

Analysis of Coupling Coordination Pathways between Urbanisation Quality and the Inclusive Development of Informal Employment from a Transnational Perspective

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Abstract

The global acceleration of urbanisation and the ongoing growth of informal employment are the key issues in current social and economic development. On the one hand, rapid urbanisation is accompanied by issues such as the allocation of economic and social resources; on the other hand, a large proportion of the workforce is employed informally. Although they alleviate employment pressure, these groups face difficulties such as a lack of rights protection and poor working conditions. The present study utilises multisource data from international databases to create a coupled coordination model linking urbanisation quality (U_1) and the inclusive development of informal employment (U_2). Through literature analysis and empirical comparison, the study focuses on Germany, Japan, Brazil and China from 2019--2024, analysing the dynamic evolution of these two subsystems. Research indicates the following: Coupling coordination exhibits a differentiated pattern: Germany maintains high-quality coordination through institutional flexibility. Japan's economic stagnation, characterised by a lack of dynamism in the labour market, can be attributed to the rigidity of its employment structures. China has advanced toward sound coordination through policy optimisation. Brazil remains locked in moderate coordination due to dual spatial fragmentation. Two-way interaction is driven by three dimensions: institutional design, policy quantification, and spatial equity. This study provides China with a theoretical framework and international insights to help it resolve the dilemma of achieving urbanisation while addressing informal employment.

Keywords

urbanisation, quality of urbanisation, informal employment, informal economy, inclusive development

1. Introduction

In the contemporary era of globalisation, urbanisation has progressively emerged as the primary catalyst for economic and social transformation across nations. As stated in a report by the UN-Habitat, the global urban population has now exceeded 5 billion for the first time, with the urbanisation rate reaching 55.3%. However, driven by rapid urbanisation, large-scale rural migration has fuelled the growth of the informal economy. Informal employment has been expanding on a global scale, with over 60% of the global adult workforce now engaged in the informal sector (International Monetary Fund, 2021). Research by the International Labour Organisation indicates that 93% of informal employment occurs in emerging and

developing countries on a global scale. Even in developed economies, such as those within the European Union, the average rate of informal employment stands at approximately 20%. The interactive relationship between the quality of urbanisation and informal employment is becoming increasingly evident: high-quality urbanisation provides development space for informal employment, whereas the disorderly expansion of informal employment may exacerbate urban resource constraints. Consequently, research on the coordinated relationship between the two is of pressing practical importance.

Preliminary research on the development of informal employment relations has been restricted to major cities in Africa and Latin America. Following the 1980s, the scope expanded on a global scale, beginning to explore the causes and manifestations of informal employment from economic and cost perspectives. Subsequently, there was a gradual shift in focus towards social and humanistic perspectives (Yao, 2008). Research has concentrated on safeguarding the social security and legitimate rights of informal workers. Since the initiation of reform and opening up, informal employment has evolved into a pivotal conduit for the absorption of surplus labor within China. Domestic scholars, drawing on prior experience and analysing the composition of the informal employment sector and related industry types on the basis of national conditions, have reported that promoting the development of informal employment requires advancing urbanisation while prioritising the entrepreneurial economic environment and social security systems (Zhang & Yu, 2022). This provides a valuable entry point for subsequently establishing and refining measurement frameworks.

In recent years, as urban planning controls have become the primary means of regulating informal economic activities, research on informal employment within the urban planning framework has attracted significant scholarly attention, thereby strengthening the connection between urbanisation development and responses to informal employment (Skinner & Watson, 2017). The advent of China's novel urbanisation strategy and population citizenization has prompted scholars to direct their attention to the nexus between the urban scale and the income of informal employment groups within spatiotemporal frameworks. This focus has also encompassed the optimisation of work-residence spatial patterns (Ma et al., 2022; Xu et al., 2019). This finding suggests that the quality of urbanisation can engender more favourable employment environments and development opportunities for informal workers. Furthermore, as the research progressed, the definitions of informal employment and urbanisation were refined, and the analytical methodologies transitioned from qualitative descriptions to quantitative measurements. The overall quality of rapid urbanisation is now reflected through quantifiable indicators. The utilisation of GDP data and cross-national urban informal employment statistics by certain scholars has enabled the demonstration of an inverted U-shaped relationship between informality and urbanisation levels. This provides a transnational perspective and relevant quantitative economic metrics for this research topic. Concurrently, domestic scholars examining regional disparities have reported that within the Chinese context, the informal economy and urbanisation development also exhibit an inverted U-shaped relationship (Elgin & Oyvat, 2013; Huang et al., 2019). This finding suggests that the growth of informal employment may serve to alleviate employment pressures associated with urbanisation, thereby increasing the quality of urbanisation. Concurrently, scholars have observed through studies adopting an inclusive urban development perspective that research indicators of urbanisation are typically associated with factors such as economic and population growth, job creation, and urban-rural heterogeneity (Bibri et al., 2020). The present paper demonstrates how achieving a shift in urbanisation and informality research from a single discipline to a multidisciplinary approach aligns closely with the research direction of this paper.

Despite the advancements witnessed in research endeavors pertaining to the correlation between urbanisation quality and the inclusive development of informal employment, there remain certain deficiencies in extant studies. In terms of research methodology, quantitative studies lack precise measurements of the degree of coupling and coordination between urbanisation quality and informal employment development. With respect to the research content, analyses of the factors influencing their mutual interaction remain incomplete and superficial. Furthermore, comparative studies on differences across countries are scarce, and systematic research on policy recommendations to promote their coordinated development is lacking. The present paper will undertake a systematic review of the core international literature through three principal methods. First, document research will be conducted. Second, a coupled coordination computational model is constructed. Third, empirical comparative analysis methods are employed. These three methods serve to clarify conceptual definitions and theoretical boundaries. The present study establishes a cross-national comparative framework for analysing the correlation between 'urbanisation quality and informal employment'. This enables the study to overcome the limitations of single-country or regional perspectives. The study examines

the multidimensional manifestations and variations of their relationships across different contexts, addressing the existing research gap that emphasises unidirectional effects over bidirectional interactions. In practical terms, the research findings can provide differentiated policy references for countries at varying stages of development, offering support for the scientific formulation of urbanisation development strategies and employment policies.

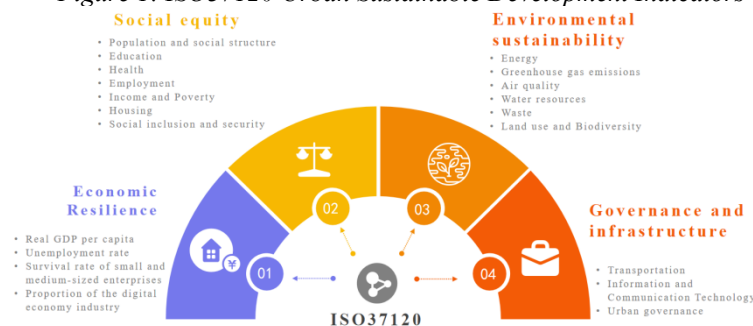
2. The Theoretical Foundations of Urbanisation Quality and the Inclusive Development of Informal Employment

2.1 Essence and Evaluation of Urbanisation Quality

The quality of urbanisation differs from the scale indicator represented by the ‘urbanisation rate’. This comprehensive concept encompasses multiple dimensions, including economic, social and environmental aspects. It serves as a crucial metric for assessing the level of urban development and its sustainability. Initially, few studies in the international literature focused directly on ‘urbanisation quality’. Urban evaluations often use the population urbanisation rate indicator, which provides limited and singular information.

The rapid increase in urbanisation rates has prompted research into ecological cities, sustainable development and the quality of human settlements, which indirectly reflects certain aspects of urbanisation quality. The Urban Sustainability Indicators (ISO 37120), for example, are a set of standards for measuring urban sustainability. They are published by the International Organisation for Standardisation in close collaboration with international bodies such as the United Nations and the World Bank. The indicators provide a benchmarking and evaluation framework for cities worldwide, offering directional guidance towards sustainable development. The indicators cover four core areas: economic resilience, social equity, environmental sustainability and urban governance (Figure 1). This multidimensional framework for urban development quality is a key means of quantifying urbanisation. It enables cities to adjust core and supplementary indicators according to their size and stage of development, thereby highlighting their adaptability and emphasis on ‘human-centred urbanisation’ (Li et al., 2019).

Figure 1: ISO37120 Urban Sustainable Development Indicators



Source: Adapted from International Organization for Standardization (2018).

