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This special issue collects a selection of peer-review papers presented at the 8th International Conference INPUT 2014 titled "Smart City: planning for energy, transportation and sustainability of urban systems", held on 4-6 June in Naples, Italy. The issue includes recent developments on the theme of relationship between innovation and city management and planning.

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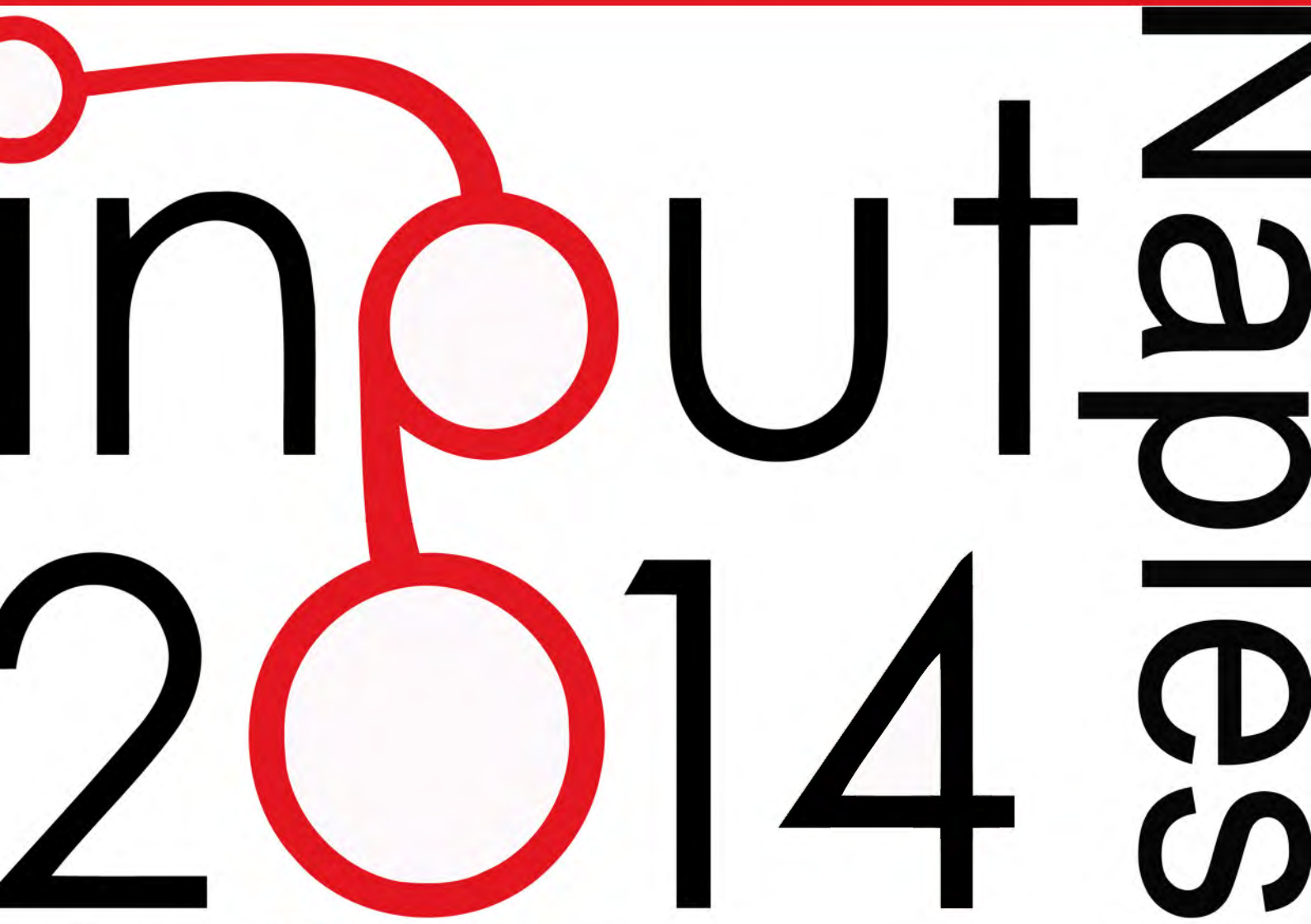

Smart City

planning for energy, transportation and sustainability of the urban system

Special issue, June 2014

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SMART CITY

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Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

TeMA Journal of Land Use, Mobility and Environment

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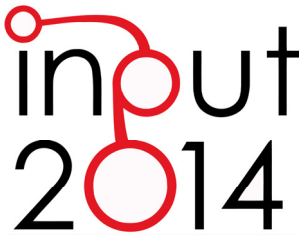
TeMA Journal of Land Use, Mobility and Environment

This special issue of TeMA collects the papers presented at the 8th International Conference INPUT 2014 which will take place in Naples from 4th to 6th June. The Conference focuses on one of the central topics within the urban studies debate and combines, in a new perspective, researches concerning the relationship between innovation and management of city changing.



TeMA Journal of Land Use, Mobility and Environment

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EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

SMART CITY. PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

This special issue of TeMA collects the papers presented at the Eighth International Conference INPUT, 2014, titled "Smart City. Planning for energy, transportation and sustainability of the urban system" that takes place in Naples from 4 to 6 of June 2014.

