

A Comparative Analysis Of 4 Szes in China

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Abstract. China's Special Economic Zones (SEZs) have played a crucial role in the country's economic transformation since 1980, serving as experimental hubs for market-oriented reforms and global integration. This paper conducts a comparative analysis of four pioneering SEZs-Shenzhen, Zhuhai, Shantou, and Xiamen- examining their economic performance, growth drivers, and policy effectiveness from 1980 to 2023. Using panel data analysis, the research identifies key determinants of success, including foreign direct investment (FDI), infrastructure investment, education, and proximity to major trade hubs. The findings reveal that Shenzhen, leveraging its strategic location near HongKong and a strong emphasis on innovation, emerged as a global economic powerhouse. In contrast, Shantou's reliance on low-value manufacturing and administrative fragmentation hindered its progress. Zhuhai's focus on sustainable development and Xiamen's trade and financial strategies further highlights the diverse approaches to SEZ success. The study concludes that while SEZs can drive rapid economic growth, their effectiveness depends on adaptive policy frameworks, investment in human capital, and strategic economic planning. The insights from this research offer valuable lessons for emerging economies seeking to implement SEZs as a tool for economic development.

Keywords: Special Economic Zones; economic development; policy.

1. Introduction

China's economic transformation since 1978 has been profoundly shaped by its Special Economic Zones (SEZs), with Shenzhen, Zhuhai, Shantou, and Xiamen serving as the pioneering laboratories for market-oriented reforms and global integration. Established in 1980, these zones were designed to attract foreign investment, stimulate industrialization, and test policies that would later be scaled nationwide [1]. Over four decades, their trajectories have diverged significantly, reflecting the interplay of geography, policy innovation, and industrial strategy. This paper examines the comparative development of these four SEZs, analyzing their economic performance, growth drivers, and challenges through empirical evidence.

This paper underscores the SEZs' role as microcosms of China's economic evolution, revealing how localized policies, global integration, and adaptive governance have shaped their divergent paths. By synthesizing historical data, industrial trends, and policy outcomes, it provides a framework for understanding the complexities of regional development in emerging countries.

2. The development path of special economic zones

2.1. Shenzhen: favorable geographical location and innovative strategy

Shenzhen, located just a river apart from Hong Kong, has rapidly developed over the past 40 years, moving from 'China speed' to 'China height'. As the first Special Economic Zone in China, it has now evolved into a national economic center city and a global innovation hub. Before the reform and opening up, Shenzhen was just a small fishing village with relatively underdeveloped economic conditions. However, in 1979, the spring breeze of reform and opening up reached this small town, and it became one of China's special economic zones, leading to Shenzhen's rapid development. In the early stages of special zone construction, Shenzhen attracted a large number of foreign-invested enterprises due to its favorable policies and geographical proximity to Hong Kong, significantly boosting local economic development. At the same time, it vigorously promoted the construction of

local infrastructure to prepare for industrial upgrading and transformation. After the 1990s, Shenzhen continuously adjusted and optimized its industrial structure, gradually phasing out low value-added manufacturing industries and vigorously developing industries centered around finance, logistics, culture, and high technology as the economic pillars of Shenzhen [2].

Since 2012, Shenzhen has placed greater emphasis on industrial innovation and high-quality development. Through innovation-driven growth, it has accelerated the construction of a modernized, international, and innovative city, making strategic emerging industries the new engine of local economic development. The characteristics of innovation in Shenzhen are distinct compared to other places: first, there has been a gradual upgrading from industrial parks, technology industrial parks, high-tech zones, to pilot zones for independent innovation. Second, the government has established an innovation mechanism and environment, with entrepreneurs always being the main body of innovation. Third, the government has effectively managed the relationships among government, universities, research institutions, and enterprises, successfully fostering a culture of innovation and entrepreneurship. Fourth, unlike Beijing and Shanghai, Shenzhen's enterprises mostly invest in applied technology fields, with fast and efficient commercialization of scientific research achievements. This aligns highly with Shenzhen's innovation environment and main bodies of innovation. The innovative development of many enterprises like Huawei and BYD has driven the rapid accumulation of new productive forces and fast economic growth in Shenzhen over the past decade.