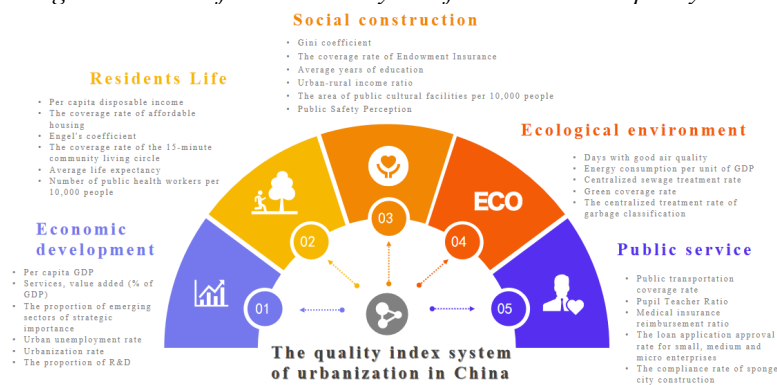
Scholars have posited that the quality of urbanisation and the level of urbanisation collectively constitute the development of urbanisation. The former is representative of the organic integration of economic, social, and spatial dimensions (Wang, 2013). From an economic perspective, the quality of urbanisation is reflected in a city’s economic standing, industrial structure, and sustainability. The pursuit of high-quality urbanisation should be characterised by the development and implementation of a comprehensive industrial system, the vigorous promotion of high-tech industries, and the generation of a greater number of employment opportunities. From a social perspective, urbanisation quality has been shown to correlate positively with residents’ well-being, public service coverage, and social equity and justice. This suggests that it serves as a crucial safeguard for sustainable urban development. From an environmental standpoint, ecological carrying capacity and resource utilisation efficiency also reflect urbanisation quality, making it the outcome of coordinated development across multiple dimensions.

In the wake of China’s economic transition from a model of high-speed growth to high-quality development, a novel urbanisation strategy has come to the forefront. This necessitates the establishment of a scientifically

evaluated indicator system to reflect the quality of urbanisation. In their study, scholars constructed a number of systems of relevance across a variety of scales to further explore the key factors of new urbanisation. This approach is of considerable academic value in theory while also providing practical foundations and references for establishing the new economic development pattern of the ‘dual circulation’ strategy (Zhou et al., 2023). Since 2017, China has progressively established a mechanism for urban health assessment within the framework of territorial spatial planning and has implemented pilot projects that directly reflect the characteristics of urbanization in the country (Yang & Wu, 2022). In 2020, the China National Institute of Standardization (CNIS) developed the ‘Evaluation Index System for Quality Cities in New Urbanization’, which facilitated greater uniformity and representativeness in standards for assessing urbanization quality.

Based on this indicator system and by integrating it with both the new urbanization quality indicators and national standard evaluation systems derived from relevant literature, it was observed that there are significant overlaps across four key dimensions: economy, residents’ livelihoods, society, and ecological environment. The literature also introduced additional indicators related to urban-rural integration, education and technology, as well as public services. This evolution suggests that the connotation and evaluation of urbanization quality are advancing towards a more comprehensive and scientific approach (Figure 2).

Figure 2: Core reference index system for urbanisation quality in China



Source: Adapted from State Administration for Market Regulation and China National Institute of Standardization (2020); Xiang et al. (2024); Yang (2024).

2.2 Implications and Significance of Inclusive Development in Informal Employment

The notion of informal employment is understood to have first emerged from the informal sector. According to the ILO definition, it encompasses small-scale production and service activities, as well as self-employment, in urban areas (International Labour Organization, 2018). The following principal characteristics are manifested: employment patterns are not constrained by formal sector requirements such as fixed working hours, resulting in high flexibility; owing to relatively loose labour relations, demands on practitioners' skills and qualifications are modest, resulting in comparatively low entry barriers. From a theoretical perspective, Lewis's economic dualism provided the theoretical foundation, with subsequent Marxist theories of the petty commodity economy and neoliberal economic theories exerting significant influence on the phenomenon of informal employment (Xing et al., 2022). Moreover, specific studies have examined the issue of informal employment through the lens of contemporary Western employment theories, including Keynesian economics, neoclassical macroeconomics, and the economics of disequilibrium and development (Gu, 2006).

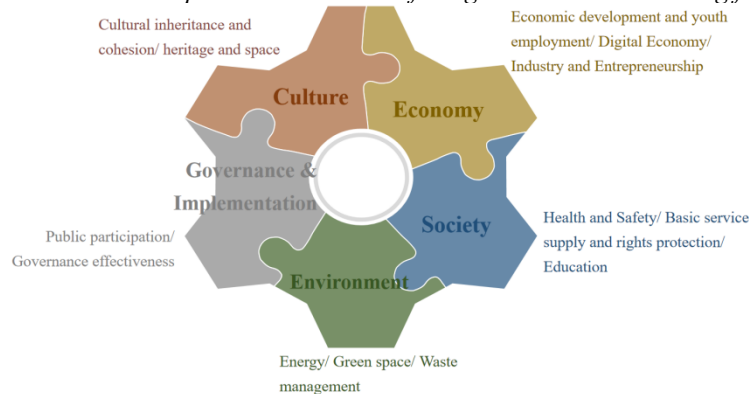
The precise definition of informal employment is a matter of some debate among scholars both domestically and internationally. However, there is international consensus on the core attribute of ‘informality’. The definition of foreign academia provided by foreign academic institutions is characterised by three distinct dimensions. First, the term is used to denote the organisational scale, with the reference being made to production and business units that have fewer than six employees. Second, the term is used in reference to sectors that are excluded from official statistics and lack formal regulatory oversight. Third, the term is used in reference to employment status, denoting a state where formal labor contracts are absent and rights protections are lacking. Domestic scholarship has been found to emphasise an integrated institutional–practical

perspective, primarily defining it through four key employment characteristics: the extent to which labour relations are formalised, the question of whether enterprises are formally registered, their incorporation into government regulatory frameworks, and aspects of working hours and income structures. Since the 1990s, the distinctive concept of ‘flexible employment’ has frequently been used to replace the term ‘informal employment’ (Liu, 2021), encompassing specific labour market forms within the formal sector, such as part-time work, temporary employment, flexible employment arrangements, and specific labour market configurations within the informal sector involving microenterprises and individual workers (Employment Department of China, 2022).

The concept of inclusive development was first introduced in 2007 by the Asian Development Bank, who proposed the term ‘inclusive growth’. This new term aims to emphasise equal opportunities and transform responses to severe poverty challenges into more inclusive growth. Building upon this foundation, inclusive development adopts a more comprehensive approach, considering the coordinated advancement of economic, social, and environmental dimensions. The Urban Monitoring Framework (UMF), a publication by United Nations Human Settlements Programme (2022), explicitly identifies cities as drivers of global productivity, thus emphasising the multifaceted evaluation dimensions of inclusive development. The framework under discussion comprises five core domains: cultural, economic, social, environmental, and governance. The analysis further enables consideration of the rights, protection and living conditions of informal workers through four dimensions: security, inclusion, resilience and sustainability (Figure 3).

The inclusive development of informal employment is predicated on the premise that informal workers should receive equitable treatment in terms of employment opportunities, social security and integration. It is imperative to eradicate all manifestations of employment discrimination and barriers that are not grounded in merit and to accord their labour the respect it deserves. Furthermore, it is essential to ensure equal opportunities for their participation in social activities. Concurrently, safeguarding the rights and legal protections of informal workers must be prioritised, encompassing fair remuneration, safety provisions, and entitlement to leave. Gradually formalising informal employment has the potential to alleviate societal employment pressures while contributing positively to social stability. Moreover, informal employment now encompasses a wide range of sectors, including self-employment, commerce, and services, thereby diversifying urban economic activities and invigorating urbanisation.

Figure 3: Five core implementation areas of the global urban monitoring framework



Source: Adapted from United Nations Human Settlements Programme (2022).

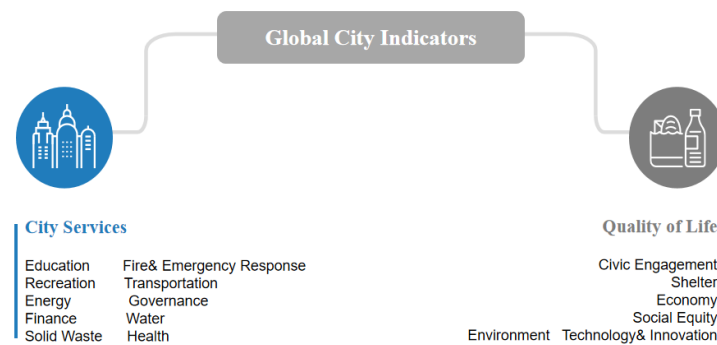
2.3 Theoretical Mechanism of Coupling Coordination

Coupling coordination is defined as the dynamic alignment and synergistic relationship between the quality of urbanisation and the inclusive development of informal employment. This forms a virtuous cycle that jointly serves high-quality economic and social development. From a mechanistic perspective, when these two elements are in a state of coupling coordination, improvements in urbanisation quality give rise to greater opportunities for informal employment. Moreover, enhanced infrastructure and public services provide robust support for its development. Furthermore, the healthy development of informal employment can reciprocally benefit urbanisation. Informal workers possess the advantage of rapidly adapting to shifting market demands, thereby filling supply gaps in formal urban employment markets and meeting diverse consumption needs

throughout urban development. Concurrently, the stabilisation of employment fosters the process of urbanisation, thereby establishing a virtuous cycle: enhanced urbanisation quality optimises informal employment, which in turn deepens the substance of urbanisation.