INPUT (Innovation in Urban Planning and Territorial) consists of an informal group/network of academic researchers Italians and foreigners working in several areas related to urban and territorial planning. Starting from the first conference, held in Venice in 1999, INPUT has represented an opportunity to reflect on the use of Information and Communication Technologies (ICTs) as key planning support tools. The theme of the eighth conference focuses on one of the most topical debate of urban studies that combines , in a new perspective, researches concerning the relationship between innovation (technological, methodological, of process etc..) and the management of the changes of the city. The Smart City is also currently the most investigated subject by TeMA that with this number is intended to provide a broad overview of the research activities currently in place in Italy and a number of European countries. Naples, with its tradition of studies in this particular research field, represents the best place to review progress on what is being done and try to identify some structural elements of a planning approach.

Furthermore the conference has represented the ideal space of mind comparison and ideas exchanging about a number of topics like: planning support systems, models to geo-design, qualitative cognitive models and formal ontologies, smart mobility and urban transport, Visualization and spatial perception in urban planning innovative processes for urban regeneration, smart city and smart citizen, the Smart Energy Master project, urban entropy and evaluation in urban planning, etc..

The conference INPUT Naples 2014 were sent 84 papers, through a computerized procedure using the website www.input2014.it . The papers were subjected to a series of monitoring and control operations. The first fundamental phase saw the submission of the papers to reviewers. To enable a blind procedure the papers have been checked in advance, in order to eliminate any reference to the authors. The review was carried out on a form set up by the local scientific committee. The review forms received were sent to the authors who have adapted the papers, in a more or less extensive way, on the base of the received comments. At this point (third stage), the new version of the paper was subjected to control for to standardize the content to the layout required for the publication within TeMA. In parallel, the Local Scientific Committee, along with the Editorial Board of the magazine, has provided to the technical operation on the site TeMA (insertion of data for the indexing and insertion of pdf version of the papers). In the light of the time's shortness and of the high number of contributions the Local Scientific Committee decided to publish the papers by applying some simplifies compared with the normal procedures used by TeMA. Specifically:

- Each paper was equipped with cover, TeMA Editorial Advisory Board, INPUT Scientific Committee, introductory page of INPUT 2014 and summary;
- Summary and sorting of the papers are in alphabetical order, based on the surname of the first author;
- Each paper is indexed with own DOI codex which can be found in the electronic version on TeMA website (www.tema.unina.it). The codex is not present on the pdf version of the papers.

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Smart City - Planning for Energy, Transportation and Sustainability of the Urban System

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SMARTNESS AND ITALIAN CITIES

A CLUSTER ANALYSIS

FLAVIO BOSCACCI, ILA MALTESE [a], ILARIA MARIOTTI [b]

[a] DAStU - Politecnico di Milano
e-mail: ila.maltese@polimi.it

[b] DAStU - Politecnico di Milano
e-mail: ilaria.mariotti@polimi.it

ABSTRACT

Smart cities have been recently recognized as the most pleasing and attractive places to live in; due to this, both scholars and policy-makers pay close attention to this topic. Specifically, urban "smartness" has been identified by plenty of characteristics that can be grouped into six dimensions (Giffinger *et al.* 2007): smart Economy (competitiveness), smart People (social and human capital), smart Governance (participation), smart Mobility (both ICTs and transport), smart Environment (natural resources), and smart Living (quality of life).

According to this analytical framework, in the present paper the relation between urban attractiveness and the "smart" characteristics has been investigated in the 103 Italian NUTS3 province capitals in the year 2011. To this aim, a descriptive statistics has been followed by a regression analysis (OLS), where the dependent variable measuring the urban attractiveness has been proxied by housing market prices. Besides, a Cluster Analysis (CA) has been developed in order to find differences and commonalities among the province capitals.

The OLS results indicate that living, people and economy are the key drivers for achieving a better urban attractiveness. Environment, instead, keeps on playing a minor role. Besides, the CA groups the province capitals according to the smart features, showing interesting results on the possible "smart specialization" of the cities.

The paper is structured into seven sections. The introduction is followed by the literature review on the concept of Smart Cities, and its measurement. Section three focuses on data and methodology. Descriptive statistics, econometric and cluster analyses follow. The last section is dedicated to discussion and policy recommendations.

KEYWORDS

Smart city, Italian province capitals, Housing market, Cluster analysis

1 INTRODUCTION

Since the most of the world population lives in urban contexts, it becomes crucial to identify the determinants of urban wealth and liveability. In particular, among the many definitions and characteristics of a "successful" city, the label of "smart city" has recently got the upper hand. The notion of "urban smartness" is thus attracting the attention of both policy-makers and academicians (i.e. European Commission 2012; Barca and McCann 2011). Among many different definitions, the "Vienna model" by Giffinger *et al.* (2007) appears as the most widely recognized. According to this functional model, the drivers of urban smartness can be grouped into six "smart" dimensions: economy, people, governance, mobility, environment, and living (Giffinger *et al.* 2007).

