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The paradox of smart cities: exploring the interaction between youth migration and urban exclusion

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ABSTRACT
Smart city initiatives aimed at enhancing sustainability, efficiency and quality of life often contribute to aggravating inequalities in urban areas. This paradox significantly affects young people as they rely on these cities for higher education and career progression. In this paper, we study how the development of smart city initiatives influences the migration and localisation of young people within a country. Using a panel dataset of 42 Italian smart city initiatives spanning 13 years, this study reveals that while smart cities serve as a catalyst for youth migration, socio-economic factors undermine inclusion goals and may exacerbate social and economic disparities.

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1. Introduction

Over the years, smart cities have gained prominence in urban and regional policies (Caragliu & Del Bo, 2022; Kitchin & Moore-Cherry, 2021; Kummitha, 2025; Su & Fan, 2023; Vanolo, 2014). While the definition of smart cities remains debated, a shared understanding refers to enacting policies on three key dimensions: (1) deploying digital and networked infrastructure enabling efficient governance and innovation; (2) promoting business- and creativity-driven urban development rooted in digitally enabled futures; and (3) attention to social inclusion and environmental sustainability as strategic long-term goals (Albino et al., 2015, p. 11). Smart city policies have gained prominence due to the growing urban population and the stress it leaves on urban infrastructure. These developments prompted cities to deploy ubiquitous digital technologies, ensuring that those who migrated to cities have access to resources and receive efficient services. Accordingly, there has been a paradigm shift in adopting smart city initiatives across cities, regions and nation-states. These initiatives include the adoption of digital services, data-driven governance, sustainable energy action plans and promoting citizen engagement tools (Kitchin & Moore-Cherry, 2021). For example, the European Union (EU) led the interest in smart cities with its policy framework, including its Mission on Climate-Neutral and Smart Cities, which aims to deliver 100 climate-neutral smart cities by 2030, subsequently extending this paradigm in a cascading model to inspire and guide other cities across the region to adopt similar practices and targets (Kummitha, 2025).[1]

Despite this policy enthusiasm, there is a lack of consensus on whether smart cities benefit the most marginalised communities – those who migrate to these cities. Smart city strategies remain highly heterogeneous in scope, orientation and implementation (Su & Fan, 2023). In many cases, their promises of efficiency and progress coexist with persistent challenges related to spatial inequality, affordability and uneven access to urban resources (Cardullo & Kitchin, 2019b; March & Ribera-Fumaz, 2016; Tomor et al., 2019; Vanolo, 2014). Recent literature, for example, emphasises that the digital technologies adopted in smart cities fail to address 'urban digital inequalities and social disconnection' (Nicholds et al., 2017, p. 250), therefore, they have a negative impact on life satisfaction (Wang & Zhou, 2023). Furthermore, the literature also refers to the failure of smart cities to promote genuine citizen engagement (Kummitha,

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2025) and the common good (Cardullo & Kitchin, 2019a). Anticipating these negative externalities, Vanolo (2014) led a critique against the utopian reference to smart technologies, noting that 'the rhetoric of smartness risked fostering a non-critical consensus due to a lack of critical opponents and numerous enthusiastic media portrayals, leading to potential problems not yet considered' (p. 894). The critical political and social debates in the last decade have raised concerns about the future of cities and the urban dwellers who migrate to them with high hopes for better living conditions (Hollands, 2015; Cardullo & Kitchin, 2019). Indeed, as a consequence of mass migration to metropolitan areas, cities are increasingly becoming exclusive and selective for residents, businesses, tourists and young people, creating social and economic barriers that contradict the foundational notion of building inclusive smart cities (Glaeser & Gottlieb, 2009; Mitra & Nagar, 2018; Romão et al., 2018).

The gap between the ideal notions and actual implementation calls for a critical reflection on whether smart cities represent a transformative paradigm or a polished continuation of longstanding exclusions in new digital forms (Datta & Odendaal, 2019). In this article, we analyse how the development of smart city initiatives influences the migration and localisation of young people within the city, referring to youth workforce and students. Localisation refers to the process by which young individuals choose a specific urban context as their primary residence for work or education, engage in community life, and build social and professional networks (Nayak, 2003). We focus on young people, considered as individuals under the age of 35, in line with demographic classifications commonly used in national migration and education statistics, as they are (1) sensitive to contemporary technological changes (Roth-Cohen et al., 2022); and (2) significantly attracted by the opportunities in cities (job integration and labour fluidity) in their migratory paths (Faggian et al., 2007; Iammarino & Marinelli, 2011; Winters, 2011a). In doing so, we consider intra- and international migration for two categories: the workforce and students, who are affected and contribute back to the urban context differently. In assessing this relationship, we consider the role of socio-economic barriers, such as housing costs, that naturally increase in cities during their growth stages, while they embrace the smart city growth paradigm (Kummitha, 2020; Vivant, 2013). Thus, this research aims to discuss the underexplored relationship between young people and smart cities. In particular, we pose the following research questions: How do smart city initiatives influence the localisation of national and international students and youth workers? How do housing costs influence this relationship?

In answering those questions, we use the generalised method of moments (GMM) to examine the interplay between smart city initiatives, socio-economic barriers, and youth migration across two categories (workforce and students) and levels (intra- and international) in 42 Italian cities over a 13-year period (2009–22). Italy is a focal point in European smart city policy (Caragliu & Del Bo, 2019; Vanolo, 2014) while youth migration (both national and international) has become increasingly relevant for urban development (Consiglio Nazionale dell'Economia e del Lavoro – CNEL), and student mobility is now central to regional studies debates on the spatial redistribution of human capital across cities (Tosi et al., 2019). Through this empirical approach, we (1) contribute to the emerging critical discussion related to smart city implementation; (2) address urban agglomeration patterns by discussing the role of smart cities in contemporary youth migration dynamics; and (3) offer practical insights about the role of intra- and international youth mobility (workforce and students) in the contemporary smart city era.

2. Literature review and hypotheses development

The development of smart cities is closely intertwined with evolving migration patterns, particularly in the context of youth migration, a central phenomenon visible in Italy and Europe. The migration trend has significant implications for the distribution of human capital, influencing the economic growth of receiving cities while also raising concerns about urban inequality. These factors can affect both the locational choices of actors that migrate and the policies cities develop to either attract or selectively manage migration patterns. Cities must strategically manage young people as active resources – whether as part of the workforce or as potential high-skilled human capital – thereby allowing them to achieve co-benefits for the cities themselves. Failing to do so may result in the latter choosing to migrate to other cities (Kummitha & Crutzen, 2019).

2.1. Smart city and migration dynamics

Smart city initiatives have become increasingly central to enhancing urban efficiency and managing migration patterns effectively, particularly among youth and highly skilled individuals. Winters (2011) argues that the growth of smart cities is significantly driven by the influx of individuals pursuing work opportunities and higher education, many of whom choose to remain in these cities after completing their education. They significantly contribute to cities' economic interests. Smart cities serve as hubs for higher education and the creative class, attracting and retaining young people and highly skilled talent. Betz et al. (2016) elucidate that regional policymakers have historically focused on attracting high-skilled human capital rather than just workers to stimulate economic growth. This strategy has led to a proliferation of human capital across cities, where those cities with an initial high share of college-educated workers have witnessed faster growth rates. Similarly, Spicer et al. (2021) note that smart city initiatives present an opportunity for regions to retain young talent and attract young professionals, which helps overcome the resource deficiency experienced by ageing populations. This assumption is supported by the fact that individuals with higher qualifications tend to be more involved in the strategic planning of smart city initiatives (Kummitha, 2020). Lupu et al. (2023) argue that by providing better conditions for capitalising on labour mobility and enhancing connectivity through public transportation, smart cities facilitate and generate employment opportunities. These factors influence youth mobility and intra- and international workforce patterns (Section 2.1.1), student mobility (Section 2.1.2) and the role socio-economic factors play in the process (Section 2.2).

