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Contextualizing smart urbanism: Emergent geography of smartness and happiness in a digitalizing world

Vinci Y.J. Cheung, George C.S. Lin *

Department of Geography, University of Hong Kong, Pokfulam Road, Hong Kong, China

A R T I C L E I N F O

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A B S T R A C T

The prevalent smart urbanism narratives commonly rest on the premise that the growth of smart cities through ubiquitous technologies is inevitable and decontextualized, with increased smartness improving efficiency and happiness. This study examines the spatial smartness-happiness variation among 113 cities worldwide, revealing patterns deviating from normal expectations. Our regression analysis of city-level data reveals diverse smartness-happiness relationships contingent upon varying regional conditions, with a stronger and positive correlation observed from the cities of the Global North and a weaker and non-linear pattern identified in the Global South including a negative association found from South America. Further analysis explores the impact of specific components of urban smartness on urban happiness, identifying urban structural characteristics, such as urban infrastructure conditions and service provision, as a significant positive predictor. Contrary to popular belief, technology displays an overall negative correlation with happiness with significant regional variations. Smart cities—universally promulgated as the banner and embodiment of state governmentality for place promotion—remain deeply embedded in place-specific regional conditions, implying the need to go beyond a technologically deterministic mentality and take on board seriously cities' locality and human-centered considerations.

1. Introduction

Despite the ever-deepening division and escalating tension among the people of different political and ideological camps nationally and internationally, a fashionable approach to urbanization gaining global currency and popularity has been the incorporation of digital technology into urban planning and development to steer the growth of cities into a direction believed to be smarter, greener and more resilient (Albino et al., 2015; Cugurullo, 2018; Datta and Odendaal, 2019; De Jong, Joss, Schraven, Zhan, & Weijnen, 2015; Kitchin, 2015). Over the recent decade, smart city initiatives have proliferated globally as the number of (self-designated) smart cities increased from 143 in 2012 to over 1000 in 2022 (Ahvenniemi, Huovila, Pinto-Seppä, & Airaksinen, 2017; Zhu, Shen, & Ren, 2022). More than two-thirds of the cities in the United States are investing in various smart technologies for urban operations or services at the municipal level (DuPuis & Rainwater, 2017), while nearly half of the cities in the United Kingdom with a population exceeding 100,000 have explicitly set smart cities as their target (Caprotti et al., 2016; Vanolo, 2016). Emergent economies like China and India proactively foster smart city development through new pilot projects, funding schemes, and policy agendas (Karvonen, Cugurullo, & Caprotti, 2019). In the business realm, smart cities are considered a promising emergent market with tremendous potential, with the global market expected to grow from $737 billion in 2018 to $2577 billion by 2025 at an annual rate of 16.6% (Anthopoulos, 2017; Kim, 2022). This proliferation of global enthusiasm for smart cities signifies the ascendancy of smart urbanization as an integral component of countless urban initiatives worldwide, with the ideology of smart urbanism swiftly intertwining and impacting urban policies, directives, visions, and citizens' urban experiences.

The global promulgation of smart urbanism appears to be anchored upon a common faith in digital technology as the infinite source of solutions to many problems concerning the (in)efficient and (un)sustainable utilization of urban resources and services. In the existing smart urbanism discourse, attention has been overwhelmingly devoted to the integration of advanced technologies, including smart sensors, grids, big data, renewable energy, and autonomous transportation, into urban design, planning, and management as a common, pervasive and

* Corresponding author. Department of Geography, University of Hong Kong, Pokfulam Road, Hong Kong, China.
E-mail addresses: vinci062@connect.hku.hk (V.Y.J. Cheung), gcslin@hku.hk (G.C.S. Lin).

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inevitable recipe supposedly applicable to all cities of the same digitalizing world (Albino et al., 2015; Allwinkle & Cruickshank, 2011; Angelidou, 2015; Datta and Odendaal, 2019; Kitchin, 2014). By contrast, the diverse responses of the people of different socio-economic and geopolitical contexts are conventionally treated either as residuals to be glossed over for convenience or natural conditions to be taken for granted. This is problematic as it obscures not only the cause-and-effect relationships between smart technology and urbanization as a process made by people for people, but also the ultimate goals of increased smartness in urban development and management.

The purpose of this study is to go beyond the popular technology-centric approach to smart urbanism and bring to the fore a people-oriented perspective attentive to the diverse responses of the different urbanites in the digitalizing world. By focusing on the interrelationship between urban smartness and people's happiness, this research ventures into a treatment of smart urbanism as not simply a technologically engineered project often imposed in a top-down fashion but more as a people-centered experience with spatially diverse, contextually sensitive, and socially contingent reactions from the ordinary urban population at the grass-roots level.

The remainder of this paper is structured into three parts. It begins with an examination of the current discourse surrounding smart urbanism. This is followed by a classification of definitive and methodological issues. The empirical section presents the results of the statistical models and discusses the smartness-happiness nexus. Research findings and their implications are summarized in the conclusion.

2. The theoretical context behind the smartness-happiness nexus

Over the past decade, smart urbanism has increasingly become a focal point of interest among scholars, urban planners, and policymakers worldwide. In light of the pressing challenges associated with an unprecedented surge in urban populations—such as increased infrastructure demand, unemployment, public health issues, and environmental degradation, among numerous others (Cohen, 2006; Khan, Woo, Nam, & Chathoth, 2017; Zhang, 2016)—the concept of "smart cities" has gained traction with its charming vision of leveraging advanced technologies and digital infrastructure to sustainably transform urban management and ensure economic competitiveness (Baraniewicz-Kotasińska, 2022; Kitchin, 2015; Monzon, 2015). In the Web of Science Core Collection database, a keyword search for articles and proceedings related to smart cities, smart urbanism, and smart technologies has identified a total of 87,019 publications with substantial growth.[1] In 10-years time, the number of related publications in smart cities, or smart urbanism, has increased fourfold from 691 in 2014 to 2946 in 2024, while the figure for related publications in smart technologies tripled from 2487 in 2014 to 7637 in 2024 (Fig. 1). Within this extensive body of work, a predominant focus is devoted to the technological and infrastructural domains of smart cities, encompassing fields such as engineering, computer science, information systems, and telecommunications, among others.

In the fields of social sciences and related disciplines, this notable proliferation of interest in smart urbanism persists with a predominant technocentric discourse that highlights the role of technology in urban planning and development, examining how technological solutions can address urban challenges and contribute to the creation of a more livable urban environment. Kim, Ramos, & Mohammed (2017) acknowledged the new Internet of Things (IoT) applications as a key enabler of smart city initiatives worldwide by enabling remote monitoring, management, and control of devices, along with generating actionable insights from real-time data. Gaur, Scotney, Parr, & McClean (2015) proposed a Multi-Level Smart City architecture that leverages wireless sensor networks and semantic web technologies to manage data from smart city infrastructures. Ahas et al. (2015) introduced a methodology that utilizes sensor data from mobile phones to identify spatial and temporal variations in daily activities within urban environments. Examples of other research areas include the use of technologies to transform tourism management and enhance visitor experience (e.g., Jeong & Shin, 2020; Li, Hu, Huang, & Duan, 2017; Marine-Roig & Clavé, 2015; Sigala, 2018), the potential of advanced technologies in promoting business performance (e.g., Haseeb, Hussain, Kot, Androniceanu, & Jermsittiparsert, 2019; Sutrisno, Kuraesin, Siminto, Irawansyah, & Ausat, 2023), and the use of green technologies for improving urban environments (e.g., Almalki et al., 2023; Hui, Dan, Alamri, & Toghraie, 2023; Sun & Zhang, 2020).

