

Housing market with informal density agglomeration: Investigating the form-context transition of urban village in China

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Urban Studies

2025, Vol. 62(11) 2309–2327

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DOI: 10.1177/00420980241309908

journals.sagepub.com/home/usj



Abstract

The prevailing discourse in urban planning often relegates the concept of ‘urban informality’ to its margins, typically viewing it as an aberration or market failure needing correction rather than a developmental phase warranting integration. While studies and policies of urban redevelopment have shifted from large-scale, clean-sweep practices to less radical, sustainable regeneration approaches, the local variations and fiscal complexity of these informal settlements render it onerous to find an adaptive spatial governance mode. Focussing on urban villages in Shenzhen, China, this study integrates the concept of the ‘form-context ensemble’ with spatial equilibrium models, thus proposing a revised framework that better accommodates the irregularities (hyper-density but below-market prices) introduced by urban informality with empirical evidence. Our empirical analysis shows that dense settlements under the expected value curve (EVC) can help mitigate housing cost disparities between income groups, while redevelopment will bring the externality to shift the EVC to a higher level, thus enlarging the discrepancy. We propose a three-way trade-off matrix between value, access and amenity for assessing the utility of urban villages, providing a comprehensive framework for balancing various factors in housing policy design and delivery. Our findings suggest that preserving some informal settlements may enhance general welfare and economic equity, even as cities pursue selective formalization. This paves the way for adopting a classification scheme and concerted measures for making targeted regeneration policies from municipal management or planning perspectives.

Keywords

Affordable housing, informal settlement, spatial equilibrium model, urban economics, urban regeneration, urban villages

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摘要

城市规划中的主流话语经常将“城市非正规性”的概念置于边缘地位，通常将其视为需要纠正的异常现象或市场失灵，而不是需要整合的发展阶段。虽然城市改造的研究和政策已经从大规模、一刀切的做法转向不那么激进、可持续的改造方法，但这些非正规住区的局部差异和财政复杂性使得寻找适应性空间治理模式变得十分困难。本文重点关注中国深圳的城中村，将“形式-背景集成”的概念与空间均衡模型相结合，从而提出了一个修订后的框架，以更好地适应城市非正规性带来的不规则现象（高密度但低于市场价格），并提供实证证据。我们的实证分析表明，预期价值曲线（EVC）下的密集住区有助于缓解不同收入群体之间的住房成本差距，但改造将带来使 EVC 变高的外部性，从而扩大差距。我们提出了考虑价值、可达性和舒适度的三向权衡矩阵，来评估城中村的效用，为平衡住房政策设计和实施中的各种因素提供了全面的框架。我们的研究结果表明，即使城市实施选择性正规化，保留一些非正规住区也可能会增进公众福利和经济公平。这为从市政管理或规划角度，采取分类方案和协调措施，制定有针对性的改造政策打下了基础。

关键词

经济适用房、非正规住区、空间均衡模型、城市经济、城市更新、城中村

Received December 2023; accepted November 2024

Introduction

Urban villages are an inextricable component of China's urban landscape, distinguished by their unique characteristics that starkly contrast with the conventional imagery of modern cities (Friedmann, 2005; Lai et al., 2017; Van Oostrum, 2022). The term 'urban villages' conveys a state of 'liminality', a hybrid space that is neither fully urbanised nor purely rural, forming what Yiftachel (2012: 243) describes as the 'pseudo-permanent margins' of contemporary urban regions. This duality embodies both a vestige of pastoral, agrarian origins and a dynamic interface with the fluidities of modern urban life (Fang, 2022; Stockman, 2013: 44). For countless migrant workers arriving in metropolitan centres each year, urban villages offer a primary 'foothold', providing close-knit communities with central locations, affordable rent, social capital and abundant employment opportunities, thus serving as a bulwark against the uncertainties of city life (Saunders, 2011).

The proliferation of urban villages correlates with China's swift urbanisation and neoliberal urban policies. This surge in land marketisation has, in turn, marked urban villages as a focal point for land capital

accumulation by real estate developers (He and Wu, 2009; Kochan, 2015). Situated within productive and high-rent districts, these village-like communities have frequently been targeted for land expropriation, succumbing to redevelopment projects designed to yield enormous profits (Romano, 2020; Zhang et al., 2022). Such 'clean-sweep' approaches that give little thought to the social costs have had profound impacts on local communities, particularly the migrant populations (tenants), often resulting in their relocation to more distant peripheries. Davidson and Lees (2005) argue that this trend towards urbanisation and the desire for an urban(e) lifestyle contributes significantly to a global pattern of gentrification under neoliberalisation, particularly in the cities of the developing world.

Implicit in these large-scale renewal initiatives is a state-led narrative that portrays the physical environment of urban villages as substandard – a trio of dirty (*Zang*), chaotic (*Luan*) and inferior (*Cha*) in Chinese – compared to newer constructions (Hayward, 2022). A dense agglomeration of five- to eight-storey tenement buildings, colloquially known as 'handshake buildings' due to their proximity to one another, creates a hyper-dense spatial pattern and high-coverage

urban fabric (Gao et al., 2020). Despite of the condemnation of their poor spatial density, existing studies have emphasised their role in forming close-knit social ties and thus fostering rural–urban social integration (Dong, 2020; Liu and Jia, 2021). Recognising the socio-economic importance of urban villages, a number of municipalities in China have promulgated a well-documented regeneration master plan and initiated pilot projects (e.g. micro-regeneration, organic regeneration) to explore an alternative redevelopment approach. In practice, nevertheless, the planings were not always implemented effectively because the renewal of urban villages rarely depends solely on a single actor but involves negotiation between different stakeholders who have their own ‘private’ goals (Liu and Wong, 2018). The government now seeks to establish a rule-based redevelopment policy rather than discretionary decision making; however, it faces difficulty in tailoring a one-size-fits-all approach to city-wide urban villages, accounting for significant variations. Cities like Shenzhen have recently carried out an informal housing renewal policy to classify urban villages contingent on their locations and physical condition for adopting targeted approaches, but the criteria for categorisation are not clear cut (Wu and Coppens, 2024). To understand why regeneration initiatives fail in particular locations, it is necessary to dig deeper into how economic forces drive the redevelopment process in the informal context.

