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Evaluation of REITs resilience of infrastructure projects from the perspective of investor heterogeneity based on Geodetector Models—Empirical data from China

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Abstract This paper focuses on the economic resilience aspects of the financialization of infrastructure projects concerning enhancing market dynamics and risk regulation. We examined 39 infrastructure REITs listed in China between June 2021 and June 2024. Utilizing an economic resilience evaluation model to assess the resistance and recovery capacities of these infrastructure REITs, we incorporate seven investor heterogeneity measures. A geographic detector model is employed to analyze divergence, identify key determinant factors, pinpoint risk zones, and investigate the interaction between these measures within the context of PPP-REITs and DI-REITs. The empirical results show that the investor ratio and expected investment tenure are critical to the construction of economic resilience indices for infrastructure REITs. Also, the interaction of factors holds significance toward influencing the divergence in economic resilience. Our findings reveal a “barrel effect” of investor heterogeneity in infrastructure project financial products, indicating a consistency between economic resilience and investor heterogeneity. By integrating the investor heterogeneity

index into the resilience evaluation framework of infrastructure REITs, this study offers valuable insights into the risk-resistance capacity of infrastructure financial products and the enhancement of economic resilience in these projects.

Keywords investor heterogeneity, economic resilience, geographic detector model, infrastructure REITs

1 Introduction

Infrastructure investment is an effective way to cope with the economic downturn, and there is a big difference between developed and emerging countries with respect to local financing-backed infrastructure (Barseghyan and Coate, 2023; Bao et al., 2024). The mismatch between authority and financial capacity amplifies the troubles in emerging markets, whereby insufficient local financing severely constrains sustainable development investment and financing in infrastructure projects. With stimuli at its disposal, Chinese provinces have since 2021 proposed extensive investment plans. However, there still remain great challenges against the philosophy of traditional investment and financing model that is typically led by government and platform companies (Li et al., 2020).

The financialization of infrastructure projects plays an important role in solving their financing difficulties. Financial markets provide a variety of financing instruments, among which are bonds, equity investments and project finance. With such diversity, infrastructure projects can attract more private capital and investment, thus relieving the financial burden on the government (Bovaird, 2004). Other benefits include allocation of the projects’ business risks across a much larger number of investors, thereby letting less voluminous sophistication-level requirement of individual investment (Chan et al., 2018). The involvement of financial markets also leads to

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better scrutiny and management of the projects. This enhances the way stakeholders interact and induces improvement to the economic efficiency of the project (Shen and Xue, 2021). With backing from financial institutions and banks, China has become one of the largest PPP markets in the world (Leviäkangas et al., 2018). The PPP model typically relies on direct inputs from both the government and private investors, which restricts other avenues of financing and exit channels (Liu et al., 2022). In April 2020, China officially launched infrastructure REITs, connecting asset securitisation directly to the capital market. This initiative allows investors to trade directly in the secondary market. By optimizing funding allocation and diversifying risks across multiple projects or regions, the liquidity of funds is significantly improved (Cheung et al., 2015).

As more diverse investors enter the infrastructure financial market, high frequency trading behaviors tend to have an impact on market liquidity and price volatility (Karkowska and Palczewski, 2023). Different investors with different investment objectives, risk tolerances and information processing capabilities can have the impact on stability and efficiency of capital market (Chan et al., 2022). Scholars have investigated the association between corporate social performance and investment institution differentiation through corporate nature (Wang and Sun, 2022). Studies also covered processes by which heterogeneous investors-including investment tenure risk attitudes-influence corporate risk-return generation (Huang et al., 2024). Moreover, researchers have focused on investigations of investors' heterogeneity (Shi et al., 2024; Onishchenko et al., 2024; Wang and Luo, 2024) and their corresponding impact on variations in investors' beliefs and information-processing capabilities on asset prices (Buffa and Hodor, 2023; Zhao et al., 2023; Botsch, 2022; Li et al., 2024). Additional studies have looked into transaction costs and the efficiency of information (Li et al., 2016; Du et al., 2016), as well as the economic resilience of capital markets (Qin and Liu, 2023; Eichen-green et al., 2024; Cheng et al., 2024; Giannakis et al., 2024). Investor variety is a consideration that has recently entered debates concerning market stability. Depending on their type, investors may provide very different contributions in turbulent times; it is expected that some may hedge or provide liquidity in a bear market (Edmans et al., 2013), while others may jump into the fray of risk provision in a bull market. Investor heterogeneity is also said to influence information efficiency in the market. Differences in information asymmetries, information transmission, and price discovery procedures among different investor cohorts have been other recurring schema for study (Zheng, 2024). Varying abilities of investing and processing information affect the quality of price realization and subsequently the efficiency of information transfer in the market (Gogineni et al., 2024).

