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Article

A preliminary study on the regional distribution of consumption competitiveness and carrying capacity

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Abstract: This study examines the spatial distribution of consumption competitiveness and carrying capacity across regions, exploring their interrelationship and implications for sustainable regional development. An evaluation index system is constructed for both consumption competitiveness and carrying capacity using a range of economic, social, and environmental indicators. We apply this framework to regional data in China and analyze the resultant spatial patterns. The findings reveal significant regional disparities: areas with strong consumption competitiveness are often concentrated in economically developed regions, while high carrying capacity is notable in less populated or resource-rich areas. Notably, a mismatch emerges in some regions—high consumer demand is not always supported by adequate carrying capacity, and vice versa. These disparities highlight potential sustainability challenges and opportunities. In the discussion, we address reasons behind the spatial mismatch and propose policy implications to better align consumer market growth with regional resource and environmental capacity. The paper concludes that integrating consumption-driven growth strategies with carrying capacity considerations is essential for balanced and sustainable regional development.

Keywords: consumption competitiveness; carrying capacity; regional distribution; sustainable development; regional planning

1. Introduction

Consumption has become an increasingly important driver of regional economic growth, especially as economies shift toward domestic demand-led development (Lin and Wang, 2021). Consumption competitiveness refers to a region's ability to attract and sustain consumer spending and retail activity relative to other regions. It encompasses factors such as income levels, retail infrastructure, and consumer market vibrancy. A region with high consumption competitiveness can stimulate economic growth through robust internal demand, enhancing overall regional competitiveness (Dobbs et al., 2012). However, rapid growth in consumption and economic activity can put pressure on local resources and the environment (United Nations, 2015).

In contrast, the concept of carrying capacity originates from ecology, describing the maximum level of activity or population an environment can sustain without degradation (Rees, 1992). In regional science, carrying capacity often refers to the resource and environmental capacity of a region—including land, water, energy resources, and ecological resilience—as well as infrastructural and social support capacity for human activities. A region with a high carrying capacity can support a large population and robust economic activities with its available resources and environmental conditions. Ensuring that development remains within carrying capacity is crucial for sustainability (Gao et al., 2021).

Regional development planning requires balancing economic competitiveness with sustainable resource use. In China, rapid urbanization and regional economic growth have led to concerns that some economically advanced regions are reaching or exceeding their environmental and resource carrying capacities, while less-developed regions may have underutilized capacity (Deng et al., 2022). Regional layout—the spatial distribution of economic activities and population—should ideally account for both the strength of consumer markets and the limits of local resources. However, past studies have typically analyzed these aspects separately. Research on regional competitiveness has focused on production factors and GDP growth, giving limited attention to consumption as a competitive factor (Florida, 2002; Glaeser et al., 2001; Lin and Wang, 2021). Meanwhile, studies on carrying capacity often evaluate environmental sustainability in isolation (Hu and Han, 2023; Y. Zhang et al., 2018). There is a clear research gap in examining how consumption competitiveness and carrying capacity intersect spatially (Wei et al., 2024).

This paper seeks to bridge that gap by evaluating the regional distribution of consumption competitiveness alongside carrying capacity and identifying mismatches between the two. We develop a composite index for each concept and apply them to Chinese regional data as a preliminary case study. The objectives of this study are to: (1) construct a scientific indicator system to measure consumption competitiveness and carrying capacity at the regional level; (2) reveal the spatial patterns of these two constructs and how they differ or coincide; and (3) discuss the implications for regional planning and policy, especially regarding sustainable development and balanced regional growth.

By achieving these objectives, our study provides a novel integrative framework. Unlike prior studies that examined either economic competitiveness or environmental limits in isolation, we explicitly combine these dual aspects of development. This approach allows the identification of regions where consumption-driven growth is out of sync with local carrying capacity—mismatches that single-factor analyses would overlook. Such a perspective directly addresses the research gap and offers insights on balancing regional prosperity with sustainability.

The remainder of the paper is structured as follows. Section 2 provides a brief review of relevant literature and theoretical background on regional competitiveness and carrying capacity. Section 3 describes the data and methodology, including the construction of the evaluation indices and the study area. Section 4 presents the empirical results of the regional analysis for consumption competitiveness and carrying capacity. Section 5 discusses the findings, explaining the observed patterns and offering policy implications to improve coherence between consumption growth and carrying capacity. Section 6 concludes with a summary of key findings and suggestions for future research.