This mechanism of coupled coordination is not confined to theoretical speculation. In recent years, the Organisation for Economic Co-operation and Development has released a database of key indicators of informality, providing comparable metrics and coordinated data on informal employment and the welfare of households. This includes data on informal workers disaggregated by urbanisation levels, covering 47 countries and regions, which to some extent enables reflection on and analysis of the relationship between the quality of urbanisation and informal employment. Furthermore, the Global City Indicators, overseen by the World Bank's Urban Department, categorise 'urban services provided by municipal governments and other entities' alongside 'key regulatory factors influencing overall quality of life' as two core domains (Bhada & Hoornweg, 2009). This framework is intrinsically linked to the living conditions of informal workers, effectively reflecting the actual level of urbanisation quality through their access to essential urban services such as housing, healthcare, and education (Figure 4). The existence of these indicator systems demonstrates that coupling and coordination are not abstract theoretical concepts, revealing the concrete nature of their interactive relationships and establishing the data foundation for this quantitative study.

Figure 4: The World Bank's Global Cities Indicator Framework



Source: Adapted from Bhada and Hoornweg (2009).

3. Analysis of the Coupling and Coordination Relationships between Urbanisation Quality and the Inclusive Development of Informal Employment

3.1 Multisource Indicator Integration

The integration of multisource data indicators serves as the foundational prerequisite for constructing a coordinated model linking urbanisation quality with the inclusive development of informal employment. As outlined in Part 2 of this study, indicators pertaining to informal employment were systematically consolidated from four primary data sources. The following sources were consulted for this study: China's Core Reference Indicator System for Urbanisation Quality (ISO 37120, including the Chinese version GB/T 39497-2020); the OECD Key Indicators of Informality database; and the World Bank's Global City Indicators. This common integration of indicators related to informal employment addresses the limitations of single-source systems, achieves localised adaptation of international standards, and serves the core dimensions of opportunity equity, rights protection, and capacity enhancement within 'inclusive development'.

The following paper presents a three-step integration process for selecting indicators on the basis of the supporting logic of inclusive development across five dimensions: economic, social, living, ecological, and urban public services. The selection process will be conducted in accordance with both primary and secondary associated indicators, with the rationale for each step clearly outlined. This approach underscores the practical underpinnings and developmental value of indicator selection, as demonstrated in Table 1:

Table 1: Multidimensional coupling coordination factor index of urbanisation quality and informal employment

First-level dimension	Secondary related directions	filter criteria	Inclusive Development Correlation
Economic	Urbanisation rate*	<ul style="list-style-type: none"> Exhibits an inverted U-shaped or N-shaped correlation with the informal economy 	<ul style="list-style-type: none"> Regulating informal employment to promote rights and market fairness
	Urban unemployment rate*	<ul style="list-style-type: none"> Maintains a relationship of ‘unemployment crowding/complementarity’ with informal employment, indirectly reflecting employment stability 	<ul style="list-style-type: none"> Impact on employment equity and income stability, relating to inclusive livelihoods
	Youth unemployment rate	<ul style="list-style-type: none"> Informal employment serves as a reservoir for youth employment, offering considerable flexibility 	<ul style="list-style-type: none"> Impacts on career development equity and intergenerational opportunity inclusion
	Support for small and medium-sized enterprises	<ul style="list-style-type: none"> Small and medium-sized enterprises (SMEs) are the primary vehicle for absorbing informal employment 	<ul style="list-style-type: none"> Enterprises expand employment capacity and promote inclusive employment opportunities
Living	Engel coefficient*	<ul style="list-style-type: none"> Informal workers tend to have lower incomes, making the Engel coefficient more sensitive 	<ul style="list-style-type: none"> Concerning the quality of life and inclusive development of the informal employment sector
	Affordable housing coverage rate*	<ul style="list-style-type: none"> The housing security gap for informal employment is substantial, reflecting residential instability 	<ul style="list-style-type: none"> Housing security narrows residential disparities, linking to social inclusion and the quality of integration for new urban residents
	Healthcare facility coverage rate* 15-minute living circle coverage rate	<ul style="list-style-type: none"> Reflect healthcare accessibility Comprehensive nature of peripheral services 	<ul style="list-style-type: none"> Equalisation of healthcare can safeguard health equity. Enhancing service accessibility to promote social inclusion and equitable access to spatial resources
Social	Gini coefficient*	<ul style="list-style-type: none"> Informal employment income is unstable, exacerbating income distribution disparities 	<ul style="list-style-type: none"> Concerning the equitable distribution of income among informal groups
	Basic social insurance coverage rate*	<ul style="list-style-type: none"> Directly reflects the social security gap for those in informal employment 	<ul style="list-style-type: none"> The expansion of social security coverage enhances the resilience of informal workers against risks and promotes social equity
	Average level of education*	<ul style="list-style-type: none"> Educational attainment influences employment choices and structure 	<ul style="list-style-type: none"> Promote employment upgrading, reduce structural constraints on informal employment, and advance educational equity
	State-funded education expenditure as a percentage of GDP*	<ul style="list-style-type: none"> Reflecting the level of education and training provided by the state to the informal employment sector 	<ul style="list-style-type: none"> Universal access to basic education, enhancing social mobility
	Cultural Employment	<ul style="list-style-type: none"> The cultural industries exhibit a high proportion of informal employment, reflecting the nature of employment patterns 	<ul style="list-style-type: none"> Diversification of Employment Innovation
	Urban–rural income ratio	<ul style="list-style-type: none"> Core manifestation of the level of integrated urban–rural development 	<ul style="list-style-type: none"> Ensuring equal development opportunities for rural informal groups to promote urban–rural equity
Ecological	Energy consumption rate per unit of GDP in the green industry	<ul style="list-style-type: none"> Green industry development can create jobs and indirectly influence the scale and structure of informal employment 	<ul style="list-style-type: none"> Low-energy development balances sustainable employment with environmental equity

First-level dimension	Secondary related directions	filter criteria	Inclusive Development Correlation
public services	Waste collection rate	<ul style="list-style-type: none"> The informal employment rate is high in this sector 	<ul style="list-style-type: none"> Promoting the Inclusive Synergy of Ecology and Employment
	Public transportation coverage rate*	<ul style="list-style-type: none"> Commuting costs affecting the informal employment sector 	<ul style="list-style-type: none"> Enhance employment accessibility, reduce spatial opportunity gaps, and promote spatial inclusion
	Loan Approval Rate for Small and Medium-sized Enterprises*	<ul style="list-style-type: none"> Informal employment is predominantly concentrated in small and micro enterprises and the self-employed sector, with associated employment platforms exhibiting stability 	<ul style="list-style-type: none"> Financing facilities support business development and can expand employment capacity
	Inpatient Medical Expense Reimbursement Rate	<ul style="list-style-type: none"> Reflecting disparities in benefits between protected and employment groups 	<ul style="list-style-type: none"> Narrowing healthcare disparities to ensure equitable access to medical services for informal workers
	E-Government Utilisation	<ul style="list-style-type: none"> Informal workers face underutilisation of digital services, with usage rates linked to the digital divide and rights protection 	<ul style="list-style-type: none"> Bridge the digital divide and enhance equitable access to services

Note: Indicators marked with an asterisk (*) are considered core indicators, whereas those not so marked are classified as auxiliary indicators.

Source: Author-created.

3.2 Construction of Coupling Coordination Models

3.2.1 Model Logic of Dual-Factor Interaction

The research subjects are decomposed into two subsystems, the Urbanisation Quality Subsystem (U_1) and the Inclusive Development of Informal Employment Subsystem (U_2), on the basis of the multidimensional indicator system in Table 1. The U_1 index comprises 12 indicators, including the urbanisation rate, the affordable housing coverage rate, and the social security coverage rate. Collectively, these indicators serve to evaluate the quality of urban development. The U_2 index is predicated on ten indicators, including support intensity for SMEs and e-government utilisation, which collectively reflect the degree of integration within the urbanisation process. The aforementioned two subsystems exhibit a coupled relationship through factor interactions. For example, the presence of public transportation coverage (U_1) has been demonstrated to reduce commuting costs for the informal employment group (U_2). Conversely, social security coverage for informal workers (U_2) has been shown to enhance urban social equity (U_1). Furthermore, the coordination model necessitates the quantification of the intensity of interactions (coupling degree C) and the balance of development (coordination degree D).