In this context, the present paper aims at investigating the role played by these "smart" characteristics in the capacity of the major Italian cities to attract people and economic activities. Therefore, the 103 Italian province capitals have been observed in the year 2011, by means of descriptive statistics and econometric analysis (OLS). The dependent variable is urban attractiveness that has been proxied by housing market prices (hereinafter HMPs), while the explanatory variables concern smart characteristics, and have been grouped according to the Vienna model, which is based on six "smart" dimensions (economy, people, governance, mobility, environment, living). Data on housing market prices come from the Scenari Immobiliari database, which records data at municipality level, in Italy, since the year 1993, while the smart characteristics have been gathered from primary and secondary data. Besides, differences and commonalities among the cities are explored by means of a cluster analysis (hereinafter CA).

The results of the econometric model (OLS) underlines that living, people and economy are the key drivers for achieving a better urban attractiveness while environmental issues stay on the backdrop. Besides, the CA showed that the most performing cluster (Cluster 1) is composed by larger "competitive" cities with excellent results in economy, governance, mobility, and living. The second best performing group (Cluster 3) is composed by large "attractive" cities mainly located in the North, which present the same characteristics of the first cluster, even to a lower level. Cluster 4, concerning the "liveable" cities, instead, includes medium-sized cities with all the variables above the average, except for unemployment. Finally, Cluster 2 collects towns located in the South and some others in the peripheral areas of the regions they belong to. These towns are small, and have on average the lowest scores in all the selected variable. However, several of them present results above the cluster average for at least one of the dimensions, suggesting a possible vocational "smart specialization".

The paper is structured into seven sections. After the introduction, the paper focuses on the literature review of the concept of Smart Cities, and the related variables and indicators adopted to measure "smartness". Data and methodology are then described in section three, while descriptive statistics is presented in the fourth one. Sections five and six are dedicated to the results of the OLS and cluster analysis, respectively. Conclusions follow in the section seven, which puts forward new research questions.

2 URBAN SMARTNESS: THE LITERATURE

In the current concept of urban competitiveness it results very important to appraise the successful cities' characteristics. A city can thus be defined in many different ways: intelligent, innovative, wired, digital, creative, cultural, and, of course, "smart". Specifically, after many contributes on the "intelligent city" in the 90s, mainly dealing with ICTs as key driver, the focus shifted to the "social" aspects of urban development: from the higher productivity of a more educated human capital (Shapiro 2006; Winters 2011), and skilled workforces (Berry and Glaeser 2005; Glaeser and Berry 2006), through the triple-featured (tolerance, talent,

technology) "creative city" (Florida 2005), to the sustainable approach to growth, in both environmental and social fields (Hollands 2008; O'Grady and O'Hare 2012).
In the last few years, chiefly due to the global crisis, also the economic component of sustainability has been heavily involved, therefore, in a Smart City (hereinafter SC), economic growth, social and environmental sustainability are supposed to be with compatible one another. Even in the most recent definition of "senseable city", the MIT suggests a new path towards urban sustainability, which entails a deep use of new technologies for the everyday life of everyone (Ratti 2012), thus involving not only intelligence and innovation as tools, but also inclusion and liveability as goals (Mitchell 2007; Sassen 2011).

2.1 LOOKING FOR THE "SMART CITY" DEFINITION

If a strict definition of SC is not easy, some operational descriptions are anyhow available: a city is smart "when investments in human and social capital and traditional (transport), and modern (ICT) communication infrastructure fuel sustainable economic growth, and a high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu *et al.* 2011). Indeed, sustainability seems the only common feature to all the possible definitions of SC (ABB 2012), together with a large – maybe too large? – target of "quality of life" (Legambiente 2012).
As a conclusion, according to the most of the theoretical studies on SCs, whatever the disciplinary approach or the research background (institutional, academic or entrepreneurial), it is possible to state that a SC has two main goals: full general sustainability and quality of life, which may be summed up in the concept of "smartness". Furthermore, even if the most of the empirical analysis on SCs ends up choosing indicators for their many dimensions, in some cases useful research tool-frames have been also provided.
Actually, the most valued description of SC characteristics has been presented in a joint research by the Technology Universities of Wien and Delft with the Ljubljana University (from now on defined "The Vienna model"), which focuses on the strict relation among six axes of the urban area (economy and governance, mobility and environment, people and living) (Giffinger *et al.* 2007)[1]. In the Vienna model, a definition of SC is provided, according to which a Smart City is "well performing in a forward-looking way in six characteristics, built on the 'smart' combination of endowments and activities of self- decisive, independent and aware citizens" (*ibidem*, 11).

2.2 EMPIRICAL STUDIES ON SMART CITIES

Several empirical studies on SC have been conducted at both European and national scales. Apart from some case-study oriented works, the literature can be grouped into two categories: ranking analysis, which is definitively very popular and classifies cities according to selected indicators depending on a general or particular perspective of sustainability, and more complex analyses like hedonic prices method, correlation analysis, econometric models, and cluster analysis.
Focusing on the Italian cities, the most of the rankings consider only a particular group of cities, according to dimensional criteria: ABB-Ambrosetti (2012) for example, has ranked the 13 most populous Italian cities, while the Euromobility Report (2013) considers 50 municipalities where over 100.000 people live, in order to analyse and discuss the level of sustainable mobility. In some cases, they consider the whole sample of the

[1] Since this model has been adopted for the current research, it will be further investigated in the next methodology paragraph.

