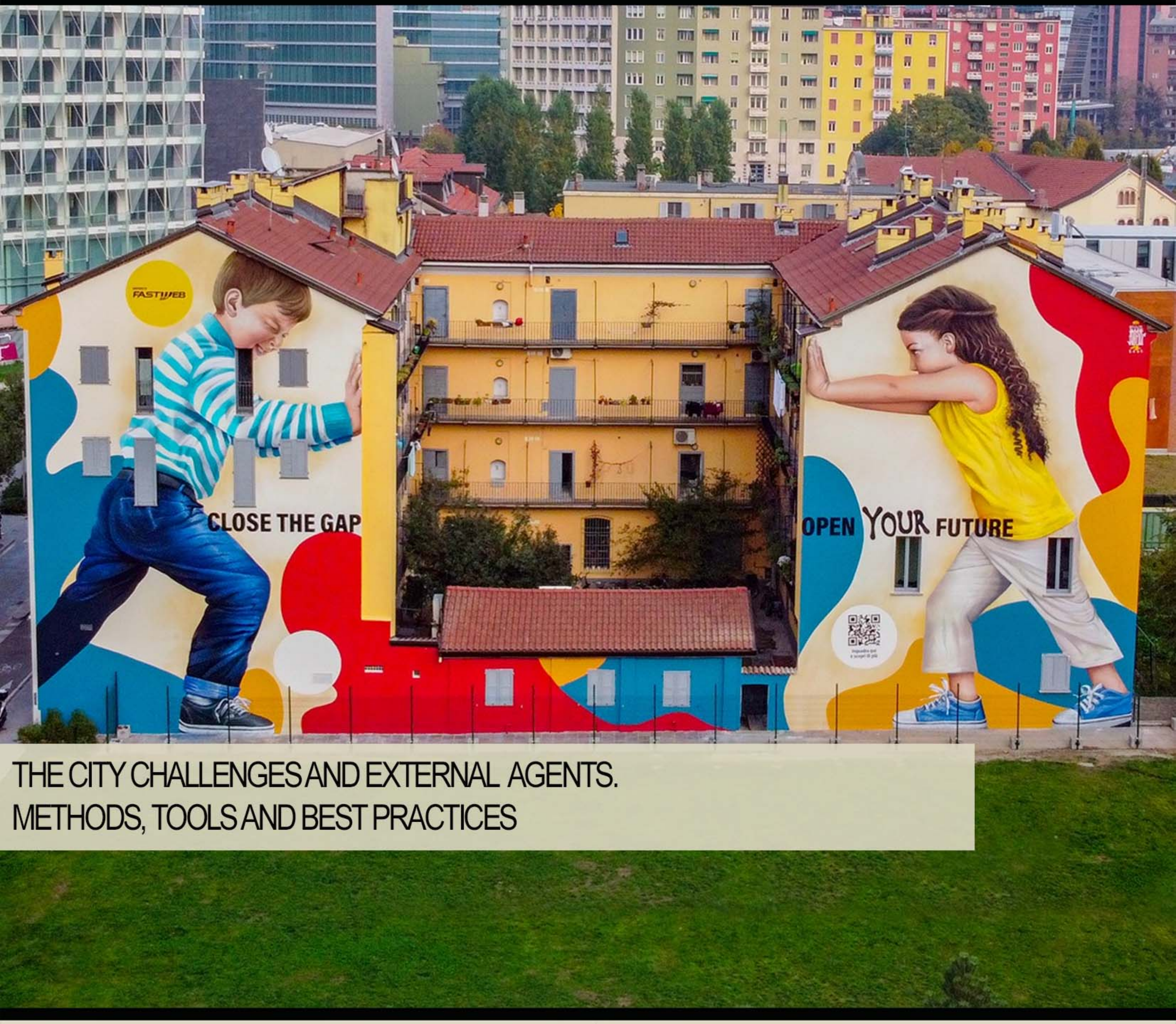


THE CITY CHALLENGES AND EXTERNAL AGENTS.
METHODS, TOOLS AND BEST PRACTICES


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The cover image shows redeveloped building in the Garibaldi neighbourhood in the city of Milano (Picture by Fastweb, retrieved from: https://www.facebook.com/Fastweb/photos/10158794132149472).

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# Municipal finance, density, and economic development. Empirical evidence from a global sample of cities

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**Abstract**

This research focuses on how population density may influence the municipal expenditure using a global dataset from UN-Habitat. Specifically, we test its role on different budget categories, including sanitation, waste, water, affordable housing, and security. We find that in general density is likely to be correlated with expenditure. This evidence is not robust across the considered expenditure categories. Rather, population density is likely to influence specific budget items and its explanatory power varies as we consider different measures of it. Among control variables, we point out the significance and magnitude of the regressors related to economic development, which in some cases matters more than density in explaining some expenditure categories. Findings suggest that making cities denser can be a valuable option of urban policy, if the target is expenditure optimization. Nonetheless, this works only when it is combined with a mix of other factors, and location is also considered.

**Keywords**

Urban density; Municipal expenditure; Economic development; Cities.

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# 1. Introduction

Density is an aspect of major interest for urban studies. It has been explored from different perspectives including spatial planning and socioeconomics, and ultimately associated with timely global issues like climate change and Covid-19 pandemic (Hernandez Palacio, 2012; Papa et al., 2015; Mert, 2021). Among these topics, in urban studies the association between density and municipal expenditure performance has been examined with particular attention (Gielen et al., 2019; Jain et al. 2021). Pioneering studies explored how population density may influence expenditure for local services and infrastructures (Ladd & Yinger, 1992; Carruthers, 2002; Burchell & Mukherji, 2003; Burchell et. al., 2005; Carruthers & Ulfarsson, 2008). This has been widely discussed in countries like the United States (Carruthers & Ulfarsson, 2008; Burchell et al., 2005) and it has become part of the vibrant debate in both Europe and emerging economies like India and China (Bhatta et al., 2010; Fregolent & Tonin, 2016; Tian et al., 2017; Bergantino et al., 2019).