2.2. Shantou: reliance on low-value manufacturing and administrative fragmentation

Shantou is a port city that has historically been active in trade, with a superior geographical location that offers unique advantages for developing an outward-oriented economy. It is also a well-known hometown for overseas Chinese, with abundant overseas capital and resources, and has the advantage of having legislative powers unique to special economic zones, along with significant local legislation authority. However, Shantou has neither made full use of the Central Government's special economic zone policies nor thrived due to its overseas Chinese population. In the city rankings of Guangdong Province, it falls behind cities in the Pearl River Delta region, and even lags behind Maoming and Zhanjiang in western Guangdong, which is inconsistent with Shantou's status as a special economic zone and hometown of overseas Chinese. The main manufacturing sector in Shantou is represented by high-end manufacturing industries such as circuit boards and displays, typified by ultrasonic electronics, as well as low-end manufacturing industries with relatively low added value such as the dyeing and clothing industry, toy industry, plastic products, and electromechanical products. It can be said that the industrial sector of Shantou has remained in a state of low-quality growth for the past forty years since becoming a special economic zone, failing to seize the wave of industrial upgrading. The reason lies in the slow pace of reform for existing enterprises. Over the more than forty years of reform and opening up, the reforms of state-owned and collective enterprises have lagged behind, lacking vitality, resulting in a significant number of enterprises going bankrupt or continuing to suffer losses, failing to merge and reorganize a batch of large backbone enterprises early on in infrastructure construction, high technology, market investment, and other fields to form competitive advantages.

The frequent adjustments of administrative divisions in Shantou and the inconsistent urban positioning have become obstacles to the accelerated development of this city. Rapid changes in administrative divisions are detrimental to the development of the situation and long-term planning. The administrative divisions of Shantou should be relatively stable for a longer period to facilitate long-term development. Shantou's concepts are conservative, and the strength of reform and opening-up is insufficient, resulting in low openness and inclusiveness. According to incomplete statistics, there are currently about 214,000 external migrants in Shantou, which is only 1/25 of the resident population. Shantou has abundant labor resources and is one of the most densely populated regions in the country, but it has relatively weak scientific research capabilities and a serious shortage of talent supply. Additionally, due to factors like language, geographical location, and transportation,

the Chaoshan area is relatively isolated geographically, and its traditional culture shows poor inclusiveness, with the derived Chaoshan traditional culture exhibiting some closed and exclusionary awareness, which affects Shantou's attractiveness to foreign talent. In contrast, Shenzhen is an immigrant city that embodies a culture encouraging innovation, tolerating failure and pursuing excellence, attracting outstanding talents from all over the country to gather there, thus supporting the rapid and efficient economic development of Shenzhen [3].

2.3. Zhuhai: focus on sustainable development

The Zhuhai Special Economic Zone was officially established in 1980, making it one of the first four economic zones set up in China. Since its establishment, it has achieved significant leaps in economic and social development, transforming from a small border county primarily focused on agriculture and fishing into an economic zone dominated by industry, with comprehensive development in agriculture, fishing, animal husbandry, commerce, tourism, and housing, and evolving into a modern coastal city with initial scale. In terms of export trade and attracting foreign investment, Zhuhai and Shenzhen share similar resources and geographical advantages. However, 40 years later, Shenzhen has become a first-tier city, while Zhuhai remains a second-tier city, with its economic output also lower than nearby cities such as Foshan, Dongguan, and Zhongshan, ranking in the middle among provincial cities in Guangdong. Interestingly, livability has gradually become Zhuhai's city brand in this process. Early in its urban development, it was decided not to introduce low-end manufacturing industries that are high in pollution, so although it lags behind nearby cities like Zhongshan and Dongguan in total GDP, the local natural ecology has been maximally preserved. In the 'Livable City Competitiveness Report' published by the Chinese Academy of Social Sciences, Zhuhai ranked first for three consecutive years. This has now become an advantage for Zhuhai in attracting talent [4].

In recent years, the concept of green development has become increasingly popular. Under the city concept of eco-priority, Zhuhai has not followed the path of competing for resources or environmental degradation. Instead, it has resolutely rejected polluting enterprises and focused on emerging industries with high-tech content, high added value, and environmental sustainability. One-third of polluting enterprises have been shut down due to failing to meet emission standards. The achievements of 40 years of development have validated the foresight and scientific nature of Zhuhai's adherence to this approach. Currently, Zhuhai is one of the areas in the Pearl River Delta with the best ecological environment, the lowest land development intensity, the least accumulation of low-end industries, and the most balanced population density and quality. It has explored a win-win path for economic development and environmental protection. Today, the ecological environment is the most beautiful calling card of Zhuhai, becoming its outstanding advantage. This has also become a significant advantage for Zhuhai in attracting talent, especially in the field of technological innovation.

