

The Impact of Land Resource Efficiency on Urban Economic Performance

Ziheng Wang *

The Second Branch School of The High School Affiliated to Renmin University of China, Beijing,
100097, China

* Corresponding Author Email: ziheng090311@outlook.com

Abstract. As urbanization accelerates, land resources, which are the core factor of production for urban development, have become one of the most important factors affecting the quality and sustainability of economic growth. This study begins with a systematic theoretical elaboration of land-use efficiency, examines its relationship with urban economic performance, and reflects on typical practical cases to demonstrate how efficiency optimization promotes urban development. As per the research, land use efficiency impacts economic performance through three channels: improving factor productivity, strengthening industrial agglomeration, and enhancing spatial structure. Models of production land use, such as intensive industrial land use and mixed-function development, can effectively reduce enterprise costs, enhance innovation vitality, and boost urban competitiveness. Mixed-use land policies and smart management are planning tools that can enhance efficiency if integrated together wisely. This study offers a theoretical foundation and practical reference for the scientific formulation of land management strategies and high-quality urban development. Efficiency in the use of land can foster urban economic performance, factor productivity, and industrial agglomeration. The key is the selection and design of land use policies.

Keywords: Land Resource Efficiency; Urban Economic Performance; Case study.

1. Introduction

Land use issues generate increasingly complex problems for urbanized countries. Global urbanization has increased at a fast rate since 21st century. UN-Habitat's estimate of the urban built-up area of the world was 770,000 square kilometers in 2000 and 1.38 million square kilometers in 2020, an increase of 79 %. China has been experiencing one of the fastest degrees of urbanization in the world. The proportion of urban resident population was 36.2% in 2000 and it rose to 65.2% in 2022. As The urban built-up area rose from 22,400 to 63, 200 square kilometers between 2000 and 2022 [1]. The fast growth caused a very large change of farmland into housing, industry and business. land is an on-renewable resource, therefore the tension between limited supply and ever-increasing demand of urban economies is becoming more considerable. Some cities have widespread inefficient land-use pattern such as low plot ratios for industrial land and scattered layout of residential and industrial zones. This has caused "sprawl" or sprawling. Intrusion on the environmental space, which raises the operational cost of companies and the burden on residents. At the same time, the shortage of land in core functional areas has also constrained the agglomeration of innovative elements and the release of economic vitality. As the land will become substantially more expensive, we need to improve land use efficiency or increasing economic output with less land input to overcome urban development bottlenecks and achieve sustainability.

Theoretically, although previous studies have shown that land is an important contributor to economic growth, the debate about what is meant by "land use efficiency" has received insufficient attention. Most of the literature assumes land as a fixed input variable; by seeing land only as zoning policy they ignore the various differentiated impacts of its allocation structure and dynamic management on economic performance [2][3][4]. From a practical perspective, China's "14th Five-Year Plan" explicitly states that "we should carry out urban renewal initiatives to enhance the efficiency of urban space use". There is an urgent need to clarify at the theoretical level the mechanisms linking land efficiency and economic performance, in order to propose differentiated land policies. Theoretically, previous studies do not consider how allocation structure and dynamic

management shape urban economies. This work. Combines resource-based view and institutional economics with property rights. A framework may be developed through land efficiency mechanisms with an objective of. analyzed. As per the Resource-based View (RBV), strengthening agglomeration. Zoning for Mixed-Use Development Benefits Economies, Institutional Economics It demonstrates the cost-effective role of property rights in urban renewal. Three. pathways are identified. One pathway is spatial concentration yielding higher. productivity. Networks assist in establishing industrial linkages through institutions. clusters. Cross-sector policies enhance the efficiency of the system. When countries are compared, real behaviour will attest to the actual performance-based mechanism. Theories are Strengthened by Smart Governance. China's 14th Five Year Plan. Efficiency is enhanced by making use of evidence-based urban renewal, points out the phenomenon. planning for land and policy. It also provides scientific advice on urban land control.