Overall, low-density is associated with higher cost, because of the considerable levels of financial resources that are required to extend basic infrastructure over greater distances to reach relatively smaller numbers of residents (Litman, 2015). Conversely, higher density may improve the operational efficiency of local authorities through cost savings from economies of scale (Tran et al., 2019).

Nonetheless, there is no consensus on the central role of urban density in influencing local finance when compared to other factors. Past studies claimed that factors like economic development, quality of institutions, and governance have greater importance (Beghelli et al. 2019; Castells-Quintana & Wenban-Smith, 2020). However, the results are not conclusive (Castells-Quintana & Wenban-Smith, 2020).

To contribute to this debate, our research explores the relationship between density and municipal expenditure. We focus on municipalities as defined by UN-Habitat (2018), as the level of local government with a certain degree of budget autonomy in terms of both revenues and expenditure.

The main contribution of this study is the test of hypotheses about urban density through a novel global dataset of municipalities, which therefore considers countries with different development levels. To the best of our knowledge, this is the first attempt to analyse this topic based on the information collected directly from a global sample of cities. Our analysis follows the broader interest of the literature in testing empirically whether density influences municipal expenditure to provide different services (Ewing, 2008), namely sanitation, waste, water, housing, and security (Carruthers & Ulfarsson, 2002; Gielen et al., 2019; Sass & Porsse, 2021). In parallel, we aim to give further evidence on the explanatory power of economic development. This is crucial because cities located in advanced countries could have more efficient governance, capabilities, and technology, and therefore reach scale economies (Andrews & Boyne, 2009; Hortas-Rico & Solé-Ollé, 2010; World Bank, 2015; Miyazaki, 2017).

Following a thorough check for a set of municipality-level indicators, we have found significant relationship between urban density and some types of budget items. Our estimates point out that it does not necessarily have a central role. We also find evidence that in more developed economies, local government may reach economies of scale for specific spending items.

The paper proceeds as follows. Section 2 presents the theoretical framework. Section 3 introduces the research method and the database. Sections 4 and 5 show results, and present discussion and conclusion.

# 2. Research Framework: theories and hypotheses

The modern term "sprawl" was used by Earle Draper in 1937 (Cinyabuguma & McConnell, 2013), and since then its meaning has been controversial. Some authors assert that it can be both defined as a consequence of land use practices (Bahl, 1968; Clawson, 1962; Downs, 1999; Glaeser & Khan, 2004; Frenkel & Ashkenazi, 2005), and associated to different urban development patterns (Nelson, 1992; Pendall, 1999). Others emphasize that sprawl reflects the massive consumption of land per person rather than either simple urban growth or population growth (Carruthers & Ulfarsson, 2003).

Among the causes of sprawl, at an early stage population growth was considered as the leading cause of spatial growth and low-density, as cities expanded to contain new dwellers. Other studies remark that three major forces – population growth, rising household income, transportation improvements – directly influence urban density as individual housing preferences combined with higher income levels have contributed to constantly expand the demand for land (Mieszkowski & Mills, 1993; Brueckner, 2000, 2001).

There are underlying factors such as lack of proper urban management as well, but in general, the growth of road networks may be considered a primary force for urban sprawling (Errigo & Tesoriere, 2018). Other contributors indicate that density is also linked to specific characteristics of the places in emerging economies, like land use policies and governance issues (Qadeer, 2004; Fregolent & Tonin, 2016). Research in India (Bhatta et al., 2010) and China (Tian et al., 2017) give evidence that sprawling is mostly led by local policy. This mainly due to incentives to maximize benefits from leasing and high-pressure from real estate developers to acquire land. To this end, local governments have "tended to oversupply land, leading to urban sprawl problems" in emerging cities (Tian et al., 2017).

Overall, two key lessons emerged from literature. First, the concept of sprawling is extended to inefficient land development pattern (Coppola, 2012; Tian et al., 2017). Second, and more importantly for the scope of this research, low density could not be associated with city sustainability, especially from a municipal finance perspective (Edwards & Xiao, 2009; Errigo & Tesoriere, 2018). This relationship has been widely treated in literature since the report entitled "Costs of Sprawl" (Real Estate Research Corporation, 1974).

The main assumption from pioneering research is that the cost per unit of development rises as density decreases. Ladd and Yinger (1991) and Ladd (1992, 1994, 1998) suggest that the relationship between the number of people per square mile and per capita spending has a U-shaped relationship. Accordingly, as density increases, at first cost decline but then increase sharply. This implies that municipal services can be subject to either economies or diseconomies of scale.

More recently, the results from similar studies have been quite controversial. On the one side, few studies remark that low-density leads to higher costs because of the significant investment required in extending roadways and other types of infrastructure like water, sanitation, roads, and other services covering long distances, in order to reach relatively fewer numbers of people (Carruthers, 2002; Carruthers & Ulfarsson, 2003, 2008). In line with this, Fregolent and Tonin (2016) found that if urban development is poorly planned, spread out, and disorganized, it may affect the spending capacity of municipalities . On the other side, other research in both developing and developed countries found that some spending items are more sensitive to urban density than others, and regulatory framework and decentralized settings may have a primary role (Gielen et al., 2019; Sass & Porsse, 2021).

Therefore, the results are not conclusive as it is not clear how urban development pattern can have a highly marked impact on municipal budget, or rather, budget performance depends on other factors, mostly related to economic development (Rico, 2014).

Accordingly, we explore the following two hypotheses regarding the correlation between density and municipal expenditure.