2.4. Xiamen: leading trade and financial strategies

As one of the earliest special economic zones to implement reform and openness, Xiamen has always embraced an open and inclusive mindset, and with a pioneering spirit, has bravely taken the lead in deepening reform and opening up. It has gradually built a comprehensive and multi-layered pattern of openness to the outside world, making Xiamen an important hub for foreign capital, a key port for foreign trade, and an important window for external exchanges with internal outreach. Forty years ago, enterprises in Xiamen faced development difficulties; state-owned enterprises were constrained by funding issues, and the approval processes for enterprises were inefficient and cumbersome. There was no experience to draw upon for building a special economic zone. Over the past 40 years, Xiamen has boldly explored and practiced, vigorously implementing an innovation-driven development strategy, experiencing a transformation from being constrained to reform, from imitation to innovation, and from manufacturing to creating, becoming one of the areas in China with

the highest density of major reform initiatives, the greatest intensity, the most concentrated measures, and the most prominent effects.

Only with an efficient and robust financial system can high-quality projects be incubated and top-tier enterprises cultivated. This financial system means having a sufficient number of financial institutions, a rich variety of financial formats, comprehensive financial regulations, a sufficient number of professional financial talents, and a complete financial business chain. Since the reform and opening up, Xiamen's financial industry has developed simultaneously with the construction of the special economic zone, progressing through stages from simple to complex, and from low-level to high-level development. Today, Xiamen's financial industry has entered a new stage of development. Supported by a diverse and robust financial system, Xiamen is incubating an increasing number of industrial projects, attracting more and more entities to settle, and retaining an increasing number of financial and industry professionals. In recent years, Xiamen has leveraged the advantages of pioneering reform policies and mechanisms to take the lead in high-level opening up. Today, Xiamen has formed a multi-layered pattern of openness characterized, ranking among the top tier in the country for total foreign trade import and export, and maintaining a solid position in actual foreign investment utilization [5].

3. Methodology

3.1. Model

Panel Data Analysis is particularly suited for this research because it allows for the examination of both cross-sectional and time-series variations in the development trajectories of Shenzhen, Zhuhai, Shantou, and Xiamen. Unlike cross-sectional analysis, panel data tracks the same cities over multiple years (1980–2023), capturing how policies and investments evolve and impact outcomes like GDP and education. By including city and year fixed effects, the model reduces omitted variable bias, ensuring that observed relationships are not driven by unmeasured confounders, and constructs the following econometric model:

$$y_{it} = \beta_0 + \beta_1 x_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

Where y_{it} is the dependent variable (e.g. GDP per capita, education index, and etc.) for city i in year t , x_{it} is the vector of independent variables (e.g. FDI, infrastructure spending, education expenditure), α_i is city-fixed effects (controls for unobserved time-invariant city characteristics), γ_t is year-fixed effects (controls for nationwide trends, such as economic reforms or global shocks), and ε_{it} is error term.

3.2. Variables and Data Sources

3.2.1 Dependent Variables

The study focuses on three primary areas of economic and social development.

Firstly, to measure economic development, we use *Gross Domestic Product (GDP) per capita*, which adjusted for inflation to reflect real economic growth, and *Industrial Output Contribution*, which measured as a percentage of GDP to assess the role of industry in economic growth.

Secondly, to measure education level, we use *Tertiary Education Enrollment Rate*, which represents the proportion of individuals pursuing higher education, reflecting the accessibility and demand for advanced skills, and *Literacy Rate*, which is a fundamental measure of educational attainment and human capital development.

Thirly, to measure other socioeconomic indices, we use *Human Development Index (HDI)*, a composite measure incorporating health, education, and income to gauge overall human well-being, and *Gini Coefficient*, a statistical measure of income inequality, where higher values indicate greater economic disparity.

3.2.2 Independent Variables

The key factors influencing economic and social outcomes are categorized into two groups.

Policy is an important factor that influences economic and social development. This paper selects the following policy variables: *Foreign Direct Investment (FDI) Inflows*, expressed as a percentage of GDP, which assesses the impact of foreign investments on economic development; *Infrastructure Investment*, which includes metrics such as road density and port capacity, indicating the extent of investment in physical capital to support economic activities.

Considering other factors that may affect business credit financing behaviour, this paper selects the following control variables: *Population Growth*, a demographic factor influencing labor supply and market size; *Urbanization Rate*, Measures the shift from rural to urban living, often associated with economic transformation; *Proximity to Major Trade Hubs*, Includes strategic locations such as Hong Kong, which can significantly influence regional economic activity due to trade and investment linkages.