When assessing the effect of investor heterogeneity on

the markets experiencing shocks, e.g., financial crises or policy changes, scholars tend to focus on institutional versus retail investors. Differences in risk preferences, trading strategies, and beliefs influence the dynamic recovery of markets post shock, with implications for price recovery, trading volume, and liquidity (Zhang et al., 2021; Tang and Wang, 2022; Ingrid et al., 2023; Gülay, Ersan, 2023; Zhou et al., 2023). However, much research into the effect of investor heterogeneity on the intrinsic value of projects fails to exist, and there is no clear definition of indicators that are closely related to its intrinsic value.

Intrinsic value of projects is considered by scholars with the concept of economic resilience to address economic and regional sciences. There has been existing research into definitions and measurements (Hynes et al., 2022), regional and business economic resilience (Muštra et al., 2023), financial market and socio-economic resilience (Langkulsen et al., 2022), and the relationship between macroeconomic policies and economic resilience (Mazzola and Pizzuto, 2020). In particular, researchers have largely studied the determinants of economic resilience differentiation. As an example, in their work, Duan et al. (2022) prove that industrial network characteristics invoke resilience and prevent the collapse of the economy using a new multidimensional nonlinear model based on Lotka-Volterra model. Jiang et al. (2022) also empirically examined how population agglomeration affects economic resilience under the 2008 financial crisis. They concluded a spatial econometric model of population agglomeration helps cities resist during a crisis, using data from 284 Chinese cities. Urban economic resilience is also affected by the structure of the labor force. Homogeneous human capital agglomeration fosters cities' crisis resistance, whereas heterogeneous human capital agglomeration strengthens cities' economic ability to recover and adjustment ability. At the country or provincial level, Wang and Li (2022) investigated regional economic resilience. A multilevel logistic regression model of how provinces influence regional performance in economic crises is built, and differences in how provinces influence regional performance in economic crises are identified. Provincial trajectories, size of economy and resources have profound impact on regional economic resilience. Even after accounting for other critical resilience aspects, Chacon-Hurtado et al. (2020) found a positive global relationship between railway density, access to intermodal services and access to local and regional markets with regional performance during recessions. Additionally, Bogdański (2021) uses a correlation analyses to obtain a statistically significant moderate negative correlation between the level of diversification of the employment structure in 2009, and subsequent employment decline, in Poland's voivodeship city sub-regions. Such a finding implies that economic resilience is limited by high employment diversification.

Economic resilience is measured in a variety of ways, providing a rich theoretical basis for the conduct of this study. Previous empirical work on economic resilience typically focuses on a selected few economic resilience factors, for instance, the efficiency of information transmission, the risk of regional market shocks and the differentiation in regional economic resilience. Yet, no studies link the firms' heterogeneity with returns of financialized infrastructure. The purpose of this study is to explore the relationship between investor heterogeneity indicators and the economic resilience of different project types. For analysis this study selected 39 infrastructure REITs listed between June 2021 and June 2024. These were categorized into two groups: PPP-REITs (where the underlying asset is a PPP project) and DI-REITs (direct issue REITs) based on the differentiation of the underlying assets. The return resilience of these 39 individual infrastructure REITs was quantitatively analyzed using the resistance and recovery measures of economic resilience presented by Martin et al. (2016). In particular, we compared the resilience of infrastructure financialization projects using the theory of resilience evaluation, and ranked the resistance and recovery indices of infrastructure financialization projects. Moreover, we applied the geodetector model for identifying driving factors, risk zones and interactions in infrastructure financialization projects. This research evaluates the economic resilience of infrastructure REITs as a function of seven different investors heterogeneity indexes. Additionally, this study proposes pathways through which heterogeneous indicators in different project types impact economic resilience as well as the key impact indicator factors.