*H1. Urban density influences municipal expenditure. The influence varies with the specific expenditure item.*

A critical point beyond the land pattern effect is that the cost of services delivery varies from city to city, especially if they belong to more advanced regions (Cappelli et al., 2021). This may depend on the level of development of the region where the city is. Most of advanced economies may reach economies of scale. This is because they benefit from more efficient administrative processes, regulations and technologies, as it was suggested in recent research focussed on local institutions in developed countries (Miyazaki, 2017). The author stresses how administrative efficiency may be the result of either high service standards or responsiveness to local preferences. Better local expenditure performance may depend also on the fact that municipalities in developed countries are able to engage private sector to directly deliver public services, thus reducing the financial burden for local budget. This mechanism is not adopted extensively in poor and developing countries, where fragile administration and low capacity and regulation affects the use of private capital for public services provision (World Bank, 2015). Overall, municipalities in advanced economies may also use alternative ways to finance local services as pointed out in Andrews and Boyne (2009).

All these issues may hinder correlation between development level and expenditure performance. Hence, our second hypothesis is formulated as follows.

*H2 The level of development of cities may influence the municipal expenditure performance, reaching economies of scale.*

It is worth noticing that the two hypotheses are related to the pending discussion on the role of urban density on public policy performance. We give empirical evidence on how different economic development stages may influence spending performances contributing to understand if consistencies significantly persist worldwide.

# 3. Research Method

## 3.1 Global Municipal Dataset: an overview

Our empirical analysis uses cross-sectional data at the municipal level from the Global Municipal Database (GMD) launched by UN-Habitat with the New York University's Marron Institute of Urban Management and the Lincoln Institute of Land Policy. The database contains budget data from a sample of 102 municipalities worldwide (UN-Habitat, 2018). This database is linked with the Atlas of Urban Expansion (AUE) by Marron Institute and the Lincoln Institute, which includes spatial and planning data from 200 cities.

The regional sample distribution is 30 percent in East Asia and Pacific Countries, 19 percent in Europe and Central Asia, 13 percent in Latin America and the Caribbean, 16 percent in Sub-Saharan Africa, and 11 percent in North America. The remainder belongs to the Middle East and North Africa and South Asia, sharing 5 and 6 percent respectively.

As to GMD limitations, there are issues related to budget responsibilities, which may be affected by several layers of governance and differences in prices of labour, especially for those categories more labour intensive such as security. Furthermore, differences in budget category definitions may emerge in such global sample. For the sake of reducing all biases, a team of city-based experts led the data collection process, gathering the data directly from public records where possible, and in many cases obtaining data directly from municipal government staff using a participatory approach (UN-Habitat, 2018).

Informal areas of cities in developing countries are not considered in official data. We refer to those areas where municipalities do not provide services and communities manage self-provisioning through informal mechanisms.

Despite limitations, the database used for this research is one of the first open-source data at the city level on municipal finance worldwide, including those located in developing regions, like Africa and Asia. GMD fills a geographical gap of the research in this field, which is mostly focussed on developed regions like the USA (Ladd, 1992; Holcombe & Williams, 2008; Carruthers & Ulfarsson, 2008), Europe (Hortas-Rico & Solé-Ollé, 2010; Fregolent & Tonin, 2016), Japan (Miyazaki, 2017), and Australia (Tran et al., 2019).

## 3.2 Empirical Model

The empirical model drew inspiration from well-consolidated literature on local public spending, especially those exploring cost and demand related factors (Carruthers & Ulfarsson, 2003; Hortas-Rico & Solé-Ollé, 2010; Gielen et al., 2019; Sass & Porsse, 2021). Accordingly, we see expenditure as depending on a group of local factors related to regional features and population size, on the one hand. On the other hand, spending is a function of demand factors like income, tax share, and transfers from higher government level

(Hortas-Rico & Solé-Ollé, 2010). Following this, our empirical approach can be synthesised by the equation:

$$exp = \alpha + \beta_1 density + \beta_2 deveopment + \beta_3 X \tag{1}$$

where *exp* is municipality expenditure (Hortas-Rico & Solé-Ollé, 2010; Sass & Porsse, 2021). As described below, we will test different expenditure items as dependent variables. With *density* we mean to include population density, our target endogenous regressor that, as such, will be handled appropriately. The variable *development* catches the level of economic development, whereas *X* includes a set of controls.
We adopt two different empirical approaches. We first perform an OLS model treating density as exogenous, and then we run an IV regression where the endogeneity of density is appropriately handled (Holcombe & Williams, 2008 and 2009; Drew & Dollery, 2014).

## 3.3 Dependent variables

As already mentioned, we test different municipal expenditure items (Rico, 2014). All items are expressed in million dollars. According to UN-Habitat (2018), capital expenditure (CEXP) is related to the general purchase and creation of "lasting assets, including land, infrastructure, buildings, or equipment". This does not include the spending for specific infrastructure and services, normal government operations and does not include debt service (Holcombe and Williams, 2008). SANI is the expenditure item for "infrastructure planning and engineering, sewer systems, wastewater treatment, septic tanks, public latrines and subsidies to private sanitation systems, asset replacement and major rehabilitation" (UN-Habitat, 2018). WASTE includes both services and infrastructure planning and engineering for waste treatment. WATER (water services) takes account for water treatment and distribution expenditure, including asset replacement or major rehabilitation. The HOUSING indicator is related to programmes that subsidize affordable housing for specific populations targets, such as low-income households. Among the capital costs this may include land acquisition, construction of housing, and programme assets and facilities. Finally, we consider SECURITY, which quantifies spending on public safety department or programming, and police, courts (UN-Habitat, 2018). As we observe for other categories, capital costs of this category are mostly referred to infrastructure vehicles, facilities, asset replacement and significant rehabilitation.

## 3.4 Regressors

Explanatory variables include the population density of the city, the economic development stage, and population size. Furthermore, we take into account municipal finance covariates. We list them as follows.