Despite the predominance of the technology-deterministic mindset in the smart urbanism discourse, the envisaged link between urban smartness and people's happiness has not completely escaped the enthusiasm of city governments for public intervention and competing interpretations of critical scholars. On the front of policy formation, many city governments have embraced smart urbanism as an inspiring tool instrumental to the enhancement of people's urban experiences and hence happiness. Dubai has been a prime example in this regard. Underpinned by its Happiness Agenda, in which happiness and the creation of optimistic urban experiences for all are prioritized, Dubai developed an ambitious target of "becoming the happiest city on earth" through innovation and smart technologies (Digital Dubai, 2022). This happiness-centric approach finds resonance in one of the core missions outlined in Hong Kong's Smart City Blueprint 2.0, which is to "make people happier, healthier, smarter and more prosperous, and the city greener, cleaner, more liveable, sustainable, resilient and competitive" (Innovation and Technology Bureau, 2020, p. 3). In a similar vein, when announcing the launch of Busan's "Smart City Vision and Strategy," the Busan Mayor outlined the plan's objective to build an internationally renowned smart city driven by data-centric operations that foster new industries and innovative ecosystems to ultimately enhance residents' happiness, embodied in the vision of "Smart Busan, a Happy Citizen" (Ministry of Land Infrastructure and Transport, 2018). Other examples of cities embracing happiness-related visions in their smart city plans include Macau, which has unveiled a visionary strategic blueprint aiming to transform the whole city into a "happy, smart, sustainable, and resilient" one, and the Thai smart city initiatives, which define the core objective of smart city as leveraging advanced technology and innovation to enhance the quality of life and foster sustainable happiness among its citizens (Cheung, 2023; Irvine et al., 2022). In contrast to the enthusiasm of policymakers and practitioners toward the imagined link between smartness and happiness, concerned scholars are critical of the perceived smartness-happiness connection. A careful inventory of the extant literature reveals ongoing controversies with two major competing interpretations.

The first stream of interpretation asserts that incorporating state-of-the-art technologies improves various operational domains and conditions within cities. Expected to offer promised solutions to fuel sustainable urban development with effective resource management and information communication technology (ICT) integration, smart cities are suggested to stimulate local innovation, economy, transport management, environment, and citizen engagement (Ismagilova, Hughes, Dwivedi, & Raman, 2019; Yigitcanlar, 2015; Zhu, Shen, & Ren, 2022). Under this mainstream advocacy, which reflects most smart city policies, the utilization of state-of-the-art technologies, particularly advanced ICTs and IoT applications, improves connectivity among various urban management systems, networks, and actors, providing a practical model with substantial efficiency and cost-lowering potentials (Ismagilova, Hughes, Dwivedi, & Raman, 2019; Wirsbinna & Grega, 2021). This emphasis on efficiency and connectivity within the smart city framework generates substantial economic benefits for businesses

[1] The inventory search was conducted on the Web of Science database on 26 April 2025, with the query: smart technology$ (Abstract) or smart cities$ (Abstract) or smart urbanism$ (Abstract) and Article or Proceeding Paper (Document Types).

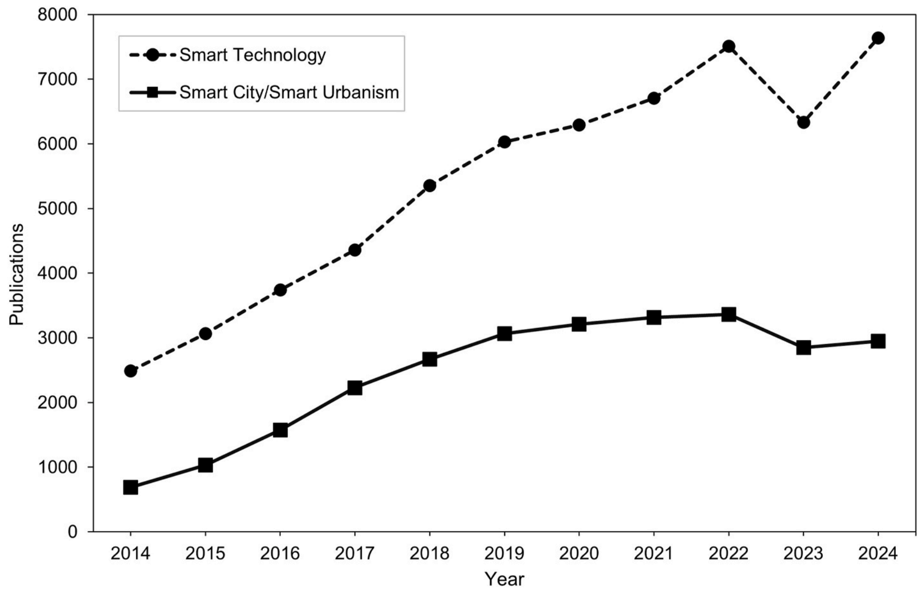

Fig. 1. Number of articles and proceeding paper publication on smart technology and smart city/smart urbanism, 2014–2024.
Source: Web of Science.

and enhances cities' competitiveness in this data-driven and knowledge-based era by stimulating innovation, improving infrastructures and urban services, strengthening resource management capabilities, attracting talent, streamlining administrative processes, and reducing energy consumption (Belanche et al., 2016; Wirsbinna & Grega, 2021; Yigitcanlar, 2015). Relatedly, Allam et al.'s (2022) connected to the 15-minute city concept and argued that ICT infrastructure and advanced technologies (e.g., AI, big data, cloud computing, IoT) can enhance mobility and optimize urban planning while addressing challenges like congestion and pollution. Under this conventional framework, integrating technological sophistication into urban systems enables a socio-technical transition that supports a green economy and a more sustainable future, ultimately enhancing citizens' quality of life and well-being (Newton, 2012). Enhanced smartness is considered to have the potentials of improving the happiness of the urban population on the premises and presumptions that happiness is essentially linked to the quality of life experienced by residents (Lin, Zhao, Yu, & Wu, 2019; Zhu, Shen, & Ren, 2022), and that enhanced smartness can address the many challenges undermining happiness and contribute to the creation of a modern, people-friendly living environment with the improved livability made possible by smart management, greater convenience, efficiency, safety, opportunities, and cost-saving benefits—all of which promote a greater quality of life (Atkinson & Castro, 2008; Lin, Zhao, Yu, & Wu, 2019; Janusz & Kowalczyk, 2022).

Conversely, the second group of researchers adopts a more critical lens in dissecting the influence of smart technologies on urban experience. From a radical perspective, the smart city concept is fundamentally flawed, as it fails to address deep-rooted social problems and disproportionately benefits the urban elite while further marginalizing and excluding already disadvantaged populations, such as the poor, illiterate, underclass, disabled, and those lacking digital access and literacy, thereby leaving society as a whole even unhappier. Unlike other academic concepts like Richard Florida's "creative cities," which gradually influenced urban policies and captured the attention of economic actors, the smart city narrative primarily originated and was predominantly shaped by multinational corporations (Vanolo, 2016). Hence, to some scholars, the smart city concept is a vendor hype, where its foundations are rooted in a neoliberal economic logic, embodying an ethos of market-driven technocratic solutionism that displays scant regard for social and environmental considerations (Anthopoulos et al., 2019; Ash, Kitchin, & Leszczynski, 2018; Cugurullo, 2018; Datta, 2015; Shelton, Zook, & Wiig, 2015). This singular priority on economic and operational efficiency intensifies municipal authorities' neoliberal agendas that favor commercial interests and profitability over sustainable urban development (Karvonen, Cugurullo, & Caprotti, 2019). Beyond exacerbating digital and socioeconomic divides, critical reflections address broader technological implications of smart cities, including cybersecurity risks, technological lock-ins, privacy invasions through surveillance, technocratic governance, and gentrification (Cugurullo, 2018; Kitchin, 2014, 2015; McNeill, 2021). These concerns underscore a gap between smart cities and happy cities, as well as a disconnect between utopian aspirations and the actual achievements of smart cities, rendering the promised idyllic future indefinitely prolonged. Aligning with this line of reasoning, Anggraini and Salomo (2023) revealed a decline in happiness levels among citizens of DKI Jakarta following their provincial government's implementation of smart city development policies. Similarly, focusing on the Chinese smart city context, Yu, Ye, Lin, & Wu (2020) illustrated that the impact of different smart city components on happiness is not uniformly positive, with perceived smart infrastructure (e.g., transportation and logistics system) reducing happiness levels by inducing stress.