3.2.2 Data Standardisation and Weighting

First, the positive or negative attributes of the indicators in Table 1 must be distinguished. The same rules for core and auxiliary indicators are applied, with standardisation being achieved via the range method: positive indicators (e.g., affordable housing coverage rate, public transport coverage rate, medical facility coverage rate, etc.):

$$x'_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

Negative indicators (such as the Gini coefficient, urban and youth unemployment rates, etc.):

$$x'_i = \frac{x_{\max} - x_i}{x_{\max} - x_{\min}} \quad (2)$$

Finally, to strike a balance between objectivity and policy orientation, the entropy weighting method is employed in combination with expert adjustments for the purpose of weight determination and differentiation. The information entropy of each indicator is calculated, with higher dispersion yielding greater weight to

reflect internal variability within the indicator data. It is recommended that the weights assigned to the 11 core indicators* in Table 1 be increased to a range of 40%-50%, with the goal of strengthening the policy focus on inclusive development for informal employment.

3.2.3 Coupled Coordination Computation

Overall development level of subsystems:

$$U_1 = \sum_{i=1}^n \omega_{1i} \cdot x'_{1i}, U_2 = \sum_{i=1}^m \omega_{2i} \cdot x'_{2i} \quad (3)$$

The coupling degree model (C) has been developed as a means to measure the closeness of the relational interactions between two subsystems. This is achieved by deriving Eq. (4) from Eq. (3), which comprises U_1 and U_2 :

$$C = \frac{2\sqrt{U_1 \cdot U_2}}{U_1 + U_2}, C \in [0,1] \quad (4)$$

$C \geq 0.8$ indicates high coupling (close interaction), whereas $C \leq 0.5$ denotes low coupling (weak interaction).

The coordination model is predicated on the measurement of balanced development. The present study introduces the coordination index T to reflect the comprehensive development level of the two subsystems ($\alpha = 0.5$), embodying an equitable scientific emphasis on both subsystems: $T = 0.5U_1 + 0.5U_2$. The combination of the aforementioned elements with Formula (4) results in Formula (5), thereby facilitating the classification of the coordination levels (Table 2):

$$D = \sqrt{C \cdot T} \quad (5)$$

Table 2: The degree of coordination level classification

D Zone	Coordination Level	Degree of meaning
$0.85 \leq D$	High-quality coordination	The twin systems are highly coupled and highly balanced
$0.7 \leq D < 0.85$	Good coordination	Closely coupled, yet development exhibits local or regional disparities
$0.5 \leq D < 0.7$	Moderate coordination	Coupling stability is sound, but balance requires urgent improvement
$0.3 \leq D < 0.5$	On the verge of imbalance	Coupling loosening, risks of imbalance in inclusive development gradually emerging
$D < 0.3$	Severe imbalance	The dual-system relationship has broken down, resulting in a severe imbalance in inclusive development

Source: Author-created.

4. Comparative Analysis of Dynamic Coupling Coordination from 2019--2024 from a Transnational Perspective

The present study concentrates on the cyclical process of ‘pandemic shock–policy adjustment response–postpandemic recovery’. The selection of Germany and Japan as developed economies and Brazil and China as developing economies will enable an examination of the six-year observation period from 2019--2024. The objective of the present study is to explore the dynamic evolutionary patterns of the coordinated coupling between urbanisation and the inclusive development of informal employment, as revealed by changes in the data indicators presented in Table 1.

4.1 Single-dimensional Metric Comparison

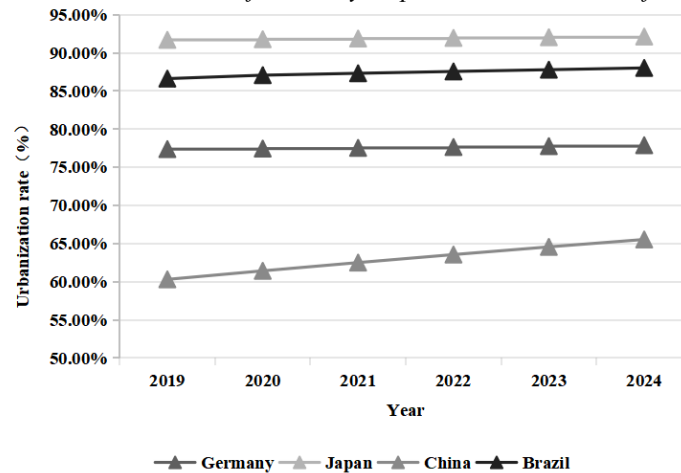
4.2 Economic Dimension

The urbanisation processes in Germany and Japan have reached a relatively mature stage, with urbanisation rates reaching 77.89% and 92.13%, respectively, by 2024. Concurrently, the rate of urbanisation growth has decelerated in comparison to China and Brazil, indicative of a more balanced development of urban clusters (Figure 5).

Germany’s approach to urbanisation is characterised by a multicentric model, with a focus on achieving balanced development across multiple regional centres. It is evident that cities such as Berlin, Hamburg and

Munich each possess distinctive features and play significant roles in the political, financial and technological spheres. Furthermore, owing to the high proportion of SMEs within its urban landscape, the majority of German enterprises are distributed across smaller settlements. For example, the headquarters of supermarket chains such as Lidl are situated in towns such as Neckarsulm, with a population of approximately 25,000 (Yu, 2025). This strategic placement enables them to address the employment needs of local communities, providing substantial numbers of stable and well-remunerated positions.

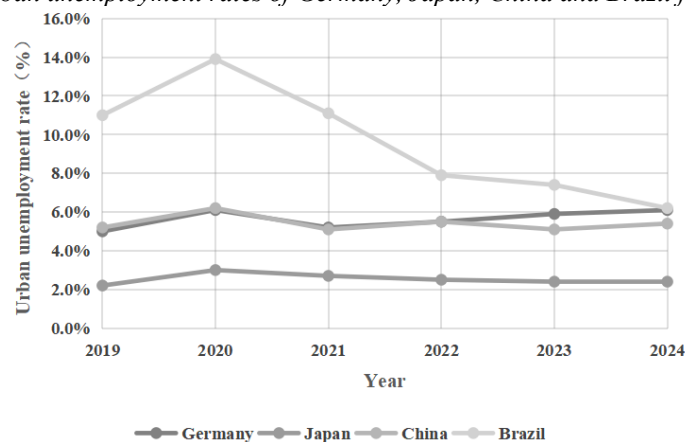
Figure 5: Urbanisation rates of Germany, Japan, China and Brazil from 2019--2024



Source: Data are retrieved from the World Bank Open Data (2024); the figure was created by the authors.

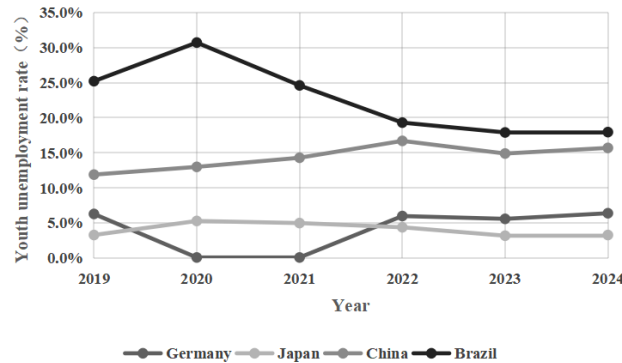
However, within this distinctive urbanisation context, Germany's informal employment sector has also become prominent. Recent data from the German Economic Institute (IW) suggest that the postpandemic economic downturn has resulted in a modest increase in unemployment and the emergence of an informal economy, which now constitutes over 10% of GDP. Subsequently, the Federal Republic of Germany has made adjustments to and optimised its current employment structure through the implementation of the minijob policy. This has led to the stabilisation of urban unemployment at approximately 5%, with youth unemployment consistently remaining below 6% annually (Figure 6 and Figure 7). Mini-jobs refer to part-time positions with earnings capped at €520 or working hours limited to three months per year. This scheme has been demonstrated to facilitate the partial absorption of unemployed and young individuals opting for mini-jobs, thereby demonstrating the integration of unemployment and reemployment services. The labour market thus exhibits both flexibility and stability, enabling Germany to achieve coordinated synergy between stable urbanisation and high-quality employment.

Figure 6: Urban unemployment rates of Germany, Japan, China and Brazil from 2019--2024



Source: Data are retrieved from the Germany Federal Employment Agency, Ministry of Internal Affairs and Communications, National Bureau of Statistics of China and Instituto Brasileiro de Geografia e Estatística; the figure was created by the author.