- To measure the variable *density* in equation (1) we will test two indicators, namely log of person per hectare (Logpersonhec), and log of the person - built up area ratio (Logbuiltpercapita) – see Libertun de Duren and Guerrero Copean (2016) and Ida and Ono (2019).
- The development variable is measured through the "Advanced" regressor, a dummy that catches if a city has reached an advanced economic level, following the classification of World Bank (2015).
- The set of municipality level controls X is taken from GMD and includes:
  - Pop, the city population size in tens of thousands (Tran et al., 2019);
  - Transfers is the amount of per capita transfers to municipal budget from higher government entities;
  - Ownsource is the amount of taxation collected by the municipality raised from local taxes and fees, and corresponds to per capita revenue (Carruthers & Ulfarsson, 2003; Miyazaki, 2017);
  - Dec is the amount of expenditure categories financed by each municipality as measure of devolution process (Carruthers & Ulfarsson, 2002; Rodríguez-Pose & Bwire, 2004). This is used

under the hypothesis that more decentralised administration may be more efficient (Hortas-Rico & Solé-Ollé, 2010).

Tab.1 reports descriptive statistics on these variables. Figure 1 shows geographical location of cities and density.

| Variable | Source | Variable | Measurement | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|---|
| CEXP | GMD | Metric | USD | 1180.352 | 2992.506 | 2.333405 | 15891.8 |
| SANI | GMD | Metric | USD | 202.3473 | 670.7522 | 0.06 | 4629.945 |
| WASTE | GMD | Metric | USD | 94.47893 | 338.5314 | 4.43 | 2706.406 |
| WATER | GMD | Metric | USD | 207.6478 | 790.5325 | 1 | 6490.191 |
| HOUSING | GMD | Metric | USD | 149.6497 | 439.8418 | 0.04 | 2303.915 |
| SECURITY | GMD | Metric | USD | 735.0063 | 2856.138 | 0.01 | 24966.8 |
| Logpersonhec | AUE | Metric | Persons/hectare | 66.56842 | 56.99658 | 7 | 352 |
| Logbuiltpercapita | AUE | Metric | Person/built up area | 131.0107 | 103.5525 | 20 | 577 |
| Advanced | GMD | Categorical | 1 if yes, 0 otherwise | .2631579 | .4426835 | 0 | 1 |
| Pop | GMD | Metric | Population | 478.97 | 598.23 | 10.46 | 2465.72 |
| Transfer | GMD | Metric | USD | 2.26e+09 | 6.75e+09 | 3.97e+10 | 9.83e+09 |
| Ownsource | GMD | Metric | USD per capita | 1098 | 1647 | 1 | 8466 |
| Dec | GMD | Metric | Number of services financed | 8.78 | 2.86 | 1 | 13 |
| Metro | UN-Habitat | Categorical | 1 if yes, 0 otherwise | 0.42 | 0.50 | 0 | 1 |
| Openspace | AUE | Metric | Hectare | 31957.62 | 47564.09 | 396.64 | 199731.6 |

**Tab.1 Descriptive Statistics**

**Fig.1 Geographical location of the sample and density**

## 3.5 Endogeneity: approach and robustness check

Endogeneity between public expenditure and density is a critical topic. For this reason, most of the recent research hints at using Instrumental Variables (IV) (Holcombe & Williams, 2008 and 2009; Drew & Dollery, 2014). Following this, we selected appropriate instruments to face endogeneity based on a literature review as suggested in Libertun de Duren and Guerrero Copean (2016). Of course, our selection was targeted to relevant and valid instruments (Imbens, 2014).

Urban studies theorised a set of practices to act against growing city footprints and lower densities, which are associated with "loss of open space, urban decay, urban air and water pollution, traffic congestion, low-density housing developments, patchwork housing developments in the midst of agricultural land, increasing reliance on the automobile, and a general spreading of urbanized development across the landscape" (Brueckner, 2001). These points were found also in Brueckner (2000), who claims that three market failures contribute to a sub-optimal pattern of land use, namely the failure of development to internalize (1) the benefits of open space, (2) the social costs of traffic congestion, and (3) the cost of the services.

Land use may reduce the sprawling of cities, especially of those oriented towards mixed planning strategies (Alberti, 1999; Freeman, 2001). Most of the empirical research suggested adopting a land use policy. Particularly, literature posits how planning land within urban boundaries may increase the density and mitigate the sprawling of cities (Qadeer, 2004). With this regard, narrative on land use stresses the role of open space to influence directly living conditions, residential and employment densities, and intermixing a variety of land use (Frank & Pivo, 1994; Dehring & Dunse, 2006). As pointed out in Wu and Plantinga (2003), "residents prefer to live close to an open space". In line with this, Martinuzzi et al. (2007) assert that open space is the leverage to make more efficient use of the land. This is primary to revitalize urban centres, re-attracting people, and support more densely populated cities (Martinuzzi et al., 2007).

In parallel, mass transit accessible to residents is advocated as a possible policy prescription to increase the density surrounding the metro areas. In fact, in countries where government policy promotes high-density residential development, transit is an effective tool in shaping development, regardless of density. Transit and land use can be mutually supportive for increasing the urban density (Smith, 1984; Salvesen, 1996). This is also found in Ewing and Cervero (2017) who explain the benefits of denser cities focusing on urban transport and city planning. Ewing and Cervero (2017) stress how transit use is strictly connected with dense development, which is enabled to produce several benefits like reduced household transportation costs, increased social interaction, and social capital. This point is also remarked in recent studies on cities in both developing and developed countries, where transportation and land use change are influential to population density (Lin & Shin, 2008; Ratner & Goetz, 2013; Tian et al., 2017).