Although the smart city narratives have captured heightened attention and enthusiastic imagination from academics, planners, and policymakers alike globally, many conceptual and theoretical issues remain vague and controversial. Apart from the chaotic definitions of "smart city"—a concept widely criticized for being "fuzzy" (Albino et al., 2015, p. 4; Leung & Lee, 2023, p. 2), "elusive" (Carvalho, 2015, p. 45) and "confusing" (Anthopoulos, 2015, p. 9) as it has been used in many different ways to refer to different things (Albino et al., 2015, pp. 6–8), two problematic tendencies in the conceptualization and theorization of smart urbanism are particularly evident. First, a smart city is popularly and conventionally understood as a city with a strong presence of digital technology widely applied to the intelligent and optimized functioning of smart urban infrastructure, smart buildings, smart transportation, and smart urban utilities and services (Allwinkle & Cruickshank, 2011; Albino et al., 2015; Angelidou, 2015; Ash, Kitchin, & Leszczynski, 2018). In this technology-deterministic perspective, the key to the making of a smart city lies in the application of digital, intelligent, wired, and networked technologies and techniques into urban development and management. The response and reaction of the urban population as recipients of smart technologies are conventionally treated as invariably affirmative or simply taken for granted. As Kitchin (2014, p. 132) observed, "there is little critical reflection on the wider implications of technologically rooted entrepreneurial urban development, or the consequences of networked urbanism, for city administrations and citizens." The second problem of the prevalent smart urbanism discourse is its tendency to see smart cities "as the epitome of digital ubiquity … often deeply decontextualized and strangely 'placeless'" (Datta and Odendaal, 2019, p. 388). The mission of smart urbanism is often imagined to be technologically driven, scientific, objective, commonsensical, non-ideological, and apolitical (Kitchin, 2014, p. 132). This is a global vision and mission to be promoted and accomplished through the application of some powerful, standardized, and placeless digital technology, for which diversity in local socio-economic-political conditions makes little difference.

In this research, we advocate a conceptual and theoretical alternative that is people-centric, place-contingent, and contextually sensitive to counterbalance the prevalent smart urbanism discourse built upon some technology-deterministic, placeless, and de-contextualized premises. First, we see a smart city as ultimately a living place, home, community, and neighborhood made by people for people using digital, intelligent, and smart technology. On the assumption that the application of smart technology would save cost and improve the efficiency of the operation and delivery of urban infrastructure, energy, transport, services and utilities and holding social equity as a constant, it would not be unreasonable to expect a positive, affirmative, and favorable reaction and better satisfaction of the urban population toward the vision and mission of smart urbanism. In other words, we may hypothesize that, other things being equal, the greater the urban smartness, the greater the happiness of the urban residents (H1). Second, we see the initiatives of smart urbanism as having diverse pathways, trajectories, and effects that are sensitive to and contingent upon various structural conditions of the city-regions. As Cugurullo and many critiques have commented, "far from being a cohesive whole, the same initiative is rolled out across different scales ranging from the individual to the region, generates different impacts in different spaces and, above all, features different components" (Cugurullo, 2018, p. 75; Datta and Odendaal, 2019, p. 387). A city or region with an advanced urban economy and a demographic structure dominated by the young and highly educated people presumably should have a pathway and trajectory of smart urbanism significantly different from one with an underdeveloped economy and dominated by an aged, unemployed, and illiterate population. It is therefore logical to hypothesize that the effect of smart urbanism upon the reaction, (un)satisfaction, or (un)happiness of the people therein is significantly related to the structural characteristics of the urban economy involved (H2). These are plausible propositions subject to testing against real-world data and information, however.

3. Definitional and methodological issues

The conceptual framework introduced and its two hypotheses made in the foregoing section are tested through an empirical study of the pattern of smartness vis-à-vis happiness across cities in different regions of the world. Our research is guided by two questions: (1) Can enhanced urban smartness increase people's happiness? (2) What specific component of urban smartness has displayed the strongest positive impact on the happiness of urban residents?

It should be acknowledged that defining and measuring urban smartness are highly controversial issues currently debated among many researchers holding different values and perspectives. There exists neither a single template for measuring urban smartness nor a one-size-fits-all definition of it (O'Grady & O'Hare, 2012). A recent systematic inventory of the definitions and measurement of urban smartness identifies as many as 23 definitions of smart city, 8 different dimensions, and 18–60 indicators of urban smartness (Albino et al., 2015, pp. 6–14). These diverse definitions and measurements can be grouped into two main categories, namely a narrowed approach focusing on the application of digital technology and a broader perspective inclusive of not just technology but also the social, institutional, and environmental dimensions. It remains debatable to what extent non-technological aspects such as "smart governance", "smart environment" (environmental sustainability), and "smart living" (social inclusivity) constitute urban smartness. Existing studies have increasingly suggested that "the smart city concept is no longer limited to the diffusion of ICT, but it looks at people and community needs" (Albino et al., 2015, p. 5), that the application of smart technology in cities has to improve the way every subsystem operates with the goal of enhancing the quality of life (Batty et al., 2012), and that urban smartness is constituted by the key components of not only technology but also the people (creativity, diversity, and education), the environment (efficiency & sustainability), and the institution (governance and policy) (Nam & Pardo, 2011; Lombardi, Giordano, Farouh, & Yousef, 2012; Albino et al., 2015). This conceptual understanding of urban smartness, which extends beyond pure technological advancements and applications to the border urban contexts, is also captured in the classic six smart city component framework proposed by Giffinger et al. (2007) and adopted by many others (Table 1). Moving along this line, the broader urban development level will also play a role in determining a city's level of urban smartness as it establishes the background for a city's technological, infrastructural, and structural advancements (Albino et al., 2015; Clement & Crutzen, 2021; Hollands, Aurigi, & Willis, 2020; Huang, Luo, Zhang, & Li, 2021). Building on the results of recent conceptual and methodological advancements in the studies of smart cities, this study opts for the broader perspective of defining and measuring urban smartness.

Our sympathy toward a broader definition and measurement of urban smartness appears to resonate with the approach adopted by the International Institute for Management Development (IMD). As a research-based index commonly used by government officials and public media, the Smart City Index (SCI) is primarily developed by the IMD—an independent academic institution with a global reach. This academic foundation of the SCI is more credible compared to other indices provided by many market corporations, which are often found to be plagued by the bias stemming from undisclosed market-oriented interests and motivations, along with a lack of transparency due to their closed nature. (Kitchin, 2015; Lai & Cole, 2023). In the SCI, smart cities are defined as cities that have become more efficient, environmentally sustainable, and socially inclusive through the implementation of digital technologies (IMD, 2016). With this sober understanding, urban smartness is measured by the local citizens' response to the surveys concerning the availability, accessibility, and actual applications of digital, intelligent, and online technology/services in a spectrum of urban life, ranging from work, environmental condition monitoring, public services, utilities, cultural activities, daily transportation, etc., which together formulate the "technology" pillar of the SCI. This unique inclusion of local citizens'

Table 1
The six components commonly used in defining smart cities and their related key terms/aspects of urban life.

Components	Related key terms/aspects of urban life
Smart Economy	Industry, innovative vibrance, competitiveness, entrepreneurship, economic image, productivity, labor market flexibility, international embeddedness, transformative ability.
Smart Environment	Efficiency and sustainability, natural environment preservation and protection, natural conditions' attractiveness, pollution, sustainable resource management.
Smart Governance	E-democracy, e-governance, transparent governance, participation in decision-making, public and social services.
Smart Living	Quality of life, security, cultural infrastructures, health conditions, housing quality, social cohesion, equality.
Smart Mobility	Logistics management, sustainable, safe, and innovative transport systems, local & international accessibility, ICT and internet accessibility, availability of ICT infrastructure.
Smart People	Education, training, human and social capital, lifelong learning, creativity, flexibility, ICT skills, qualification levels.