Figure 7: Youth unemployment rates of Germany, Japan, China and Brazil from 2019--2024

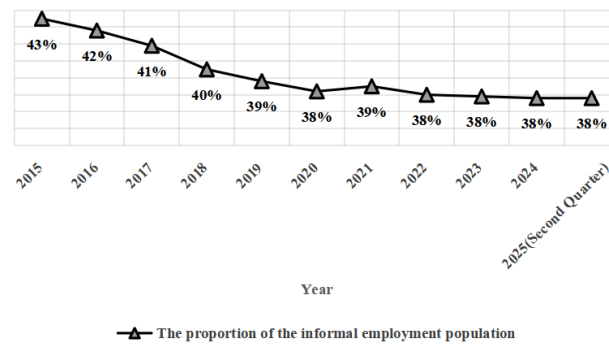


Source: Data are retrieved from Statistisches Bundesamt, MIC, NBSC and IBGE; the figure was created by the author.

Japan has a relatively high level of urbanisation, with large and medium-sized enterprises predominantly concentrated within the metropolitan areas of Tokyo, Osaka, and Nagoya. However, owing to the pronounced structural challenges posed by an aging population, Japan has witnessed a gradual expansion in nonregular employment. This has led to the emergence of employment support schemes targeting silver-haired individuals. Concurrently, surveys on the employment behaviour of young people indicate that 40% of young people have no intention of pursuing full-time work. The nonregular employment cohort is predominantly concentrated in the catering and hospitality sector (81%) and manufacturing sector (43%), which collectively provide a substantial volume of informal employment opportunities. Japan's urban unemployment rate is approximately 2–3% lower than that of Germany, consistently remaining below 3%. However, the expansion of employment among the older population coincides with a contraction in youth employment, resulting in significant hidden youth unemployment. Consequently, the youth unemployment rate exceeds the urban unemployment rate, reflecting Japan's economic employment coordination characterised by 'high urbanisation and low unemployment'.

Brazil, the largest economy in Latin America, exhibits the characteristic urbanisation pattern of 'rapid expansion with lagging quality', with its urbanisation rate reaching 88.02% by 2024. As demonstrated by data provided by the IBGE, accelerated and unplanned urbanisation has resulted in the substantial growth of informal employment as a notable component of the labour market. The concentration of employment opportunities is observed to be centered within central urban areas, whereas low-income demographics are found to reside in suburban fringe zones that are peripheral to these areas (Pinto et al., 2023). Slum-like conditions are estimated to account for approximately 22% of all settlements. Over the past decade, Brazil's informal employment rate has shown a gradual decline, from 42.5% in 2015 to 37.8% in Q2 2025 (Figure 8). Nevertheless, the overall scale has remained consistent, fluctuating between 38 and 42 million workers. This is indicative of the fact that, owing to the asynchronous development of urbanisation in conjunction with economic, industrial, and educational progress, Brazil's unemployment rate is approximately double that of the other three countries. This combination of high urbanisation and high unemployment has resulted in the rigid persistence of informal employment within Brazil's labour market.

Figure 8: Proportion of the informal employment group in Brazil from 2015--2025



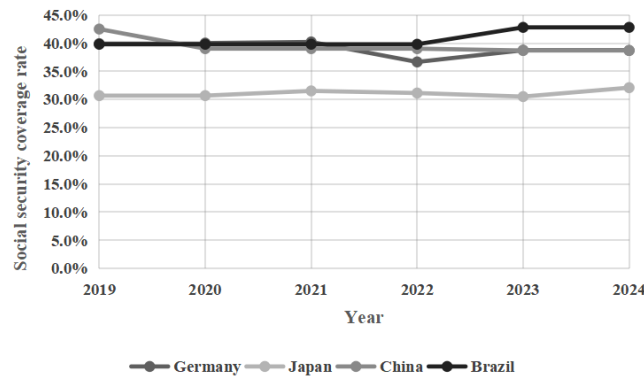
Source: Data are retrieved from IBGE; the figure was created by the author.

The urbanisation process in China is proceeding at an accelerated rate, with the urban structure displaying a pyramidal configuration characterised by a relatively small number of large and medium-sized cities in conjunction with a greater quantity of smaller urban centres (Xu & Jiao, 2021). In terms of the employment structure, China has adopted a proactive urbanisation mechanism, synchronising new-type urbanisation with industrial upgrading. For example, the Yangtze River Delta and Pearl River Delta urban clusters have absorbed populations through manufacturing sector enhancement and service industry expansion. Concurrently, the pandemic has precipitated a shift in work patterns from home-based to physical office environments, resulting in fluctuations across sectors such as internet services and education training. Moreover, talent absorption by emerging new energy industries has exerted an indirect influence on the structural distribution of informal employment. In the aftermath of the pandemic, the delayed expansion in university enrolment has given rise to the emergence of flexible employment forms as a means of providing a safety net for young people as they transition into stable employment. Consequently, China exhibits a dynamic coupling pattern in its economic dimension, reflecting rapid urbanisation alongside employment transformation responses.

4.2.1 Social Dimension

The inclusive development of informal employment, as perceived from a social dimension perspective, is manifested through the convergence of three primary domains: social security, educational attainment, and government investment. The Institute for Work (IW) has published research data indicating that higher-income groups and younger individuals in Germany are more likely to engage in informal employment. Furthermore, the data reveal a gender disparity, with female participants outnumbering their male counterparts in these roles. For instance, the domestic services sector effectively promotes women's paid employment, yet 90% of workers within this industry are engaged in informal work (Dominik & Christina, 2024). In the aftermath of the emergence of informal employment, the Federal Republic of Germany prioritised the establishment of safeguards for this cohort while concomitantly implementing entrepreneurial incentives. The mini-job scheme stipulates that part-time employment must be registered at designated employment centres, with the objective of reducing the prevalence of undeclared work. Concurrently, this system offers preferential treatment regarding taxation and social security contributions: individuals engaged in part-time employment under the mini-job scheme are subject to a 2% wage tax, a contribution rate that is less than that applicable to regular employees with regard to pension, health, and unemployment insurance. However, they are guaranteed a minimum wage in accordance with statutory provisions. Consequently, Germany's social security coverage rate remains stable at approximately 40% (Figure 9). The flexible social security framework for the formal employment sector, in conjunction with the mini-job scheme for the flexible employment sector, collectively fosters sustainable employment and high coverage rates.

Figure 9: Social security coverage rates of the four countries from 2019--2024



Source: Data are retrieved from Trading Economics; the figure was created by the author.

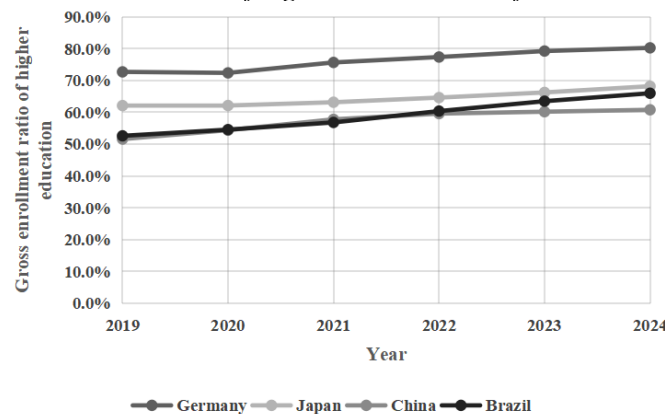
In the field of education, Germany has a gross enrolment rate in higher education that exceeds 80%, with educational expenditures accounting for approximately 5% of GDP (Figure 10 and Figure 11). The implementation of the dual vocational education system, which maintains a consistent focus on vocational training, is of fundamental importance. This approach fosters close collaboration between enterprises and vocational schools, enabling nonstandard workers to enhance their skills through practical experience. This approach has been shown to facilitate more rapid adaptation to evolving market demands, ensuring seamless integration between education and employment. In the context of the accelerated development of digital technologies, the German Federal Ministry of Education has launched initiatives to digitise cross-company vocational training centres and competence centres. This strategic move is intended to catalyse the reform and transformation of the dual vocational education system.

Japan has achieved universal basic coverage through its National Pension and Employment Insurance schemes. With respect to pension types, the National Pension is mandatory for all residents, including students and unemployed individuals, while formally employed individuals join the Employees' Pension on the condition of their employment. Given that the Employees' Pension is equivalent to 1.7 times the National Pension, it is anticipated that the government of Japan will proceed with the abolition of the threshold for the Employees' Pension and the enhancement of National Pension subsidies. Concurrently, a reduction scheme for nonstandard workers will be implemented. Within the healthcare system, nonregular workers can gain coverage either through spousal dependency or by enrolling independently, with the government subsidising 30% of costs. In 2023, the weekly working hours threshold for unemployment insurance eligibility was reduced from 20--10 hours, and transitional subsidies were introduced for employees who were made redundant due to corporate closures. Consequently, social security coverage experienced a modest increase in 2024. With respect to the field of education, the gross enrollment rate in higher education in Japan remains significantly lower than that in Germany, and education expenditure is also below the OECD average. Consequently, by 2025, Japan will have integrated flexible enrolment, dynamic subsidies and vocational education. This will permit nonregular workers to accumulate credit through fragmented learning and implement education models involving industry-academia collaboration. The establishment of a local youth education fund is proposed as a means of addressing the educational and employment disparities experienced by nonregular workers, with the overarching objective being the attainment of sustainable development in the labor market.