2.1.1. Intra- and international youth migration and workforce

A growing body of scholarly research agrees that unemployment and economic disparities significantly increase the likelihood of migration, although this effect varies across nations and demographic subgroups, determined by factors such as race, gender, occupation and prior mobility (Faggian et al., 2017; Iammarino et al., 2011). The impact of youth migration is further shaped by job search duration, individual preferences, social instability, and living and economic conditions, suggesting that labour markets play a pivotal role in determining the migration patterns (Faggian et al., 2017).

Youth migration plays a particularly crucial role in shaping smart cities. Characterised by advanced digital infrastructure, a dynamic economic environment, and a commitment to social inclusion and urban liveability (also called the smart living dimension; Appio et al., 2019; Su & Fan, 2023; Vanolo, 2014), smart cities attract young migrants seeking better job prospects and an enhanced quality of life. It is essential to distinguish between intra- and international migration flows, driven by distinct motivations and needs, which shape how these populations interact with smart cities. While intra-migration refers to migration within a specific country, international migration refers to migration from one country to another.

Intranational migration is driven by a combination of personal and contextual factors. On the one hand, job-related interests play a crucial role, while on the other, access to supportive job opportunities, a liveable and human-centred environment and dynamic urban labour markets reinforce this relationship (Cennamo & Gardner, 2008). The ambition of young people to build their future in cities that prioritise human well-being and those that welcome and integrate individuals and talents plays a central role in shaping actors migration decisions (Gordon, 2015). In this context, Spicer et al. (2021, p. 548) highlight that for cities to be smart, they need to attract new, young professionals and retain young people who can contribute to the socio-economic vibrancy of their cities. This prospect reflects an evolving understanding of smart cities driven by their technological advancements and their capacity to respond to demographic and youth-based challenges. As smart cities tend to have advanced technology-led urban systems that provide a higher quality of life, opportunities for employment, foster collaboration, improve service delivery, and promote transparency and accountability (Marchesani et al., 2025), it is not surprising that intranational young people are attracted to these cities (Winters, 2011). Thus, we propose the following hypothesis:

> *Hypothesis 1a: The higher the level of smart city initiative implementation in a city, the higher the localisation of the intranational youth workforce.*

International youth migration is driven by diverse factors, including the pursuit of better working conditions, an enriching quality of life, geopolitical influences and broader career opportunities (Faggian

et al., 2017). Unlike internal migration, international migration presents distinct challenges tied to cultural proximity, such as language barriers, high living costs, cultural differences and varying legal frameworks (Ceci & Masciarelli, 2020). These barriers significantly impact the ease of integration and the overall experience of migrants. For example, Coulombe and Tremblay (2009) found that international migrants in Canadian provinces tend to be less skilled on average compared with internal migrants – a trend also observed in other countries, including Italy. This disparity underscores the additional challenges faced by international youth, particularly when settling in regions with distinct cultural and socio-economic conditions.

Traditional migration drivers – such as job opportunities, insufficient public services, and the pursuit of better living conditions and economic prospects – continue to propel rural-to-urban migration in both urban agglomerations and smart cities (Chatterjee & Kar, 2015; Naval et al., 2024; Spicer et al., 2021). These factors also influence international return migration patterns, as observed in China (Ma et al., 2024), as well as international migration trends in smart cities. Particularly, Naval et al. (2024) highlight the intersection between international migration and smart cities, demonstrating how globalisation and digitalisation processes, alongside the depopulation of rural areas, shape the spatial and temporal evolution of smart cities. This transformation positions smart cities as central nodes within global migration networks.

Smart city initiatives integrate technological and governance interventions to optimise urban infrastructure, making cities competitive and efficient. By leveraging innovation, these governance arrangements effectively reduce cultural barriers, fostering more inclusive and interconnected environments (Borkowska & Osborne, 2018). This adaptability enhances the appeal of major European smart cities to international populations, particularly young, skilled and mobile individuals (Betz et al., 2016). Smart cities attract international knowledge and young people by offering advanced digital infrastructure, improved public services, and opportunities aligned with the dynamics of globalisation and digitalisation (Christofi et al., 2021; Marchesani et al., 2023). As a result, smart cities emerge as hubs of opportunity, offering improved living conditions and enhanced career prospects (Marchesani et al., 2023). In this line, Marchesani et al. (2025) observed that smart cities attract international human capital by creating inclusive and economically integrated environments. These cities not only adapt to global contexts but also actively influence youth international migration patterns, leveraging human capital inflows to foster innovation, entrepreneurship and sustainable urban development.

The emphasis on digitalisation and inclusion, combined with advanced economic environments in smart cities, holds significant potential for bridging these cultural gaps. The digital tools and technological infrastructure of smart cities facilitate access to information, services and local integration, thereby mitigating the barriers imposed by cultural differences. Given these considerations, we propose the following hypothesis:

Hypothesis 1b: The higher the level of smart city initiative implementation in a city, the higher the localisation of the international youth workforce.

2.1.2. Intra- and international students' mobility

The literature on intranational student mobility suggests that relocation choices are shaped by a combination of educational, economic and territorial factors (Marinelli, 2013; Qian et al., 2019; Winters, 2011). The presence of renowned universities with strong ties to local labour markets and applied research increases the attractiveness of certain cities (Winters, 2011). For example, focusing on the Italian case, Marinelli (2013) analyses student migration dynamics and shows how localisation patterns are influenced by the spatial transition from university systems to regional labour markets, highlighting the interconnection between education and local opportunity structures. Moreover, students often take into account employment accessibility during and after their studies, especially in cities with a strong service or innovation sector (Faggian et al., 2017). These structural factors interact with perceptions of future stability, shaping localisation choices in more nuanced ways, moving beyond digital advancements.

In this context, the relationship between smart cities and international student mobility has only recently gained significant attention. Florida (2004) highlighted, even before the rise of smart city initiatives, how urban characteristics and the creation of a vibrant and inclusive environment – encompassing quality of life and other urban amenities – can attract students and highly skilled human capital. This insight has

spurred a growing body of research exploring the nexus between smart cities and student mobility, emphasising the catalytic role that cities play in attracting student migration, knowledge and talent (Marchesani et al., 2023; Winters, 2011b). For example, Winters (2011) underscores how students who move to smart cities to pursue higher education often choose to remain in these cities after graduation, drawn by the vibrant and advanced urban environment. Similarly, Marchesani et al. (2022) demonstrated that innovation within cities contributes to attracting intranational migration, which, in turn, generates knowledge flows and contributes to the city's growth.

In the context of intranational mobility, the perception of a city as a 'smart city' – often considered a form of urban branding – plays a crucial role (Bonakdar & Audirac, 2020). This perception is influential in attracting students and young people who anticipate advantages such as high-quality higher education, employment opportunities, vibrant social life, recreation and other benefits embedded within the dimensions of a smart city (Naval et al., 2024). In this vein, Ardito et al. (2019) highlight that smart city initiatives foster environments where universities play a pivotal role in enabling cross-organisational knowledge integration and sharing, lending to the creation of a 'contexts of ideas' for national students, positioning them as the citizens of today and tomorrow (p. 317). These dynamics have an even greater impact on the migration of students to cities due to the familiarity and favourability of these locations for pursuing higher education opportunities (Faggian et al., 2007; Marchesani et al., 2022). Thus, based on these insights, we propose the following hypothesis:

Hypothesis 1c: The higher the level of smart city initiative implementation in a city, the higher the localisation of intranational students in the city.

Regarding international student mobility, the relationship between cities and students becomes even more complex, as a broader set of factors beyond technological infrastructure come into play. City attractiveness is strongly influenced by the global reputation and ranking of universities, particularly in disciplines relevant for international labour markets (Fratesi et al., 2014). Additionally, post-study work opportunities and policies related to visa extensions can significantly affect students' decisions to remain or leave after graduation (Boczy et al., 2020; Iammarino et al., 2011; Mazzarol & Soutar, 2002). Social factors such as liveability, welfare systems, and cultural openness, along with economic development and institutional quality, play a key role in shaping localisation preferences (Faggian et al., 2017). For example, Mazzarol and Soutar (2002) examined the factors driving international students' interest, from choosing foreign universities to selecting their final destination, revealing that economic and social considerations are predominant in the choice of destination country. Similarly, Boczy et al. (2020), in analysing the cases of Milan, Vienna and Aarhus, discussed how the attractiveness of international students is shaped by local policies, safety perceptions and overall quality of life.