Previous research has explored the economic interaction between urban villages and their surrounding city zones, particularly the disamenity effect on housing prices (Chen and Jim, 2010; Hussain et al., 2021). Also, informal settlements tend to generate and grow incrementally regarding spatial extension and attachment, which requires a longitudinal study to trace the interaction mechanism (Kamalipour and Dovey, 2020). Yet a comprehensive understanding of the

self-organised evolution of these settlements within a cross-city economic geography context remains elusive. Urban economic theories have traditionally modelled cities under assumptions of formal regulatory and market environments (Glaeser, 2008), which do not hold in scenarios where informal settlements and economics activities like urban villages thrive. More precisely, the standard models (i.e. the spatial equilibrium model), which typically align increased property values with proximity to urban centres, are often inadequate for explaining non-linear irregularities – high spatial agglomeration with surprisingly low housing prices – generally presented by informal settlements in the Global South (Karunaratne, 2023). These theories often fail to account for the resilience of informal housing markets and their influence on urban land values and development trajectories.

This study aims to address these missing accounts by integrating the concept of the ‘form–context ensemble’ (Alexander, 1964) with spatial equilibrium models in urban economics, thus proposing a revised framework that better accommodates the irregularities introduced by urban informality. It contributes to the scholarship on two fronts. First, at the theoretical level, we introduce a modified spatial equilibrium model that incorporates the anomalies of high-density, low-cost housing areas. In contrast to the standard Alonso–Muth–Mills (AMM) model that mainly focuses on the formal housing market, this helps to provides a more nuanced understanding of urban agglomeration, recognising the role of informal settlements in shaping urban economic landscapes. Second, at the methodological level, we propose a ‘trade-off triangular matrix’ to evaluate the utility of informal settlements according to multiple socioeconomic factors, such as density, accessibility and affordability. It provides a comprehensive framework to assess the impacts of

upgrading programmes and policy interventions on these vulnerable communities.

Urban informality, locations and price discrepancies

The existing literature on informality has grown over the past 30 years, with studies highlighting the positive role of informality in shaping the affordable housing market (Arnott, 2008; Durst and Wegmann, 2017; Roy, 2005). Informality, in many of the study contexts, refers to temporary accommodation settings or illegal dwellings in contrast to the regulatory housing market. Notably, Gurran et al. (2021) coined the term ‘hidden homes’ to indicate informal housing arrangements in Sydney that exist outside of the formal legal frameworks. That pressure alleviation mechanism has been observed in many high-cost cities in the Global North, where informality is recognised as a choice for addressing affordable housing shortages in mature capitalist markets (Wegmann and Mawhorter, 2017). Conversely, in the Global South, a massive portion of the urban population, mainly the poor and low-income group, has no choice but to reside in informal settlements (United Nations Human Settlements Programme (UN-Habitat), 2020). Compared with the sporadic praxis of informal housing in the Global North, these settlements are often situated on the peripheries of urban areas or within underutilised urban spaces, form in response to acute housing shortages and are characterised by a lack of formal land-use planning and regulation by the public authorities (Boanada-Fuchs et al., 2024; Grashoff, 2020).

Chinese urban villages provide a peculiar form of informal settlement which blends the characteristics of both the Global North and the South. On the one hand, they are typically located in regions that were once peripheral but have become enveloped by

sprawling urban growth (Wang, 2016). These ‘urban enclaves’ are not merely a remnant of the rural landscape but are now an integral element of the highly knitted urban fabric, though contrasting starkly with the formal cityscape, serving as critical hubs of affordable housing and vibrant economic activity (He, 2013; Wu, 2016). On the other hand, the informal status of the urban village is similar to that in the Global North; property rights are directly embedded in the well-established housing market because landlords (i.e. indigenous villagers) use the property as a ‘business’ to procure profits by leasing as many units as possible to migrant workers who cannot afford the exorbitant rents of the formal housing sector (He et al., 2010; Niu et al., 2021).

There have been ongoing debates on the impact of the informality location on property or land value. Typically, land and housing prices around urban villages are significantly lower than those in the formal housing market at the same location, and they have a disamenity effect on the surrounding area (Chen and Jim, 2010; Hussain et al., 2021). Drawing on field surveys in Shenzhen, Song and Zenou (2012) point out the ‘price discrepancies’ arising due to the cluttered physical environment, perceived instability and lack of services, factors that reduce the desirability of these informal housing units. However, in a changing context, the presence of urban villages in a central location may also place a potential premium on surrounding land values over time, as these areas are more likely to become focal points for redevelopment, and later on for more lucrative commercial or real estate projects (Wu and Wang, 2017).

Scholars have tried to understand the persistent disconnection between these settlements’ actual land values and what would be expected given their desirable locations; however, it has been widely acknowledged that the economic interaction is highly

complex with significant intra-system variation (He et al., 2024; Zhang et al., 2016). Previous studies have attempted to unravel the valuation determinants of informal settlement by using quantitative econometric measures (e.g. the hedonic pricing model) (He et al., 2024; Nakamura, 2017). Thus far, the theoretical models of urban economics, which typically align increased property values with proximity to urban centres via a spatial equilibrium lens, cannot explain the realities of informality. These models fail to account for the deviation of hyper-density exhibited in informal settlements, which depart from the standard assumption of urban density distribution patterns under agglomeration economies. To fill this lacuna, this study aims to incorporate informality into the classical spatial equilibrium model to deepen the understanding of how density, property values and location influence both the morphological traits of urban villages and their socio-economic outcomes.

Form-context ensemble: A conceptual framework

The intersections between the physical space, functional use and institutional processes of settlements invite a re-evaluation of the relationship between the built environment's 'physical' and 'social' dimensions. Established studies often make rigid distinctions between the dual realms, limiting the understanding of how physical structures like buildings and roads influence socioeconomic activities (Gao et al., 2020; Kamalipour and Dovey, 2020). For example, superficial similarities in form and layout between urban villages and slums may obscure fundamental institutional differences. To transcend the weakness of overgeneralizations, we propose a synthetic framework that appreciates the symbiosis between the physical and social domains.