Unlike international REIT market in the most part, the Chinese market mainly utilizes infrastructure as the underlying asset. It is concerned with supplying public services while being for a not-for-profit. This therefore brings a special relationship between the operation of real assets and the capital market. Taking investor heterogeneity into account, this paper adds an evaluation system of resilience to Chinese infrastructure REITs. From a spatial perspective, we also analyze how market performance of infrastructure REITs responds to interaction effects of these heterogeneity indicators. It increases the resistance of the project to risks. The key contributions of this study include the following aspects: (1) The assessment of the resistance and recovery indices of the infrastructure REITs market, which involved performing a relative, absolute and comprehensive evaluation of economic resilience, thereby enriching the theory of financial market resilience evaluation. (2) For the first time, this study integrates the geodetector model to investigate how investor heterogeneity affects the economic resilience of infrastructure REITs. Finally, it deepens investigators' understanding of how heterogeneity of investors affects market resilience and offers theoretical foundation to guide government and management entities to regulate

systematic risks and the dynamic of market.

2 Economic resilience measures of infrastructure financialization projects from the perspective of market response

Building on the economic resilience evaluation model proposed by Martin et al. (2016), Faggian et al. (2018), and Oliva and Lazzaretto (2018), this study measured the resistance and recovery of various infrastructure REITs since their inception, focusing on the largest decline in net value after product purchase. The formulas for measuring the Resistance and Recovery of infrastructure REITs are as follows:

$$Resi = \frac{E_{r,t}/E_{r,t-1}}{E_{n,t}/E_{n,t-1}}, \quad (1)$$

$$Reco = \frac{E_{r,t+1} - E_{r,t}}{E_{r,t-1} - E_{r,t}}. \quad (2)$$

In this equation, *Resi* stands for the resistance index, *Reco* denotes the recovery index, E_r represents the net value of the analyzed infrastructure REITs, and E_n indicates the infrastructure REITs Market Fund Index. The variable t represents the time of maximum retracement since listing, $t - 1$ indicates the early stage of maximum retracement, and $t + 1$ signifies the late stage of maximum retraction. According to the definition, Eq. (1) is centered at 1. If *Resi* exceeds 1, the infrastructure REITs show greater resistance than the fund market. If it is below 1, they are less resistant and more vulnerable to external factors. Equation (2) compares the net value of recovery at the same time to the net value of resistance. Ideally, this value should be greater than 1; however, few real samples achieve this threshold. Thus, this paper considers a value greater than 0.9 as the critical point. If *Reco* is below 0.9, will take longer to restore to the original level.

2.1 Sample selection and data source

Using specific data on infrastructure REITs from the Wind database, this study focuses on 39 infrastructure REITs listed on the SSE and SZSE from June 2021 to June 2024. Among these, seven are PPP projects, identified with the (PPP) suffix in their project names, while the remaining 32 are DI-REITs (Direct Issuance REITs). Basic information is presented in Table 1.

2.2 A measure of economic resilience and resilience

Based on the net value data for infrastructure REITs from the Wind database since their listing, the resistance and recovery indexes of the 39 infrastructure REITs listed in Table 1 can be calculated using Eqs (1) and (2) during the