In the context of smart cities, this relationship becomes intricately tied to the social and technological dimensions influencing the international flow of students. Smart cities, with their advanced infrastructure and innovative ecosystems, amplify these factors by providing tailored environments that attract international students (Benltoufa et al., 2017; Engelbert et al., 2019; Thite, 2011). For instance, Engelbert et al. (2019) highlight that smart city practices ensure universities play a crucial role in cities by organising urban hackathons, boot camps and living labs, predominantly to engage well-educated, technology-savvy groups, including students. These initiatives not only foster participation but also enhance the visibility of cities as hubs for learning, innovation and professional growth. Similarly, Benltoufa et al. (2017) highlight the role of universities in international cooperation within smart cities, as exemplified in Monastir, where partnerships through Erasmus and H2020 projects facilitate the integration of international students into technologically driven ecosystems. In addition to technological and educational factors, city branding also plays a pivotal role in the attractiveness of smart cities. As global competition for talent intensifies, cities craft advanced and cohesive identities to position themselves as desirable destinations, as early highlighted by Thite (2011), thereby attracting international students, skilled migrants, investors and tourists.

Thus, it is assumed that to attract international students, cities must prioritise investments in high-quality education while simultaneously fostering urban environments that position them as destinations of choice for international students, skilled migrants, investors and other key stakeholders (Boczy et al., 2020; Faggian et al., 2017; Kummitha & Crutzen, 2019; Thite, 2011). This requires cities to leverage universities, services, and infrastructure to actively attract and shape migration flows, thereby influencing the

mobility and localisation of international students. Based on this premise, we propose the following hypothesis:

Hypothesis 1d: The higher the level of smart city initiative implementation in a city, the higher the localisation of international students in the city

2.2. Housing prices, migration and smart city development

Housing costs have long been recognised as a crucial factor in influencing migration and their convergence within cities has been extensively discussed in the literature (Erol & Unal, 2023; Nguyen et al., 2022). This phenomenon is even more significant within smart cities, as according to the European Commission,[2] 75% of Europe's population currently lives in cities, and this number is expected to rise to 85% by 2050. Housing is expensive in larger cities as the demand outstrips supply (Adler & Florida, 2021). This inelasticity is intrinsically linked to migration patterns, where factors such as birth rates and new household formations have minimal impact on housing prices (Erol & Unal, 2023). Early analyses of smart cities echo these findings (Cairns, 2014; Gyourko et al., 2013; Lin & Robberts, 2024). For example, Gyourko et al. (2013) observed that larger smart cities have grown at a slower rate compared with their smaller counterparts, partly due to the relatively inelastic housing supply in major urban centres such as San Francisco and Boston. Instead of experiencing population growth, these areas saw substantial increases in housing costs. This shift in urban growth dynamics has reshaped the interaction between smart cities and younger populations. While smart cities view youth as particularly attuned to urban transformation (Marchesani et al., 2022), a significant body of emergent research emphasises the need for increased focus on vulnerable groups in relation to housing costs within smart cities (Cairns, 2014; Lee & Clarke, 2019; Winters, 2011). Such attention is essential to foster inclusion, which ensures accommodating diverse socio-economic groups (Shamsuddin & Srinivasan, 2021).

Consequently, we assume that the factors driving increases in housing costs and, subsequently, the cost of living in cities are predominantly exogenous. Erol and Unal (2023), focusing on internal migration in Australia, underscore that the decision of new residents to relocate and settle is a key indicator of housing cost, directly affecting the cost of living and people's integration. However, while these dynamics enhance the economic vitality of cities, they often lead to social conflicts, disrupting urban equilibrium and highlighting the need for public intervention (Garcia & Raya, 2011; Lin & Robberts, 2024; Nguyen et al., 2022). For example, in their study of Barcelona, Garcia and Raha (2011) found that public-sector intervention, coupled with rising housing market inflation, has made access to housing difficult for certain social groups, thereby exacerbating social inequalities. These dynamics feed into the ongoing debate in smart cities about social class divisions and migratory patterns. On one side, there are migrations driven by young individuals (18–35) seeking job integration, opportunities and personal growth (Fratesi & Percoco, 2014; Iammarino et al., 2011), while on the other, students within a similar age range migrate to pursue higher education and often remain in the city after graduation, contributing further to urban growth (Winters, 2011). We therefore posit that housing prices are (1) a determining factor in migration patterns toward smart cities; (2) a key discriminant in youth migration; and (3) a socio-economic barrier that naturally emerges in urban environments. This shift alters current migration dynamics, disrupting existing equilibria and necessitating the development of urban policies that specifically target the integration and retention of young workers and students, while also addressing challenges in the housing market to ensure inclusiveness in growing urban centres. Thus, based on the previous discussion, we posit the following hypotheses:

Hypothesis 2a: Housing prices negatively moderate the relationship between smart city initiatives and the localisation of intranational youth workforce in the city.

Hypothesis 2b: Housing prices negatively moderate the relationship between smart city initiatives and the localisation of international youth workforce in the city.

Hypothesis 2c: Housing prices negatively moderate the relationship between smart city initiatives and the localisation of intranational students in the city.

Hypothesis 2d: Housing prices negatively moderate the relationship between smart city initiatives and the localisation of international students in the city.

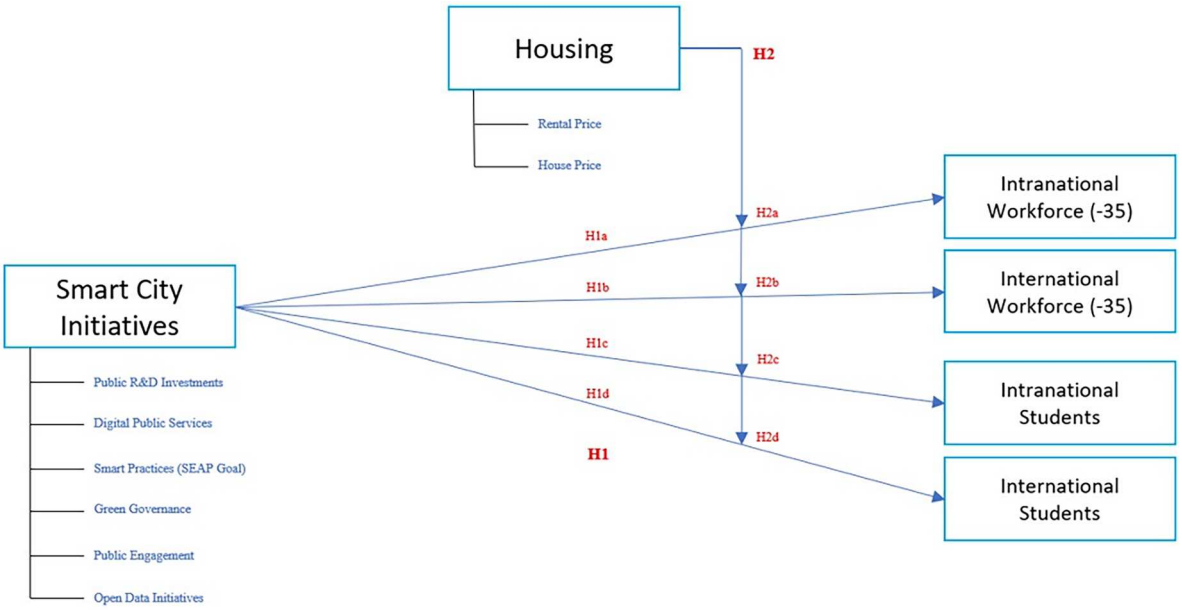

Figure 1. Conceptual framework guiding the empirical analysis.

Figure 1 presents the conceptual framework guiding our empirical analysis.