This analysis framework incorporates two critical dimensions: an integrated analysis of

settlement form-contextual factors, and a diachronic analysis focusing on the evolution of institutional processes. Drawing from Christopher Alexander's 'form-context ensemble' concept, we adopt a perspective that evaluates the 'fitness' between form and its context as central to any design problem. Alexander posits that understanding the complexity of an ensemble begins by examining the fit at an 'arbitrarily chosen boundary' and that the form's evaluation apart from its context relies on a precise mathematical description of that context (Alexander, 1964):

Fitness is a relation of *mutual acceptability* between these two. In a problem of design we want to satisfy the mutual demands which the two make on one another. We want to put the context and the form into effortless contact or frictionless coexistence. (Alexander, 1964: 18–19; emphasis mine)

Applying these principles to the study of informal settlements implies an organic growth process, where differentiation and adaptation culminate in a coherent whole. This perspective reveals that a urban village is constructed through the gradual differentiation of its components, adapting both to each other and to their broader context. To advance this analysis, we delineate the economic boundary as our field of context, based on theories of agglomeration economies and spatial equilibrium models (Glaeser, 2008), with a particular focus on 'density' as a critical nexus linking economic analysis with morphological study.

We present a longitudinal analysis in the second part of our framework. While previous studies on urban economic modelling often prioritise current condition or isolate time series related to a specific event (Huang and Kahn, 2023; Meltzer and Schuetz, 2012; Wu and Coppens, 2024), we aim to capture an evolutionary trajectory of urban form within economics of space from an institutional lens. An archival approach informed

by Boustan et al. (2018) allows us to appreciate the context, timing and policy outcomes across historical periods. As such, the term ‘urban village’ is scrutinised not as a static concept but as one that evolves through time, shaped by policy interventions and institutional junctures (Sorensen, 2023).

Methods

Study area

As a high-density city accommodating over 60% of the migrant population without formal citizenship, Shenzhen offers a prime example to study the evolution of informal settlements during the fastest-urbanising process in the Global South, with rapid demographic shifts, economic development and rural-to-urban migration (Raco, 2003; Wu and Wang, 2017). According to municipality data from the land resource sector, the total land area of urban villages in Shenzhen reaches above 3.2 km², accounting for about 16.7% of the total land area in the city.

Given the large volume of informal properties, which comprise nearly half the total housing stock, the government has made various attempts in the last two decades to redevelop urban villages; however, a city-wide renewal policy has not been effectively implemented. Many of the conservation attempts in the early stages ended up with the ineluctable demolish–reconstruction decision, which solely profits the stakeholders in the short run while displacing migrants and increasing inequality (He, 2013; Lai et al., 2017; Wu and Coppens, 2024). From the late 1970s to 2020, the number of village units in Shenzhen dwindled from approximately 2000 to below 320. Yet, as of 2021, informal housing in these villages still constituted over 70% of the city’s rental market volume. In fact, these village enclaves have been the ‘last resort’ for a significant portion of young graduates and migrant workers with low

earnings in the labour market and substantial income inequality.

Data

We used the Shenzhen Statistical Yearbook 2020 of different administrative districts, along with open-source commercial urban village datasets like CoralDATA (<https://www.coraldata.com.cn/>), as the two main data sources for compiling development matrices of urban villages, including population density, sizes, land use attributes and renewal status. To capture the tendency for property value change in the real estate market, we collected historical housing transaction data on urban villages from Anjuke (<https://www.anjuke.com/>), one of the biggest online housing consulting platforms in China. By integrating these datasets in ArcGIS, a comprehensive picture of the economic and spatial dynamics of urban villages in Shenzhen was formed. Given the polycentric nature of Shenzhen, we used spatial big data (i.e. point of interest (POI) data) for identifying the urban centre system, which can pinpoint each urban village’s location in the spatial equilibrium model. POI data across the entire city area was collected and extracted from Gaode Maps API (<https://lbs.amap.com/>), including entity names, geographical coordinates, categories and addresses. Following previous studies (Burger and Meijers, 2012; Deng et al., 2019), we divided these into 10 categories for calculating the centrality index based on functionality density and diversity. We used normalised entropy to measure the agglomeration degree of various types of POI within each fishnet with a granularity of 200 m × 200 m. This was then corrected by the Theil index considering hierarchical differences of facilities distribution (i.e. neighbourhood, street unit, district, etc.). Finally, we extracted the top five percentile of the regional aggregation surface and marked the urban centres by Thiessen polygons analysis.

We also employed a stratified random sampling (SRS) procedure with Neyman Allocation for selecting representative urban village samples covering different administrative districts (Wright, 2012), which ensures that the samples cover a wide range of locations and maintains internal diversity within each stratum. The main stratification taken into consideration is the location (the average distance to urban centres), while we allocated more samples to strata with greater variability such as population density, the type of functional zone (residential, commercial, industrial) and socio-economic status.

Model

The foundational urban economics model for understanding spatial equilibrium is the AMM framework, which employs an optimal-control model for a representative agent within a monocentric city structure (Brueckner, 1987; van Den Bergh et al., 2012). More precisely, it articulates how individuals and businesses distribute themselves across space in a way that balances the benefits and costs of location. The model assumes that higher density areas, such as city centres, offer greater accessibility to jobs and amenities, which in turn increases the demand for land and property value. Conversely, as one moves towards the urban periphery, the density decreases along with the land value, reflecting lower accessibility and amenity levels (Glaeser, 2008; van Den Bergh et al., 2012).

Notably, the standard form of the model is based on a monocentric assumption, which has proven unfit for many large cities under suburbanisation, therefore prior studies (see DeSalvo and Su, 2019; Schmidt et al., 2021) have extended the AMM model in the context of the polycentric urban structure. The validity and performance of the model has been empirically testified in the major US cities and European metropolitan regions. Drawing on these analyses, the

basic formula for expressing housing price in relation to weighted mean distance under polycentric setup is given by:

$$Price(\bar{d}) = P_0 e^{-\beta \left(\sum_{i=1}^n Cl_i d_i \right) / \left(\sum_{i=1}^n Cl_i \right)} \quad (1)$$

where P_0 is the housing price at the main city centre; β is a decay parameter that reflects how quickly prices decrease with distance from the centre; d_i is the distance from the point of question to the i th centre; and Cl_i is the centrality index of the i th centre. This gradation in density and land value can be visualised in Figure 1, panel (a). The distribution results from the trade-offs that individuals make between living in high-density areas with higher costs but more amenities, and living in lower-density areas that require longer commutes but at a lower cost. Spatial equilibrium is achieved in this Pareto efficiency where no individual can improve their utility by relocating, given the distribution of prices and amenities.