In Brazil, the demographic profile of informal workers is characterised by 'low educational attainment, low income, and marginalised status'. A mere 60% of the population possesses only primary education, a figure significantly below the rate among formal workers. There is a marked discrepancy in the quality of higher education, with a significant number of public universities offering curricula that are not aligned with market demands. This phenomenon leads to a significant number of highly educated individuals remaining in informal employment, thereby diminishing the efficiency of educational investment. Concurrently, Brazil's informal workers lack social security and employment stability, contributing to the rapid expansion of favelas. Although Figure 9 suggests that Brazil's social security coverage is relatively high, coverage is severely fragmented, leaving informal workers vulnerable to risks of multidimensional poverty. For example, in the favelas of Rio de Janeiro and São Paulo, informal workers constitute more than 75% of the workforce. These areas are characterised by inadequate infrastructure and deficient public services, which collectively engender considerable difficulty in facilitating the transition of informal workers into formal employees.

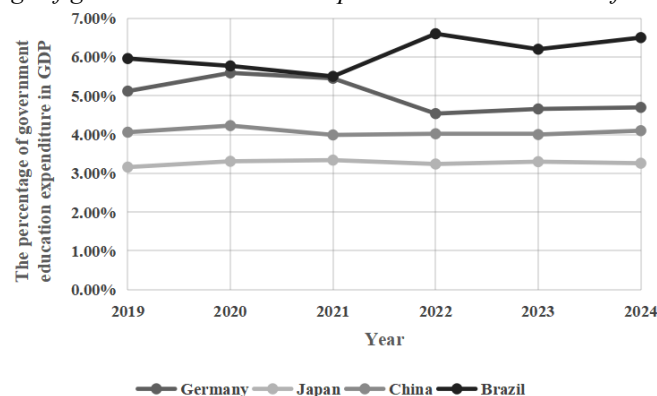
China, because it has a significant amount of informal employment, has embarked upon a process of upgrading informal employment. As demonstrated by data provided by the Ministry of Human Resources and Social Security, social security coverage for the informal employment sector has increased from 40% in 2019 to 60% in 2024. In light of the high mobility characteristic of employment groups such as food delivery personnel and ride-hailing drivers, the People's Republic of China has implemented special medical insurance schemes and initiated pilot programmes for work injury insurance for workers in new business models. Projections indicate a steady increase in China's social security coverage in the future. In the field of education, China is witnessing a transition in its higher education structure, with a shift from general undergraduate programmes towards vocational education. This involves the expansion of vocational undergraduate enrolment and the adaptation of adult higher education, drawing on Germany's dual training system to achieve the integration of industry and education. The training of skills is aligned with industrial demands. For example, in the field of e-commerce, traditional couriers are transitioning into new self-employed entrepreneurs through specialised e-commerce operations training. In addition, there has been an increasing allocation of educational investment towards vocational education, rural education, and training for disadvantaged groups, with the provision of resource support for the transformation of informal employment.

Figure 10: Gross enrollment ratios of higher education in the four countries from 2019--2024



Source: Data are retrieved from the World Bank Group; the figure was created by the author.

Figure 11: The percentage of government education expenditures to GDP in the four countries from 2019--2024



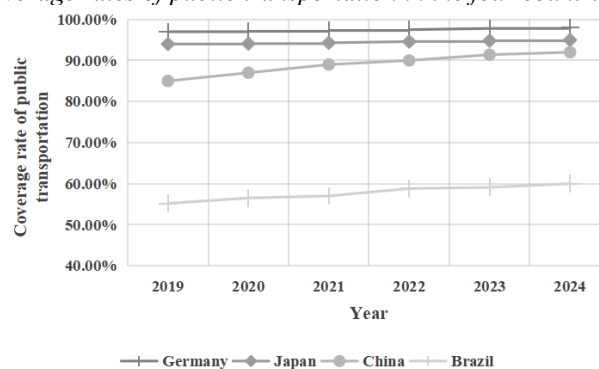
Source: Data are retrieved from the World Bank Open Data; the figure was created by the author.

4.2.2 Public Services and Ecological Dimension

The capacity of the informal workforce to access fundamental protection is determined by public services, while the environmental impact on the sustainability of livelihoods is a key consideration. Germany's implementation of the principle of 'equal rights and equal protections' for both informal and formal workers serves to eliminate barriers to employment. The high proportion of businesses located in small towns results in relatively equitable public services. Public transportation is dominated by rail systems, with urban buses and other modes operating in coordinated networks. The introduction of monthly travel passes enabled passengers to utilise public transport across all regions of Germany at a fixed monthly rate, thereby increasing usage rates and achieving over 97% universal coverage (Figure 12). Furthermore, Germany's transition in the

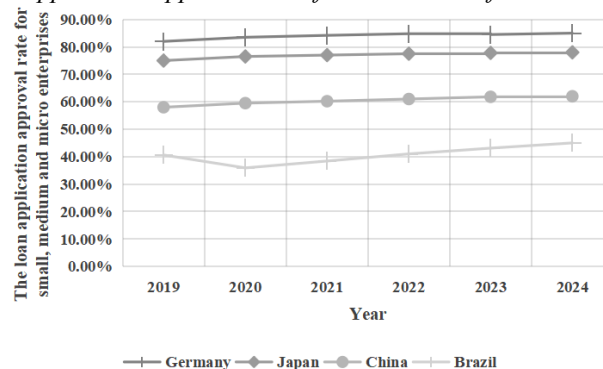
field of transportation has emerged as a pivotal catalyst for the advancement of the green industry. Since 2007, the green sector's share of GDP has exhibited a consistent upwards trajectory, with an average growth rate of 8.8% from 2016--2025. Consequently, Germany has substantial demand for green technologies while actively expanding its ecological agriculture and digitalisation, primarily relying on covert R&D and the promotion efforts of SMEs (Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2018). As demonstrated by data from the German Federal Statistical Office in 2018, micro and small enterprises represent more than 82% of all businesses. This has led to a significant policy focus on supporting their development. Germany's inclusive financing system is anchored by policy banks such as Kreditanstalt für Wiederaufbau (KfW), which provide long-term, low-interest loans to SMEs and offer tailored guarantee and adjustment services on the basis of business type. The European Central Bank's Q1 2024 survey revealed that Germany's SME bank loan application rejection rate stood at 6%, which is significantly below the EU average. German SMEs have been found to enjoy a loan approval rate consistently above 80%, a figure higher than that of Japan, China and Brazil (Figure 13). This can be attributed to the high accessibility and low rejection characteristics of German SMEs.

Figure 12: Coverage rates of public transportation in the four countries from 2019--2024



Source: Data are retrieved from Destatis, MLIT, the International Transport Forum and the Ministry of Transport of the People's Republic of China; the figure was created by the author.

Figure 13: Loan application approval rates for SMEs in the four countries from 2019--2024



Source: Data are retrieved from the European Central Bank, KfW, METI, Bank of Japan, Sebrae and Report on Inclusive Finance of the People's Bank of China; the figure was created by the author.

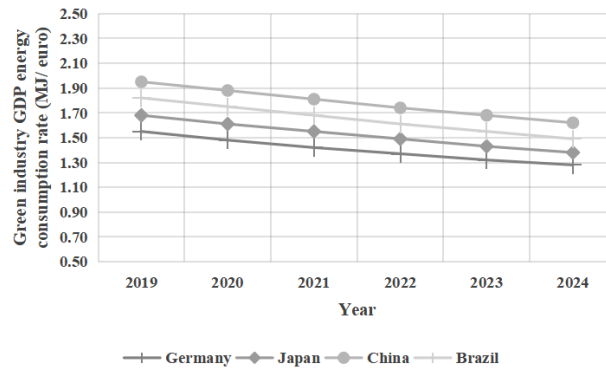
Japan's public transportation network is characterised by a high density of metropolitan rail and bus services, with an 85% transfer rate between these modes in major urban areas. It is evident that rural areas maintain fundamental coverage through the utilisation of local transit lines and community buses. This enhances employment opportunities and labour market mobility in these regions. Consequently, the national public transportation coverage rate stands at approximately 94%, second only to Germany (Ministry of Land Infrastructure Transport and Tourism, 2024). As demonstrated by data provided by the Japan Finance Corporation, the mean approval rate for SME loan applications is approximately 80%. A nationwide network of 52 credit guarantee associations has been established to provide security, whereas the Ministry of Economy, Trade and Industry (METI) has implemented a policy of injecting capital into regional banks with the goal of stimulating growth in informal employment sectors such as agricultural processing and tourism services. For

example, the "Youth Support Loan" program initiated by Kobe city offers interest rates as low as 1.4% and fully subsidises credit guarantees, thereby enhancing financing access for micro- and small enterprises. Moreover, the METI allocates funds for the purpose of conducting research and development in the field of low-carbon technology. For example, construction workers who successfully complete training in zero-energy housing technology can seek employment in the green building sector, often with the opportunity for informal employment with increased hourly wages.