Synthesized based on: Albino et al., 2015; Appio, Lima, & Paroutis, 2019; Clement & Crutzen, 2021; Giffinger et al., 2007.

daily life feedback to smart technology and services highlights the citizen-centric approach to the smart city concept and provides valuable insights into the actual penetration of urban smartness into the everyday lives of the people in the cities, a feature not readily found in other related indices (Lai & Cole, 2023). Acknowledging that the smart city concept extends beyond traditional technological focus to encompass other determinants of sustainability and urban growth, the SCI encompasses both hard and soft infrastructure, with the former detailing urban technical systems and ICT applications, and the latter focusing on cultural and societal conditions, such as governance, policy, social inclusion, and education which foster the necessary environment for effective ICT implementation, formulating the "structure" pillar of the SCI (Albino et al., 2015; Angelidou, 2014; Bernardo & Maria, 2017; Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). In addition, in contrast to other indices that provide insights into urban smartness but include other less directly-related indicators—such as the Innovation Cities Index, which covers classical music, the Cities in Motion Index, which includes the number of McDonald's outlets in the city, and the Global E-Government Survey, which considers the font color of official websites—the SCI is specifically designed around the smart city concept, with a clear explicit emphasis on measuring urban smartness in particular, making it the preferred choice for this study.

The Happy City Index (HCI) is generated by the Institute for Quality of Life independently from the IMD by a different approach. Instead of focusing on urban residents' reaction to the provision of intelligent and digital technology, the HCI measures happiness on the basis of statistical information concerning the living conditions of cities that go beyond digital technology and across five domains, including (1) citizens, which takes into consideration factors related to citizens' experiences, such as the quality of education and social inclusion, (2) governance, which focuses on evaluating cities' operational transparency, citizens' involvement in decision-making progress, and strategies related to improving quality of life, (3) environment, which considers cities' management of natural resources, green space availability, and pollution, (4) economy, which sheds light on cities' economic productivity, innovation, entrepreneurship, and market conditions, and (5) mobility, which concerns cities' availability, safety, accessibility, and efficiency of a multimodal transport system (Institute for Quality of Life, 2023).[2]

In 2023, 141 and 200 cities were analyzed and included in the SCI and HCI databases, respectively. Together, the two databases encompass a total sample of 228 cities worldwide. Concerning data discrepancy, to ensure consistency and reliability in the analysis, only cities with data from both sources were included, resulting in a final sample of 113 cities grouped by geographical region for further spatial analysis (Fig. 2).[3]

In a manner similar to other research, the raw data from the original datasets required preprocessing for compatibility in further analysis. The average of the accompanying scores for the technology and structure pillars was then constructed and assigned as the respective overall pillar score for the individual cities.[4] Drawing insights from the SCI ranking methodology (see IMD, 2023) and grounded in the common conceptual understanding that a smart city is an "advanced" city (Bakıcı, Almirall, & Wareham, 2013, p. 139), the two pillar scores were thereafter multiplied by the individual cities' Human Development Index (HDI),[5] which serves as a baseline evaluation for the cities' respective development level, to compute an overall evaluation of their urban smartness level.

To test our two working hypotheses, two analytical models are constructed on the same conceptual and theoretical premises upon which the two hypotheses are made. To test Hypothesis I concerning the possible relationship between urban smartness and the happiness of the urban residents, Model 1 is constructed in which urban happiness (UH) is the dependent variable, while urban smartness (US) serves as the independent variable. Grounded in the consideration of the distinct contrasts in urban contexts between cities in the Global North and their counterparts in the Global South (Odeh, 2010), to provide further insights into the potential regional variations of the smartness-happiness nexus, the 113 cities were divided into Global North and Global South region based on their geographical location to construct two supplementary models based on the same design as Model 1.[6] The specific equation for Model 1 and its supplementary Models 1a and 1b is as follows.

$$UH = \beta_0 + \beta_1 US + \varepsilon \tag{1}$$

$$UH_{North} = \beta_0 + \beta_1 US_{North} + \varepsilon \tag{1a}$$

$$UH_{South} = \beta_0 + \beta_1 US_{South} + \varepsilon \tag{1b}$$

To test Hypothesis II concerning the possible relationship between happiness or the reaction of urban residents toward increased performance of different components of urban smartness, Model 2 is built with UH as the function of two independent variables, namely the structure pillar (S) and the technology pillar (T) of urban smartness of the cities. The selection of these two variables is based not only on a conceptual and theoretical understanding of urban smartness and the contingency of people's happiness towards increased urban smartness upon social, economic, political, and geographical conditions of the cities but also on established methodology in the extant literature, as well as data availability. In addition to the SCI, the division of cities' urban smartness into two key components—the structure and technology pillars—is evident in past studies, including the work of Chen (2023). This approach is grounded in the previously noted conceptual understanding that urban smartness is highly complex, encompassing not only technological advancements and service provision but also broader urban conditions covering the infrastructural contexts and structural characteristics of the cities involved (demographic, social, economic, political, and environmental attributes). Huang et al. (2023) emphasize that the multifaceted dimensions of a place—comprising socio-demographic and economic factors like income, employment conditions, health, education, social capital, sense of security, trust, perceptions of fairness, housing conditions, urban environment, and institutional infrastructure—play a pivotal role in shaping urban happiness. Furthermore, Ballas (2013) and Rodríguez-Pose & Maslauskaite (2012) highlight the significant influence of cities' macroeconomic and institutional contexts on individuals' well-being and life satisfaction, particularly regarding the social and physical environment, including amenities and urban facilities. In Model 2, these urban conditions and infrastructural considerations that extend beyond mere technological advancements—yet are closely linked to the concept of urban smartness and its influence on urban happiness—are

[2] It should be noted that the indicators chosen for SCI and HCI are significantly different in three respects: they are different by virtue, generated by two different institutions independently, and processed with different approaches. The SCI focuses on the utilization of digital and intelligent technology in urban life, whereas the HCI measures statistically the living conditions of the people in the cities. The categorization of some of the domains in the SCI and HCI may be seemingly similar (e.g., "education", "governance", "environment"). However, the specific attributes and measurements concerned are very different—the SCI focuses on local citizens' response to digital technology, whereas the HCI uses statistical information on urban life. To ensure the necessary robustness of analyses and modeling, we have further tested the endogeneity of the variables involved. See Footnote 7.

[3] See the full list of cities included in this study and their groupings according to geographical regions in Table A1 in the Appendix.

[4] The detailed indexes and codes for the technology and structure pillars are provided in Table A2 in the Appendix.

[5] The HDI is calculated using a composite of the mean years of schooling for adults aged 25 and older and the expected years of schooling for children aged 6, the life expectancy at birth of the population, and the gross national income per capita.

[6] European, North American, and Oceania cities were grouped as the Global North group; Asian, Middle Eastern, and South American cities were grouped as the Global South group.