Table 1 Infrastructure REITs information sheet

Number	Code	Name	Type	The plate
1	508027	Soochow Suzhou Industrial Park Industrial ParkREIT (PPP)	Park infrastructure	Shanghai stock exchange
2	180202	Huaxia Yuexiu Expressway REIT (PPP)	Transportation infrastructure	Shenzhen stock exchange
3	508001	Zheshang Securities Shanghai-Hangzhou-Ningbo high-speed REIT (PPP)	Transportation infrastructure	Shanghai stock exchange
4	180201	Ping'an Guangzhou Exchange and Guanghe Expressway REIT (PPP)	Transportation infrastructure	Shenzhen stock exchange
5	508018	Huaxia China Communications and Construction Expressway REIT (PPP)	Transportation infrastructure	Shanghai stock exchange
6	180801	AVIC Shougang Biomass REIT (PPP)	Eco-environment protection	Shenzhen stock exchange
7	508006	Wells Fargo Pioneered Water REIT (PPP)	Eco-environment protection	Shanghai stock exchange
8	508088	Guotai Junan Long New Economy REIT	Park infrastructure	Shanghai stock exchange
9	180103	Huaxia Hangzhou and Daoke Production Park REIT	Park infrastructure	Shenzhen stock exchange
10	508021	Guotai Junan Lingang Innovation Industrial Park REIT	Park infrastructure	Shanghai stock exchange
11	508000	Hua'an Zhangjiang Everbright Park REIT	Park infrastructure	Shanghai stock exchange
12	508099	CCB Zhongguancun Industrial Park REIT	Park infrastructure	Shanghai stock exchange
13	180101>	Boshi Merchants Shekou Industrial Park REIT	Park infrastructure	Shenzhen stock exchange
14	180102	Huaxia Hefei High-tech Production Park REIT	Park infrastructure	Shenzhen stock exchange
15	508066	Huatai Jiangsu Traffic Control REIT	Transportation infrastructure	Shanghai stock exchange
16	508009	CICC Anhui Communications Control REIT	Transportation infrastructure	Shanghai stock exchange
17	508008	Guojin China Railway Construction High-speed REIT	Transportation infrastructure	Shanghai stock exchange
18	180401	Penghua Shenzhen Energy REIT	Energy infrastructure	Shenzhen stock exchange
19	508058	CICC Xiamen Housing Affordable Rental Housing REIT	Inaffordable rental housing	Shanghai stock exchange
20	180501	Red Earth Innovation Shenzhen Talents Live in REIT	Inaffordable rental housing	Shenzhen stock exchange
21	508077	Huaxia Fund Huarun Youchao REIT	Inaffordable rental housing	Shanghai stock exchange
22	508068	Huaxia Beijing Affordable Housing REIT	Inaffordable rental housing	Shanghai stock exchange
23	508056	Zhongjinoulos Warehousing Logistics REIT	Warehousing logistics	Shanghai stock exchange
24	180301	Red Earth Innovation Yantian Port Warehouse Logistics REIT	Warehousing logistics	Shenzhen stock exchange
25	508098	Harvest Jingdong Storage Infrastructure REIT	Warehousing logistics	Shanghai stock exchange
26	508019	CICC Hubei Science tou Optical Valley REIT	Park infrastructure	Shanghai stock exchange
27	508031	Guotai Junan City wide wide ting rental REIT	Inaffordable rental housing	Shanghai stock exchange
28	180601	China Resources Commercial REIT	Consumption infrastructure	Shenzhen stock exchange
29	508011	Jia Physical Beauty Consumption REIT	Consumption infrastructure	Shanghai stock exchange
30	508017	Huaxia Jinmao Commercial REIT	Consumption infrastructure	Shanghai stock exchange
31	180602	China Gold Printing Force Consumption REIT	Consumption infrastructure	Shenzhen stock exchange
32	508026	Harvest Power China Clean Energy REIT	Eco-environment protection	Shanghai stock exchange
33	508096	AVIC Jingneng Photovoltaic REITs	Eco-environment protection	Shanghai stock exchange
34	508007	CICC China High Expressway REIT	Transportation infrastructure	Shanghai stock exchange
35	508033	E-Fund-Shenzhen High-speed REIT	Transportation infrastructure	Shenzhen stock exchange
36	508086	ICBC Hebei Expressway REIT	Transportation infrastructure	Shanghai stock exchange
37	508028	CITIC Construction Investment State Power Investment New Energy REIT	Eco-environment protection	Shanghai stock exchange
38	508089	Huaxia TBEA Electric New Energy REIT	Eco-environment protection	Shanghai stock exchange
39	180302	Huaxia Shenzhen International REIT	Warehousing logistics	Shenzhen stock exchange

maximum drawdown. The measurement results are shown in [Table 2](#).