2. Literature review

Regional competitiveness has long been a subject of interest in regional science and economic geography. Classic competitiveness studies often emphasize production factors—such as labor, capital, and innovation—in determining a region's economic success (Porter, 1990). However, with the evolution of economies, consumption

competitiveness has emerged as a complementary perspective, focusing on the demand side. This concept considers how attractive a region is to consumers and to firms in the retail and service sectors. Prior studies have explored related ideas like consumer market potential and retail performance across regions. For instance, Glaeser et al. (2001) demonstrate that consumer amenities can drive urban growth, and Florida (2002) argues that a region's appeal to consumers and the creative class is increasingly crucial. In China, recent policy discourse explicitly acknowledges that consumption capacity is becoming a key determinant of regional competitiveness in the new development era (Lin and Wang, 2021). Researchers have increasingly called for examining regional consumption competitiveness—a region's ability to attract and sustain consumer spending—as a complement to traditional production-based measures of competitiveness. This perspective defines regional success partly by the capacity to improve local living standards and meet domestic demand, linking competitiveness with internal market strength. Some definitions of regional competitiveness explicitly include the ability to use a region's resources to enhance residents' well-being and satisfy local needs. Such evidence suggests that boosting a region's consumer market appeal and spending power has become a crucial aspect of regional development strategies in both advanced and emerging economies.

On the other hand, the concept of carrying capacity in a regional context typically relates to how much development (population, economic activity) the region's resource base and environment can support. Theoretical foundations of carrying capacity in human systems were introduced by ecologists and environmental economists in the late 20th century (Rees, 1992). In China, research on resource and environmental carrying capacity has gained prominence alongside the push for ecological sustainability in planning (Y. Zhang et al., 2018). Recent assessments of carrying capacity reveal significant regional variations; for example, Hu and Han (2023) evaluate land resource carrying capacity across China's provinces and find notable differences in the ability of local environments and infrastructure to accommodate growth. Recent studies have advanced more comprehensive frameworks; for example, Z. Zhang et al. (2022) developed a multi-dimensional carrying capacity assessment for the Yangtze River Economic Belt, incorporating economic, social, resource, and environmental subsystems. Their work reflects a growing consensus that carrying capacity must be viewed holistically, including not just natural resources and ecology but also the built environment and societal support systems. Considerable research attention has focused on environmental and resource carrying capacity as a foundation for sustainable regional development. The carrying capacity concept—originally rooted in ecology—has been adapted to evaluate whether a region's resource endowments and environment can support its population and economic activities without degrading. In recent years, resource and environmental constraints have become a pressing challenge for many countries (particularly fast-growing developing nations), driving a resurgence of carrying capacity assessments to guide policy. A variety of analytical tools have been applied, from composite index systems to ecological footprint analysis, to gauge how close regions are to their sustainable limits. Notably, a systematic review of carrying capacity research finds that modern studies rarely impose a fixed "ceiling" on growth; instead, carrying capacity is often used as a guiding concept to warn of emerging stresses before

irreversible damage occurs. Contemporary approaches increasingly integrate socioeconomic and quality-of-life factors into carrying capacity evaluations, underscoring that societal tolerance and adaptive capacity (e.g., infrastructure, technology, governance) can modify a region's effective limits. This evolution reflects a broader shift in regional sustainability research—from defining hard limits toward managing trade-offs between human development and environmental protection. Indeed, the focus has expanded from simply maximizing growth to achieving high-quality development, emphasizing the synergy between economic prosperity and ecological security.

Despite these advances, relatively few studies explicitly integrate the analysis of consumption strength with carrying capacity. Most literature either focuses on improving competitiveness (broadly defined) or on evaluating sustainable limits. One notable gap is understanding how regions can pursue competitive consumer economies while staying within sustainable carrying limits. The spatial interplay between these two factors is critical. For instance, a region might be very competitive economically and in terms of consumer spending, but if its land, water, and environment are overburdened, that success may be precarious. Conversely, a region with abundant resources and capacity might languish economically if it cannot attract enough population and consumption to utilize its potential. In summary, past economic geography and policy choices have created imbalances: coastal urban hubs are economically "overloaded" relative to their environment, while interior regions remain underdeveloped relative to their potential carrying capacity.