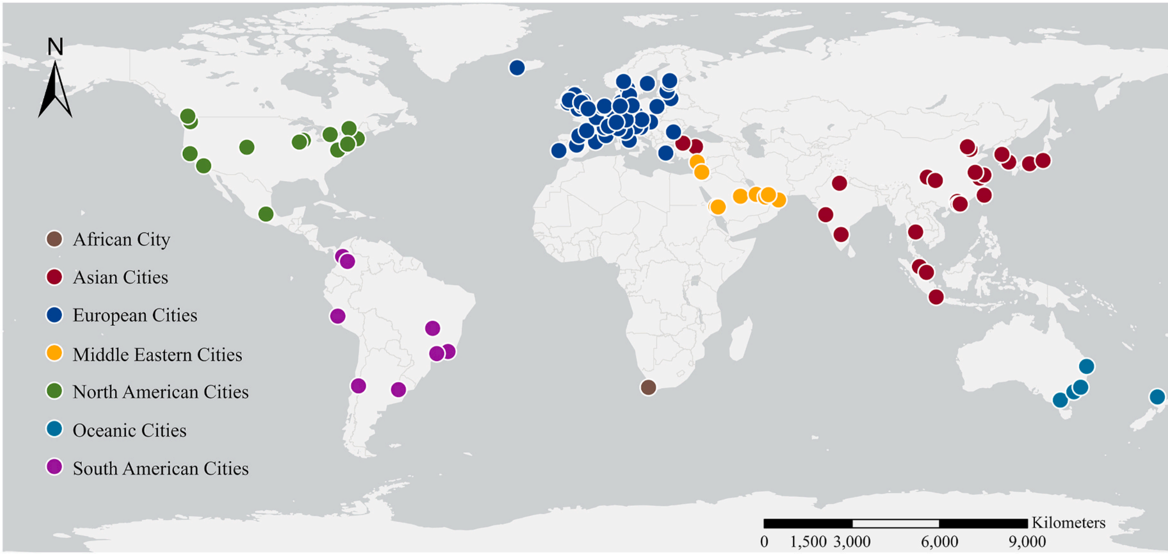

Fig. 2. Location of the 113 cities included in this study.

captured by the structure pillar. Considering technology as a widely accepted foundational component of urban smartness, the technology pillar—focused on technological advancements and service provisions available to citizens—is included as another predictor in Model 2. As the developmental level varies across different cities and regions, potentially destabilizing the model estimation, cities' HDL, which serves as a baseline evaluation for urban smartness, is included as a control variable. The specific equation for Model 2 is as follows:

$$UH = \delta_0 + \delta_1 S + \delta_2 T + \delta_3 HDL + \varepsilon \tag{2}$$

All models underwent robustness checks to ensure the validity and reliability of the regression results in meeting the core statistical assumptions.[7] The summarized findings of the regression analyses are presented in Table A3 in the Appendix.

[7] Robustness checks for the models commonly include examinations of multicollinearity, assessments of the assumption of normality, and tests for heteroscedasticity and the presence of autocorrelation. The tools used to check possible endogeneity risks are notably Ebbes, Wedel, Böckenholt, & Steerneman, 2005 latent instrumental variables (LIV) approach and Lewbel's (1997) higher moments (HM) approach. In the LIV approach, the rule of thumb is that endogeneity is a concern and the risk of endogeneity in the original model (ordinary least square (OLS)) warrants the use of the LIV model IF the LIV model shows significantly different estimates compared to the OLS model (such as reversed coefficient signs and p-values) or IF the Hausman-LIV test yields a p-value below the standard threshold of 0.05, rejecting the null hypothesis of no misspecification and "both the OLS and LIV estimates are consistent" (Ebbes, Wedel, Böckenholt, & Steerneman, 2005, p. 372; Georgakopoulos, Toudas, Poutos, Kounadeas, & Tsavalias, 2022; Hausman, 1978). In our case of Model 1 (a and b), the LIV models demonstrated aligning coefficients and p-values, with the Hausman-LIV test revealing a high p-value above the standard threshold (Model 1a: p-value = 0.487; Model 1b: p-value = 0.343), ***indicating no significant evidence of endogeneity***, and the OLS models are likely consistent and reliable (Ebbes, Wedel, Böckenholt, & Steerneman, 2005). In the case of Model 2, the HM approach is adopted considering the involvement of multiple independent variables (Ebbes, Wedel, Böckenholt, & Steerneman, 2005; Gui, Meierer, Schilter, & Algesheimer, 2023). Similar to the LIV approach, the rule of thumb is that endogeneity may be a concern IF the HM model's estimates are significantly different from the OLS model or IF the Wu-Hausman test shows a low p-value below the significance level at 0.05 (Kock, 2022; Thurman, 1986). In our case of Model 2, the HM model demonstrated aligning coefficients and p-values, with the Wu-Hausman test revealing a high p-value (0.273) above the standard threshold and hence ruling out the danger of endogeneity.

4. Exploring the smartness-happiness connections

From a broad global perspective, a positive relationship between urban smartness and happiness is observed (Fig. 3), suggesting that enhanced city smartness is generally associated with increased urban happiness. With the exception of South American cities, which exhibited a negative trend, all other regions demonstrate a positive smartness-happiness nexus, although variations in degree and certainty exist. This observation seems to reinforce the claims of prior advocates for smart cities, which highlight that greater urban happiness could be derived through smart city development and technological innovations as they enable improved governance, interagency collaboration, streamlined access to goods and services, enhanced mobility, timely and reliable healthcare services, more effective operation and delivery of urban infrastructure, and the interoperability of urban systems and subsystems (Chen, 2022; Shwedeh et al., 2021). Nevertheless, this overarching conclusion should be approached with caution, given the significant inter- and intra-regional variations that go beyond the conventional understanding of smart urbanism and its smartness-happiness nexus as a linear, decontextualized, and placeless progression driven by ubiquitous technologies with uniform benefits across different cities.

Highlighting the importance of place contingency in understanding smart urbanism and its potential impacts, the stark contrast between the Global North and South regions in the smartness-happiness nexus serves as a compelling example. Specifically, cities in the Global North region typically rank above the global average, while those in the Global South region exhibit flatter trend lines—indicating a weaker connection between urban smartness and happiness, accompanied by more diverse patterns. Further analysis using the two supplementary models (Model 1a and 1b) reinforces these findings, highlighting a more favorable and stronger positive smartness-happiness nexus in the Global North region, while revealing comparatively weaker and more complex links in the Global South region. These results imply that the same level of enhancement in urban smartness is likely to contribute to an uneven outcome depending on the socio-spatial and urban contexts involved. The expectation of smart urbanism to improve the lives and well-being of urban residents universally could be a rather reductionist perspective that oversimplifies the inherent complexities in real-life urban transitions.

While it is necessary to emphasize that the intent of this study is not to provide a comprehensive and definitive account of these complex relationships across the myriad cities and geographic contexts examined but to frame and empirically contextualize smart urbanism through the

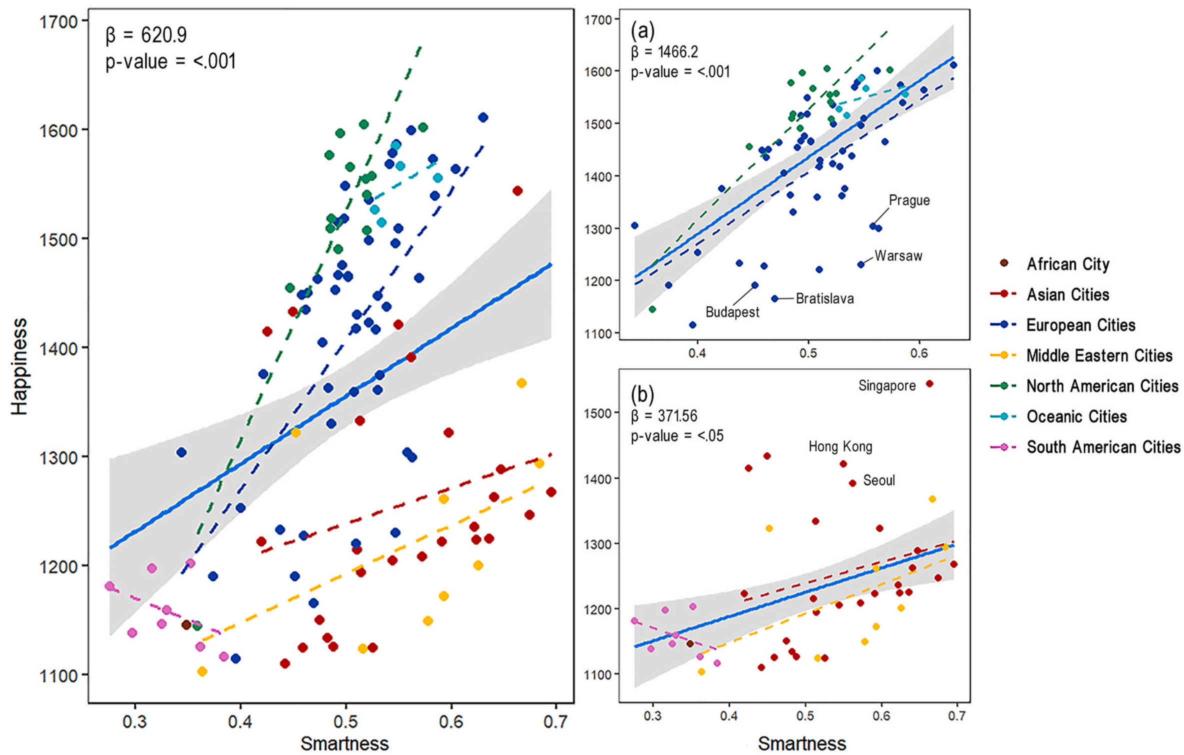

Fig. 3. Visualization of Model 1 on the relationship between urban smartness and urban happiness: (a) Global North region, (b) Global South region
Note: The grey area indicates the confidence band (0.95), whereas the blue line represents the fitted regression line. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