Urban informality, as observed in places like Shenzhen's urban villages, can alter standard price gradients by introducing anomalies in the expected utility and cost functions due to factors such as lower rents, higher density and substandard housing quality. To integrate these aspects, we adapt the utility function to reflect deviations from informality:

$$Utility(x, h, \bar{d}) = \alpha \log(h) - \gamma c(\bar{d}) - \phi(x, h, \bar{d}) \quad (2)$$

$$Price_{UV}(\bar{d}, \delta) = P_0 e^{-\beta \left(\sum_{i=1}^n Cl_i d_i \right) / \left(\sum_{i=1}^n Cl_i \right) + \delta} \quad (3)$$

where household utility derived from housing consumption h , at a location x with a weighted mean distance $\bar{d}$. ϕ represents the informality term, including variables like housing quality, density and social-economic activities. δ represents a discount factor

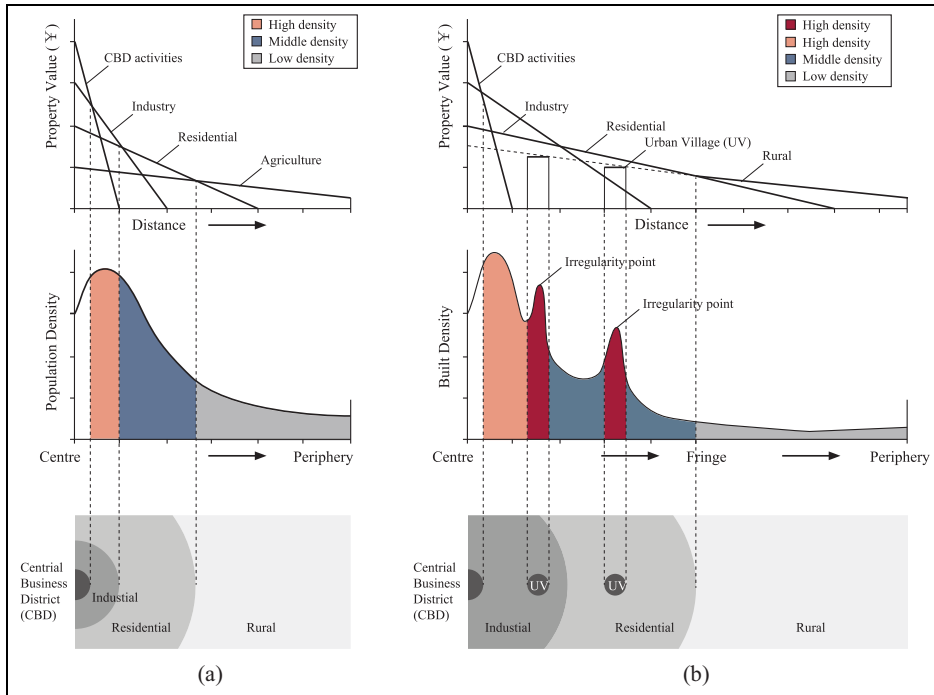


Figure 1. Urban density and property price gradients across urban configurations. (a) Standard monocentric model. (b) Model with urban informalities

Notes: The figure illustrates theoretical patterns of urban density and property values. Panel (a) shows the conventional urban economic model with smoothly declining gradients from centre to periphery. Panel (b) introduces urban village effects, showing density and price 'irregularity points' that deviate from standard patterns. Both panels display property values (top), population/built density (middle), and land use patterns (bottom)

attributable to informality. As shown in Figure 1(b), the amended AMM model on urban informality shows fluctuations in built density along the curve. These deviations signify urban villages that exhibit hyper-density and provide affordable housing options yet do not conform to the standard expectations of diminishing property values with increasing distance from the CBD.

Empirical results: Urban villages in economics of space

Density deviation from informality

The premise of rational choice theory prompts us to question why individuals

decide to reside in crowded, disordered and seemingly unsightly urban village enclaves rather than in the city's periphery. The answer appears sharply clear: the access to amenities and services. However, the spatial equilibrium hypothesis assumes that the choice of residence is a trade-off under the constraint of various factors to maximise household utility. Among these, we prioritise density and price for two reasons. First, density provides a tangible measure of morphological conditions and is often equated with crowding and extensive land use (Kamalipour and Dovey, 2020). Second, housing price acts as a primary market force that determines

Table 1. Urban village samples in Shenzhen.

UV sample	Admin district	Location in the city	Population density (people/hectare)	Density ratio (UV/FC)	Floor area ratio (FAR)	Floor area ratio (UV/FC)	Housing price (US\$/m ²)	Price ratio (UV/FC)
FT-1	Futian	CBD	52,127	2.857	6.385	1.663	9353	0.881
LH-2	Longhua	Technology park	32,562	3.524	5.731	1.550	8014	0.804
LH-3	Longhua	Residential area	19,850	3.972	4.840	2.135	7605	0.833
LU-4	Luohu	Commercial hub	45,302	4.205	5.254	2.077	9120	0.748
YT-5	Yantian	Historical district	25,323	3.240	4.516	1.922	6834	0.783
BA-6	Baoan	Transportation hub	28,259	2.702	3.853	2.474	5025	0.811
LG-7	Longgang	Industrial zone	31,965	3.021	4.808	1.983	4623	0.650
DP-8	Dapeng	Urban periphery	15,600	2.314	3.560	2.346	3706	0.726
NS-9	Nanshan	University neighbourhood	36,282	3.715	4.083	1.830	7114	0.663
LH-10	Longhua	Mixed-use zone	29,557	3.067	5.132	2.561	6734	0.796

Notes: The table reports urban village characteristics and comparative metrics in Shenzhen, China. Housing prices are expressed in constant 2021 US dollars per square metre. FC denotes metrics for formal communities while UV represents urban villages. The density ratio is calculated as UV population density divided by adjacent FC population density. Floor area ratio measures the ratio of total floor area to land area. Price ratio represents the UV housing price as a fraction of comparable FC housing price in the same location. All ratios are derived from author's calculations using Statistical Yearbook 2021–2022 data supplemented with CoralDATA records.

individual choices. Therefore, in urban areas, the advantages of a convenient location and abundant amenities typically come with a trade-off of higher property prices.

However, when we apply the AMM model to the real urban landscape, particularly those characterised by inextricable informality, we find discrepancies between the theoretical predictions and the observable patterns. To investigate these discrepancies, we undertook a cross-sectional analysis measuring both density and price levels of the urban village form–context ensemble.