From the recovery index of infrastructure REITs in [Table 2](#), five units have recovery indexes greater than 0.9, while 34 units fall below this threshold. The CICC Shan-

dong Expressway REIT has the highest recovery index at 0.9737, indicating the strongest recovery. In contrast, the CICC GLP Warehouse & Logistics REIT shows the lowest recovery at 0.1217. The top five REITs with indexes above 0.9, ranked from highest to lowest, are:

Table 2 Results of the economic resilience measures of PPP-REITs and DI-REITs

Resistance index	Number	Resistance index	Number	Recovery index	Number	Recovery index	Number
1.0128	3	0.9189	39	0.9737	34	0.4775	11
1.0090	18	0.9173	22	0.9378	15	0.4569	7
1.0089	17	0.9133	38	0.9286	30	0.4499	4
1.0031	34	0.9099	29	0.9266	10	0.4370	3
1.0002	25	0.9085	13	0.9200	39	0.4230	13
0.9962	16	0.9060	21	0.9030	31	0.3960	14
0.9816	9	0.9053	5	0.8953	38	0.3750	29
0.9800	31	0.9047	27	0.8254	17	0.3672	6
0.9795	23	0.9039	36	0.7727	25	0.3636	33
0.9724	19	0.9034	20	0.6912	16	0.3333	36
0.9701	30	0.9030	33	0.6829	2	0.2871	37
0.9699	15	0.9028	6	0.6772	26	0.2754	12
0.9564	2	0.9020	37	0.6667	28	0.2500	20
0.9483	11	0.8975	32	0.6066	1	0.2364	35
0.9411	26	0.8922	8	0.6063	8	0.2212	5
0.9377	24	0.8914	7	0.5652	9	0.1961	32
0.9357	12	0.8835	1	0.5598	27	0.1667	21
0.9320	28	0.8764	14	0.5488	18	0.1630	24
0.9296	4	0.8732	35	0.5284	22	0.1217	23
0.9182	10			0.5217	19		

CICC Shandong Expressway REIT, Huatai Jiangsu Jiaotong Control REIT, Huaxia Jinmao Commercial REIT, Guotai Junan Lingang Innovative Industrial Park REIT, and Huaxia Shenzhen International REIT. It is noteworthy that the seven PPP-REITs generally show weak performance concerning their recovery indexes.

2.3 Economic resilience evaluation and analysis

According to the data from 39 REIT groups presented in Table 2, this study performed a visual analysis using Origin to plot the scatter distribution, as shown in Fig. 1. In this analysis, resistance is represented on the horizontal axis and recovery on the vertical axis. The distribution center of the resistance and recovery index data establishes our boundaries.

For resistance, the threshold is set at 0.94: values below 0.94 indicate low resistance, while those above it indicate high resistance. For recovery, a threshold of 0.55 is used: values below this mark represent low recovery, and those above represent high recovery. These boundaries segment the plot into four distinct regions:

- Region I: low resistance and high resilience
- Region II: high resistance and high resilience
- Region III: low resistance and low resilience
- Region IV: high resistance and low resilience

PPP-REITs are highlighted in red font, while DI-REITs are in black font. This analysis aids in understanding the

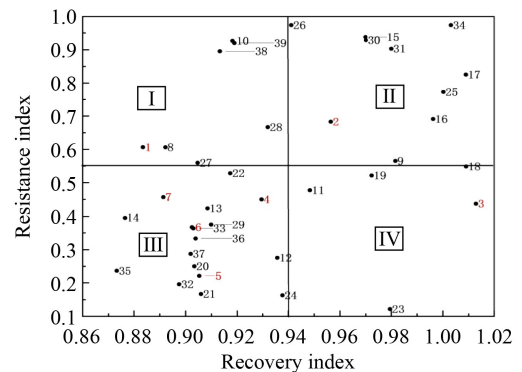


Fig. 1 Index distribution diagram of the resistance and resilience of infrastructure REITs.

economic resilience of infrastructure REITs, as detailed in Table 3.

Building on the framework proposed by Faggian et al. (2018), the economic resilience of infrastructure REITs can be divided into four types based on their resistance and resilience values, as depicted in Table 4.

An absolute evaluation table for the economic resilience of infrastructure REITs is available from the resistance and resilience indices for each REIT, as shown in Table 5.