smartness via-a-vis happiness linkages with a place-contingent alternative perspective, several explanations can be provided to offer insights into understanding the geographical variations revealed. As we previously acknowledged, smart urbanism and its process of smart city development are predominantly not constructed from scratch in a vacuum through the wholesale incorporation of universal pursuits. Rather, they are merged in a sometimes-awkward manner into existing policy agendas and shared aspirations for the future, shaped and embedded into the unique geographical and urban contexts of each city (Cugurullo, 2018; Karvonen, Cugurullo, & Caprotti, 2019; Shelton, Zook, & Wiig, 2015). With cities being fundamentally complex, varied, and multifaceted, the agenda and actual implementations of smart urbanism initiatives would also vary significantly among cities, leading to diverse development trajectories of smart urbanism and impacts on citizens' living conditions. These underscore the critical role of regional and urban context in driving the success or failure of smart urbanism initiatives. Taking the Global North-South regional contrast as an example, cities in the Global North region—where the concept of smart urbanism originally emerged—typically enjoy a more advantageous economic development status, along with better access to financial resources, infrastructure, and advanced knowledge (Odeh, 2010). This favorable positioning often enables them to better implement cutting-edge technologies and deploy smart urban initiatives to enhance residents' urban experiences and conditions compared to some Global South cities that are confronted with notable financial contrasts and technological lag, along with a more complex array of challenges, including the struggles in achieving adequate financial and digital inclusion, which impede the potential of smart urbanism initiatives in improving urban conditions in the society.

Nevertheless, the relationship between urban smartness and happiness is complex and cannot be reduced to a simplistic North-South regional dichotomy. Instead, it reflects nuanced, place-specific dynamics, as evidenced by intra-regional variations. As shown in Fig. 3, while both the European and North American groups exhibit an overall positive trendline, North American cities display a stronger positive correlation between smartness and happiness. Notably, some European cities emerge as outliers, diverging from the broader European trend. Cities in the Visegrad Group (also known as the V4) serve as notable examples in this regard (Fig. 3). Located in Central Europe, the V4 group comprises cities from former Soviet-influenced states, including Budapest (the capital of Hungary), Bratislava (the capital of Slovakia), Warsaw (the capital of Poland), and Prague (the capital of the Czech Republic). Despite achieving comparable levels of urban smartness to some of their Western European peers, such as Newcastle (United Kingdom), Leeds (United Kingdom), Gothenburg (Sweden), Lyon (France), and Milan (Italy), these V4 capitals report lower happiness levels.

While our findings on the urban smartness levels of the V4 capitals align with the analysis by Janusz & Kowalczyk, 2022, which ranks Prague as the smartest city among the V4 capitals, followed by Warsaw, Bratislava, and Budapest, the existing economic and technological gaps between the V4 countries and their Western European counterparts may offer insights into the observed intra-regional variations within the European group. As the V4 capitals undergo transformation in their pursuit of smart city development, challenges are also prevalent. In addition to technical issues such as the integration of various systems and data, digital privacy and security concerns, and unequal access to technology among residents, these cities face several other smart developmental obstacles, including a lack of social capital, limited funds for long-term strategic development, and diminished decision-making power owing to excessive centralization (Górka, 2024; Janusz & Kowalczyk, 2022). Administrative barriers, such as lengthy procurement and tendering processes, further hinder the timely and effective implementation of smart initiatives and urban development strategies to respond to urban challenges (Janurova, Chaloupkova, & Kunc, 2020). These developmental challenges may substantially hinder the potential benefits of smart city initiatives, illuminating the smartness-happiness gap observed in comparison to their Western European counterparts. Without addressing these contextual factors and challenges, the promise of urban smartness may not be fully realized.

In the context of the Global South region, spatial heterogeneity and intra-regional variations are also evident. Singapore stands in stark contrast to other cities in Asia, the Middle East, and South America, exhibiting high levels of both urban smartness and happiness (Fig. 3). This distinction aligns Singapore more closely with certain European cities, such as Zurich and Oslo, known for their advanced economic development and more favorable urban conditions. This observation is not surprising, as Singapore, despite its geographical location in the Global South, possesses an economic developmental status that aligns more closely with the characteristics typically associated with Global North cities. Its remarkable economic development is characterized by strategic governance, robust technological infrastructure, and a highly educated workforce, which collectively enhance its ability to implement innovative smart city initiatives more effectively, positioning it as a leader in the Asian region. Other notable examples of cities that deviate from the general Asian trend include Hong Kong (China) and Seoul (South Korea) (Fig. 3). These cities boast more sophisticated economies, characterized by a robust ecosystem of knowledge-based industries and extensive international connectivity. This advantageous position allows them to better embrace the benefits of smart urbanism, which may explain better outcomes in citizens' well-being and quality of life compared to their regional peers still undergoing transformation and facing significant obstacles, including inadequate infrastructure, limited financial resources, and a lack of social and human capital necessary for effective implementing such initiatives.

The inter- and intra-regional variations indicate that, although smart urbanism is often viewed as a universal panacea and a transformative opportunity for tackling complex urban challenges, its effects upon different regions are highly complex with significant spatial heterogeneity. While smart urbanism presents potential benefits, its realization and actual impact on citizens remain greatly contingent upon the specific conditions of individual cities, including socio-economic factors, governance structures, and technological infrastructure. Echoing the concept of isomorphic mimicry, imitating some successful smart city models originating from Western urban contexts may be appealing to some developing cities, as these models present a compelling and future-looking blueprint for modernization and efficiency, suggesting a pathway to enhance urban living and management with numerous opportunities. Nevertheless, as demonstrated by the varying relationships between smartness and happiness across different cities and regions, an uncritical adoption of external smart urban development models with a one-size-fits-all mindset—without addressing the underlying core challenges of individual cities' locality—may lead to inefficiencies and missed opportunities for launching actual meaningful improvements in citizens' experiences and well-being. This calls for a shift from the conventional imaginary of smart urbanism as a decontextualized, objective, and placeless phenomenon driven by technological advancements that supposedly provide ubiquitous benefits, regardless of local socio-economic and political conditions. Instead, a contextualized approach is needed—one that recognizes the individuality of each city, including its unique challenges and opportunities.

5. Delving into the linkages between smart city components and happiness

In line with our second hypothesis—which posits that the impact of smart urbanism on urban happiness is significantly influenced by the structural characteristics of the urban economy and context—our analysis found that the structure pillar of urban smartness emerged as a statistically significant positive predictor, demonstrating a consistent upward trend across all regions studied. The only exception was observed in the Oceanic cities, where the slight negative trend may be attributed to the relatively limited data points available. In contrast, while holding other factors consistent and glossing over the regional variations observed, the Technology pillar demonstrated a significant global trend of negative association with urban happiness. Fig. 4 below visualizes the results of Model 2.