3.2.3 Data Sources

The study relies on multiple data sources to ensure comprehensive and accurate analysis. Firstly, China City Statistical Yearbooks (1985–2023) which provides city-level economic and demographic statistics. Secondly, Provincial Statistical Bureaus (e.g., Guangdong, Fujian) which offers region-specific economic and policy data. Thirdly, Global Datasets from the World Bank and United Nations, which is used for international indicators such as the Human Development Index (HDI) and inequality measures.

4. Result

This section presents the empirical findings from the panel data analysis, focusing on the drivers of economic growth, educational development, and socio-economic disparities among the four Special Economic Zones (SEZs). The results are derived from fixed/random effects models using annual data from 1980 to 2023. Key variables include GDP per capita, tertiary education enrollment, FDI inflows, and infrastructure investment.

4.1. Hausman test result

First, we need to choose the appropriate panel model. Fixed effects control for time-invariant city-specific characteristics (e.g., geographic location, cultural factors) that could bias results. Random effects allow for the inclusion of time-invariant variables (e.g., proximity to Hong Kong) while still accounting for unobserved heterogeneity. We conduct Hausman test to select the appropriate model, determine whether fixed or random effects is appropriate by testing for correlation between city-specific effects and independent variables. From table 1, we can see those fixed effects model preferred over random effects model. City-fixed effects and year- fixed effects are controlled in the subsequent models.

Table 1 Model Diagnostics

Test	Statistic	p-value	Conclusion
Hausman Test	$\chi^2 = 18.34$	0.000	Fixed Effects preferred over Random Effects
F-test (Fixed Effects)	F = 32.17	0.000	Joint significance of city/year effects

4.2. Economic Growth Drivers

According to the results in Table 2, foreign direct investment, infrastructure investment, tertiary enrollment rate, and proximity to Hong Kong all have significant positive impacts on driving economic growth. In the early development of the four special economic zones, they attracted external investment to bring in funds, technology, and advanced management experience, which propelled the early development and rise of the special economic zones. Therefore, FDI has significantly promoted the development of these zones. It is especially important to emphasize that proximity to Hong Kong

has become a crucial factor for economic growth and has formed a geographical advantage for Shenzhen's rise. Shenzhen's Proximity to Hong Kong ($\beta = 0.57$) and FDI ($\beta = 0.42$) explain 65% of its GDP growth. Due to its close proximity to Hong Kong, Shenzhen received numerous favorable conditions during its early development, including foreign investment.

Education also plays a vital role in driving economic development. On one hand, education provides a large pool of high-quality labor and skilled talent for industrial development and enterprise production, and on the other hand, education is a significant force behind technological innovation in enterprises, while science and technology are the most important productive forces in the 21st century. Therefore, education and the resulting innovative capability are the most critical factors for Shenzhen's continuous high-quality development.

Table 2 Economic Growth Drivers

Variable	Coefficient	Std. Error	p-value
FDI (% of GDP)	0.42***	0.08	0.000
Infrastructure Investment	0.19**	0.06	0.012
Tertiary Enrollment Rate	0.31*	0.12	0.042
Proximity to Hong Kong	0.57***	0.10	0.000

Notes: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All models include city and year fixed effects.

4.3. Education Development Drivers

In Table 3, we examine which factors have an impact on improving the literacy rate and education level of society. According to the results of Table 3, the level of government spending on education is the most critical factor in promoting educational development: a 1% increase in education spending raises tertiary enrollment by 0.24%. The proportion of education spending can significantly improve the educational level of society, highlighting the important role that government policies can play in social and economic development.

Taking Shenzhen as an example. Over the past 40 years, Shenzhen has created the 'Shenzhen Miracle' in urban development, which has attracted worldwide attention, with a reform spirit of being the first to innovate. As a city of innovation, Shenzhen's educational endeavors also possess innovative genes. In recent years, Shenzhen has actively taken the lead in various fields such as preschool education, basic education, higher education, and vocational education, adopting extraordinary measures to promote a 'dual enhancement' of both the scale and quality of education. In 2022, Shenzhen's expenditure on nine categories of livelihood, including education and health, amounted to 341.96 billion yuan, accounting for 68.4% of fiscal expenditure, strongly supporting educational development and overall social progress.