Table 1 presents a comprehensive index catalogue encompassing the form–context ensemble, which includes a range of physical and socio-economic indicators such as land area, population density, floor area ratio and pricing information. Meanwhile, comparisons are calculated of different indicators between the urban village sample and its neighbouring formal community in the same location. Subsequently, this cross-sectional data is juxtaposed against the AMM model's projections to discern variances and to offer a more nuanced understanding of urban form and economic dynamics accounting for urban informality. We display the cross-sectional profiles of urban village samples in Figure 2, showing significant density deviations along the urban–rural gradient from the standard AMM model (dashed line) in Shenzhen. The solid line records several urban villages exhibiting remarkable irregular spikes in density (over 3000–5000 people/km²). These outliers (LU-4, NS-9, LG-7 and LH-10) are consistent with our amended AMM model's characterisation of urban villages – exceptional population density concentrations while maintaining below-market housing costs. The discrepancy here underscores the need to re-evaluate traditional urban economic theories, acknowledging that urban villages represent a distinct typology within the urban matrix that defies standard gradients of density and price dictated by formal market forces.

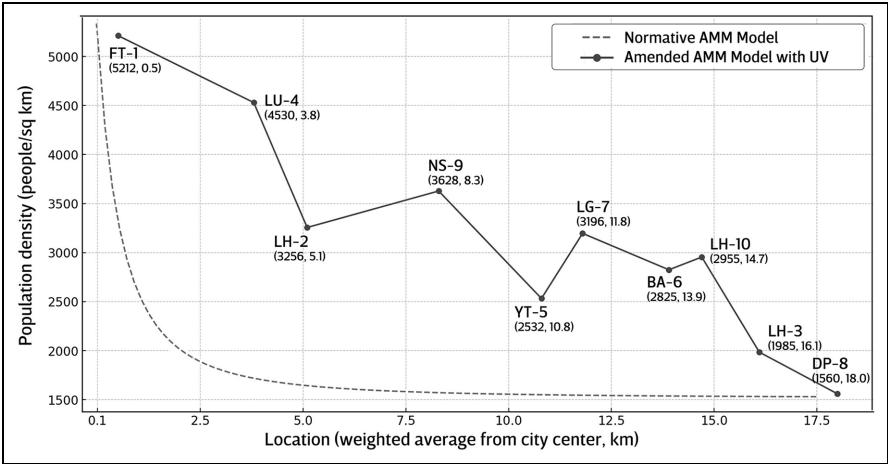


Figure 2. Population density distribution under standard and amended AMM models.
Notes: The figure plots population density (people per square kilometre) against distance from city centre (kilometres) for 10 urban village samples in Shenzhen. The dashed line represents the standard AMM model prediction, while the solid line with data points shows actual observations incorporating urban village effects. Numbers in parentheses show (density, distance) pairs. Sample covers 2020–2021; distances are weighted averages calculated using centrality indices.

The dynamics captured here emphasise the resilience and adaptability of informal settlements in Shenzhen, operating outside the formal parameters of urban economics. One of the main flaws of the standard model is that it rules out the possibility of ‘metabolism’ (Marull et al., 2010), which means that every land has already been used at its optimal level. The hyper-density of these urban villages, with their relatively lower property prices, stands in stark contrast to the anticipated outcomes of this idealised environment, pointing to a coaction of old rural communities, economic constraints and social factors shaping these developments. The complex urban form, embedded within the continuously evolving urban fabric, necessitates a broader understanding that goes beyond a simplified AMM model as assumed, embracing the irregular and often spontaneous nature of urban growth and the creation of informal communities. It is this gap that calls for closer investigation, and in the next section we will offer a longitudinal review.

Features and dynamics of urban village transition

The diachronic evolution of urban villages in Shenzhen epitomises the latent socio-economic developments, underscored by the intricacies of China’s land ownership system. This transformation must be understood against the backdrop of China’s dual-track political economy, which has shaped the process of urbanisation in profound ways since the country’s political economic reforms. Set out like this, we divide the evolution into four phases (Figure 3) – each demarcated by pivotal shifts within the institutional framework, influencing the morphological shifts of urban villages.

- (1) *Phase 1: Pre-reform period (before 1978)*
Prior to China’s economic reforms, Shenzhen’s landscape was predominantly rural. The land was collectively owned by villages, and agriculture was the primary economic activity. The use of land was strictly controlled, and the socio-economic structure was homogeneous, with limited

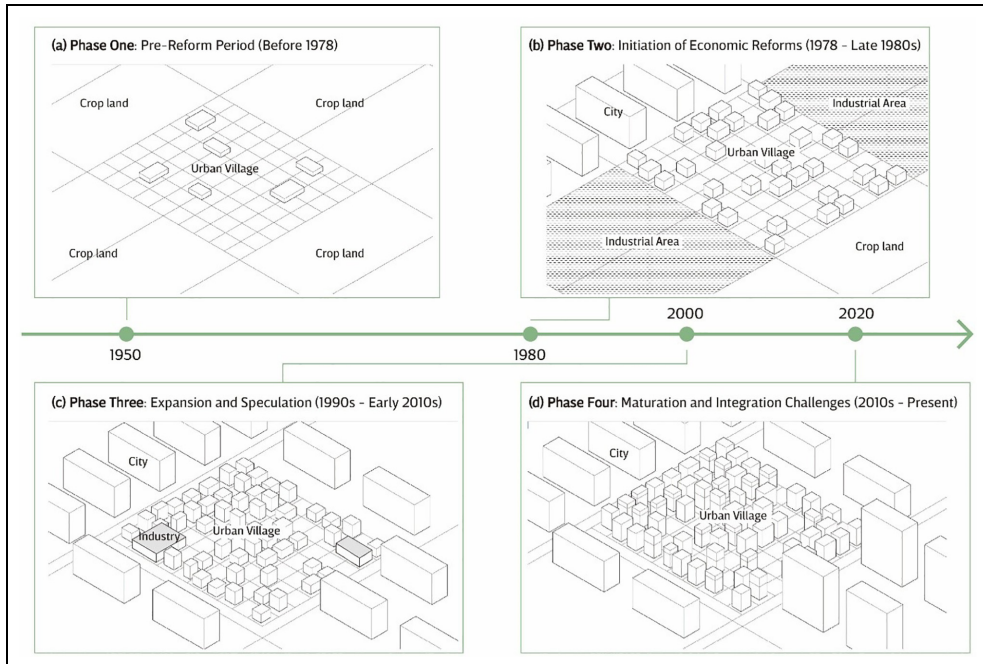


Figure 3. The morphological transformation of urban villages in Shenzhen. There are four phases: (a) Pre-reform rural settlement (pre-1978); (b) early industrial development (1978 to late 1980s); (c) urban expansion period (1990s to early 2010s); and (d) contemporary Integration Phase (2010s to present).