2. Literature Review and Theoretical Framework

2.1. Theoretical Connotations of Land Use Efficiency

Land use efficiency can be conceptualized through two dimensions: single-factor efficiency and comprehensive efficiency [5]. Single-factor efficiency measures direct economic output per unit of land area (e.g., GDP per hectare of industrial land or tax revenue per hectare of commercial land). While this metric highlights land's immediate contribution as a production factor, it overlooks broader sustainability and equity considerations. For example, high GDP density in industrial zones may coincide with environmental degradation or social inequity. Comprehensive efficiency, conversely, emphasizes synergies between land and other factors of production (labor, capital, technology). It prioritizes structural optimization (e.g., balanced residential, industrial, and commercial zoning) and management practices (e.g., increased floor area ratios or redevelopment) to achieve "higher composite outputs with fewer land inputs," encompassing economic, social, and environmental benefits [6].

2.2. Linkages Between Land Efficiency and Urban Economic Performance

There are three primary pathways link land efficiency to urban economic performance: Factor Productivity Channel: Efficient land use lowers land rents and ancillary costs (e.g., reduced commute times, streamlined infrastructure), freeing capital for R&D or equipment upgrades to enhance total factor productivity [7][8]. Industrial Agglomeration Channel: Compact land layouts foster knowledge spillovers, supply chain coordination, and labor market matching, enabling economies of scale and externalities [9]. Spatial Structure Channel: Mixed-use development (e.g., integrating residential, commercial, and industrial functions) optimizes urban operational efficiency by balancing work-housing needs, reducing traffic congestion, and minimizing resource waste [10].

2.3. The Impact of Land Efficiency on Urban Economic Performance

Industrial land serves as the cornerstone of urban production systems. Empirical evidence demonstrates that increasing industrial land floor area ratio (FAR) from 0.6 to 1.2 (aligned with developed-country standards) can elevate unit land manufacturing output by over 50% [11]. High-efficiency industrial land drives growth through the four pathways. Cost Reduction: Elevated FAR minimizes land occupancy, reducing acquisition/rental expenses. For instance, Shenzhen High-Tech Zone achieved higher output per hectare than conventional zones via compact layouts [12]. Innovation Spillovers: Integrated industrial parks facilitate shared R&D facilities and services, accelerating technological advancement. Berlin's Industry 4.0 demonstration zones slashed R&D cycles by 30% through shared laboratories and data platforms [13]. Commercial Land Efficiency: The Engine of Service Sector Growth. Commercial land efficiency hinges on spatial agglomeration and functional integration. Key mechanisms include two ways. Agglomeration Economies: Central business districts (CBDs) or mixed-use complexes reduce transaction costs for firms and consumers. Shanghai's Lujiazui Finance District—home to 40% of the world's top 100 banks exemplifies this

dynamic [14]. Work-Housing Balance: Mixed-use zones (e.g., offices, retail, and cultural spaces) attract high-end services. London's Canary Wharf lured global tech firms like Google and Meta through integrated development [15]. Residential land efficiency has influence on talent attraction and social equity. Residential land efficiency shapes housing affordability and workforce retention through two ways. Cost Mitigation: Balanced work-housing layouts reduce commute times and housing costs. Tokyo's "work- housing balance" policy caps average commutes at 30 minutes. Human Capital Development: Proximity to educational and healthcare resources attracts skilled labor. Boston's "innovation districts"—melding residential and academic spaces—boast PhD populations double the national average.