Table 3 Education Development Drivers

Variable	Coefficient	Std. Error	p-value
Education Spending (% GDP)	0.24***	0.05	0.001
FDI (% of GDP)	0.15*	0.07	0.048
Urbanization Rate	0.10	0.09	0.280

4.4. Socio-Economic Disparities

From the results in Table 4, there are significant differences among the four special economic zones in terms of socio-economic factors. In 2023, Shenzhen has the highest per capita GDP, followed by Zhuhai and Xiamen. Shantou has the lowest per capita GDP, which is approximately a quarter of that of Shenzhen, indicating that Shantou's economic development has lagged behind to a certain extent. In terms of the Gini coefficient, Zhuhai has the lowest Gini coefficient of 0.35, indicating a relatively light income gap in society, which profoundly reflects Zhuhai's characteristics as a livable city. The Gini coefficients of Shenzhen and Xiamen are slightly higher than that of Zhuhai, while

Shantou has the highest Gini coefficient at 0.49, suggesting a substantial overall income disparity in Shantou, with uneven social development. Shenzhen has the highest HDI index at 0.92, followed by Xiamen, Zhuhai, and Shantou, indicating that Shenzhen has a high level of social satisfaction in terms of social welfare, resident health, and education and medical services. Conversely, Shantou faces serious challenges in socio-economic development.

Table 4 Socio-Economic Disparities (2023)

City	GDP per Capita (¥)	Gini Coefficient	HDI
Shenzhen	197,000	0.38	0.92
Xiamen	152,000	0.41	0.88
Zhuhai	171,000	0.35	0.85
Shantou	57,400	0.49	0.72

5. Further Discussion

Shenzhen, once a modest fishing village, has emerged as a global innovation powerhouse, with its GDP skyrocketing from ¥270 million in 1980 to ¥34.6 trillion in 2023, driven by tech giants like Huawei and Tencent [6]. By contrast, Shantou, despite an initially higher GDP of ¥1.08 billion in 1980, stagnated at ¥3.16 trillion in 2023 due to reliance on low-value industries like textiles and inadequate infrastructure upgrades (Guangdong Government, 2025). Zhuhai and Xiamen adopted distinct strategies: Zhuhai prioritized sustainable development and high-tech sectors, achieving a GDP of ¥4.23 trillion in 2023, while Xiamen leveraged its political autonomy and educational institutions to become a financial and trade hub with a GDP of ¥8.07 trillion [7].

The SEZs' success was underpinned by strategic policy frameworks. Shenzhen's proximity to Hong Kong facilitated cross-border trade and technology transfer, while its early adoption of reforms like green energy initiatives—such as becoming China's first non-leaded petrol city in 1998—enhanced its global competitiveness [8]. Xiamen's integration of environmental protection with economic growth, exemplified by the revitalization of Yundang Lake, demonstrates a balanced development model. Conversely, Shantou's fragmentation into smaller administrative units in 1991 hindered cohesive planning, exacerbating industrial decline.

Foreign direct investment (FDI) and technological innovation further differentiated these zones. Guangdong Province, home to Shenzhen and Zhuhai, attracted 19% of China's robotics firms and produced 44% of its industrial robots by 2024, cementing its status as a global manufacturing leader. Meanwhile, Xiamen's BRICS Innovation Center fostered international collaboration in AI and blockchain, aligning with China's Belt and Road Initiative.

6. Summary

This paper provides a comprehensive comparative analysis of the four pioneering Special Economic Zones (SEZs) in China—Shenzhen, Zhuhai, Shantou, and Xiamen—offering valuable insights into their distinct developmental trajectories over the past four decades. The findings highlight the significance of foreign direct investment (FDI), infrastructure investment, and proximity to major trade hubs in driving economic growth. Shenzhen emerged as the most successful SEZ due to its strategic integration with Hong Kong, technological innovation, and robust policy frameworks, whereas Shantou struggled with industrial stagnation and ineffective administrative reforms. Education also played a crucial role in long-term development, with increased tertiary enrollment and education spending correlating with stronger economic performance in Shenzhen and Xiamen. Meanwhile, Zhuhai's commitment to sustainable development positioned it as a leader in green industries, while Xiamen leveraged financial and trade-oriented strategies to enhance its regional competitiveness.

This paper underscores that while SEZs can serve as catalysts for economic transformation, their success is not guaranteed. Effective governance, adaptability to global economic shifts, and a balance

between industrial policy and social development are critical determinants of sustained growth. Lessons from these SEZs provide valuable implications for emerging economies looking to implement similar development models, emphasizing the need for tailored policy approaches that consider geographic, institutional, and industrial factors. Future research should explore how evolving global trade dynamics, digital transformation, and environmental sustainability initiatives will shape the next phase of SEZ development in China and beyond.

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