By reviewing the literature, it becomes evident that an integrated approach is needed. Most prior studies tend to address economic competitiveness and carrying capacity in isolation. A clear research gap remains in bridging these two aspects. The present study contributes to the literature by examining consumption competitiveness alongside resource-environment carrying capacity within a unified framework, thereby offering a more holistic perspective on regional sustainability and competitiveness. Drawing on the concepts above, our study contributes to the literature by combining these two lines of inquiry. We build on the competitiveness literature by formulating a measure of consumption-driven competitiveness. At the same time, we extend carrying capacity research by applying it in tandem with an economic competitiveness metric. This approach differs from general sustainable development indices that aggregate many factors without isolating consumption-driven demand (Zhou and Dai, 2025), allowing us to identify misalignments—cases where a region's economic demand outstrips its capacity, or vice versa—that might be overlooked by single-focus analyses. The framework we propose offers a more nuanced picture of long-term regional viability (United Nations, 2023), demonstrating that a region's success must be evaluated through both economic and environmental lenses.

3. Materials and methods

3.1. Study area and data

The empirical analysis focuses on regional units within China. For this preliminary study, we consider China's 31 provincial-level regions (including provinces, autonomous regions, and directly administered municipalities) as the

spatial units of analysis. These regions offer a broad spectrum of economic development levels and resource endowments, making them suitable for comparing consumption competitiveness and carrying capacity. The data for constructing the indices were obtained primarily from the National Bureau of Statistics of China (NBS, 2021), including the *China Statistical Yearbook 2021*, and from regional statistical reports. Most data correspond to the year 2020 (the most recent year with comprehensive statistics at the time of study). Additional data on environmental and resource factors were gathered from the Ministry of Ecology and Environment and related agencies' publications. All monetary figures are deflated to constant prices where applicable to ensure comparability.

3.2. Index construction

We developed a composite index for consumption competitiveness and another for carrying capacity. **Table 1** outlines the indicator system used for each. The selection of indicators was guided by existing literature (Gao et al., 2021; Y. Zhang et al., 2018; Z. Zhang et al., 2022) and data availability. For consumption competitiveness, the focus is on metrics reflecting consumer market size, consumer affluence, and retail sector development. For carrying capacity, the index includes indicators of resource endowment, environmental resilience, and infrastructure support.

Table 1. Indicators for evaluating consumption competitiveness and carrying capacity.

Dimension	Indicator	Description (per capita or relative measure)
Consumption competitiveness	Disposable income per capita (¥)	Average income level of residents, indicating consumption potential.
	Retail sales of consumer goods	Total retail sales volume, indicating market size (normalized by population).
	Number of major retail outlets	Density of large supermarkets/shopping centers per 10,000 people.
	Urbanization rate (%)	Share of population in urban areas (proxy for consumer market concentration).
	Tertiary sector share (%)	Percentage of GDP from services (including retail and hospitality), reflecting reliance on the consumer economy.
Carrying capacity	Arable land per capita (ha)	Land resources available per person (supports food and development needs).
	Water resources per capita (m^3)	Renewable freshwater availability per person.
	Environmental quality index	Composite environmental performance (air/water pollution levels, green coverage, etc.).
	Infrastructure development index	Access to infrastructure (roads, energy, public services) supporting the population and economy.
	Population density (persons/km^2) (inverse)	Crowding pressure (used inversely, as higher density can imply lower remaining capacity).

Note: All indicators are normalized to ensure comparability. For instance, population density is used inversely in the carrying capacity index calculation (lower density contributes positively to the capacity score). The composite indices are constructed by aggregating the normalized indicators (after appropriate weighting). Higher values of the consumption competitiveness index (CCI) indicate a stronger consumer market, while higher values of the carrying capacity index (CaCI) indicate greater ability of the region to support human activities sustainably.

For clarity, these indicators are grouped into several key sub-dimensions within each index. The consumption competitiveness index captures consumer affluence (e.g., income per capita), market size and activity (e.g., retail sales volume and number

of outlets), and urban development level (e.g., urbanization rate and tertiary sector share). Similarly, the carrying capacity index reflects resource endowment (e.g., arable land and water per capita), environmental quality (e.g., an environmental quality index), and infrastructural support capacity (e.g., an infrastructure development index and population density used inversely as an indicator of crowding pressure). These subsystems represent the main components of each concept, as detailed in **Table 1**.