Following this literature, we select open space and metro system as instruments. Open space (openspace) is related to the hectare of city allocated to this land use. Instead, metro system (metro) is a dummy variable that equals 1 if city has such transportation system within its boundaries. Although open space and metro system might hide a direct effect on the value of properties and likely on public expenditures, this is not conclusive for all urban settings; rather, this is the effect of several local factors as stressed in Fausold and Lilieholm (1999). Another caveat is related to the type of open space and the metro system that may impact on property value and thus on public expenditure. This is not a standard rule, despite it depends on local features, like distance, land market size and real estate development (Rodriguez & Targa, 2007; Sander & Polasky, 2009; UN-Habitat, 2016). Our approach may be plausibly appropriate for our sample focused on cities belonging to differently developed contexts. The two instruments selected are exogenous and not correlated with the error term in the equation, as we will see afterwards in the robustness check. To test this assumption, we use Sargan test (1958) of overidentifying restrictions and Anderson test (1984) for instrument relevance. This likelihood ratio test is under the null that the equation of interest is under identified. Finally, we performed Pagan and Hall's (1983) tests of heteroskedasticity for instrumental variables. Under the null of no heteroskedasticity, the test statistic is distributed as chi-square with degrees of freedom equal to number of indicator variables. F-test on the instruments in the first-stage regression is included as suggested in Staiger and Stock (1997).

Furthermore, we used robust clustered estimates of standard errors at country level in order to account for potentially non-i.i.d. observations (Cameron & Miller, 2015). The clustered standard error estimates have been considered the most feasible solution to put into account all those country-level aspects the model does not catch, and support the evaluation of the parameters' significance. Finally, we make an IV Lasso to estimate structural parameters in the presence of many instruments and controls based on methods for estimating sparse high-dimensional models (Chernozhukov et al., 2015). This robustness check is included in Tables 4 and 5.

## 4. Results

We ran OLS first, where CEXP and the other expenditure categories (SANI, WASTE, WATER, HOUSING, and SECURITY) were the dependent variables. Findings gave evidence of misspecification and thus bias as emerged from the Ramsey test. For this reason, we do not include the results of the OLS regressions (see the appendix). We directly shifted to IV regression (Cameron & Trivedi, 2005) whose results are presented in Tab. 2 and 3. They include the two measures of density, person per hectare (Tab.2) and person per built up area (Tab.3), instrumented by openspace and metro. They include clustered standard error at country level.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | **CEXP** | **SANI** | **WASTE** | **WATER** | **HOUSING** | **SECURITY** |
| Logpersonhec | -1440.8 | -810.0* | 175.4 | -1424.3** | 137.7 | -4491.7** |
| | (1.58) | (2.24) | (0.86) | (3.04) | (0.63) | (2.89) |
| Advanced | -3434.7*** | -533.8* | 157.3 | -598.7* | 20.79 | -1012 |
| | (5.64) | (2.28) | (1.20) | (1.98) | (0.15) | (1.01) |
| Pop | 0.950* | 0.468** | 0.258** | 0.631*** | 0.232** | 2.145*** |
| | (2.37) | (3.16) | (3.09) | (3.29) | (2.58) | (3.37) |
| Transfer | 0.156*** | 0.00542 | 0.0158* | 0.00498 | 0.0205** | 0.0086 |
| | (4.20) | (0.43) | (2.22) | (0.31) | (2.68) | (0.16) |
| Ownsource | 1.610*** | 0.205*** | 0.00292 | 0.0811 | 0.0539 | 0.593** |
| | (11.99) | (4.10) | (0.10) | (1.25) | (1.77) | (2.75) |
| Dec | -147.5* | -56.69** | -10.99 | -45.08 | -0.129 | 54.22 |
| | (2.24) | (2.61) | (0.90) | (1.60) | (0.01) | (0.58) |
| Intercept | 3564.9* | 1774.3** | -235.6 | 2767.3** | -303 | 6436.7* |
| | (2.15) | (2.73) | (0.64) | (3.29) | (0.77) | (2.31) |
| Anderson | 47.865 | 50.443 | 50.443 | 50.443 | 50.443 | 50.443 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Sargan | 0.264 | 0.157 | 0.833 | 0.672 | 1.041 | 0.3 |
| | (0.6071) | (0.6924) | (0.3614) | (0.4123) | (0.3076) | (0.5839) |
| Pagan-Hall | 26.997 | 53.66 | 15.177 | 33.76 | 25.657 | 39.544 |
| | (0.0003) | (0.0000) | (0.0338) | (0.0000) | (0.0006) | (0.0000) |
| F-Test | 30.0124 | 30.7411 | 30.7411 | 30.7411 | 30.7411 | 30.7411 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Partial $R^2$ | 0.47 | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 |
| N=102 | | | | | | |

**Tab.2 IV Regression with Logpersonhec as instrumented variable – clustered SE in parenthesis (*p<0.05, **p<0.01, ***p<0.001)**

| | (7) CEXP | (8) SANI | (9) WASTE | (10) WATER | (11) HOUSING | (12) SECURITY |
|---|---|---|---|---|---|---|
| Logbuiltpercapita | -1,827.4 | -1,054.8** | 198.9 | -1,872.8* | 206.5 | -5,624.7 |
| | (1905.7) | (344.9) | (258.8) | (763.5) | (359.0) | (3,002.5) |
| Advanced | -3649.4** | -675.3*** | 174.1 | -856.1* | 57.63 | -1,691.5 |
| | (1369.5) | (163.1) | (139.0) | (382.6) | (261.9) | (1,956.0) |
| Pop | 0.900* | 0.434*** | 0.269* | 0.572** | 0.235** | 1.925* |
| | (0.43) | (0.12) | (0.11) | (0.22) | (0.08) | (0.84) |
| Transfers | 0.149*** | 0.00627 | 0.0160* | 0.00321 | 0.0210** | 0.01 |
| | (0.02) | (0.09) | (0.08) | (0.01) | (0.06) | (0.02) |
| Ownsource | 1.627*** | 0.220*** | 0.000761 | 0.108 | 0.0504 | 0.668 |
| | (0.26) | (0.03) | (0.04) | (0.08) | (0.05) | (0.45) |
| Dec | -138.5 | -52.97 | -11.67 | -38.46 | -0.877 | 73.91 |
| | (114.8) | (31.3) | (19.6) | (47.9) | (19.7) | (58.1) |
| Intercept | 4,762.4 | 2,516.1*** | -336.8 | 4,108.0* | -483.8 | 10,098.5 |
| | (3,861.4) | (578.5) | (451.1) | (1,873.9) | (827.4) | (5,683.6) |
| Anderson | 28.068 | 27.813 | 27.813 | 27.813 | 27.813 | 27.813 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Sargan | 0.114 | 0.057 | 1.995 | 0.328 | 0.661 | 1.303 |
| | (0.7355) | (0.8107) | (0.1579) | (0.5669) | (0.4163) | (0.2536) |
| Pagan-Hall | 26.803 | 48.481 | 14.214 | 30.067 | 25.454 | 37.658 |
| | (0.0004) | (0.0000) | (0.0405) | (0.0001) | (0.0006) | (0.0000) |
| F-Test | 20.3844 | 14.4563 | 14.4563 | 14.4563 | 14.4563 | 14.4563 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Partial $R^2$ | 0.32 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 |
| N=102 | | | | | | |