3. Empirical approach

3.1. Data

The article builds on a dataset created by merging data collected by national and international institutions with primary data collected from digital portals of municipalities through the Wayback Archive website to retrospectively recreate the digital development of cities (Table 1). The data refer to a 13-year period ranging from 2009 to 2022 and consider 42 Italian cities, equally distributed within the country, using the probability-proportional-to-size sampling to align with EU policies.[3] All data are collected on a calendar year basis (1 January–31 December), rather than according to academic year cycles. We build the research on the Italian context as it is considered at the centre of the current smart city debate (Vanolo, 2014) and a nation at the forefront of the smart city transition in Europe (Caragliu & Del Bo, 2022). The selected sample covers 26% of the population residing in Italy and 68% of the population residing in the 100 most populous cities in Italy in 2020. This approach enables us to ensure the homogeneity of the variables and indicators considered, while allowing for heterogeneity in the distribution within the country.

3.2. Variable construction

3.2.1. Dependent variables

We consider four dependent variables to assess the *intra-* and *international youth workforce* (< 35) and *intra-* and *international students* (< 35). Regarding the first two variables, we consider new residents registered annually in the city's registry office who come from regions different from the focal city's region for the intranational youth workforce (WF) and from other nations for the *international WF* variable. To assess this variable, we consider the new residents aged under 35 who arrive annually from other regions within the country, based on registration in the cities' register (*Anagrafe Nazionale della Popolazione*). We excluded citizens from cities within the same region to avoid statistical issues in the analysis, such as regional autocorrelation, which could skew the results and impede clear distinctions between intra- and interregional/city flows.[4] In constructing the variable, we consider the total number of incoming residents under 35 by subtracting the number of outgoing residents under 35 to weigh the value of youth WF mobility within the city. In this regard, while we can quantify the number of outmigrants, data on their exact destinations are not available, which prevents a distinction between national and international outflows. The

Table 1. Variable description and operationalisation.

Variable	Model	Description and operationalisation	Data and source
Intranational Youth Workforce	DV	New residents aged less than 35 years old, net of outgoing residents of the same age group, arriving annually from other cities within the country, based on registration in the cities' register (ANPR). Variable operationalised over the population of the city yearly	ANPR
International Youth Workforce	DV	New residents aged less than 35 years old, net of outgoing residents of the same age group arrived annually from other countries, based on registration in the cities' register (ANPR). Variable operationalised over the population of the city yearly	ANPR
Intranational Students	DV	The number of students arriving from cities in different regions of the country to attend bachelor's and master's degree courses in the city, net of outgoing students. Variable operationalised over to the total number of students in the city yearly	NSC – MIUR
International Students	DV	The number of students arriving from other countries to attend bachelor's and master's degree courses in the city, net of outgoing students. Variable operationalised over to the total number of students in the city yearly	NSC – MIUR
Rental Price	IV	The average annual price per m^2 for home sales in the city is assessed through three levels (centre, subcentre and periphery within the city's territory)	Immobiliare.it
House Price	IV	The average rental price per m^2 for rentals in the city is assessed through three levels (centre, subcentre and periphery within the city's territory)	Immobiliare.it
Public R&D Investments	Index (IV)	Total amount of public sector investments in R&D in year n considered. Variable operationalised over the population yearly	ISTAT
Digital Public Services	Index (IV)	Total number of online services implemented by the city yearly and accessible from the official municipal website	WayBack Archive
Smart Practices (SEAP)	Index (IV)	Attainment of 2 or 3 of the Sustainable Energy Action Plan (SEAP) goals. Binary variable which considers 1 for 'yes' and 0 for 'no'	PAES
Green Governance	Index (IV)	Investment in green practices for urban redevelopment and infrastructure. Variable operationalised over the population yearly	GreenItaly – Unicamere
Public Engagement	Index (IV)	Municipal app download number per year (Android) over the population of the city yearly	PlayStore
Open Data Initiatives	Index (IV)	Total number of public access databases provided by the municipality yearly	FPA
Population	CV	Descriptive number of the total population in the city yearly. Natural logarithm of the variable	ISTAT
GDP	CV	Gross domestic product produced in each city in the year *n* considered. Variable operationalised over the population yearly	EUROSTAT-ISTAT
Employment	CV	Percentage rate of employment in the city (over 18 years). Variable operationalised over the population yearly	ISTAT
Total Firms	CV	Total number of firms active in the city, based on registration on the chamber of commerce. Variable operationalised over the population yearly	IBS
Airports	CV	Total number of airports in cities and nearby areas (50 km). Variable operationalised over the population yearly	Assoaeroporti
Safety and Security	CV	Number of crimes reported by the police to the judicial authority in the city yearly. Variable operationalised over the population yearly	LAB24
Total Students	CV	Total number of students registered at the university and enrolled in bachelor's and master's degree courses in the city. Variable operationalised over the population annually	NSC – MIUR
University Courses	CV	Total number of university courses offered by private and public universities in the city annually	NSC – MIUR
City Size	CV	Size of the city, considering that 300,000 is the threshold between medium and large cities. Binary variable that considered (1) cities with a population greater than 300,000 and (0) cities with a lower population	ISTAT
City Development	CV	The city's economic development is structured according to the division proposed by the European Community. Binary variable that considered cities in the 'developed' urban areas (1) and cities in 'transition' and 'less developed' areas (0)	ISTAT

Databases: ANPR = Anagrafe Nazionale della Popolazione Residente; Assoaeroporti = assoaeroporti.it; GreenItaly = Unioncamere, www.unioncamere.gov; ISTAT = Italian National Institute of Statistics; NSC = National Students Clearinghouse; FPA = European Financial Planning Association; Immobiliare.it; EUROSTAT = Statistical Office of the European Union; PEAS = Sustainable Energy Action Plan; MIUR = Italian Ministry of University Education and Research; IBS = Italian Business Register.

variables are operationalised over the population of the city yearly. We subtracted the number of total students (registered in the city) from other regions to clearly distinguish the proportion of individuals under 35 as part of the workforce from those as students. We based our analysis on those under 35 years of age for (1) their sensitivity to technology in society (Roth-Cohen et al., 2022); (2) their sensitivity to the cost of living (Fratesi et al., 2014); and (3) to make the sample comparable with the literature on knowledge mobility and students (Iammarino & Marinelli, 2011; Marinelli, 2013).

Regarding the variables for *intra- and international students*, we relied on the number of students from other regions (*intra-national* students) and other countries (international students) enrolled each year in doctoral, master's and bachelor's programmes at both public and private universities in the given city. We relied on the official website of the MIUR (Ministry of Education, University and Research) and

NSC (National Students Clearinghouse) to reconstruct student mobility over the last 13 years, analysing incoming (and outgoing) interactions by city and region to systematically reconstruct the movement of talents in Italy.[5] In constructing the variable, we consider the total number of incoming students by subtracting the number of outgoing students to weigh the value of talent mobility within the city. Referring to intranational students, we focused on students coming from other regions within the same country rather than the same region to capture the localisation in the city as accurately as possible (excluding potential biases from commuting students). The data were operationalised based on the total number of students in the city.

3.2.2. Independent variable

We consider two independent variables, *Smart City Initiatives (SCI)* and *Housing*. *SCI* is the first independent variable that aims to assess the smart city development in the city quantitatively. To do this, we build upon the smart city literature (Kummitha & Crutzen, 2017; Marchesani et al., 2023) to evaluate four indicators, including sustainability, digital implementation, public engagement and innovation, reflecting the key pillars in smart city policies.[6] To assess this variable, we follow the Organisation for Economic Co-operation and Development (OECD) (2008) handbook to measure and validate an index that represents SCI. To construct our index, which aggregates six variables detailed in Table 1 (i.e., *Public R&D Investments*, *Digital Public Services*, *Smart Practices (SEAP)*, *Green Governance*, *Public Engagement* and *Open Data Initiatives*), we applied min–max normalisation to ensure comparability across indicators with different units. All components were then aggregated using equal weights, in line with standard practices for composite indices when no theoretical justification exists for differential weighting. The resulting index ranges from 0 to 1, where higher values indicate more advanced and integrated smart city development. Robustness and internal consistency were verified through multiple procedures. The Bro and Smilde (2014) stability test confirmed the compositional robustness of the index over time, while a principal component analysis (PCA) supported the coherence among the included variables. Cronbach's alpha ($\alpha = 0.81$) further confirmed the internal reliability of the index. In this way, the final SCI index captures the multidimensional development of smart cities across the 42 cities in our sample. In doing so, the final results rank the cities from the most advanced in SCI (such as Milan, Bologna and Bergamo) to those less developed ones (e.g., Reggio Calabria, Caserta and Foggia).