Brazil's public transportation system has a dual structure characterised by high-density coverage in core cities and weak infrastructure in rural areas. Core cities such as São Paulo possess sophisticated integrated transportation systems centred on subway and bus rapid transit (BRT) networks. However, informal shared minibus services remain the primary mode of transportation in economically disadvantaged areas. The level of public transit coverage in rural areas is one-third that in urban areas. This is due to the reliance on community buses, which are only operational during certain seasons. Consequently, Brazil's overall public transit coverage lags significantly behind that of the other three countries, with coverage gaps fluctuating between 30% and 40%. Furthermore, certain Brazilian cities are implementing slum rehabilitation projects with the aim of enhancing living conditions for informal workers, thereby creating legal space for the informal economy. For example, Recife's 'Special Zone of Social Interest' policy has successfully integrated 23 slums into municipal planning, assigned street addresses to informal dwellings, and provided residents with legal proof of residence, thereby enabling them to access public services. In the context of corporate lending, Brazil has implemented a dual-tier credit guarantee mechanism and digital risk control measures to increase financing accessibility. The National Credit Guarantee Fund (FGC) provides guarantees covering 70% of the principal for SMEs. By 2025, it is projected that the approval rate for SME loan applications will rise to 48% from 45% in 2024. Nevertheless, existing regional disparities and racial issues continue to impact financing equity.

The Chinese public transportation system has characteristics reminiscent of both Japan and Brazil and is characterised by a high-density network alongside an urban–rural dual structure. By 2025, the proportion of metropolitan residents covered by public transportation is projected to reach 90%. The BeiDou navigation system has been implemented in 95% of buses, with real-time bus information services achieving an 85% penetration rate. However, certain counties and townships continue to experience a paucity of bus services, with schedules that are either sporadic or infrequent. Furthermore, the availability of these services is significantly influenced by seasonal weather conditions. This phenomenon has a direct and indirect impact on the commuting conditions of informal workers, thereby necessitating policy interventions to enhance cross-regional urban–rural connectivity. With respect to corporate loan applications, the China SME Credit Guarantee Fund provides risk compensation for loans amounting to nearly 70%. The National Integrated Financing Credit Service Platform has achieved an 85% online loan processing rate, and the average interest rate for inclusive microloans has decreased to 4%. Nevertheless, undisclosed expenses persist, and loan approval rates vary considerably across the eastern, central, and western regions due to local time costs and economic development disparities. Manufacturing faces approximately 10% lower loan rejection rates than services do. In the context of green industries, the utilisation of renewable energy has emerged as a predominant feature within the energy efficiency framework. Furthermore, a decline in the annual GDP energy intensity has been observed (Figure 14). The Ministry of Economic Affairs has a commitment to the advancement of low-carbon technology R&D, with 40% of its budget allocated to the subsidisation of SME equipment upgrades. Furthermore, it offers skill enhancement pathways for informal workers, incorporating emerging professions such as ESG analysts and carbon asset managers into the national occupational classification system with the goal of promoting the formalisation of informal employment.

Figure 14: Green industry GDP energy consumption rates in the four countries from 2019--2024



Source: Data are retrieved from the Umwelt Bundesamt, METI, The Brazilian Center for Research in Energy and Materials and NBSC; the figure was created by the author.

4.3 Dynamic Evolution of Coupling Coordination

4.3.1 Dynamic Calculation Results at Critical Nodes

The dynamic coordination degree calculations are presented in Table 3 and are based on the coupling coordination model outlined in Section 3.2. Germany has exhibited considerable capacity to adapt its economic and institutional policies in response to economic fluctuations, both during the pandemic and in the postpandemic period. The preservation of the voluntary nature of informal employment, the elevation of the income ceiling for mini-jobs, and the implementation of green mini-jobs have collectively resulted in an expansion of coverage for young individuals engaged in informal employment. Concurrently, these measures have facilitated a green-collar transition, thereby ensuring the attainment of high-quality coordination.

Japan, however, has experienced a lag in the implementation of reforms and an impediment to coordination, attributable to the rigid composition of its population age structure. The Non-Regular Employment Security Act has been identified as a legislative development that has served to strengthen the rights of agency workers. However, the seniority-based pay system has been identified as a factor that hinders career advancement for young people. Concurrently, within silver reemployment schemes, older individuals entering the recruitment pipeline account for more than 40% of nonregular employment. Consequently, while Japan's coordination level remains high-quality, it approaches the lower threshold of the degree of coordination (D) at 0.85. The optimisation of the employment age structure is imperative for the realisation of the developmental potential inherent in nonregular employment.

In the aftermath of the pandemic, the People's Republic of China has accorded primacy to the formalisation of informal employment sectors, assimilating these workers into the category of new employment from labourers. In the period between 2021 and 2023, a series of documents were issued that pertained to the establishment of safeguards for rest and remuneration rights, the formulation of guidelines for labour regulations and rights protection services, and the initiation of pilot schemes for social insurance subsidies for flexible employment. The 2024 county-level dual innovation and entrepreneurship upgrade initiative aims to integrate informal employment into county economies, mitigate disparities arising from dual-track systems, and foster integrated urban–rural development. Consequently, coordination levels have progressively improved, shifting from scale-based to quality-driven inclusive development. This trajectory positions China as rapidly advancing into the ranks of high-quality coordinated development.

The social and economic disparity between Brazil's favelas and its elite society, exacerbated by the dualisation of the country, resulted in the provision of emergency relief payments during the pandemic, which temporarily alleviated the survival pressures experienced by informal workers. However, following the termination of the scheme in 2023, there was a resurgence in poverty rates, highlighting the limitations of targeted public service provision. Consequently, coordination levels remain moderately low, necessitating vigilance against impending instability risks. It is imperative that efforts are concentrated on the process of favela urbanisation, with a transition being made from the optimisation of physical spatial structures towards the realisation of institutional spatial equilibrium.

Table 3: Dynamic results of the degree of coupling coordination in Germany, Japan, China and Brazil

State	Year	Subsystem	Degree
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		U ₁	U ₂	Coupling degree C	Coordination Index T	Coordinated Degree D	
	2019	0.85	0.82	0.97	0.835	0.91	
	2020	0.84	0.81	0.96	0.825	0.90	
	2021	0.83	0.80	0.96	0.815	0.90	
Germany	2022	0.84	0.81	0.97	0.825	0.91	High-quality coordination
	2023	0.86	0.83	0.98	0.845	0.92	
	2024	0.87	0.84	0.98	0.855	0.93	
	2019	0.82	0.75	0.94	0.785	0.88	
	2020	0.82	0.74	0.93	0.781	0.87	
Japan	2021	0.83	0.73	0.93	0.780	0.87	High-quality coordination
	2022	0.83	0.73	0.93	0.780	0.87	
	2023	0.83	0.74	0.94	0.785	0.88	
	2024	0.84	0.75	0.94	0.795	0.89	
	2019	0.68	0.61	0.91	0.645	0.77	
	2020	0.66	0.58	0.89	0.620	0.73	
China	2021	0.65	0.57	0.88	0.610	0.72	Good coordination
	2022	0.68	0.60	0.90	0.640	0.76	
	2023	0.71	0.64	0.92	0.675	0.79	
	2024	0.73	0.66	0.93	0.695	0.81	
	2019	0.52	0.40	0.86	0.464	0.63	
	2020	0.50	0.38	0.84	0.440	0.61	
Brazil	2021	0.49	0.37	0.83	0.431	0.60	Moderate coordination
	2022	0.51	0.39	0.85	0.450	0.62	
	2023	0.52	0.40	0.86	0.463	0.63	
	2024	0.53	0.41	0.87	0.478	0.64	

Source: Author-created.

4.4 Lessons from Transnational Experience and Exploring Pathways for Coupling and Coordination

4.4.1 Lessons from Transnational Experience

The calculations for the 2019–2024 period demonstrate that the quality of urbanisation, in conjunction with coordinated informal employment, constitutes a dynamic equilibrium of resilient institutions, economic adaptability and equitable resource distribution. Germany's proficiency in cultivating inclusive urbanisation and informal employment is rooted in the synergistic integration of policy, education, and emergent economic frameworks. This approach establishes flexible mechanisms for informal employment, utilising survey and monitoring data on informal workers to adjust policies and regulate indicators that safeguard their fundamental rights. This policy foundation is then built upon to enhance educational resilience by supporting informal workers' transition into formal positions within emerging sectors such as green energy and digital services. This facilitates their integration into the formal employment ecosystem.