**Tab.3 IV Regression with logbuiltpercapita as instrumented variable – clustered SE in parenthesis (*p<0.05, **p<0.01, ***p<0.001)**

| | (13) CEXP | (14) SANI | (15) WASTE | (16) WATER | (17) HOUSING | (18) SECURITY |
|---|---|---|---|---|---|---|
| Logpersonhec | -237.259 | -46.1747* | 190.6005 | -207.056* | 419.2303 | -864.2694 |
| Advanced | -2,323.944*** | -51.98684** | 85.38065 | -144.0906* | 35.29072 | -127.9016 |
| Pop | 0.3757139 | 0.2501354** | .5439717** | .6862311* | 0.221882** | 2.560276** |
| Transfer | 0.2213293*** | 0.0134393 | -0.0646811 | 0.0658619 | 0.454001*** | -0.016063 |
| Ownsource | 1.362154*** | 0.1564087** | 807161 | 0.0948892 | 0.0590645 | 1.117265 |
| Dec | -65.20723 | -42.27011 | -49.34358 | -55.79443 | -81.44783 | -15.58846 |
| N=102 | | | | | | |

**Tab.4 IVLASSO with Logpersonhec (*p<0.05, **p<0.01, ***p<0.001)**

| | (19) CEXP | (20) SANI | (21) WASTE | (22) WATER | (23) HOUSING | (24) SECURITY |
|---|---|---|---|---|---|---|
| Logbuiltpercapita | 204.496 | -114.4803* | 135.0506 | -167.7957* | 323.2105 | -774.5062 |
| Advanced | -2335.252 | -57.97395** | 54.13303 | 116.7284* | 2.314799 | -34.63093 |
| Pop | 0.3931617 | 0.2642166* | .5630952* | 0.7091641* | 0.2514827* | 2.471434*** |
| Transfer | .2211168*** | 0.0127987 | -0.0582572 | 0.0640858 | .0434905*** | -0.0099596 |
| Ownsource | 1.363541*** | 0.1559703*** | 0.0852757 | 0.1000074 | 0.0637038 | 1.103324 |
| Dec | -66.49773 | -40.72005 | -44.61104 | -55.1805 | -75.68576 | -6.375162 |
| N=102 | | | | | | |

**Tab.5 IVLASSO with logbuiltpercapita (*p<0.05, **p<0.01, ***p<0.001)**

## 4.1 Main findings

Looking at the Tab.2, Models 1 to 6 gives evidence that most of our regressors are significant. Our target regressor for density, Logpersonhec, is negatively and significantly correlated with SANI, WATER, and SECURITY. This finding implies that a percentage point increased may reduce the corresponding capital expenditures, which may indicate that denser cities are able to generate economies of scale. Nonetheless, this is not valid for all and intuitively depends on the type of infrastructure and public service.

Interestingly, the economic development variable (Advancedeco) may reach economies of scale for the general budget category CEXP, and for WATER, and SANI services, thus supporting Bergantino et al. (2019) who point out the efficiency of advanced economies to reduce the financial burden of municipalities. Indeed, this result is not surprising if we take into account that WATER and SANI services could be provided by private sector in the advanced economies. In the opposite direction, this mechanism is not adopted extensively in poor and developing countries (World Bank, 2015). In most cases the magnitude of the coefficient (Advancedeco) is lesser than those related to Logpersonhec.

Robustness check is provided through Sargan test of overidentifying restrictions, Anderson and Pagan and Hall's tests of instrument relevance, including F-test and partial R-squared values from the first stage regressions of the set of exogenous variables on the relevant endogenous variable. Our results show that the F-statistic is aligned with the indication of Staiger and Stock (1997), especially when Logpersonhec is significant. After these tests, we observe that the instruments are both robust and relevant for our research hypothesis.

Focussing on the results we obtain when using the second measure of urban density, that is person/built up area (Logbuiltpercapita), they are in line with our assumptions. The direction and significance of our target regressors in Models 7 to 12 (Table 3) change in terms of significance and magnitude if compared to Table 2. Particularly the coefficient of Logbuiltpercapita has a more explanatory power for water services (SANI and WATER) than those captured by the previous measure of population density (Logpersonhec). Furthermore, denser cities may have higher positive effect on specific expenditure than that shown in Advancedeco – Models 8 and 10. Overall, a city of Advancedeco may generate economies of scale for general expenditure (CEXP), Sanitation (SANI), and Water services (WATER) as verified in Models 7, 8, and 10.

Regarding the robustness check, Sargan test, Anderson and Pagan and Hall's test confirm the empirical approach, despite they are weaker than the models in Tab.3. F-test is slightly weaker (Staiger and Stock 1997). Nonetheless, all robustness checks are still valid.