In formulating our second independent variable – housing – we considered the cost of renting or buying houses in cities over the years. To create this variable, we constructed two variables (*Rental Price* and *Housing Price*) at three levels (centre, subcentre and periphery). Then, we weighed the value of the three levels and the two variables for all the cities and created a weighted composite value for the analysed sample. This sample was then compared with the absolute market value in Italy to assess its stability.[7] The final value incorporates the evolution of housing in the cities, offering a comprehensive value of the price trends in the analysed cities. The model with the 3 distinct levels (centre, subcentre and periphery) is available from the authors upon request.

3.2.3. Control variables

Control variables are included at each aggregation level to avoid the possibility of the results being due to urban-, economic- or social-specific differences. Specifically, we followed the literature on urban agglomeration to consider a set of variables to assess possible biases (Black & Henderson, 1999; Faggian et al., 2017; Gambardella et al., 2009; Glaeser & Gottlieb, 2009). Specifically, we consider *Population* and gross domestic product (*GDP*) to assess the influence of city-level characteristics. Second, we focus on *Employment rate* and *Total firms* active in the city yearly to consider the economic factors that influence intra- and international migration patterns. Third, we focus on the universities, controlling the total number of students in the city (*Total Students*) and the total number of *University Courses* active in the city yearly. Fourth, due to the characteristics of the dependent variables, we also control for the openness of the city using *Airports* as a proxy (Gambardella et al., 2009). Finally, we build upon EU policies to construct two binary variables, which consider cities participating in transition or well-developed regions (0–1) and cities categorised as small, medium or large (0–1). The distinction is highlighted in note 1, the description and operationalisation of the variables are presented in Table 1.

3.3. Econometric approach

To test our hypothesis, we adopt the generalised method of moments (GMM) estimation due to the (1) characteristics of the panel data structure to provide more efficient and unbiased estimates; (2) to handle time-varying effects within the panel; and (3) for capturing dynamic urban processes and addressing endogeneity among variables which is a common issue in longitudinal urban studies. We considered the Akaike information criterion (AIC) for model selection (Sakamoto et al., 1987) which confirms the consistency and robustness of our model compared with other estimation techniques.[8] Furthermore, following Baum et al. (2003) approach, we conducted a heteroscedasticity test, which confirmed the absence of heteroscedasticity, ensuring the model's reliability.[9] Thus, the adoption of the GMM approach is statistically supported, considering its ability to effectively address endogeneity, heteroscedasticity and the characteristics of our balanced-panel data, which considers a wide cross-section (42 cities) and a relatively short period (13 years), including both time and city-fixed effects (Roodman, 2009; Windmeijer, 2005). In doing so, we also consider the internal instruments from lagged variables, useful to prevent the over-identification problem (Windmeijer, 2005). To assess the robustness of the results, we performed the Sargan, Arellano–Bond (AR2) and Wald Chi-square tests (Tables 2 and 3), confirming no over-identification or autocorrelation issues and establishing the model's validity and robustness. The variance inflation factor (VIF), descriptive statistics and correlation analyses are available upon request.

4. Results

Tables 2 and 3 present the results of the GMM model. Stepwise robust regressions proposed by Agostinelli (2002) were employed to control for the main effects, control variables and interactions. In both tables, models I and V show the relationship between the dependent variable and the control variables only. Models II and IV display the interaction of direct variables without considering controls. Models III and VII highlight the direct relationship between smart city initiatives and the dependent variable, while models IV and VIII test the moderating effect of the housing variable within the models.

Support was found for Hypothesis 1 across all four levels (Hypothesis 1a–d), although the results indicate divergent effects between intra- and international mobility for both the youth workforce and students. Specifically, regarding the youth workforce, model III in Table 2 shows that the direct effect of *SCI* on the *intranational workforce* is positive and highly significant ($\beta = 0.791$; $p = 0.001$), while model VII demonstrates a weaker but still significant positive effect for the *international workforce* ($\beta = 0771$; $p = 0.039$). This suggests that the influence of SCI on attracting youth workers may be more pronounced for internal migration within national borders than for international flows.

Regarding student migration, the interaction is positive and statistically significant for both intranational students ($\beta = 0.653$; $p = 0.009$) and international students ($\beta = 0.827$; $p = 0.001$). The results indicate that (1) the transformation of cities through smart city initiatives has a positive influence on student localisation and that, in contrast to youth workforce localisation; and (2) cultural distance is reduced through the role of universities, which welcome, integrate and guide international students within the smart city context.

In considering the moderating role of housing costs within this relationship, Hypothesis 2 yields mixed results, providing partial support. Specifically, models IV and VIII in Table 2 support Hypotheses 2a and 2b, although with varying intensities. Model IV indicates that the *SCP*×*Housing* interaction is negative and statistically significant at the 1% level ($\beta = -0.164$; $p = 0.001$) for *intranational workforce* migration, while model VIII shows a negative and statistically significant interaction at the 10% level ($\beta = -0.216$; $p = 0.047$) for *international workforce*, highlighting a reduced negative effect on the localisation of international workforce compared with international workforce. Regarding student migration, models IV and VIII in Table 3 reject Hypotheses 2c and 2d, indicating that while there is statistical significance, it does not produce negative effects in the previous relationship. Specifically, model IV shows that the *SCP*×*Housing* parameter is positive and partially statistically significant for *international students* at the 10% level ($p < 0.095$), while model VIII demonstrates a positive and statistically significant interaction for *international students* at the 5% level ($p < 0.033$). This reveals a positive effect on student localisation, in contrast to the negative impact observed on intra- and international youth workforce migration. Table A1 in Appendix A in the supplemental data online provides a hypothesis summary; Table 4 summarises the key factors that influence

Table 2. Generalised method of moments (GMM) results for intra- and international *Youth Workforce* as a dependent variable.

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Intranational Youth WF (n − 1)	1.554***	1.570***	1.683***	1.713***				
	[0.055]	[0.071]	[0.068]	[0.059]				
International Youth WF (n − 1)					0.914***	0.961***	0.916***	0.897***
					[0.014]	[0.033]	[0.024]	[0.041]
Smart City Initiative		0.873***	0.791***	0.716*		0.789*	0.771*	0.766*
		[0.121]	[0.118]	[0.107]		[0.133]	[0.124]	[0.127]
Housing	−0.588**	−0.582*	−0.674**	−0.573**	−0.304*	−0.448*	−0.366*	−0.380**
	[0.221]	[0.208]	[0.199]	[0.210]	[0.173]	[0.170]	[0.168]	[0.162]
*SCI*Housing*		−0.176***		−0.164***		−0.209*		−0.216*
		[0.101]		[0.098]		[0.062]		[0.054]
Population	1.357**		1.299**	1.258**	1.443***		1.417***	1.392***
	[0.166]		[0.180]	[0.169]	[0.132]		[0.116]	[0.120]
GDP	0.754*		0.715*	0.709*	0.791**		0.799**	0.780**
	[0.056]		[0.059]	[0.060]	[0.082]		[0.087]	[0.091]
Employment	0.313**		0.320***	0.331**	0.321***		0.303***	0.301***
	[0.032]		[0.034]	[0.040]	[0.021]		[0.024]	[0.018]
Total Firms	0.537***		0.541***	0.538***	0.569***		0.570***	0.583***
	[0.087]		[0.089]	[0.091]	[0.077]		[0.073]	[0.111]
Airports	0.199*		0.187*	0.193*	0.150**		0.155**	0.159**
	[0.003]		[0.012]	[0.018]	[0.022]		[0.027]	[0.030]
Safety and Security	0.087*		0.092*	0.090*	0.101		0.099	0.112
	[0.122]		[0.126]	[0.119]	[0.131]		[0.133]	[0.130]
Total Students	0.488*		0.432**	0.428**	0.441**		0.449*	0.463*
	[0.070]		[0.077]	[0.080]	[0.069]		[0.064]	[0.060]
University Courses	0.114*		0.109*	0.112	0.123*		0.146	0.150
	[0.215]		[0.189]	[0.201]	[0.206]		[0.188]	[0.190]
City Size	0.802**		0.799**	0.805**	0.788**		0.790**	0.788***
	[0.348]		[0.399]	[0.360]	[0.339]		[0.343]	[0.350]
City Development	0.644**		0.632**	0.630***	0.678***		0.680***	0.677***
	[0.221]		[0.213]	[0.206]	[0.230]		[0.243]	[0.250]
City effect	Included	Included	Included	Included	Included	Included	Included	Included
Year effect	Included	Included	Included	Included	Included	Included	Included	Included
Wald Chi^2	123.15	129.56	136.33	135.35	127.23	135.12	140.04	138.73
AR(2)	1.55	1.64	1.77	1.74	2.42	2.13	2.21	2.34
P-value	0.095	0.099	0.101	0.089	0.113	0.114	0.121	0.120
Hensen test	55.13	57.52	59.38	58.35	51.02	53.44	57.34	55.13
P-value	0.123	0.126	0.145	0.140	0.112	0.118	0.121	0.120
Observations	504	504	504	504	504	504	504	504
*N**City	42	42	42	42	42	42	42	42