103[2] NUTS3 Provinces (Sole 24 Ore 2012) or capital provinces. Specifically, the ICity Rate report (Forum PA, 2012) analyses the "intelligent cities"[3], classifying them according to the Vienna model dimensions, using about one hundred indicators at the local and provincial scales. Similarly, according to "La Dolce Vita" (Colombo *et al.* 2012a; b), which ranks cities according to the quality of life level, the best performers show better results mainly in the economy and services dimensions, more than in those linked to environment or society, and climate.

On the contrary, the Ecosistema Urbano by Legambiente (2012) focuses on the environmental quality issue, considering 25 indexes (over about 70 indicators) that measure urban performance regarding air, water, energy and waste management, transports and mobility, green areas, environmental, and mobility policies. The best cities present good results in the most of the indicators like waste management (share of recycled wastes), ciclability, which considers the urban "bike-friendliness" level, and in the willingness to reply to the Ecosistema Urbano questionnaire.

Moving to the studies based on econometric or cluster analyses, Caragliu and Dal Bo (2012) focus on the impact of smart characteristics on urban performance – measured by per capita GDP – and investigate this impact at the local level for a sample of 94 cities in 14 EU countries in 1999-2006. They find that urban density is negatively associated to urban performance[4], while the smartness indicator – measured as the mean urban value for the number of visitors to museums per resident, the length of public transportation (in logs) and the number of administrative forms available for download from official web site (in logs) – is always positive and significant. Besides, cities specialized in industries with high-tech content[5] (knowledge intensive services – KIS[6]), with higher amenities, and more attractive as concerns tourist inflows are better performing.

Colombo *et al.* (2012a; b) analyse, on one side, the relationship between quality of life and housing prices, on the other side, the link between quality of life and wages within the Italian province capitals in 2001-2009. In this study quality of life is defined as the weighted average of a set of local amenities, branched into five main domains: climate, environment, services, society and economy (Table 4). It results that housing prices are higher in cities with less pollution, more green areas, and located on the coast. As concerns services, positive differentials are observed in cities with higher teacher-pupil ratio, better transport and cultural infrastructures. As concerns social conditions, housing prices are lower in cities with higher crime rates and higher shares of foreigners, while they are positively related to civic-ness and university enrolment. Finally, housing prices are higher in cities with higher value added per capita and lower unemployment rate. As far as the geographical composition is concerned, quality of life is highest in medium-sized towns in the Centre-North of Italy.

Finally, it is worth mentioning the recent analysis conducted by Siemens-Anci in 2012 on 54 out of the 110 Italian province capitals, identified according to the size: cities with more than 90.000 inhabitants. These province capitals have been grouped through a Cluster Analysis on the basis of five synthetic indexes[7] which represent: urban environment (air quality, urban green, water and waste managements), real estate stock,

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2 In the most of the studies, although using current information, due to the lack of data provoked by frequent administrative borders changes, the number of provinces is still 103, despite the fact that they are 107 since 2005 (adding four provinces in Sardinia) and 110 since 2009 (with Monza, Fermo and Barletta-Andria-Trani).

3 The "I" in the title of the report does not stand only for intelligent, but also for innovative, inclusive and interacting (Forum PA 2012).

4 This may suggest that cities in the sample are experiencing the right-hand side of the optimal city structure, where costs exceed benefits (Caragliu and Dal Bo 2012).

5 These cities are expected to outperform those with more traditional and lower value-added sectors.

6 See Organization for Economic Cooperation and Development (2005) for further details.

7 These indexes have been developed by means of principal components analysis.

energy management, mobility, and health service supply. Six clusters are identified. The "becoming cities" (cluster 5) have got below average scores in every measure, but the commonality among the 10 cities of this group[8] seems to be the growing specialization in one specific sector. The best cluster is the "Ideal Cities" one (cluster 3), which is composed by four medium sized cities in the North-East of the country, with the best scores in all the measures. It is followed by a small group of big cities (7) belonging to "good living and moving cities" cluster (4) where mobility and real estate stock are excellent if compared to the average values. If Cluster 4 presents low scores in the environmental measure, in the "ideal cities" Cluster 3, environment proves instead to be better taken into account. Two other groups (environmental and energy clusters), which account for 25% of the cities sample, seem concentrated only on the environmental issue, while the wealth cities, a geographically diffused group, show good results referring to the real estate stock and the health service supply as well.

3 DATA AND METHODOLOGY

The aim of the present paper is twofold. First, it aims at investigating the impact of smart characteristics on urban attractiveness of the 103 Italian province (NUTS3) capitals in 2011, which is proxied by housing market prices. Subsequently, differences and commonalities among the cities are explored by means of a cluster analysis. Data on housing market prices come from the Scenari Immobiliari database, which records data at municipality level, in Italy, since the year 1993, while smart characteristics, suggested by the Vienna model (Giffinger *et al.* 2007), come from various sources, and have been grouped into six axes.