Notes: Author's own elaboration on the four-phase transformation of urban villages in Shenzhen. The diagrams show the progression from agricultural villages to dense urban enclaves, illustrating changes in building density, spatial organization and relationship to surrounding urban development across each historical period.

differentiation between social classes. The emerging *hukou* system since the 1950s enforced a clear separation between the rural and urban populations, restricting migration and therefore keeping urban and rural areas distinct.

(2) *Phase 2: Initiation of economic reforms (1978 to late 1980s)*

The designation of Shenzhen as a Special Economic Zone in 1978 catalysed rapid industrialisation and urbanisation. The introduction of the household responsibility system marked a shift in land use from collective farming to more individualised control within collective ownership. This era saw the emergence of village-level enterprises on collective

lands, transforming agricultural fields into rural collective industrial lands. The industrial boom attracted a wave of rural-to-urban migration. Urban villages began to emerge, as rural lands engulfed by urban sprawl were repurposed to accommodate burgeoning industrial set-ups, beginning as affordable housing sources for migrant workers.

(3) *Phase 3: Expansion and speculation (1990s to early 2010s)*

The 1990s brought about a more pronounced division in the land ownership system, with the state reinforcing its control over urban land while rural land remained under collective ownership. As urban sprawl continued and

land values rose, rural industrial lands became prime targets for acquisition and redevelopment into formal community. At the local level, the separation of land ownership and land use rights became a critical feature, as it allowed villagers to build and rent properties without relinquishing ownership. There was a construction boom where urban villages thrived as mixed-use and unregulated environments, with residential spaces coexisting with or converted into industrial units. The local economic development attracted vast numbers of migrant workers, and villagers (property owners) capitalised on this influx by expanding the number of residential units or adding more floors.

(4) *Phase 4: Maturation and demolition threat (2010s to present)*

The present stage is marked by the maturity of Shenzhen's urban villages. The economic role of these areas has been solidified, and they serve as critical hubs for affordable housing and local entrepreneurship. However, the rapid development has also led to overcrowding, inadequate infrastructure and social stratification. There has been increasing decay and desertion of desolate industrial units, as traditional manufacturing enterprises are upgraded or moved, leaving behind inefficient industrial lands that pose additional challenges for redevelopment. The land ownership system has continued to evolve, with recent reforms attempting to clarify property rights and integrate urban villages into the city's formal planning processes. Despite these efforts, the dual-track system still influences the development patterns, perpetuating a degree of informality in land transactions and use. The challenge now lies in reconciling the need for upgrading and urban integration with the preservation of the

socioeconomic functions that urban villages bear.

Following the outlined four-phase historical trajectory of Shenzhen's urban village transition, we introduce a dynamic urban spatial equilibrium model to analyse in graphic form how the housing prices shift has impacted urban informality. Plotting historical housing transaction data in Shenzhen, Figure 4 presents a comparative analysis of the trajectories of housing prices within formal communities and urban villages over time. The scatter plots capture the upward shift in housing prices as a function of distance from the city centre, delineated for the years 2000, 2010 and 2020. To emphasise the heterogeneity, formal community values are depicted by dots, while the urban village values are marked by plus symbols. Each set of data points is accompanied by an EVC with a 95% confidence interval, representing the projected property values based on the location's distance to the city centre.

The data reveals that the housing values of urban villages always fall below these expected curves in each year of interest, signalling a persistent undervaluation in comparison to the formal community. Moreover, the undervaluation is persistent over the years with urban sprawl, regardless of the changing economic landscape and the delivery of urban policies. The consistent lower price within urban villages underpins informal practices to provide more supply with increasing density, such as self-construction and renovation, with landowners seeking to capitalise on their holdings in the absence of formal market regulations and legal provisions. However, on the flip side, this undervaluation also serves as a signal for redevelopment initiatives, as these areas possess untapped financial potential due to their lower-than-expected market prices.

Based on the empirical analysis, Figure 5 provides a theoretical model of the housing

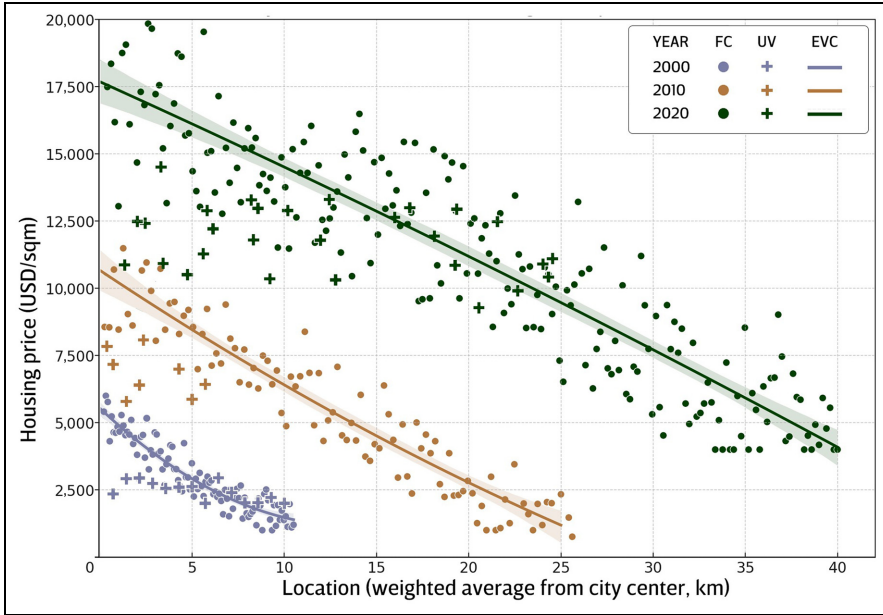


Figure 4. Comparative trajectories of housing prices in formal communities and urban villages from 2000 to 2020.