Each indicator was normalized (e.g., expressed per capita or per unit area where appropriate) to allow fair comparisons across regions and then aggregated into the composite index. We determined the weights for the indices by using a combination of expert judgment and statistical analysis. Specifically, we consulted a panel of experts in regional development and environmental management to assign initial importance weights to each indicator. We then performed a principal component analysis (PCA) on the dataset; the PCA results were largely consistent with the expert-opinion weights. This dual approach (expert insight and PCA) was chosen to ensure that the composite index weights are both theoretically grounded and empirically robust (weights were determined through expert judgment or principal component analysis in this study).

Using the above indicators, we calculated the CCI and CaCI for each of the 31 regions. The weights for aggregation were determined through a combination of expert consultation and statistical techniques (e.g., principal component analysis) to ensure robustness. We also categorized regions into groups based on their index scores (high/low CCI versus high/low CaCI) for further analysis.

Before proceeding to the results, it is important to acknowledge the data limitations. Some indicators (e.g., detailed environmental quality metrics) were not available for all regions, and proxy measures were used in such cases. Nonetheless, the selected indicators capture the essential aspects of consumer economy strength and regional carrying capacity.

4. Results

Spatial Pattern of Consumption Competitiveness (CCI): The regional Consumption Competitiveness Index shows a distinct spatial pattern. Generally, economically advanced and urbanized regions score highly on CCI. For example, our results indicate that the top-ranking regions in consumption competitiveness include major metropolitan areas such as Beijing, Shanghai, and Guangdong (Pearl River Delta region), and Jiangsu, all of which have high per capita incomes and large consumer markets. These areas benefit from dense urban populations, high levels of disposable income, and well-developed retail and service industries. In Beijing and Shanghai in particular, the concentration of affluent consumers and retail infrastructure pushes their competitiveness index near the top. In contrast, several inland and western regions exhibit much lower CCI values. For instance, Tibet, Qinghai, and Gansu rank near the bottom in consumption competitiveness. These regions are characterized by smaller economies, lower income levels, and sparse retail networks, which translate into limited consumer market activity.

Spatial Pattern of Carrying Capacity (CaCI): The distribution of the Carrying Capacity Index across Chinese regions presents an almost inverse pattern in some

cases. Less densely populated regions with abundant natural resources tend to have higher carrying capacity scores. Qinghai and Tibet, for example, despite their low consumption scores, have some of the highest carrying capacity values in our index—owing to their low population densities, ample land per capita, and relatively intact environments. Other regions with high CaCI include resource-rich areas like Inner Mongolia (with vast grasslands and mineral reserves) and Heilongjiang in the northeast (with abundant land and water). On the other hand, some highly urbanized and densely populated provinces show constrained carrying capacity. Shanghai has one of the lowest CaCI scores due to extremely high population density and limited land and resources within a small area. Beijing and Guangdong also rank low in carrying capacity, reflecting environmental stress (e.g., air pollution, water scarcity in Beijing's case) and heavy utilization of land.

Comparative Analysis of CCI vs. CaCI: Comparing the two indices for each region makes clear that regions strong in consumption competitiveness are not always strong in carrying capacity. **Figure 1** provides a visualization of the relationship between CCI and CaCI for regions. The horizontal and vertical dashed lines correspond to the values of CCI and CaCI, respectively, dividing the plot into four quadrants.