The multiple definition of smartness is mainly based on the theories of regional competitiveness, thus considering the whole "infrastructural endowment" of the city, both the physical and the immaterial one. As a consequence, not only the "hard" factors, which account for efficiency like transport and ICT, and natural resources, are taken into account, but also the "soft" ones, like human and social capital, quality of life, citizens' and stakeholders' participation must be considered. Following this model, a city can be considered "smart" if its dimensions are "smart" in turn: smart economy mainly concerns competitiveness; smart people is about social and human capital; smart governance refers to participation; smart mobility affects ICTs and transport; smart environment involves natural resources; smart living is a synonymous of quality of life. According to the large multitude of rankings and empirical investigations presented in section 2, and adding some tweaks, many variables for each dimension have been chosen for the empirical analysis.

It is worth saying that some changes occurred in choosing the variables used by Giffinger *et al*. as to better differentiate the six dimensions, as to cope with data availability. In fact, since it has been very important to find as many data as possible on the city-sample, the local scale (province capital) has been strongly preferred to the larger ones. Furthermore, unlike the Vienna model, no regional or national level data have been considered. In some cases, data related to the whole province have been collected instead of those for the province capital itself: this was due to lack of data but also to be able to analyse a higher impact scale. Data were collected in desk research, by analysing primary and secondary data. Despite the huge data availability, a high correlation between couples of them suggested to reduce the number of selected variables to 14.

The urban attractiveness of the 103 NUTS3 province capitals is modelled by means of an OLS regression, where the dependent variable is PRICE (€/sqm) – market real estate price of the residential units in the semi-central area in 2011 (Scenari Immobiliari), and the explanatory variables are the following:

- TAX Income (€): average taxable income per taxpayer, for each Italian province capital in 2010 (http://www. comuni-italiani.it);

[8] These cities are mainly small-sized and in the South of the country.

- JKShare (%) : is the share of firms in the J and K sectors[9] over the total, by province in 2010 (CNEL), and represents the innovation level of the province the capital city belongs to;
- UNemplShare (%): is the share of unemployed people over the total in each province the capital city belongs to, in the year 2011 (Sole24Ore);
- ImmIntegrShare: is a Cnel index measuring the immigrants integration level[10] in the province the capital city belongs to, in the year 2009 (CNEL);
- Network: is the number of networks and associations the province capital belongs to on the total number of existing associations in the year 2012 (Ancitel);
- ResponseRate: is the administrative local institutions' replyness level, measured by the number of answers given to the Legambiente questionnaire in 2012 (Legambiente);
- UniResearch: is the number of universities and research centres in the city, year 2012 (Ancitel);
- Pollution: is the maximum number of times Particulate Matter (PM10) exceeded the limit level in the province capitals in the year 2009 (ISTAT);
- PopWasteShare (%): is the share of inhabitants making separate collection of rubbish over the total at province capital level in the year 2011 (ISTAT);
- BykeIndex: is a complex ciclability index within the province capitals in 2011 (Legambiente);
- Rain (mm): is the average of rainfall occurred in 2000-2009, at provincial level (ISTAT);
- ElderlyFacShare: share of facilities for elderly people over 1000 elderly in 2008 at provincial level (Ministry of Interior);
- InstitCult: number of institutions and cultural goods in the province capital level in the year 2012 (Ancitel);
- TouristShare: share of tourists staying overnight over the total inhabitants at the province level in 2010 (Sole24Ore).

Besides, region-capital dummy and macro-area dummy have been included in the model, in order to control for fixed effects. The equations suggest that urban attractiveness defined as real estate prices is explained by the explanatory variables as defined above.

Once urban attractiveness has been investigated, a k-means[11] cluster analysis is carried out in order to analyse similarities and differences of the province capitals in terms of smartness and urban attractiveness. In the Cluster Analysis, only 8 out of the 14 previous variables have been considered (Price, TaxIncome, JKShare, UnemplShare, ImmIntegrShare, Networks, Pollution, BykeIndex, TouristShare). Besides, the size variable (population) as classified by Legambiente (2012)[12] has been added to the analysis.

4 DESCRIPTIVE STATISTICS

As concerns the geographical distribution, the 103 NUTS3 province capitals are located in the northern areas (45.2%), South and Islands (34.3%) and Centre (20.4%) (Figure 1a). Focusing on the size of the province capitals, most of them are medium-sized, while a third of the sample is composed by small cities (Figure 1b).

[9] According to NACE (Nomenclature statistique des activités économiques dans la communauté européenne) J and K are: Financial intermediation; real estate; renting, and business activities.

[10] In the index, Cnel considers the ability to gain access to local services (real estate market, education), and to be locally embedded (deviant behavior; naturalization – citizenship achievement – family reunification).

[11] In this k-means CA, each observation is placed in the group where it is closest to the means which represents the cluster itself.

[12] See footnote 4.

Besides, only about 20% are big cities (more than 200,000 inhabitants) with only four of them above 1,000,000 people.