An economic resilience index (RES) is established based on the resistance and resilience indices. Since resistance and resilience contribute equally to the stability of

Table 3 evaluation table of the economic resilience of the infrastructure REITs

Type of economic resilience	Infrastructure REITs serial code (Table 1)
Low resistance- -high recovery	8、10、1、27、28、38、39
High resistance- -high recovery	9、2、15、16、17、25、26、30、31、34
Low resistance- -low recovery	12、14、4、20、21、5、22、13、24、6、7、29、32、3、35、36、37
High resistance- -low recovery	11、3、18、19、23

Table 4 Classification table of the economic resilience of infrastructure REITs

Type of economic resilience	Group standard
High resistance-rapid recovery	Resistance > 1 and resilience > 0.9
High resistance- -slow recovery	Resistance > 1 and resilience < 0.9
Low resistance-rapid recovery	Resistance < 1, resilience > 0.9
Low resistance- -slow recovery	Resistance < 1 and resilience < 0.9

Table 5 Absolute evaluation table of the economic resilience of the infrastructure REITs

Type of economic resilience	Infrastructure REITs serial code (Table 1)
High resistance-Rapid recovery	34
High resistance-Slowly recovery	3、18、25、17
Low resistance-Rapid recovery	10、15、26、30、31、38、39
Low resistance-Slowly recovery	9、8、1、11、16、23、13、19、2、24、22、21、12、5、20、6、7、14、4、27、28、29、32、33、35、36、37

real net market value, each is assigned a weight of 1/2 in calculating the *RES*, as shown below:

$$RES = \frac{Resi + Reco}{2}. \quad (3)$$

The top three infrastructure REITs ranked in the economic resilience index are 10, 34 and 15: (1) REIT 10 has the most balanced resistance and recovery indexes of 0.9182 and 0.9266, respectively, indicating strong overall stability. It can return to its pre-shock net asset value (NAV) level quickly when facing external shocks. Its NAV remains stable within a certain range, making it suitable for investors seeking low-risk, stable holdings. (2) REIT 34 exhibits a notably high resistance index, with a resilience index of 0.9. This means it is less affected by market volatility. Its net asset value shows a consistent upward trend, even when market conditions fluctuate. (3) REIT 15 ranks second, demonstrating significant resilience during market disturbances. Although it experienced the largest decline when first listed, it rebounded by over 80% in a short period. Its subsequent trend is steady and shows progressive growth, suggesting strong recovery potential.

Among the four types of REITs in China's 25 listed REITs, infrastructure-type REITs have shown the best

economic resilience. Notably, two of the top three are transport infrastructure REITs. As a leading country in infrastructure development, China emphasizes the planning and deployment of transport infrastructure in its national strategies. National policies, particularly the five primary measures proposed by the Ministry of Transport in September 2022 to support transport infrastructure construction, play a crucial role in stabilizing the domestic economy. This explains the greater economic resilience of transport infrastructure REITs compared to other infrastructure types.

In contrast, the weakest economic resilience is seen in REIT 21, which had not been listed for six months as of February 2023. The underlying asset of this project is guaranteed rental housing, marking a new exploration in China's infrastructure REITs. There remains significant potential for market performance in this area. Most PPP-REITs are part of the first batch of listed infrastructure REITs from 2021. However, their economic resilience is not strong and is generally lower than that of DI-REITs.

3 Research on the economic resilience of infrastructure financialization based on investor heterogeneity

The evaluation of economic resilience among listed infrastructure REITs reveals that different types of underlying assets and the project's funding background at issuance—whether it is a PPP or not—exhibit varying levels of economic resilience. However, the specific heterogeneous factors responsible for these findings remain unclear. This section further investigates how indicators of investor heterogeneity impact the economic resilience of projects through geo-detectors.

3.1 Study Methods

Geoprobe is employed as a statistical approach to identify spatial dissimilarities and explore their underlying causes. Key aspects include dissimilarity detection, factor detection, risk zone identification, and interaction analysis (Wang et al. 2010). This method imposes fewer assumptions than traditional econometric models, avoiding linearity requirements, and it possesses clear physical interpretations. It has gained traction in the social sciences, natural sciences, and other fields in recent years.

Geodetector models are effective for examining the influence and interaction of multiple independent variables (*X*), such as pollution, noise, amenities, human, and natural environments, on a dependent variable (*Y*), like livability satisfaction. In this study, the investor heterogeneity index and the infrastructure financialization resilience index correspond to multiple independent variables corresponding to a single dependent variable, making this

method suitable for further analysis.