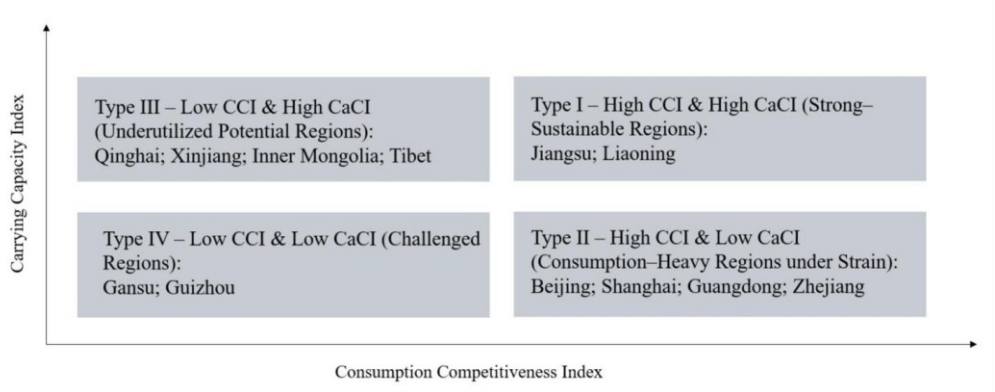

Figure 1. Relationship between consumption competitiveness and carrying capacity.
Note: CCI denotes the consumption competitiveness index and CaCI the carrying capacity index.

From **Figure 1** and the underlying data, we identify four types of regions as theorized:

Type I—High CCI & High CaCI (Strong-sustainable regions): A few regions manage to achieve relatively high values in both indices. For instance, Jiangsu Province falls in this category—it has a strong consumer market (benefiting from wealthy cities like Nanjing and Suzhou) and also scores above average in carrying capacity. These regions are relatively well-balanced; they enjoy vigorous consumption-driven economies and have the resource and environmental base to support that activity (at least for now). They could serve as models for sustainable competitiveness if they maintain this balance.

Type II—High CCI & Low CaCI (Consumption-heavy regions under strain): This group includes regions like Beijing, Shanghai, and Guangdong, which boast strong consumption competitiveness but have relatively low carrying capacity scores. These are the economically dynamic urban hubs where consumer demand is high, but

local resources and environments are under significant pressure. In such regions, there is a risk that continued growth could be unsustainable unless mitigated by policy (e.g., resource imports or environmental protection efforts).

Type III—Low CCI & High CaCI (Underutilized potential regions): Examples are Qinghai, Tibet, and parts of inland northwest China. These regions have ample carrying capacity—abundant land, water, or other resources—but currently low consumption competitiveness due to smaller economies and populations. They have room (in terms of resources and environment) to support more economic development and population, indicating unused potential for growth.

Type IV—Low CCI & Low CaCI (Challenged regions): Regions such as Gansu and perhaps some northeast provinces fall here, with weak consumer economies and relatively strained capacity (often due to fragile environments or historical overuse of resources). These regions face dual challenges in stimulating economic growth and managing resources sustainably.

This classification provides a framework for discussing how different types of regions should tailor their development strategies. This comparative overview is summarized in **Table 2**, which lists illustrative regions in each category along with their index standings. The table highlights the mismatch patterns discussed above, providing concrete examples for each type.

Table 2. Regional classification by consumption competitiveness and carrying capacity indices (illustrative examples).

Type (CCI, CaCI)	Characteristics	Example regions	Index profile
I. High-High (Strong-Sustainable)	Strong consumer economy, robust resources/capacity.	Jiangsu; Liaoning (moderate high)	High CCI (~top 5); High CaCI (top 5–10).
II. High-Low (Capacity-Stressed)	Strong consumer economy, strained capacity.	Beijing; Shanghai; Guangdong; Zhejiang	Very high CCI (top 5); Low CaCI (bottom 5–10).
III. Low-High (Underutilized)	Weak consumer economy, ample unused capacity.	Qinghai; Xinjiang; Inner Mongolia; Tibet	Low CCI (bottom 5–10); High CaCI (top 5).
IV. Low-Low (Double-Weak)	Weak consumer economy, limited capacity.	Gansu; Guizhou	Low CCI (bottom 5); Low CaCI (bottom 5–10).

Note*:* CCI = Consumption Competitiveness Index, CaCI = Carrying Capacity Index. "Top" or "bottom" rankings refer to position among 31 regions. This table is a simplified representation for illustrative purposes; actual index values are continuous. Regions in each category may change over time as economic and environmental conditions evolve.

The above results underline a clear reality: regional disparities are significant, and critically, economic vibrancy and environmental capacity do not always coincide. In the next section, we delve deeper into the implications of these findings, discussing why these patterns occur and how policy can address the misalignments.