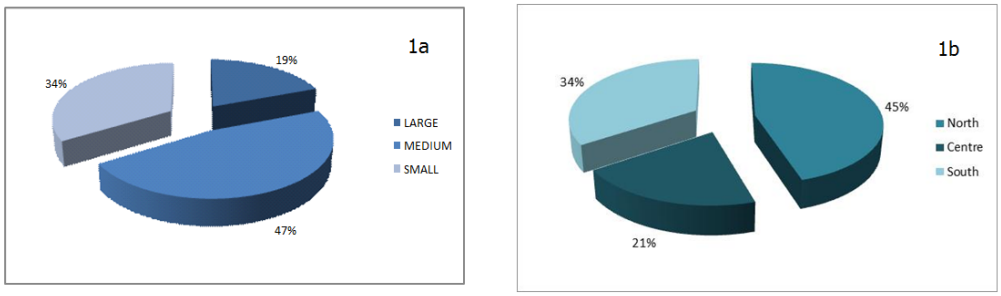

Figure 1 Italian province (NUTS3) capitals by Macroregion (1a) and size (1b)

Looking at the housing prices distribution among the capital cities (Figure 2), it results that about 10% show housing average prices ranging from 2,551€ and 4,550€ (cat.1 and 2), while the rest of the sample is almost equally subdivided into the left three categories. The housing prices of the first two categories (4,550-2,551) mainly refer to cities in the northern (7 out of 10) and central macro-areas (2 out of 10), while 88% of the southern cities belong to the lowest prices categories (4 and 5).

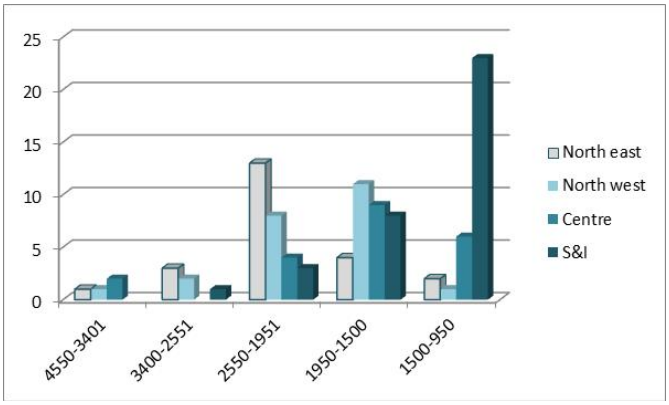

Figure 2 Price-class distribution by Macroarea

These first impressions are confirmed by the rankings of the first and the last ten cities in terms of housing prices, with Rome, Milan, Venice and Florence in the first positions with the highest housing prices (around 4.000€/sqm), followed by Bologna, Verona, Bolzano, Genoa, Naples and Turin, characterised by housing prices in the second category. Conversely, the last 10 positions of the ranking mainly concern southern cities, with the exception of Rovigo and Gorizia in the less developed areas of the North East.

As concerns the wealth of the cities, a good proxy of the GDP[13] is the average taxable income per taxpayer in 2010. Despite high housing market prices, Florence and Venice seem to be less "rich" than other cities: they are only 15th and 41st respectively. Southern cities, as expected, have a minor part in building the internal revenue: the first in this ranking is Caserta, in 19th place.

The housing prices are correlated with the other economy's variables, as expected. Indeed, cities with a more expensive housing stock are those with higher tax income, higher share of firms with high tech content (Knowledge Intensive Services), and with higher employment rate. Then, the most attractive cities are

[13] GDP is not available at urban scale after 2004.

expected to host universities and research centres, have higher amenities, attract inflows of tourists. Besides, according to Colombo *et al.* (2012a), housing prices are supposed to be higher in cities with less pollution, more green areas, located on the coast.

5 OLS ESTIMATION RESULTS

The OLS model presented in Section 3 suggests that the real estate price of the residential units and the taxable income in the 103 province capitals in 2011 is related to a list of smartness' characteristics belonging to the six dimensions of the Vienna model. The results of the OLS regression are presented in Table 1 below, where four models have been run in order to control for the correlation between two variables (JKshare and UniResearchSh), and to control for fixed effects.

DIMENSION	VARIABLE	PRICE1	PRICE1	PRICE1	PRICE1
Economy	Tax Income	0.051921***	0.051358***	0.053748***	0.053188***
	JKshare	240.987***	237.2623***		
	UnemplShare	-31.5808***	-23.2098	-56.223***	-43.0048***
People	ImmIntegrShare	-16.9526***	-16.2596***	-16.5274***	-16.0254***
	UniResearch			24.17474***	23.89541***
Governance	Networks	37.23117***	42.66081***	16.72397	22.48166*
	ResponseRate	-2.90944	-3.40445*	-1.40335	-43.0048
Environment	Pollution	-0.68757	-0.87854	-0.10184	-0.35077
	PopWasteShare	-5.98467	-6.82482	-4.10813	-5.10405
	Rain	-0.32615	-0.35856	-0.0176	-0.09593
Mobility	BykeIndex	2.971613*	3.42406*	2.409295	2.732871
Living	ElderlyFacShare	0.550445	0.413728	0.22831	0.079027
	InstitCult	15.65109***	15.06742***	19.43383***	18.44719***
	TouristShare	16.76364***	17.45921***	13.6985***	14.1261***
	_cons	1377.517***	1404.84***	1853.976***	1916.689***
	DummyRegion Capital	Yes	Yes	Yes	Yes
	Dummy macroarea	No	Yes	No	Yes
	Obs.	97	97	97	97
	P-value	0.0000	0.0000	0.0000	0.0000
	R-2 – adj	0.7957	0.7942	0.7942	0.8000

Tab. 1 OLS results

The Economy indicators are positive and significant, suggesting, as expected, that province capitals with higher tax income and specialised in industries with high-tech content, are more willing to experience higher housing prices; conversely, cities with higher unemployment rates have a lower attractiveness. The cities specialised in high-tech industries are, therefore, expected to outperform those with more traditional, and lower value-added, sectors.