Japan's case study underscores the imperative to circumvent the inherent structural employment traps that are embedded within conventional pathways. To resolve the conflicts that arise between established and emerging employment models, there is a need for greater collaboration between industry and academia, with the aim of achieving a more precise alignment of skills. Nevertheless, this approach is susceptible to lagging behind the development of new sectors, such as artificial intelligence and the digital economy. Consequently, highly educated individuals are more likely to be employed in the informal sector, thereby creating what is termed 'hidden unemployment'. In addressing this discrepancy, it is imperative to consider not only the alignment between educational qualifications and job requirements but also the necessity of bridging the existing gap in aging-related social security provisions. This approach is crucial to reduce the incidence of individuals being compelled to enter the informal workforce. Brazil's predominant developmental challenge pertains to the incongruity between urbanisation and advancement, compounded by the prevalence of substandard slum conditions. This has resulted in a growing number of informal workers being trapped in a vicious cycle of unemployment and poverty, largely due to inadequate healthcare and education systems. Consequently, the acquisition of vocational skills becomes a matter of intergenerational burden, thereby intensifying social stratification. It is therefore incumbent upon the Chinese government to explore an inclusive

coupling pathway suited to a major economy undergoing transformation, transforming informal workers from urban marginalised groups into catalysts for high-quality urban development.

4.4.2 Exploring Pathways for Coupling and Coordination between China's Urbanisation and Inclusive Development of Informal Employment

A comparative analysis of the aforementioned transnational case studies and data establishes a coordinated pathway across four dimensions: institutional, economic, social, and technological. First, an inclusive framework featuring flexible safeguards and targeted coverage is constructed institutionally. The approach under discussion draws upon the practical logic of China's social security pilot schemes for new employment models, thus transcending the traditional dichotomy between formal and informal employment. The establishment of a graduated social insurance contribution scheme for nonstandard workers, which is based on monthly income, is proposed. This scheme draws inspiration from Germany's income-based tiered contribution model. Concurrently, the development of personal entitlement accounts and social mutual aid platforms is recommended, with a view to prioritising healthcare and occupational injury protection for this demographic. In the formulation of the policy, it is recommended that the Ministry of Human Resources and Social Security's pilot flexible employment monitoring platform be utilised in conjunction with central and state-owned enterprise service platforms for flexible workers. It is imperative to track the scale and characteristics of the nonstandard employment sector in real time, distinguishing between subsistence-level workers and growth-oriented workers, to tailor policy adjustments. Such adjustments may include the provision of start-up subsidies for e-commerce sole traders, the streamlining of temporary trading permits for street vendors to formalise the hawker economy, and the achievement of high alignment between policy supply and dynamic demand.

Second, it is imperative to enhance the collaborative support between employment platforms and industrial transformation, with a focus on economic strengthening. Considering Japan's demonstrated capacity to facilitate the resilience of SME supply chains, the establishment of compliance incentive mechanisms for informal employment is recommended. This can be achieved by integrating tax incentives with labour compliance rates, thus promoting enhanced social inclusivity for SMEs. In addition, the establishment of informal employment transition incubators at the county level is recommended, with the provision of auxiliary services such as live-streaming operations and e-commerce platform integration. This will facilitate the transformation of rural informal employment into roles such as rural revitalisation advocates and e-commerce entrepreneurs, thereby narrowing regional economic disparities between urban and rural areas.

Third, in addressing the spatial divide between Brazil's favelas and elite classes alongside China's urban-rural dual structure, the social dimension must focus on breaking down barriers through equitable rights and spatial fairness. It is recommended that food delivery and ride-hailing platforms be mandated to publicly disclose labour regulations, thus ensuring that the rights of informal workers are safeguarded. The proportion of informal workers transitioning to formal employment should be incorporated into corporate responsibility assessments, thereby addressing the career advancement challenges faced by this demographic. In addition, within the domain of urban spatial planning, the integration of zoning for fundamental affordable housing, in conjunction with cross-district collaboration in the provision of public services such as healthcare and education, should be accorded a high degree of priority. For example, Beijing's coordinated planning between its central urban districts and suburbs has mitigated the tiered disparity in public services between city centres, urban-rural fringe areas, and rural townships. This ensures that informal workers have equal access to essential resources such as education and healthcare, thereby reducing spatial exclusion within these communities.

Fourth, with the advancement of big data intelligence, digital technologies have the potential to empower the inclusive development of the informal employment sector. The integration of multisource data from tax authorities, human resources departments, and e-commerce platforms facilitates the construction of spatial-temporal models of income fluctuations, employment trajectories, and skill gaps within informal employment. This facilitates the identification of highly vulnerable groups within this sector, enabling targeted policy interventions. Furthermore, a policy simulation system based on a coupled coordination model can be developed to model changes in indicators such as social security subsidies and corporate loan quotas. This would visualise long-term transmission effects and provide quantitative data for policy optimisation. Given that China's rural e-commerce user base has reached 350 million, high-usage third-party platforms such as online banking, WeChat and Alipay can also be leveraged to establish government service interfaces. The

implementation of this proposal would facilitate the integration of services such as social security declarations, rights consultations and skills training within the context of everyday applications. This approach ensures the delivery of lightweight public services.

5. Conclusion

5.1 Research Findings

(1) The present study integrates multisource indicator data to construct a five-dimensional indicator system encompassing the economic, livelihood, social, ecological and public service dimensions. By surmounting the constraints imposed by single data sources and attaining localised alignment with international standards, it refines the capture of three core demands for inclusive development among the informal employment sector: rights, opportunities and technical capabilities. These elements form an interactive coupling with the elements constituting urbanisation quality.

(2) The coupling coordination model employed in this study validates a ‘bidirectional interaction and phased differentiation’ coupling pattern between urbanisation quality and the inclusive development of informal employment. Germany, which leverages its balanced economy and resilient institutions, has sustained high-quality coordination over the long term ($D \geq 0.91$), characterised by informal employment featuring voluntary part-time work and flexibility. In contrast, Japan, which is constrained by traditional structural employment patterns, has a high proportion of young temporary workers and elderly part-timers, maintaining good coordination but stagnant growth ($D \geq 0.87$). In the context of Brazil, characterised by pronounced spatial segregation between wealth and poverty, informal employment is observed to be entrenched in a low-level subsistence cycle, exhibiting moderate coordination ($D \approx 0.62$). This dynamic is susceptible to imbalance without the implementation of timely policy adjustments. In contrast, China’s economic landscape, propelled by emerging business models and county-level innovation initiatives, has potential for advancement from sound coordination ($D \geq 0.76$) towards high-quality coordination. This trajectory signifies the vitality and resilience of its transitioning economy.

(3) The degree of coupling coordination from a transnational perspective is found to be a fundamental reflection of systemic disparities between policy flexibility and rigidity, economic structural equilibrium and disparities, and social spatial inclusivity and exclusion. To successfully navigate the ideological inertia that has been inherited from outdated systems, China must draw upon successful case studies during its employment transition. This will allow it to chart an inclusive pathway that is tailored to its national circumstances.

5.2 Research Shortcomings and Future Prospects

The present study has certain limitations in terms of data acquisition, with the incompleteness of certain factor data potentially introducing errors into the findings. With respect to the methodology, although a variety of approaches have been employed, there is still scope for improvement. For example, the selection of factors was not entirely comprehensive. The research process revealed that potential factors within the informal employment sector—such as gender composition, age distribution, and highly vulnerable groups (including persons with disabilities, cross-border migrants, and low-educated individuals)—significantly influence the coupling and coordination of inclusive development. The omission of protection gaps for certain special groups resulted in findings that leaned towards averaging. Consequently, subsequent research may benefit from incorporating demographic adjustment dimensions, such as age and gender, to further quantify the pathways of coupling coordination.

Future research may further extend the study period and broaden the data sources to encompass postpandemic recovery and new cycles within the era of artificial intelligence. The adoption of enhanced scientific data collection methodologies would serve to improve the reliability of findings. Methodologically, the exploration of sophisticated econometric models and analytical techniques, including spatial econometric models and machine learning algorithms, has the potential to elucidate the intricate relationship between urbanisation quality and the inclusive development of informal employment. Research could also be conducted from additional dimensions and perspectives, such as examining the impact of AI replacing traditional labour in smart cities on the inclusivity of informal employment or integrating system dynamics to enhance policy

simulation tools for informal employment. This would provide more comprehensive and in-depth theoretical support and practical guidance for promoting the coordinated development of both phenomena, driving the in-depth advancement of inclusive coupling, and contributing Chinese wisdom to the global urbanisation process.

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Conflicts of Interest

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