Considering the structural characteristics of cities and their urban economies—including the state of their infrastructure and service provision—as fundamental factors that influence not only the success or failure of smart city projects but also the daily experiences of citizens, such as their work life, civic participation, education, living environment, transportation, and many other domains of urban life, it is not surprising that the structure pillar of urban smartness significantly predicts urban happiness. This finding resonates with the discussion by Cardoso, Sobhani, & Meijers (2022), which emphasizes that the condition of urban infrastructure and services significantly influences how well cities meet the diverse needs of their residents—such as the needs for subsistence, protection, and participation. Well-developed infrastructure and services serve as the backbone of urban functionality, enhancing citizens' access to essential resources, fostering social interactions, and creating an environment that supports community engagement and innovation. These elements are critical for improving the overall quality of life and well-being of city residents, explaining the significant positive sign of the structure pillar in Model 2.

On the contrary, the technology pillar reveals a negative global average trend gloss over, suggesting that the pure pursuit of technological advancement and the incorporation of digital technologies across various urban sectors are inadequate for improving urban happiness within cities. Instead, these efforts may even diminish urban happiness, refuting the conventional viewpoints that consider implementing digital technologies and related technological-centered initiatives as limitless solutions to multiple urban challenges and effective means to enhance urban living experiences. This finding echoes the growing scholarly caution against the reductionist tendencies of the smart city paradigm, which often privileges digital innovation and technology incorporation over the deeper social determinants of urban livability and community well-being. As Kitchin (2014) and Krivý (2018) argued, the technological solutionism mindset fails to address complex social problems at the root due to its overly narrow-minded, technocratic view that overlooks broader factors shaping urban life. Here, the discussion surrounding the Techno-Fix concept is highly relevant. Challenging the widely held beliefs that advanced technology alone can solve complex social, environmental, and economic issues, Huesemann and Huesemann (2011, p. 17) assert that "technology by itself can't save us" by referring to the often ignored (and sometimes unintended) negative consequences of technologies, including the concerns about exploitation, fairness, social control, social disconnection and manipulation, which frequently undermine urban happiness and quality of life. A technological fix can be a beneficial innovation; however, many complex urban problems—such as persistent social inequality, social stratification, and the digital divide stemming from unequal access to technology—cannot be addressed solely through the implementation of advanced technology (Rosner, 2013; Wilson, Wallin, & Reiser, 2003). Instead, these issues require a holistic, people-centered approach to develop effective solutions that genuinely enhance urban life. Technology does not operate in a vacuum; it functions within the intricate systems of urban environments, which cannot be simplified to a binary framework. Thus, the assumption that technological interventions can resolve all urban challenges while allowing the rich to continue prospering and the poor to catch up is fundamentally flawed (Huesemann & Huesemann, 2011). With urban development processes being far more intricate than mere technological programming, technological sophistication alone or a superficial incorporation of technology, without addressing the broader urban challenges, would be insufficient to enhance living standards or urban

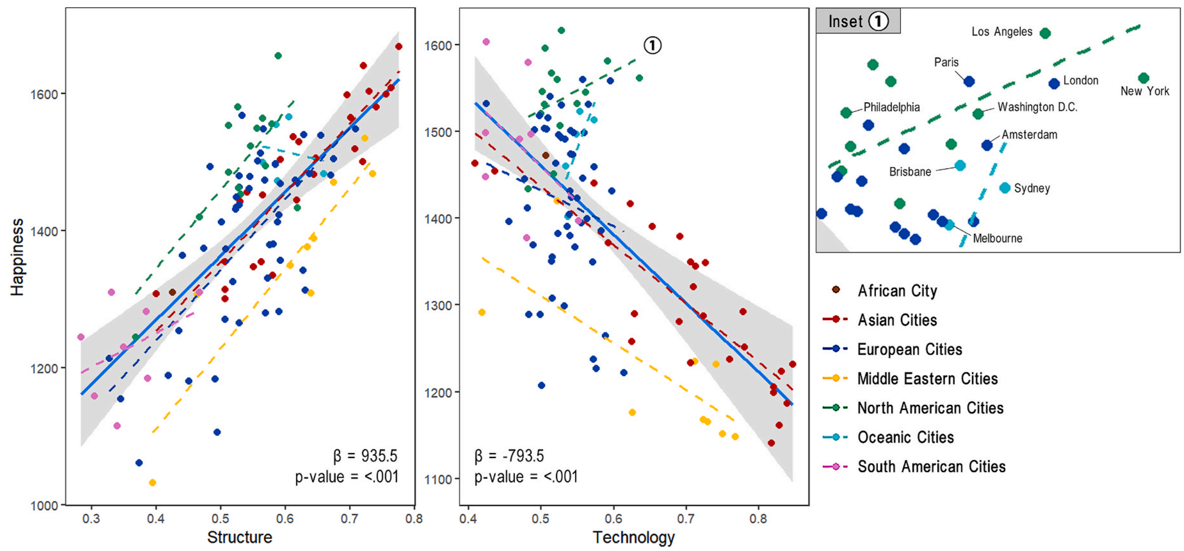

Fig. 4. Visualization of Model 2 on the relationship between the structure and technology pillars and urban happiness
Note: The grey area indicates the confidence band (0.95), whereas the blue line represents the fitted regression line. Inset ① provides a focused, zoomed-in view of the overall plot marked. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

happiness and may even worsen existing social issues, as indicated by the negative coefficient for the technology pillar in our model (Chen, 2022; Cugurullo, 2018; Kitchin, 2014, 2015; Mattern, 2020; McNeill, 2021; Zhu, Shen, & Ren, 2022).

However, as similarly identified in the previously discussed smartness-happiness nexus, it is important to note that the potential negative relationship between technology and happiness is far from uniform across different geographical regions. Notably, cities in North America, Oceania, and certain advanced European countries exhibited a reversed positive correlation between the two constructs (Fig. 4). Examples of related cities included New York (United States), Los Angeles (United States), Washington D.C. (United States), London (United Kingdom), Paris (France), Amsterdam (Netherlands), Sydney (Australia), and Melbourne (Australia). To explain these variations, several factors can be considered. First, these cities generally possess more advanced economic development, which often means they are better equipped with substantial financial resources and infrastructure for the effective implementation of technologies, possibly enhancing the potential of these technologies to improve citizens' urban experiences. Second, in these cities with typically high digital literacy, citizens may be better positioned to utilize technology and navigate digital tools more effectively, leading to better engagement with community resources, information, and convenience, all of which may positively impact their urban happiness and quality of life. Thus, while the overall trend suggests a general negative relationship between technology and happiness, the regional variations observed in certain cities indicate that context plays a crucial role. Understanding the underlying factors that contribute to these positive outcomes could offer valuable insights for policymakers seeking to leverage technology in ways that genuinely enhance urban happiness. Further research is essential to elucidate the complex dynamics between digital technology implementation and the urban experiences and happiness of residents, employing a place-contingent and human-centered perspective.

6. Conclusion

Over the recent decade, the dawn of an urban age—widely heralded following a reportedly locational shift of the majority of the human population from rural to urban settlements—has ushered in renewed enthusiasm for the triumph of cities as not only the mainstay of human civilization but also the inexhaustible source of energy for the making of a better, smarter and sustainable future. Despite continuing ontological and epistemological debates between the scholars faithful to the planetary urbanization thesis and others insisting on an idiographic and provincializing interpretation, a popular belief shared by academics and practitioners has been in the instrumental role played by the powerful, ubiquitous, borderless, and placeless digital technology in the process of smart urban transition. In the burgeoning literature and proliferating practices of smart urbanism, smart technology is commonly considered the premise upon which smart cities are built. Other discursive social, political, and geographic factors are treated as of secondary importance or residualized for simplicity and convenience. This study goes beyond the conventional technology-deterministic intervention in smart urbanism theories and practices. It foregrounds a humanistic perspective focusing on the diverse, contextually sensitive, and geographically contingent responses of people in different world regions to smart city initiatives. Our systematic cross-sectional regression analysis of the data collected from 113 cities worldwide has identified an emergent geography of smartness vis-à-vis happiness that deviates from normal expectations. The research findings revealed a nuanced interplay between urban smartness and happiness, with significant implications for conceptual/theoretical enquiries and policy formation.