Overall, our findings suggest that density is a significant factor for the expenditure patterns of cities. Our data seem to support both Hypotheses 1 and 2. Specifically, for what concerns Hypothesis 1, density is likely to influence the expenditure performance when we account for specific services, like water, sanitation, and security. This is also confirmed when using Logbuiltpercapita, which seems to have better explanatory power.

Hypothesis 2 is partially supported. Therefore, if a city belongs to more developed countries the performance of local expenditure could be influenced. If this emerges from the general budget category CEXP, the significance and magnitude of the coefficient for other categories (SANI and WATER) gives weaker support than those related to density, especially if we use person/built up area as dependent variable.

## 4.2 Other evidence

Exploring the results that emerge from control variables, we may stress the following main points. First, population size (Pop) influences most of the expenditure of municipalities, as remarked in the literature (Carruthers & Ulfarsson, 2008; Tran et al., 2019). We observe positive association, in line with the pioneering research on city size and public expenditure (Alonso, 1964). Throughout the models, larger population influences the spending performance for all budget categories (Tables 2 and 3). This is consistent with urban studies stressing how the population size is a driven force of local finance. This finding may be indicative of the concerns that emerged in most populated cities (Castells-Quintana & Wenban-Smith, 2020).

Transfer from national government, taxation and decentralisation are primary to support municipal finance (Carruthers & Ulfarsson, 2008; Hortas-Rico & Solé-Ollé, 2010). In this sense, the significance of Transfer suggests that it could be crucial for general expenditure (CEXP) and other welfare expenditure such as HOUSING (Tab.2 and 3), remarking its role in financing specific needs of the population. The same direction is found in Models 3 and 9 related to the WASTE.

Regarding own-source revenue from taxes and fees, the variable reports significant correlation with capital expenditure. Interestingly, the positive significance of Ownsource is not for all expenditure categories, as shown in Models 1, 2, and 6. This may produce an increase of expenditure for CEXP and specific category, like SANI and SECURITY. Conversely, it seems that other form of compensation, like transfer from higher government level, may have a stronger role as financial sources of services like WASTE, and HOUSING.

Another remarkable feature emerges from decentralization (Dec), which does not have the expected significance. Looking at Tab. 2 and 3, Dec is negatively associated with CEXP and SANI expenditure (Models 1 and 2). Contrarily to the expectations, more decentralised power is not significantly associated with expenditure performance. However, this finding is aligned with Rodríguez-Pose and Bwire (2004) who discuss how devolution may create inefficiency among government levels.

## 5. Discussion and conclusion

Over the last two decades, cities have been experiencing a terrific horizontal growth. Connected with this, urban sprawl and low density have raised environmental, social, and economic concerns (Sass & Porsse, 2021; Mert, 2021).

This inefficient urban development model has significant effect on the unit cost of local public services, generating higher levels of local government expenditures, as suggested by the "antisprawl" literature (Carruthers & Ulfarsson, 2008). Nonetheless, the impact is not always verified and transferred homogeneously to all budget categories. There are spending items that are more sensitive to low density, like expenditure on security and public transportation, sanitation, water supply and distribution, road cleaning, and public lighting (Gielen et al., 2019).

In parallel, local context characteristics have become a matter of interest especially to investigate if efficient administration, capabilities and technologies may have a primary role. Thereby, the relationship between planning and municipal finance has been observed by geographical and institutional lens (Hortas-Rico & Solé-Ollé, 2010; Miyazaki, 2017). With this regard, the results on how urban density may impact municipal expenditure and how context may influence local finance are mixed.

Recalling our research question, the empirical results give an indication that this correlation is not a silver bullet. It may change following the type of services and infrastructures. Besides, other factors seem to have a primary role. For instance, it may be asserted that the economic development of city matters. Nevertheless, the significance and magnitude of coefficients give a flavour that this matters less than density in most of the models. On the other hand, population size, own-source revenue, and transfers from higher government levels are relevant, thus influencing the financial performance of local governments.

Based on these findings, three main policy implications emerged. First, urban density can be associated with economies of scale in municipalities' expenditure. Our results stress that making cities denser and thus achieving more desirable living conditions is a right option of urban policy. In particular, density may be influential to centralised facilities like sanitation, water, and security. However, in our view this has to be pursued with a "quality-of-life orientation", as stated by previous contributions (Gyourko & Tracy, 1991;

Carruthers & Ulfarsson, 2008).
Second, advanced economies may perform well in terms of municipal spending, taking advantage likely from rules and regulations, technology, and capabilities. This gives a flavour on the important role of strengthening efficient local government to provide local services in a more effective fashion.
Moreover, the results related to welfare categories remark the role of national government layers to finance local needs, then filling the gap of financial resources. This result seems to be insightful. For instance, social housing is interlinked with contributions from other government layers, giving evidence that specific budget items are dependent on higher government financial transfers.
To this end, spending performance seems to be associated with both planning and governance factors (UN-Habitat, 2014, 2018). In this sense, urban planning may create the right conditions for supporting efficient local expenditures. On the other hand, administrative efficiency may respond to local needs, reaching economies of scale. This latter may recall the idea of Glaeser (2011) who mentioned that laisser-faire is not a good option in urban policy. Rather, it needs a stronger institutional framework, in which cooperation at different government levels may make cities a better place to live for everyone.
In conclusion, our research remarks how urban planning associated with efficient administrative system is crucial to allocate efficiently public goods and services (World Bank, 2015). However, our results should be interpreted carefully, given the variety of global cities included in the sample, which belongs to both rich and developing countries. Analysis on a municipality-by-municipality basis may provide more accurate evidence, especially if data at the neighbourhood levels are provided. This is a challenge, especially in developing regions in Africa and Asia, where informality, lack of transparency and reliable data may have a key role. For this reason, the main contribution of the paper stands in testing some hypotheses about municipal finance, density and economic development using micro data, and therefore in finding if some regularities persist across a global sample, including developing countries' cities. To the best of our knowledge, our research is the first attempt to analyse this topic based on the information collected directly from cities across the world.