Note: Intra-national human capital (HC) and international HC are dependent variables. $p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Standard errors are shown in parentheses.

the localisation of intra- and international youth populations in smart cities, drawing from the emerging literature and our results.

5. Discussion

The findings of this study underscore the complex interplay between smart city initiatives, youth migration patterns and housing costs, as well as their mutually reinforcing dynamics. To date, a critical debate has drawn attention to the complex and sometimes contradictory nature of smart city transformations, raising concerns about the paradoxes they unfold (Leitheiser & Follmann, 2020). Research has pointed out the distance between people residing in cities and smart city implementation (Datta & Odendaal, 2019; Kummitha & Crutzen, 2017; Marchesani et al., 2023; Su & Fan, 2023; Vanolo, 2014). It is argued that socially disadvantaged groups with lower education levels or low salaries might suffer from this transition, while skilled and high-salaried individuals may be capable of reaping the benefits (Caragliu & Del Bo, 2022; Glaeser & Gottlieb, 2009; Stapper & Duyvendak, 2020). On the contrary, recent empirical evidence shows that smart city initiatives mitigate conditions of social or income inequality (Caragliu & Del Bo, 2022). Overall, there is a lack of clarity on whether young people are affected by smart city initiatives. Given the paucity of literature, our study clarifies that internal migrants are more likely to be attracted to smart city initiatives than international migrants. This may be explained by cultural proximity (e.g., language or legal frameworks), which has a greater impact on labour migration. Both within the country, economic disparities and opportunities, and cultural familiarity facilitate relocation choices of the internal students to the smart cities

Table 3. Generalised method of moments (GMM) results for intra- and international students as a dependent variable.

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Intranational Students (n – 1)	0.341***	0.355***	0.358***	0.366***				
	[0.098]	[0.093]	[0.101]	[0.097]				
International Students (n – 1)					0.159***	0.174***	0.169***	0.166***
					[0.012]	[0.061]	[0.034]	[0.040]
Smart City Initiative (SCI)		0.661**	0.653**	0.649**		0.845***	0.827***	0.789***
		[0.098]	[0.104]	[0.118]		[0.044]	[0.049]	[0.039]
Housing	0.248*	0.235**	0.327**	0.219**	0.304**	0.299***	0.281**	0.297***
	[0.198]	[0.177]	[0.169]	[0.174]	[0.167]	[0.148]	[0.151]	[0.146]
*SCI*Housing*		0.240*		0.231*		0.192*		0.198**
		[0.109]		[0.118]		[0.117]		[0.112]
Population	1.477**		1.460***	1.439***	1.552***		1.539***	1.511***
	[0.204]		[0.193]	[0.189]	[0.177]		[0.170]	[0.172]
GDP	0.677*		0.656*	0.560*	0.692*		0.690*	0.788*
	[0.112]		[0.109]	[0.114]	[0.095]		[0.097]	[0.101]
Employment	0.280**		0.284***	0.281***	0.376**		0.290***	0.283***
	[0.061]		[0.059]	[0.057]	[0.035]		[0.037]	[0.034]
Total Firms	0.501**		0.493**	0.506*	0.587**		0.580**	0.575**
	[0.095]		[0.096]	[0.090]	[0.083]		[0.082]	[0.0979]
Airports	0.147*		0.149*	0.151*	0.139*		0.140**	0.128**
	[0.058]		[0.055]	[0.058]	[0.045]		[0.044]	[0.051]
Safety and Security	0.083*		0.090	0.079	0.077		0.079	0.081
	[0.117]		[0.121]	[0.118]	[0.138]		[0.136]	[0.140]
Total Students	0.470***		0.462***	0.473***	0.503***		0.495***	0.512***
	[0.081]		[0.085]	[0.091]	[0.055]		[0.057]	[0.062]
University Courses	0.122**		0.127**	0.129**	0.135***		0.140***	0.138***
	[0.196]		[0.203]	[0.205]	[0.219]		[0.220]	[0.198]
City Size	0.832*		0.840**	0.824**	0.811*		0.815*	0.807*
	[0.312]		[0.319]	[0.333]	[0.348]		[0.350]	[0.339]
City Development	0.651*		0.649*	0.656**	0.613**		0.622***	0.627**
	[0.201]		[0.215]	[0.199]	[0.240]		[0.241]	[0.230]
City effect	Included	Included	Included	Included	Included	Included	Included	Included
Year effect	Included	Included	Included	Included	Included	Included	Included	Included
Wald Chi^2	118.85	124.48	130.52	129.14	124.89	132.35	147.23	145.93
AR(2)	1.94	2.05	1.99	1.87	2.36	2.20	2.41	2.38
P-value	0.110	0.119	0.131	0.125	0.085	0.091	0.098	0.83
Hensen test	54.45	58.59	60.12	59.16	53.47	55.36	58.97	57.76
P-value	0.163	0.164	0.171	0.167	0.135	0.143	0.177	0.164
Observations	504	504	504	504	504	504	504	504
N°City	42	42	42	42	42	42	42	42

Note: Intra-national human capital (HC), international HC, intra-national students and international students are dependent variables. $p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p<0.001$. Standard errors are shown in parentheses.

Table 4. Drivers of youth localisation.

	Students		Workforce	
Key dimensions	Intranational	International	Intranational	International
University quality	Key driver for relocation	Strong impact, especially global rankings	Moderate relevance, especially for recent graduates	Limited relevance
Housing affordability	Strong constraint for low-income households	Can be offset by scholarships/welfare	Crucial factor in urban settlement choices	Barrier if not matched by high wages
Job opportunities	Relevant for post-study retention	Key for those planning to remain post-degree	Strong driver of migration	Dependent on legal and economic access
Cultural and linguistic proximity	Moderate importance	High importance for daily integration	Facilitates adaptation and networks	May limit initial settlement choices
Smart-city branding	Moderate value	High influence through urban narratives	Weak-to-moderate indirect effect	Medium-to-strong attractor for digital professions

Note: This table summarises the existing academic literature (see Section 2) on youth localisation in smart cities and is complemented by the empirical insights emerging from our quantitative analysis (see Tables 2 and 3). The assessment integrates findings from both the smart-city and urban studies literature, and does not represent absolute effects, but rather indicative patterns emerging from the current debate.

(Marchesani et al., 2025). Our results further indicate that student localisation is positively affected by the smart city initiatives compared with youth workforce localisation.