Contrary to the prevailing notions of smart urbanism as a decontextualized phenomenon or a universal framework driven by ubiquitous digital technologies, our research illustrates that smart urbanism is deeply contextualized and rooted in place-specific regional conditions. The relationship between smartness and happiness is not as straightforward as commonly perceived in public policy and the conventional wisdom, which often views smart urbanism as a powerful game-changer that delivers ubiquitous benefits and numerous opportunities to cities. Although a general positive correlation between smartness and happiness is observed, it is important to recognize that this relationship is contingent upon varying regional socio-economic-cultural conditions. While a stronger and positive correlation is observed from the cities of the Global North, a weak and non-linear pattern is identified from the Global South with a negative relationship found from the cities of South America. This warrants caution against drawing a simple, overarching conclusion that overlooks the significant inter- and intra-regional variations.

Diverging from the prevailing technocratic view that promotes the integration of digital technologies into urban life as a universal and transformative panacea to many urban challenges, our findings indicate that a singular focus on technological advancement is unlikely to bring effective improvements in urban happiness, but may even diminish it, depending on the urban contexts involved. This highlights the problematic nature of a technocentric solutionist approach, which often adopts a reductionist mindset that prioritizes simplified technological fixes over more holistic and context-sensitive solutions, overlooking the complex factors underlying urban challenges. Technologies in smart cities should not be viewed as the ultimate solution, but rather as tools to improve the quality of urban life, requiring careful consideration of each city's unique social and developmental conditions. The regional variations in our results illustrate that the experiences of those economically advanced cities may diverge significantly from the developing cities that are still undergoing rapid urban developmental transformation. These findings underscore that a Western-centric, one-size-fits-all approach—often modelled on successful examples from developed cities with a strong technological emphasis—is unlikely to transfer effectively across all urban contexts, calling for the need to move beyond broad generalizations and universal policy prescriptions commonly found in the conventional smart urbanism discourse. Further research is essential to unpack the intricate and context-dependent dynamics of smart urbanism, focusing on the nuanced interplay between technology and communities within distinct urban environments.

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CRediT authorship contribution statement

Vinci Y.J. Cheung: Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **George C.S. Lin:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: George C.S. Lin reports financial support was provided by Research Grants Council of the Hong Kong Special Administrative Region. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table A1
Groupings of the 113 Cities based on their Geographical Location

Africa	Asia	Europe		Middle East	North America	Oceania	South America
Cape Town	Ankara	Amsterdam	Ljubljana	Abu Dhabi	Boston	Auckland	Bogota
	Bangkok	Athens	London	Doha	Chicago	Brisbane	Brasilia
	Beijing	Barcelona	Luxembourg	Dubai	Denver	Canberra	Buenos Aires
	Bengaluru	Belfast	Lyon	Jeddah	Los Angeles	Melbourne	Lima
	Busan	Berlin	Madrid	Mecca	Mexico City	Sydney	Medellin
	Chengdu	Bilbao	Manchester	Muscat	Montreal		Rio de Janeiro
	Chongqing	Birmingham	Marseille	Nicosia	New York		Santiago
	Delhi	Bologna	Milan	Riyadh	Ottawa		Sao Paulo
	Guangzhou	Bordeaux	Munich	Tel Aviv	Philadelphia		
	Hangzhou	Bratislava	Newcastle		San Francisco		
	Ho Chi Minh City	Brussels	Oslo		Seattle		
	Hong Kong	Bucharest	Paris		Toronto		
	Istanbul	Budapest	Prague		Vancouver		
	Jakarta	Cardiff	Reykjavik		Washington D.C.		
	Kuala Lumpur	Copenhagen	Riga				
	Mumbai	Dublin	Rome				
	Nanjing	Dusseldorf	Rotterdam				
	Osaka	Geneva	Stockholm				
	Seoul	Glasgow	Tallinn				
	Shanghai	Gothenburg	The Hague				
	Shenzhen	Hamburg	Vienna				
	Singapore	Hanover	Vilnius				
	Taipei City	Helsinki	Warsaw				
	Tianjin	Leeds	Zagreb				
	Tokyo	Lisbon	Zurich				
	Zhuhai						

Table A2
Indicators from the SCI 2023 (IMD, 2023) Grouped by Technology and Structure Pillars

Pillar	Code	Indicators
Technology	T-01	"Online access to job listings has made it easier to find work"
	T-02	"Online services provided by the city has made it easier to start a new business"
	T-03	"A website or App allows residents to effectively monitor air pollution"
	T-04	"Online reporting of city maintenance problems provides a speedy solution"
	T-05	"Online public access to city finances has reduced corruption"
	T-06	"Online voting has increased participation"
	T-07	"An online platform where residents can propose ideas has improved city life"
	T-08	"Processing Identification Documents online has reduced waiting times"
	T-09	"CCTV cameras has made residents feel safer"
	T-10	"Arranging medical appointments online has improved access"
	T-11	"Online purchasing of tickets to shows and museums has made it easier to attend"
	T-12	"A website or App allows residents to easily give away unwanted items"
	T-13	"Free public wifi has improved access to city services"
	T-14	"Car-sharing Apps have reduced congestion"
	T-15	"Apps that direct you to an available parking space have reduced journey time"
	T-16	"Bicycle hiring has reduced congestion"
	T-17	"Online scheduling and ticket sales has made public transport easier to use"
	T-18	"The city provides information on traffic congestion through mobile phones"
	T-19	"The current internet speed and reliability meet connectivity needs"
	T-20	"IT skills are taught well in schools"
Structure	S-01	"Businesses are creating new jobs"
	S-02	"Employment finding services are readily available"
	S-03	"Green spaces are satisfactory"
	S-04	"Basic sanitation meets the needs of the poorest areas"
	S-05	"Recycling services are satisfactory"
	S-06	"Air pollution is not a problem"
	S-07	"Information on local government decisions are easily accessible"
	S-08	"Corruption of city officials is not an issue of concern"
	S-09	"Residents contribute to decision making of local government"
	S-10	"Residents provide feedback on local government projects"
	S-11	"Cultural activities (shows, bars, and museums) are satisfactory"
	S-12	"Public safety is not a problem"
	S-13	"Medical services provision is satisfactory"
	S-14	"Finding housing with rent equal to 30 % or less of a monthly salary is not a problem"
	S-15	"Minorities feel welcome"
	S-16	"Traffic congestion is not a problem"
	S-17	"Public transport is satisfactory"
	S-18	"Most children have access to a good school"
	S-19	"Lifelong learning opportunities are provided by local institutions"

Table A3
Summary of Regression Modeling Results of Model 1(a & b) and 2

		Unstandardized Coefficients			
Model		B	Std. Error	t	Sig.
1*	(Intercept)	1045.7	85.6	12.216	<0.001
	Smartness (US)	620.9	166.5	3.729	<0.001
1a**	(Intercept)	703.0	115.4	6.090	<0.001
	Smartness (US)	1466.2	226.9	6.461	<0.001
1b***	(Intercept)	1039.48	62.22	16.71	<0.001
	Smartness (US)	371.56	119.08	3.12	0.00326
2****	(Intercept)	273.2	173.3	1.576	0.118
	Structure (S)	935.5	146.3	6.394	<0.001
	Technology (T)	−793.5	160.4	−4.948	<0.001
	Development (HDL)	1144.6	166.6	6.868	<0.001

*$R^2 = 0.1113$, Adjusted $R^2 = 0.1033$, $F = 13.91$, p-value = <0.001.
**$R^2 = 0.3839$, Adjusted $R^2 = 0.3747$, $F = 41.75$, p-value = <0.001.
***$R^2 = 0.1882$, Adjusted $R^2 = 0.1689$, $F = 9.736$, p-value = 0.003263.
****$R^2 = 0.6712$, Adjusted $R^2 = 0.6622$, $F = 74.18$, p-value = <0.001.

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