5. Discussion

(1) Drivers of spatial mismatch

Several factors contribute to the mismatch between consumption competitiveness and carrying capacity. Historically, China's development model has favored rapid industrialization and urbanization in the eastern coastal regions, leading to high population densities and booming consumer markets there (Kanbur and Zhang, 2005; Chan, 2014). These same regions, however, face natural limitations—land scarcity,

heavy pollution loads, and stressed ecosystems—as a consequence of concentrated economic activity. For example, the Type II regions (high CCI, low CaCI, such as Beijing and Shanghai) became economic powerhouses due to advantages in human capital, infrastructure, and investment, but their growth has outpaced local resource availability. Conversely, interior regions (many Type III regions like Qinghai or Inner Mongolia) have abundant land or resources but historically lower levels of industrialization and urban development, due in part to remoteness and less-attractive investment climates. This has kept their consumption competitiveness low even though, in principle, they could support more development given their capacity. In summary, past economic geography and policy choices have created imbalances: coastal urban hubs are economically overloaded relative to their environment, while interior regions remain underdeveloped relative to their potential carrying capacity.

(2) Implications for sustainable development

The misalignment between where consumption is strongest and where capacity is highest poses a challenge for sustainable development. Regions in Type II (high consumption, low capacity) are at risk of environmental degradation and resource crises. The high consumption levels in these areas mean high waste generation, carbon emissions, and resource demand, straining local (and even distant) ecosystems (S. Zhang et al., 2022). These regions highlight the classic dilemma of unsustainable growth: without intervention, their economic competitiveness could be undermined by quality-of-life issues and by regulatory limits as authorities attempt to curtail pollution (IPCC, 2022; Rees, 1992). Conversely, Type III (low consumption, high capacity) regions represent missed opportunities. In a country seeking to boost domestic consumption and reduce regional inequalities, failing to utilize the capacity of underpopulated, resource-rich areas means potential economic benefits are left on the table. Moreover, encouraging some growth in these regions could relieve pressure on the congested eastern cities, aligning with China's goal of more balanced regional development (IMF, 2023).

(3) Policy recommendations

To address these challenges, a coordinated regional policy approach is required. We propose several policy measures, as outlined below:

Guiding development to underutilized regions: Government incentives can encourage businesses and populations to relocate or expand in Type III regions that have underutilized capacity. Strategies might include investing in transportation and digital infrastructure to better connect these regions, establishing special economic zones, or providing tax benefits for firms (especially in service and consumer industries) that set up operations there. If successful, these actions could increase jobs and incomes in those areas, thereby raising their consumption competitiveness in a sustainable way. For example, promoting eco-tourism or clean energy industries in western China can leverage environmental capacity for economic gain without causing heavy degradation.

Enhancing capacity in stressed regions: For Type II regions that are economically vital but capacity-constrained, policy should focus on either expanding carrying capacity or reducing the resource intensity of consumption. This includes stricter environmental regulations and technological upgrades to reduce pollution (e.g., investments in waste treatment, clean energy, and public transit to cut emissions).

Urban planning measures are also important, such as controlling population density through satellite cities and greenbelts and securing resources through interregional transfers. For instance, water diversion projects or regional power grids can alleviate local shortages in water or energy (though such measures must be weighed against impacts on donor regions). Additionally, demand-side management—encouraging sustainable consumption habits among residents (e.g., energy saving, recycling)—can help moderate the strain on local capacity.

Balanced regional planning: A broader implication is the need to integrate competitiveness and sustainability metrics in regional planning. National and provincial planners should use analyses like ours to inform the next stages of urbanization. For example, China's ongoing New Urbanization Plan emphasizes developing small and medium-sized cities and towns. Our findings support that approach: fostering growth in second-tier cities of central and western provinces could capitalize on available capacity while reducing over-concentration in megacities (Chan, 2014). Moreover, regional cooperation mechanisms can be strengthened. Regions with surplus capacity (Type III) could form partnerships or twinning arrangements with those in deficit (Type II)—for example, through ecological compensation schemes, wherein coastal provinces fund conservation in interior provinces that, in turn, provide ecological services (such as clean water or carbon sequestration) or host certain resource-intensive industries for the benefit of the nation (World Bank, 2021).

Monitoring and adaptive management: Government agencies should continuously monitor both economic and environmental indicators. The composite indices developed in this study could be refined and tracked over time (SolAbility, 2023). If a region's consumption competitiveness is growing, authorities must check that its carrying capacity is not being dangerously exceeded. Conversely, if a region has invested heavily in infrastructure (boosting capacity) but demand remains low, policy might need to attract population or industries to utilize that capacity. An adaptive management approach ensures that strategies can be adjusted in response to changing conditions, maintaining a balance between growth and sustainability.