As concerns the "smart people" dimension, the availability of universities and research institutes is significant and positive suggesting that a city supplying this kind of services is better performing; conversely the index

measuring the immigrants integration level at provincial level shows a negative and significant sign, thus stressing that the presence of immigrants, although well integrated, is still not positive for the housing market, by lowering average prices.

On the contrary, results are not so steady for the Governance and Mobility dimensions, since they gain and lose significance within the models, while the Environment dimension seems not to have any impact on the housing prices.

Interesting results are then provided by two out of the three variables related to the Living dimension: tourism and cultural heritage, which positively influence the housing prices. Both the variables can proxy the city's attractiveness, thus underlying that higher tourist inflows are positively associated with urban wealth and economic performance (Caragliu and Dal Bo 2011).

Finally, the geographical location of the province capitals plays a role: being located in the North of the countries increases the probability to have higher prices.

By contrast being the capital city of a region does not appear relevant.

6 CLUSTER ANALYSIS

The 103 province capitals have been clustered through a k-means CA, according to 11 selected variables. The following four clusters of homogeneous cities have, thus, resulted (Table 2).

DIMENSION	VARIABLE	CLUSTER1 Competitive cities	CLUSTER 2 Specializing cities	CLUSTER 3 Attractive cities	CLUSTER 4 Liveable cities	Average	Sign.
Economy	Price11	4163	1458	3008	2159	1895.59	.000
	clustDensity	2.50	2.69	1.83	2.54	-	.168
	JK_Sh	5.3	3.1	4.1	3.6	3.426	.000
People	ImmIntegr_Sh	45	54	49	55	52.599029	.041
	BykeIndex	53.6225	20.4891	41.0433	39.8560	29.920404	.000
Governance	Unempl_Sh	7	10	8	6	8.51	.000
	Pollution	38.9750	29.5071	34.5200	33.8969	31.957831	.022
Environment	Networks	17	5	11	8	7.01	.000
	Tourists_Sh	15	5	14	9	7.14	.017
	Centre	1	0	0	0	-	.303
Mobility	North West	0	0	0	0	-	.126
Living	North East	0	0	1	0	-	.007
	South	0	1	0	0	-	.000
	Small	0	1	0	0	-	-
	Medium	0	0	0	1	-	-
	Large	1	0	1	0	-	-
	Nr. of cities	4	58	6	35	-	-

Tab. 2 Cluster Analysis

The best performing cities (Roma, Milano, Venezia and Firenze) belong to the "Competitive Cities" Cluster (1) and are. very large, hosting high added-values activities (JK share), a good network of administrations and institutions (Networks), and various amenities attracting tourists (Tourist-share). On the contrary,

despite a good sustainable mobility, pollution in these metropolis is very high. Housing market prices are also the highest.

The second best performing group is Cluster 3, composed by 6 large "Attractive Cities" (Bologna Verona Bolzano Genova Napoli Torino), mainly located in the North, which present the same characteristics of the first cluster, but to a lower level.

Cluster 4, composed by the "Liveable cities", instead, includes 35 medium-sized cities with all the variables above the average, except for unemployment. These appear as good cities to live in. The tail end is Cluster 2 "Specializing cities", with the most of the cities located in the South and some others in the peripheral areas of the regions they belong to. These are small cities, presenting on average the worst scores in all the selected variable, but many of them present results above the cluster average for at least one of the dimension, suggesting a possible future smart specialization, which could help in improving the current situation.

Furthermore, considering both the results of OLS and CA, it results that Economy proves to have a strong impact on housing prices (both unemployment and skilled employees are significant for the CA), together with People dimension.

Governance and Mobility, whose impact was undefined according to the OLS, show high scores in the cities with highest prices. In the CA the people dimension is represented by the level of immigrates' social integration, which seems to lower housing market prices. Besides, pollution is higher in the richest cities.

7 CONCLUSION

The OLS analysis underlines the key role played by the Economy, People and Living dimensions. Indeed, it results that most attracting cities are "richer", show high employment rates, are specialised in high technology sectors, host universities and research institutes, belong to a high number of networks, and are more attractive for tourists. These cities are, then, more likely to be located in the north of the country.

On the other hand, better climate, lower pollution levels (Environment dimension), and better mobility (Mobility dimension) do not seem to impact housing prices significantly. Similarly, the groups of the competitive and attractive cities, as defined by the CA, present good results in the economy, living, mobility and governance dimensions. Besides, they are located in the north- centre-of the Country.

In both the analyses, on the contrary, Environment does not seem to play a key role, as already highlighted by the empirical contributes quoted in Section 2.2 (Caragliu and Dal Bo 2012; Colombo *et al.* 2012a; b; Siemens and ANCI 2012). Mobility, as well as density, is worth to be better and deeper analysed because its result is not univocal.