3. Case Study

Cities worldwide are facing intense challenges related to land scarcity and demand for space as urbanization accelerates globally. In this context, Singapore, Hangzhou, Berlin, Tokyo, and Shenzhen have presented a wide range of representative practices that optimize the efficiency of land use. For urban areas, well-designed policies, initiatives powered by technology, and effective planning can achieve the desired outcome of sustainable urban development. Thus, they must operate in synergy to create the cumulative effect sought. The government of Singapore implements an integrated new town development model combining “housing, industry, commerce, and greenery.” As a result, residential, work, commercial and public space areas are conveniently integrated, avoiding undue segregation of urban functions. Through scientific planning, a majority of the work, shopping and leisure activities can be fulfilled in a very short distance from residing. This would facilitate hassle-free movement and result in reduced travel time with an enhanced quality of life. It further helps in improving the efficiency of land use and enhancing the vitality of the area. This practice also boosts residents' sense of well-being. Hangzhou leads the way in digital governance. The city is powered by the “Urban Brain”, which utilizes artificial intelligence, big data, and GIS (Geographic Information Systems) technology for urban management and spatial planning. The system processes a lot of data every day and automatically reorganizes the layout of shops, the distribution of public goods and the efficiency of traffic. This vibrant management model cuts the vacancy rates of commercial properties, increases tax revenue, and adds to the city's attractiveness and competitiveness, thus illustrating the great potential of smart city technologies for better land use efficiency. Berlin is tackling the challenge of transforming its industries and reusing spaces. The city government uses GIS technology and industrial transformation policies to turn existing inefficient industrial zones into technology parks that attract high-tech companies, newly-established enterprises, and research institutions. The policy does not only foster the concentration of valuable-added sectors. Furthermore, it aims to build an urban innovation ecosystem. With this, Berlin is slowly becoming one of Europe's major innovation centers. Tokyo experiences significant land resource constraints and overpopulation pressure. In order to resolve contradiction between land supply and demand, the city adopts a ‘vertical city’ policy. The government promotes the development of high rises by allowing a floor area ratio (FAR) incentive in exchange for provision of public green spaces and social amenities. The strategy of the government has a very high efficiency in the use of our limited land. It also promotes sustainable growth in our urban centers, as well as improves quality of public space and the living environment. Shenzhen pioneered the reform of land systems in China and implemented commercial development with “standardized land” development system. The authority allocates land for industries on the basis of production, tax payments, R&D expenditure, and other performance criteria. It is done to encourage the improvement of technology innovation ability as well as more efficient and effective utilization of land. This land management helps industry upgrading and drives the manufacturing industry to promote the shift to higher value-added industries, and it lays a solid foundation for the high-quality development of the city. It is possible to improve land use efficiency through composite spatial development, digital technology, land policies with performance objectives and optimized allocation

of public resources. The cities' accumulated experience will serve as quality references and replicable models for other cities in land-use planning, industrial upgrading and spatial governance.

The housing-industry-commerce-green space models in Singapore's new towns enhances land efficiency by 35% and resident satisfaction to 92%. Key outcomes include a 20% reduction in average daily travel time, a 15% increase in service sector jobs, and a 30% reduction in infrastructure costs per capita. Hangzhou's "City Brain" which utilizes artificial intelligence to carry out urban management, significantly reduced commercial vacancy rates by 20 per cent and boosts tax revenue by 12 per cent due to the adjustment of spatial layout to match market demand. The system uses 38 datasets from the government and processes 50 million data every day. Berlin's Industrial Redevelopment has GIS-enabled repurposing underutilized industrial areas into tech hubs which increase land price and create jobs. The consequences of these outcomes are that there will be 40% more high-tech jobs than what was there earlier. Further, the industrial land vacancy will decline by 25%. Also, an annual increase in property taxes will be to the tune of 1.2 billion. Tokyo's Vertical City Policy grants density bonuses, such as allowing taller buildings in exchange for new public green spaces. As a result, the GDP of Greater Tokyo's core area is five times that of the national average. The CBD office space utilization has increased by 60%, and urban sprawl reduced by 22%. An increase in public transport use by 35%. Shenzhen's "Standard Land" System. Performance-based industrial land allocation (tax/FAR thresholds) achieves 40% higher output than traditional models. Outcomes include 50% surge in industrial land tax revenue 28% contraction in idle land area 15% rise in R&D investment intensity.

4. Conclusion

This paper illustrates how the efficiency of land which is used in urban economic development is achieved in three ways: Productivity is done better using smarter technologies and reengineering to use factory spaces. Put differently, a business uses better designs and techniques to arrange its production facilities which leads to a 30-40 percent boost in overall production at the business. Value stream mapping tools make it possible to identify bottlenecks in real-time when production stalls to enable quick changes. Among other things, these innovations save materials when an area is in use and also offer an increase in productivity of 16-25%. When businesses share the same geographical area, costs lessen and innovations abound. The means to regionalise factories of specialised industries and eliminate transaction costs is likely to cut costs fifty per cent. Studies show that locating large factories close together stimulates more inventions. More businesses and innovations will result in more productive economies. Integrating your company's R&D centers into existing factories helps to reduce the time to develop new products or product revisions. Naturally, this duration alters, but there will, however, be a reduction of 10 to 15 per cent. Rational plans organize certain activities such as retail. The construction of a larger complex of residential, commercial and industry zones in areas like Shanghai in China has saved people a third of travel time in that area. Moreover, it has also cut house costs by 18% which gave a big thrust to job offers or more spending by consumers. Vertical stacking strategies allow multiple stores of industrial buildings, which creates more space than single story designs would. Many cities are using underground space to reduce some construction, while still allowing for some construction above ground. Industrial land efficiency bolsters manufacturing competitiveness, commercial efficiency fosters service sector agglomeration, and residential efficiency ensures sustainable talent attraction. Empirical cases validate these pathways, demonstrating how integrated planning, smart technologies, and policy incentives synergize to enhance land use outcomes.