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# Appendix

| | CEXP | SANI | WASTE | WATER | HOUSING | SECURITY |
|---|---|---|---|---|---|---|
| Logpersonhec | 83.06 | -224.4 | -110.3 | -424.2 | -56.49 | -1859.6 |
| | (634.3) | (237.1) | (134.6) | (298.6) | (147.5) | (1015.6) |
| Advanced | -2771.8*** | -278 | 32.5 | -161.9 | -64 | 137.5 |
| | (541.4) | (201.8) | (114.6) | (254.2) | (125.5) | (864.5) |
| Pop | 0.632 | 0.347* | 0.317*** | 0.423* | 0.273** | 1.598** |
| | (0.379) | (0.137) | (0.078) | (0.173) | (0.085) | (0.588) |
| Transfer | 0.182*** | 0.00514 | 0.0209** | 0.023 | 0.0170* | 0.0389 |
| | (0.035) | (0.011) | (0.006) | (0.0147) | (0.007) | (0.049) |
| Ownsource | 1.557*** | 0.188*** | 0.0114 | 0.0515 | 0.0597 | 0.515* |
| | (0.133) | (0.049) | (0.028) | (0.062) | (0.030) | (0.213) |
| Dec | -149.4* | -57.22* | -10.73 | -45.98 | 0.0446 | 51.86 |
| | (66.37) | (21.84) | (12.40) | (27.52) | (13.59) | (93.57) |
| Constant | 980.1 | 776.2 | 251.4 | 1062.7 | 27.92 | 1950.5 |
| | (1238.7) | (453.4) | (257.5) | (571.2) | (282.0) | (1942.5) |
| Ramsey Test | 7.38 | 29.58 | 4.55 | 5.24 | 3.33 | 47.26 |
| | (0.0003) | (0.0000) | (0.0053) | (0.0023) | (0.0235) | (0.0000) |
| N=102 | | | | | | |

**Tab. 6 OLS check for misspecification (Ramsey Test) - clustered SE in parenthesis (*p<0.05, **p<0.01, ***p<0.001)**

| | CEXP | SANI | WASTE | WATER | HOUSING | SECURITY |
|---|---|---|---|---|---|---|
| logbuiltpercapita | 308.7 | -261.5 | -174.7 | -251.3 | -137.9 | -2648.7* |
| | (634.7) | (239.3) | (135.3) | (304.4) | (148.5) | (1006.6) |
| Advanced | -2665.8*** | -302.8 | -1.361 | -94.71 | -104.1 | -294.1 |
| | (549.3) | (206.2) | (116.6) | (262.3) | (127.9) | (867.4) |
| Pop | 0.607 | 0.333* | 0.316*** | 0.367* | 0.278*** | 1.547** |
| | (0.365) | (0.131) | (0.074) | (0.167) | (0.081) | (0.553) |
| Transfers | 0.186*** | 0.00536 | 0.0215** | 0.027 | 0.0160* | 0.0336 |
| | (0.035) | (0.011) | (0.006) | (0.014) | (0.007) | (0.047) |
| Ownsource | 1.548*** | 0.191*** | 0.0146 | 0.0482 | 0.0631* | 0.558** |
| | (0.133) | (0.0499) | (0.0282) | (0.0634) | (0.0309) | (0.21) |
| Dec | -151.1* | -56.32* | -10.09 | -45.3 | 0.575 | 61.36 |
| | (66.36) | (21.83) | (12.34) | (27.76) | (13.54) | (91.81) |
| Constant | 505.8 | 919.8 | 415 | 845.4 | 209.1 | 4110.4 |
| | (1405.3) | (523.5) | (296.0) | (665.8) | (324.8) | (2201.9) |
| Ramsey Test | 7.25 | 20.83 | 9.64 | 6.26 | 3.8 | 62.35 |
| | (0.0003) | (0.0000) | (0.0000) | (0.0007) | (0.0133) | (0.0000) |
| N=102 | | | | | | |

**Tab. 7 OLS check for misspecification (Ramsey Test) - clustered SE in parenthesis (*p<0.05, **p<0.01, ***p<0.001)**

# Image Sources

Fig.1: Author Elaboration from UN-Habitat (2018).

# Author's profile

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He currently works at UNIDO, United Nations Industrial Development Organization, as Chief of the Division of Innovation Strategies and Digitalization. He was with UN-HABITAT at Headquarters in Kenya, Coordinator of the former Urban Economy and Finance Branch, and later Senior Economist of the Knowledge & Innovation Branch. He managed field projects and conducts research in areas of municipal finance, economics of urban expansion, and local infrastructure investment policies. Prior to joining UN-Habitat, he was with (CAF) Development Bank of Latin America in Caracas, and with the Inter-American Development Bank in Washington DC. He was project director of Development Projects at PADECO Co., Ltd., a global consulting firm in Tokyo. He held a PhD in economics.

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He is full professor of Applied Economics at the Faculty of Economics and Law, Kore University of Enna (Italy), where he currently serves as the Dean of the Faculty. He is editor of Tourism Economics. His research areas include tourism and cultural economics, urban and regional economics, development economics. He holds a PhD in applied statistics.

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He currently works at WRI, World Resources Institute, as Senior Urban and Regional Economist. He leads and conducts economic research and analysis that help address key knowledge gaps and advance the objectives of WRI Ross Center project teams working globally across urban issues, including economic geography, inequality, municipal finance, and mobility. Prior to joining WRI, Giuseppe was senior urban economist at UN-HABITAT knowledge and innovation branch, and urban economy and finance branch. He also has several years' experience conducting data collection, and studies focussed on agglomeration economies, public goods and resilience working with World Bank and African Development Bank urban programmes and projects in Africa, and collaborating with consulting companies in Middle-East and Italy. He held a PhD in economics.