Notes: The figure presents housing prices (USD per square metre) plotted against distance from city centre (kilometres) for both formal communities (FC, shown as dots) and urban villages (UV, shown as plus signs). Expected value curves (EVC) are fitted for each year. All prices are in constant 2020 USD. Location distances are weighted averages accounting for Shenzhen's polycentric structure.

price dynamics associated with urban village developments and their susceptibility to redevelopment. Again, the EVC is central to understanding the discrepancies between the formal and informal sectors, representing theoretical housing prices based on location. Initially, housing prices exhibit a standard decline from urban centres to rural outskirts. With the introduction of economic reforms, the vacant lands were developed for real estate market investment, which pushed up the expected value and enlarged the urban boundary. This development resulted in urban villages generally falling below the second EVC, with new urban villages emerging since the demand for the informal market is sensitive to price. The gap in prices could only be recouped by additional UV-FCE supply, which is quite elastic under informality, such

as densification or mixed-use development. Meanwhile in the redevelopment stage, urban sprawl working in tandem with regentrification brought externality to elevate the third EVC to a much higher level, and to exacerbate the discrepancies and send a signal to the formal market. It is hard to capture the value gap merely through additional building, thus targeting these areas for either deconstruction or significant structural changes. This persistent undervaluation has been a crucial driver of regeneration practices, such as self-directed upgrades or government-led renovation, aimed at maximising the utility of urban village holdings in the absence of formal development. Concurrently, this undervaluation acts as a stimulus for private investment redevelopment, attracting external interests eyeing the expected profits from these areas.

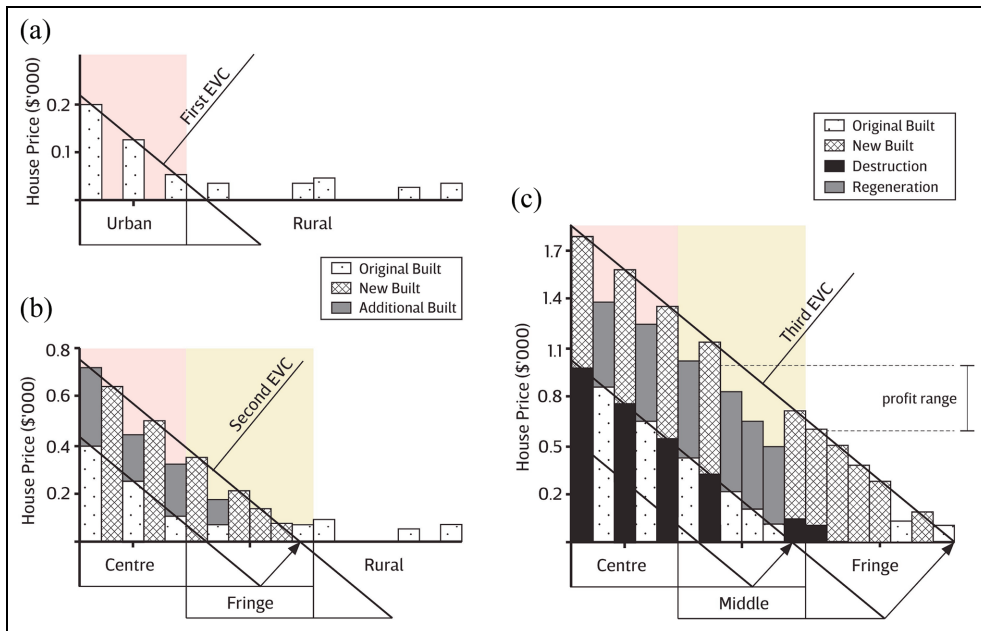


Figure 5. The trajectories of housing value and dynamics of urban village (re)development.

Notes: The figure illustrates the evolution of housing values and development patterns across three stages. (a) Initial urban-rural disparity. (b) Price dynamics during urbanization. (c) Mature-phase development with profit ranges for redevelopment (0.6–1.0 of EVC). EVC denotes the expected value curve; all prices in thousands of constant 2020 USD.

Through statistical analysis of urban village samples that are currently undergoing whole-scale redevelopment or have been listed for resettlement, we found that the urban village property values within the interquartile range of 0.6–1.0 represent viable targets for redevelopment (see ‘profit range’ in Figure 5(c)). Properties within this band are typically located between central urban areas and suburbs, where the economic viability of redevelopment significantly exceeds the value of existing informal settlements. There is an urgent need for alternative value augmentation approaches or the adoption of policy interventions to mitigate the adverse consequences brought about by the great chance of deconstruction and displacement. By integrating our findings with a geographic information system, we can accurately identify and map the spatial distribution of vulnerable informal settlements, granting them the

foresight to anticipate areas at risk before they succumb to the pressures of deconstruction.

Discussion

The redevelopment of urban villages in Shenzhen presents unique challenges that stem from their informal status and the complex socio-economic dynamics they encapsulate (Kochan, 2015; Wu, 2016). Although the redevelopment of urban villages has become an object of public concern, it still faces great challenges. One of the principal issues lies in reconciling the economic imperatives driving land development with the social and housing needs of the low-income and migrant population. The tension becomes more acute near the city centre, where the baseline land value is higher than in peripheral districts. Due to the elasticity and flexibility of UV-FCE, the

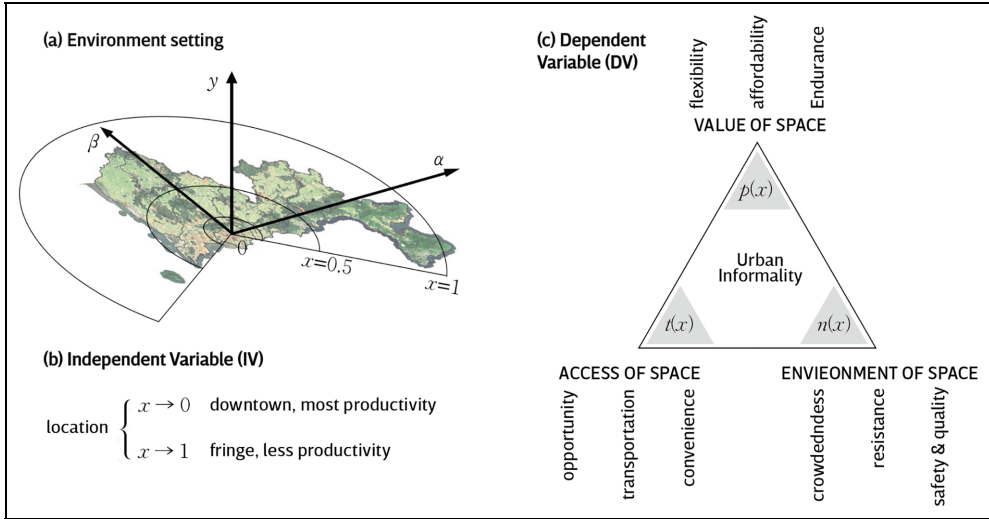


Figure 6. Spatial optimality matrix of urban informality for urban planning.