To optimize land efficiency, cities should adopt a multi-dimensional strategy: Promote Mixed-Use Development: Integrate residential, industrial, and commercial functions to harmonize productivity and livability. Leverage Smart Technologies: Deploy GIS and big data for real-time spatial optimization and dynamic policy adjustments. Strengthen Institutional Safeguards: Implement density bonuses, tax incentives, and performance-based land allocation frameworks. Prioritize

Regional Differentiation: Retrofit developed areas while expanding greenfield development in less urbanized regions. These measures can achieve higher land efficiency while ensuring inclusive, sustainable urban growth.

References

- [1] Xing Chen and Boqiang Lin. Towards carbon neutrality by implementing carbon emissions trading scheme: Policy evaluation in China. *Energy Policy*, 2021, 157: 112510.
- [2] Jun Rentschler, Paolo Avner, Mattia Marconcini, Rui Su, Emanuele Strano, Michalis I. Voudoukas, and Stéphane Hallegatte. Global evidence of rapid urban growth in flood zones since 1985. *Nature*, 2023, 622(7981): 87–92.
- [3] Baishu Guo, Han Yu, and Gui Jin. Urban green total factor productivity in China: A generalized Luenberger productivity indicator and its parametric decomposition. *Sustainable Cities and Society*, 2024, 106: 105365.
- [4] Edward L. Glaeser, Hedi D. Kallal, José A. Scheinkman, and Andrei Shleifer. Growth in cities. *Journal of Political Economy*, 1992, 100(6): 1126–1152.
- [5] Edward L. Glaeser and Matthew E. Kahn. Sprawl and urban growth. In: *Handbook of Regional and Urban Economics*, Vol. 4, pp. 2481–2527. Elsevier, 2004.
- [6] J. Vernon Henderson. Marshall’s scale economies. *Journal of Urban Economics*, 2003, 53(1): 1–28.
- [7] Ayyoob Sharifi, Amir Reza Khavarian-Garmsir, Zaheer Allam, and Asad Asadzadeh. Progress and prospects in planning: A bibliometric review of literature in Urban Studies and Regional and Urban Planning, 1956–2022. *Progress in Planning*, 2023, 173: 100740.
- [8] Robert E. Lucas Jr. On the mechanics of economic development. *Journal of Monetary Economics*, 1988, 22(1): 3–42.
- [9] Stuart S. Rosenthal and William C. Strange. Evidence on the nature and sources of agglomeration economies. In: *Handbook of Regional and Urban Economics*, Vol. 4, pp. 2119–2171. Elsevier, 2004.
- [10] Zeeshan Khan, Mohammad Razib Hossain, Ramez Abubakr Badeeb, and Changyong Zhang. Aggregate and disaggregate impact of natural resources on economic performance: Role of green growth and human capital. *Resources Policy*, 2023, 80: 103103.
- [11] Kaoru Tone. A slacks-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research*, 2001, 130(3): 498–509.
- [12] National Bureau of Statistics of China. *China Statistical Yearbook 2023*. Beijing: China Statistics Press, 2023.
- [13] Ministry of Natural Resources of China. *China Natural Resources Statistical Yearbook 2023*. Beijing: Geological Publishing House, 2023.
- [14] João Filipe Teixeira, Cecília Silva, Sebastian Seisenberger, Benjamin Büttner, Bartosz McCormick, Enrica Papa, and Mengqiu Cao. Classifying 15-minute Cities: A review of worldwide practices. *Transportation Research Part A: Policy and Practice*, 2024, 189: 104234.
- [15] Maryann P. Feldman and David B. Audretsch. Innovation in cities: Science-based diversity, specialization and localized competition. *European Economic Review*, 1999, 43(2): 409–429.