Housing costs play a complex and differential role in moderating the relationship between smart city initiatives and the localisation of the youth workforce versus students. Paradoxically, while high housing costs create barriers that deter low-skilled workers from relocating, they simultaneously contribute, through institutional and governmental support (i.e., Italian University Housing Policies –

2024[10]), to the concentration of potential high-skilled human capital and talent within smart cities that are looking for a more competitive labour market, career opportunities and higher wages. These institutional mechanisms include national and regional programmes specifically aimed at supporting the urban localisation of young professionals. For instance, the Fondo Nazionale Giovani (Law 160/2019)[11] offers rental subsidies and co-financing schemes for graduates relocating to urban innovation hubs. Moreover, several municipalities have introduced fiscal incentives for co-living spaces and startup-oriented residential models.[12] These instruments reduce the financial pressure associated with elevated housing costs and selectively enable highly skilled individuals to access competitive urban labour markets, reinforcing the smart city's capacity to attract talent despite affordability barriers. These results reveal that smart city initiatives do have a positive impact on the localisation of young workers, but this effect is not linear nor unconditional. As housing costs rise, the benefits associated with smart city environments become increasingly less accessible, particularly for youth segments with limited financial resources. In such contexts, the inclusive promise of smart cities risks being undermined by the very structural conditions that limit access to affordable living. Rather than being universally accessible, smart city environments may become exclusive to those who can afford them, thereby reducing their potential to foster urban inclusivity. Thus, our results extend and partially contradict those of Caragliu and Del Bo (2022) and Yang et al. (2024), who argued that greater adoption of smart city initiatives reduces income inequalities. Particularly, we argue that income inequalities may continue to grow for specific population segments, as actors with low skills and income may fail to benefit from smart cities due to rising housing costs. Our findings reinforce the need to interpret smart city outcomes not just through the lens of innovation and growth, but also through critical attention to affordability, inclusiveness, and the uneven capacity of individuals to interact with smart city initiatives and urban transition. Our findings feed into the paradox of smart cities, which, despite their ambition to be inclusive and accessible to all, are increasingly becoming selective and exclusive. The empirical evidence suggests that housing costs are a critical moderating factor, influencing migration patterns in a way that reinforces socio-economic divides within urban areas.

5.1. Contributions

We make three contributions to the literature. First, there is a long-standing understanding led by conceptual work from critical scholars who argue that smart cities could potentially contribute to growing inequalities (Datta & Odendaal, 2019; Vanolo, 2014). For example, Grossi and Pianezzi (2017), argue that the smart utopias that smart cities represent paradoxically serve the interests of the urban elite and fail to account for the most deprived and those who need immediate attention. Smart cities driven by their digital ingenuity offer opportunities for young talent, but they also paradoxically leave low-skilled talent vulnerable (Curşeu et al., 2021). However, a recent body of literature based on empirical work clarifies that smart cities indeed reduce urban inequality (Caragliu & Del Bo, 2022; Yang et al., 2024). Given this contradiction, our study clarifies that growing housing costs in smart cities indeed contribute to the urban divide, whereby those with low skills tend to find themselves marginalised as the benefits from the smart city initiatives outweigh the negative consequences. Particularly, the associated rise in housing costs results in socio-economic barriers, effectively excluding lower skilled workers, young people and low-income residents (Nguyen et al., 2022). This phenomenon contributes to the growing tension between the inclusive ideals of smart cities and the reality of urban exclusion.

Second, we join numerous scholars in elucidating the paradox of smart cities, which, on the one hand, promise utopias and urban glory, and on the other, leave sections of the population vulnerable, powerless, where their passive engagement is sought to gain legitimacy and support. Kummitha (2025) emphasises the paradoxical nature of smart cities, whereby he argues that, although there is growing evidence that indicates significant levels of citizen engagement in smart cities, paradoxically, their engagement is limited to a passive and tokenistic nature. Similarly, Calzada and Cobo (2015) argue that citizens continue to lack any say in whether to adopt digital technologies in urban contexts. However, paradoxically, it remains difficult for them to disconnect themselves from the digitally enabled urban environments. Another paradox emphasises that the very digital technologies adopted in urban contexts that offer opportunities may also be

used to conduct surveillance and censorship (Kummitha, 2020; Viitanen & Kingston, 2014) and divert the focus to real social problems that cities face (Grossi & Pianezzi, 2017). We join this growing body of literature and argue that although the adoption of digital technologies may offer opportunities, they paradoxically contribute to urban inequalities.

Third, this study adds to the literature on urban migration (Faggian et al., 2017) by demonstrating that the effects of smart city initiatives are not uniform across different segments of the population. Specifically, the findings highlight the importance of considering the socio-economic barriers that emerge as cities evolve, particularly in relation to different users and citizens while also considering their intra – or international origin. These barriers challenge the inclusive rhetoric of smart cities, suggesting that without careful policy interventions, smart cities may continue to drift toward creating further divide. By linking smart city policy to housing market dynamism, this study emphasises the need for integrated approaches that balance the benefits of attracting students and potential high-skilled human capital and talents with the imperative of maintaining social equity.

5.2. Wider policy implications

This study underscores a paradox within smart city initiatives – the paradox of inclusion and exclusion. While smart cities are envisioned as hubs of innovation, sustainability and quality of life, our findings suggest that their benefits may not be evenly accessible, as socio-economic barriers can persist, particularly for younger populations facing affordability constraints. Rising housing costs and limited affordability challenge the inclusive ideals of smart cities, creating a disconnect between their aspirations and realities. Addressing this paradox requires an integrated policy framework that aligns technological advancements with strategies for social equity and inclusion, especially for younger demographics

5.2.1. Local policy directions and interventions

In discussing policy implications, our suggestions echo the theories posited by Florida (2004), which emphasise the central role of youth and knowledge in urban evolution. However, the current trajectory of smart cities risks excluding these critical groups, undermining their potential contributions to innovation and societal progress. Policymakers must implement integrated strategies that reconcile economic efficiency with social equity within urban contexts. Central to these strategies is the development of affordable housing policies that prioritise young people, shielding them from the adverse effects of market-driven economic pressures.

To date, cities have responded to these challenges by implementing initiatives aimed at fostering inclusion and mitigating socio-economic barriers. One recent approach involves the development of social housing projects that consider a range of innovative interventions in the housing market, designed to foster a new culture of living. These projects often emerge from public–private collaborations and aim to combine high-quality living standards with diverse needs, addressing the necessity for adaptable and inclusive urban housing solutions. For example, the Milan2035 housing initiative, supported by Fondazione Cariplo's Welfare in Azione programme, offers affordable co-housing opportunities for students and young workers, promoting shared living arrangements at affordable prices and aiming to partially reduce these barriers for young people.[13] As this research points out, existing measures are primarily directed toward students, while neglecting young workers who face significant barriers. Although migration to cities and the housing market – largely driven by supply and demand dynamics – play a crucial role in shaping youth integration, urban planning must incorporate local and social policies to ensure equitable access and effectively address exclusionary practices. In this line, Turin has introduced non-profit social housing intermediaries (an alternative to the private market) for young people aged 18–35, including students and workers, actively contributing to mitigating youth urban exclusion.[14] To further enhance these efforts, policymakers must focus on fostering a culture of living that aligns with the evolving social and digital transformations of urban spaces. This involves integrating innovative urban living solutions, such as co-housing and community-driven initiatives, while simultaneously addressing speculative market dynamics and the proliferation of short-term rental platforms (e.g., Airbnb). These measures should include regulatory contingencies to prevent market distortions that disproportionately impact younger populations, ensuring that urban housing remains accessible and equitable for all.

5.2.2. National and EU-level recommendations

National and EU-targeted interventions are also critical to ensure that young people are not excluded from the opportunities that smart cities initiatives offer. To this end, our findings provide suggestions and action plans to policymakers and public managers while, at the same time, corroborating the pressing concerns raised by the EU and the European Economic and Social Committee (EESC) regarding housing inaccessibility, which increasingly exposes the well-being and socio-economic mobility of young people across Europe.[15] This phenomenon, marked by rising housing costs and financial insecurity, disproportionately affects younger generations, delaying their independence and integration into urban environments. The reported increase in the age of independent living – from 26 to 28 years between 2007 and 2019 – underscores the systemic challenges faced by youth, particularly in countries like Italy, Spain and Greece, where the issue is most acute.