Focusing on the "specializing cities" of Cluster 2, it is worthwhile to select "in each region a limited number of sectors in which innovation can most readily occur and a knowledge base built up. [This] approach [is] defined in the current policy debate as 'smart specialization'" (Barca 2009, XVII).

Smart cities could have the best scores in many dimensions, but, since there is not "one-size-fits-all" strategy, for some cities the smart specialization could be the "therapy". Besides, this also implies that the success of an area or region is largely affected by the set of local institutions that are, in turn, path-dependent and rely upon the local characteristics.

Actually, if place-based policies matters on the way to smartness, they should be implemented, within a set of general priorities, by local actors with specific knowledge of the spatial dimension and characteristics of the area. It is, therefore, important to take into account both material and immaterial factors in framing

specific place-based policies, at the top-down and bottom up levels, aimed at achieving better urban performance and attractiveness through smart components.

Furthermore, fixed/geographical effects in the OLS and CA also suggest that differentiated policies are expected to be successful, thus depending on the regions will adopted them.

Last but not least, smart cities – with their high level of data availability – will be faster and more effective in implementing strategies and policies.

Finally, further research needs to focus on the potential omitted variables issue, thus trying to better investigate the variables and dimensions that did not play a significant role in the present analysis.

REFERENCES

ABB, The European House-Ambrosetti (2012), *Smart Cities in Italia: un'opportunità nello spirito del Rinascimento per una nuova qualità della vita,* www.abb.it.

Barca, F. (2009), *An agenda for a reformed cohesion policy,* European Commission.

Barca, F. McCann, P. (2011), *Outcome indicators and targets: Towards a performance oriented EU cohesion policy*, European Commission.

Berry, C.R., Glaeser, E.L. (2005), "The Divergence of Human Capital Levels across Cities", *Papers in Regional Science*, 84, 407-444.

Caragliu, A., Del Bo, C., Nijkamp, P. (2011), "Smart cities in Europe", *Journal of Urban Technology*, 18(2), 65-82.

Caragliu, A., Del Bo, C. (2012), "Smartness and European urban performance: assessing the local impacts of smart urban attributes", *Innovation*, 25(2), 97-113.

Colombo, E., Michelangeli, A., Stanca, L. (2012a), *Città italiane in cerca di qualità*, Università Bocconi, Milano.

Colombo, E., Michelangeli, A., Stanca, L. (2012b), "La Dolce Vita: hedonic estimates of quality of life in Italian Cities", *Regional Studies*, 1-15.

Euromobility (2013), *La mobilità sostenibile in Italia: indagine sulle principali 50 città,* www.euromobility.org.

European Commission (2012), *Smart cities and Communities,* ec.europa.eu.

Florida, R. (2005), *Cities and the Creative Class,* Harper Business, New York.

Forum PA (2012), *ICity Rate. La classifica delle città intelligenti italiane,* www.saperi.forumpa.it.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., Meijers, E. (2007), *Smart cities – Ranking of European medium-sized cities*, Centre of Regional Science, Vienna. http://www.smart-cities.eu/.

Glaeser, E.L. Berry, C.R. (2006), *Why Are Smart Places Getting Smarter?,* Taubman Center Policy Brief, 2, John F. Kennedy School of Government, Cambridge.

Graham, S. Marvin, S. (1996), *Telecommunications and the City: Electronic Spaces, Urban Places,* Routledge, London.

Hollands, R.G. (2008), "Will the real smart city please stand up?*", City*, 12(3), 303-320.

Legambiente (2012), *Ecosistema Urbano. XIX rapporto sulla qualità ambientale dei comuni capoluogo di provincia*. www.legambiente.it.

Mitchell, W.J. (2007), Intelligent cities, *UOC Papers,* 5.

Organization for Economic Cooperation and Development (2005), *Science, technology and industry scoreboard 2005,* OECD, Paris.

O'Grady, M., O'Hare, G. (2012), "How smart is your city?", *Science*, 335, 1581-1582.

Ratti, C. (2012), "Decalogue for a (smart) senseable city". *Keynote speech at SmartCityExhibition 2012,* Bologna, Italy, October.

Sassen, S. (2011)," Who needs to become 'smart' in tomorrow's cities", *Keynote speech at the LIFT Conference*. Marseille, France, July.

Shapiro, J.M. (2006), "Smart cities: quality of life, productivity, and the growth effects of human capital", *The Review of Economics and Statistics*, 88(2), 324-335.

Siemens, ANCI (2012), *EfficienCITIES. Città modello per lo sviluppo del Paese.* www.swe.siemens.com.

Sole 24 ore (2012), *Speciale Qualità della vita*, November 26th., www.ilsole24ore.com.

Winters, J.V. (2011), "Why Are Smart Cities Growing? Who Moves And Who Stays", *Journal Of Regional Science*, 51(2), 253-270.

AUTHORS' PROFILE

Ila Maltese

Fellow researcher in Urban and Applied Economics. She teaches Economics and Environmental Economics at the Politecnico of Milan and at the Università Statale in Milan.

Ilaria Mariotti

Assistant professor of Applied Economics at the Politecnico di Milano. She teaches Urban and Regional Economics.

Flavio Boscacci

Full professor of Applied Economics at the Politecnico di Milano. He teaches Business and Urban Project Evaluation.