(4) Academic and theoretical implications

From an academic perspective, this study underscores the value of an interdisciplinary approach to regional analysis. The results demonstrate that traditional measures of regional success (like GDP or even overall competitiveness indices) may overlook critical sustainability factors (United Nations, 2023). Incorporating carrying capacity into regional competitiveness assessments provides a more nuanced picture of long-term viability. The approach used here offers a framework for other researchers: by combining socio-economic and environmental indices, one can identify latent problems that pure economic analysis might miss. For instance, a region might appear successful until resource scarcity becomes a binding constraint. Early identification of such issues through composite indicators can prompt preemptive action. Additionally, our findings encourage further research into dynamic analysis—how do consumption competitiveness and carrying capacity co-evolve over time? Future studies could explore whether regions move between the identified categories (I–IV) as a result of policy interventions or economic shifts, yielding insights into the effectiveness of various development strategies.

(5) Limitations

It is important to acknowledge that this research is a preliminary exploration. The indices and data used have limitations. The choice of indicators and their weights in the composite index, for example, could be adjusted; different indicator selections or weightings might change certain regional scores. Some aspects of carrying capacity (such as cultural or governance factors) were not included due to lack of data or difficulty in quantification. Additionally, our analysis treats each region largely as a closed system, but in reality regions trade resources and goods (e.g., electricity, water, consumer products)—meaning a deficit in one region can be partly offset by imports from another. A more advanced analysis (perhaps using input-output models or ecological footprint analysis) could account for these interregional flows. Lastly, the study is cross-sectional (one point in time); a time-series or panel analysis could capture how improvements in one dimension affect the other over time and whether regions shift between categories.

Despite these limitations, it remains crucial to align regional consumption growth with carrying capacity to achieve sustainable prosperity. The policy measures discussed above are intended to contribute to this balance—by easing resource and environmental strains in high-CCI regions and by stimulating growth in underutilized high-CaCI regions—so that all areas can move toward a more balanced and sustainable development path.

6. Conclusion

This paper presented an analysis of the regional layout of consumption competitiveness and carrying capacity, using China as a case study to illustrate broader concepts. By constructing composite indices for consumption competitiveness and carrying capacity, we examined how these two critical dimensions of regional development are distributed spatially and how they interact.

Several key findings emerged. First, there is a clear spatial disparity in consumption competitiveness, heavily favoring economically developed coastal and metropolitan regions. Second, the carrying capacity index exhibits a different pattern, often higher in less-developed, resource-rich regions. Third, comparing the two revealed that many regions with high consumer market activity face limitations in resources and environment, while many resource-abundant regions lag in economic development. This mismatch points to challenges in the sustainability and efficiency of regional development.

In discussing these findings, we emphasized their implications. Regions with high consumption but low capacity risk unsustainable development trajectories and require policy attention to enhance their resource base or curb excessive strain. Regions with low consumption but high capacity represent opportunities for guided future growth, which could help balance national development. The study suggests that strategic regional planning should involve redirecting some growth to underutilized areas and investing in sustainability improvements in overburdened areas.

In conclusion, aligning consumption competitiveness with carrying capacity is essential for long-term regional resilience. A region can only be truly competitive in a

sustainable sense if it does not irreversibly deplete the resources and environment that support it. This preliminary exploration highlights the value of integrated regional analysis and offers insights for policymakers: Sustainable regional prosperity requires a dual focus on boosting economic vitality and safeguarding or expanding the underlying carrying capacity. Future research can build on this foundation in several ways. First, a dynamic (longitudinal) analysis over time would reveal how improvements in one dimension affect the other and whether regions transition between the identified categories as a result of policy interventions or economic shifts. Second, applying this dual-index framework to other countries or to finer spatial units (such as cities or counties) would test its generalizability and provide comparative insights. Additionally, refining the index components (for example, incorporating governance or innovation factors) could further enhance the analysis. Ultimately, the goal is to inform regional development strategies that foster economic well-being while respecting ecological and resource limits, ensuring balanced growth for generations to come.

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