To date, the EU is actively addressing this problem. In collaboration with the Union for the Mediterranean (UfM), the EU has launched the Strategic UfM Urban Development Action Plan 2040, along with its accompanying housing plan.[16] This initiative aims to advance 'human-centric and holistic approaches for cities of all sizes, offering a robust operational framework for activating necessary urban transitions in the regions and urban areas'. Among the proposals discussed in this action plan are: (1) fostering and reinforcing multilevel and multi-stakeholder partnerships; (2) exchanging knowledge, experience, best practices and innovative approaches between member states, local authorities and other relevant stakeholders; and (3) identifying gaps in policy, implementation and financing. These objectives represent a starting point but must be complemented by effective and practical applications aligned with policies on smart city development. In this line, we suggest that national and supranational governments incorporate *ex-ante* policies aimed at reducing these disparities into the Recovery and Resilience Plans and European Smart City policies. These policies should regulate transitions and reward cities that excel in inclusively by redistributing European funding based not only on sustainability and efficiency but also on their capacity to overcome the paradox of urban exclusion. This approach would anticipate the *ex-post* discussions planned in the Urban Development Action Plan 2040 while simultaneously setting new benchmarks for the financing and implementation of smart city initiatives. By doing so, policymakers could ensure that smart city initiatives align more closely with the goals of inclusivity and social equity, providing a roadmap for a more equitable urban future.

5.3. Limitations and future avenues

Our study is not without limitations.

First, while the focus of the study was on the moderating effects of housing costs, it is important to recognise other factors, such as job integration, economic condition and cultural proximity, in shaping migration patterns, which may further contribute to the paradox of smart cities.

Second, the study did not disaggregate the impact of housing costs by specific demographic groups, which could provide deeper insights into the differential effects on various population segments.

Third, this study does not include detailed tracking of outmigration destinations, limiting our ability to determine whether specific cities or regions systematically attract outflows of youth. Future research should aim to integrate individual-level or longitudinal tracking data that can distinguish between intra-national and international migration pathways. This would enable a deeper exploration of the drivers behind not only youth attraction, but also retention and selective outmigration dynamics.

Fourth, the housing cost index includes both purchase and rental prices as a general measure of urban affordability. While appropriate for capturing overall housing conditions influencing localisation decisions, this measure may not fully reflect the specific cost pressures experienced by students, for whom rental prices are typically more relevant.

Fifth, although we control for key structural and urban characteristics, the relationship between housing costs and student migration may also reflect the influence of unobserved variables such as urban amenities, institutional strategies or public subsidies for student housing that are not directly captured in our model. Future research could integrate city-level qualitative data to disentangle these intertwined effects.

Sixth, we have also not observed the tensions perceived by the local actors, which would require a qualitative study. Moreover, while this paper hypothesised relationships between housing costs, smart city initiatives, and the migration of the youth workforce and students, these relationships were explored empirically without directly modelling the underlying theoretical mechanisms. Specifically, the paradox of smart cities – where initiatives designed to foster inclusivity may inadvertently contribute to urban exclusivity – demands further exploration and a proactive response from policymakers and institutions. This tension highlights the need for future theoretical studies to investigate the mechanisms underlying this paradox, thereby shedding light on how smart city policies can more effectively balance inclusion and equity.

Finally, the analysis does not account for variables related to perceived quality of life or overall liveability, which are recognised as key determinants of individual well-being. These factors may play a substantial role in shaping migration and localisation patterns, beyond economic and institutional drivers. Future research should aim to incorporate well-being-oriented indicators (both structured and strategic) to better capture how urban environments interact with youth settlement decisions within the context of smart cities.

6. Conclusions

Placing young people at the centre of urban planning is essential for shaping cities that are not only innovative but also equitable and socially inclusive. Our findings underscore the urgent need for swift action from policymakers and urban governance to address the paradox of smart cities, where inclusion and exclusion often coexist in a state of tension. This paradox highlights the risk that innovation, when detached from equity concerns, may reinforce existing divides. A proactive and youth-centred approach is crucial to ensuring that smart city initiatives empower younger generations, integrating them into urban planning and policymaking processes.

Policymakers should prioritise strategies that position youth as key stakeholders in the development of smart cities. By doing so, cities can foster inclusive environments that leverage the potential of youth – not only as a workforce but also as active contributors to societal transformation. Smart city innovation should be guided not only by technological ambition but by a commitment to social purpose and generational inclusion. The call to action is clear: cities must embrace innovation with a purpose that prioritises equality and inclusion. This means avoiding the tendency to target users based solely on their economic influence or potential and instead focusing on creating opportunities for diverse social groups that collectively shape the future of society. Achieving this vision requires cities to truly embody the essence of being 'smart' by integrating the potential of younger generations and shaping an inclusive, forward-looking urban future.

Notes

1. According to the Smart City Observatory (https://www.osservatori.net/it/ricerche/osservatori-attivi/smart-city), in 2023 investments in smart city projects in Italy alone exceeded €1 billion (+11% compared with 2022) with strong incentives from the Piano Nazionale di Ripresa e Resilienza (PNRR) (https://temi.camera.it/leg19/pnrr.html) promoted by the European Commission (https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_it).
2. See https://commission.europa.eu/strategy-and-policy/strategy-documents/commission-work-programme/commission-work-programme-2023_en.
3. In assessing the distribution, we consider three strata: geographical location, size and economic development. For the parameter of economic development, we based our analysis on distinctions based on the European Regional Development Fund (ERDF), specifically guided by Articles 174–178 of the Treaty on the Functioning of the European Union (TFEU). For further details, see https://www.europarl.europa.eu/factsheets/en/sheet/95/european-regional-development-fund-erdfv.
4. To ensure there is no autocorrelation, we adopt the Durbin–Watson statistic test, which highlights a value of 2.26 (a value around 2 suggests no autocorrelation, those around 0 indicate positive autocorrelation, and those around 4 suggest negative autocorrelation).
5. The systematic evaluation of students' mobility allowed for the analysis of incoming students at both intra- and international levels, the operationalisation of the variable concerning outgoing talents, and the establishment of two control variables to assess the total student population (*Total Students*) within the study.
6. European Commission – Smart City and Communities; see https://digital-strategy.ec.europa.eu/en/policies/smart-cities-and-communities.

7. We applied the *t*-test for independent samples and the analysis of variance (ANOVA) to compare housing prices across different city categories (centre, subcentre and periphery) within our sample.
8. We estimated the model using generalised least squares (GLS), ordinary least squares (OLS), two-stage least squares (2SLS), and fixed effects (FE) or random effects (RE) models to assess the suitability of the model.
9. In this panel dataset, heteroscedasticity may emerge due to the disparate characteristics of countries within the sample, leading to non-constant variance in the residuals across observations.
10. Decree-Law issued in February 2024 for university students called the 'housing package': simplified procedures and a call for tenders worth €1.2 billion for 60,000 new places; see https://www.mur.gov.it/it/atti-e-normativa/decreto-ministeriale-n-481-del-26-02-2024.
11. See https://3.flcgil.stgy.it/files/pdf/20191230/legge-160-del-27-dicembre-2019-legge-di-bilancio-2020.pdf.
12. See https://consiglionazionalegiovani.it/wp-content/uploads/2023/10/Piano-Nazionale-Giovani-2024-1.pdf.
13. See https://www.meglio.milano.it/progetti/milano-2035/.
14. See http://www.comune.torino.it/torinogiovani/vivere-a-torino/housing-sociale.
15. See https://www.eesc.europa.eu/en/news-media/press-releases/finding-together-solution-growing-housing-crisis-especially-vulnerable-groups-and-young-people.
16. See https://ufmsecretariat.org/platform/ufm-regional-platform-on-sustainable-urban-development/.

Disclosure statement

No potential conflict of interest was reported by the authors.

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