Notes: The figure presents the analytical framework for evaluating urban village development. (a) The geographic setting with productivity gradient ($x \in [0,1]$). (b) Definition of the location-based productivity index. (c) The triangular optimization matrix showing relationships between space value, access, and environmental quality. Variable definitions: α = angular coordinate, β = radial coordinate, $p(x)$ = price function.

densification and production of informal space will persist, driven by the incentive to bridge the value discrepancy. This often results in an increase in substandard rental units with construction and management risks. Simply demolishing these areas can only push up the EVC to a higher level, causing large-scale eviction and enlarging inequality, as long as the demands for affordable housing still exist. Therefore, diverse redevelopment policies, such as small property rights housing, long-term rental apartments and welfare housing, have been explored to support long-term tenancies and maintain affordability amid rising prices (He et al., 2024). The need to scale back the ‘invisible hand’ and decide which approach is more suitable for each urban village within the broader urban redevelopment landscape has been brought into sharper focus.

We propose an optimality matrix to measure the externalities and utility gains derived

from the redevelopment of urban villages within the spatial equilibrium framework. The focus here is more on a theoretical framework that reveals the trade-offs when making targeted redevelopment planning across metropolitan geographies. Our starting point is the spatial coordinate, conceived as a continuum of potential neighbourhoods within the urban economy, each quantified by a productivity index x within the interval $[0,1]$. At one extreme, we have central locations (e.g. Nanshan district) at $x = 0$, representing the zenith of productivity in Shenzhen. As x approaches 1, we transition towards the metropolitan peripheries, characterised by diminished productivity and increased commuting challenges. In this setting, each axis represents an independent variable, and the radian measure may be employed to precisely locate positions within the two-dimensional coordinate system, as demonstrated in Figure 6(a).

In this spatial framework, a planner's role is to select and classify subsets of urban villages for different redevelopment approaches, aiming to efficiently distribute the population and resources to maximise the overall utility of the city. This decision-making process is steered by the principle of spatial equilibrium, where the planner must reconcile between diverse location-specific dependent variables. As illustrated in Figure 6(c), the optimality triangular matrix emerges as a pivotal tool for balancing these dependent variables, ensuring that the value of space, access to space and amenity (environmental quality) of space are fully considered. For example, on-site upgrading standards may be employed to balance household affordability with high-density risks, thus standardising utility levels for all households. Whether government-led or market-driven, the redevelopment project would inevitably generate negative externalities and lower social surplus if it pursues an imbalanced goal. Therefore, from the perspective of optimality, it is necessary to establish reasonable redevelopment expectations for stakeholders, guiding the transformation of urban villages into integrated, sustainable parts of the urban fabric.

Conclusion

In 'The economics of urban density', Duranton and Puga (2020) demonstrate a meaningful trade-off between the benefits and costs of density, mediated by both market and political forces. This article supports this claim by observation from the density irregularity of urban villages in Shenzhen, which throws new light on the broader framework of urban informality. The spatial equilibrium model was applied and adapted to examine the relationship between urban location, spatial density and housing price. The study revealed three key findings about the form-context ensemble.

First, it challenges the standard AMM model by revealing a unique density deviation pattern exhibited in informal settlement. Characterised by 'anomaly hyper-density' at lower housing prices, these areas defy the expected norms, providing empirical evidence on how the self-organised, adaptive nature of urban villages responds to market shift, economic pressures and spatial constraints. Second, our research traced the evolution of urban villages in the economics of space from a longitudinal observation. The results showed that the price discrepancy under the EVC is crucial to understand the economic thresholds that trigger redevelopment, potentially leading to the displacement of these established communities. Third, we proposed an optimisation approach to evaluating and maximising the utility of informal settlements based on multiple socioeconomic factors. The development of a trade-off triangular matrix allows for a balanced consideration of various urban factors, providing a more qualitative and explanatory perspective on urban planning decision-making.

In total, the redevelopment of urban villages in Shenzhen is not merely an isolated phenomenon but a reflection of a broader socio-economic structure and land-use transition that characterises rapid urbanisation in mega-cities across developing countries. Our findings align with Nakamura's (2017) and Posada's (2018) attempt to incorporate informal housing into the standard urban economic model (Glaeser, 2008). We extend this understanding to the specific context of informal settlements in rapidly urbanising cities where the economic implication of informality remains insufficiently explored. While the results bolster the evidence for understanding the evolution and functionality of urban villages in Shenzhen, it is important to acknowledge certain limitations and suggest directions for future research. One key limitation lies in the focus on economic and

spatial factors, which do not encompass the entire spectrum of contextual forces shaping informality. Social, cultural and institutional factors also play significant roles in the development of these communities.

The findings of this study laid the groundwork for future urban policymaking and planning, which may assist in optimising the physical environment of informal settlements and avoiding drastic clearance. Local governments need to be cautious regarding the urban villages falling into the profit range and develop alternative regeneration planning to alleviate the pressure brought by value discrepancy. Additionally, a classification of urban villages based on access, value and environment is suggested for a targeted redevelopment approach. The implications of this research are far-reaching, offering guidance for cities worldwide grappling with similar challenges of rapid urbanisation, informality and the need for sustainable, inclusive urban development strategies.

Acknowledgements

This research began during my tenure as a city planner at the Arcpuls Institute of Shanghai Design & Research (AISA). I am thankful to AISA for providing grants and resources for several field studies in Shenzhen. The core research and writing was later completed at the University of Cambridge, where I received valuable support and insightful suggestions from Simon Han at the Department of Architecture. I am also grateful to my current PhD advisor, Rachel Meltzer (Harvard University), for her expertise in urban economics, which was instrumental for me in finalising the analytical part. Finally, I deeply thank the editor and anonymous reviewers for their constructive comments and feedback.

Declaration of conflicting interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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