1) Spectrum detection and factor detection

This section explains how economic resilience differentiates based on the extent of an index (X), measured by the q -value, which ranges from $[0,1]$. A higher q -value indicates a greater ability of the heterogeneity index to explain the economic resilience of infrastructure REITs, calculated as follows:

$$\left\{ \begin{array}{l} q = 1 - \frac{\sum_{h=1}^L n_h \sigma_h^2}{n \sigma^2} = 1 - \frac{SSW}{SST}, \\ SSW = \sum_{h=1}^L n_h \sigma_h^2, \quad SST = n \sigma^2, \end{array} \right. \quad (4)$$

where h represents the classification of economic resilience or investor heterogeneity indicators; n and n_h represent the global number of cells and the number of cells of layer h , respectively; σ^2 and σ_h^2 represents the Y value variance of the full region and layer h , respectively; SST and SSW represent the sum of the total variance and within-layer variance in the whole region, respectively. If the stratification of the Y value is generated due to the independent variable X value, the larger the q value represents the stronger the explanatory power of X for Y , and vice versa. In cases where q equals 1, it signifies that the independent variable (X) completely controls the distribution of the dependent variable (Y); a q -value of 0 indicates no relationship between X and Y .

2) Risk area detection

Risk zone detection primarily focuses on the economic resilience of PPP-REITs and DI-REITs. Using the natural breakpoint method, we identify high-risk zones for the economic resilience of infrastructure REITs and assess whether the risks in these zones are statistically significant compared to other zones. This detection method measures the statistical significance of the differences in economic resilience between PPP-REITs and DI-REITs. The test standard is $\alpha = 0.05$.

$$t_{\bar{Y}_{h=1} - \bar{Y}_{h=2}} = \frac{\bar{Y}_{h=1} - \bar{Y}_{h=2}}{\left[\frac{Var(\bar{Y}_{h=1})}{n_{h=1}} + \frac{Var(\bar{Y}_{h=2})}{n_{h=2}} \right]^{1/2}} \quad (5)$$

In the formula \bar{Y}_h represents the economic resilience

index of PPP-REITs or DI-REITs, n_h is the number of samples within the study area. Var represents the variance. The t -test value follows the Student's t -distribution, and the degree of freedom df is calculated as follows:

$$df = \frac{\frac{Var(\bar{Y}_{h=1})}{n_{h=1}} + \frac{Var(\bar{Y}_{h=2})}{n_{h=2}}}{\frac{1}{n_{h=1} - 1} \left[\frac{Var(\bar{Y}_{h=1})}{n_{h=1}} \right]^2 + \frac{1}{n_{h=2} - 1} \left[\frac{Var(\bar{Y}_{h=2})}{n_{h=2}} \right]^2} \quad (6)$$

Furthermore, the statistical tests proposed the null hypothesis, H_0 . $\bar{Y}_{h=1} = \bar{Y}_{h=2}$ represents no difference in economic resilience between the two types of PPP-REITs and DI-REITs. A rejection of H_0 below confidence level α indicates that the difference in economic resilience between the two types is statistically significant.

3) Interaction detection

This method aims to identify interactions between different indicators. Specifically, it examines whether investor heterogeneity indicators $X1$ and $X2$ enhance or diminish the explanatory power of economic resilience Y when acting together in the context of PPP-REITs. It also considers whether the effects of these indicators on economic resilience Y are independent. To assess this, we calculate the q -values for the two investor heterogeneity indicators $X1$ and $X2$ separately regarding economic resilience Y . Next, we calculate the combined q -value when both indicators act together on economic resilience Y . We then compare $q(X1 \cap X2)$ with $q(X1)$ and $q(X2)$. The relationship types between the indicators are detailed in Table 6.

In summary, the total explanatory power of two independent, non-interacting indicators is treated as the sum of their individual explanatory powers on Y . Thus, if the two indicators exhibit nonlinear enhancement, it indicates a positive interaction. Conversely, if they show independence, they are considered non-interacting. Additionally, a single factor showing nonlinear weakening is deemed a reverse interaction.

3.2 Empirical analysis

To categorize the different types of heterogeneity indicators, this study reviewed the literature from 2007 to 2024, including 34 articles. From this review, this study

Table 6 Table of interaction probe types

Judgment basis	Classification of interactions
$\text{Min}(q(X1), q(X2)) < q(X1 \cap X2) < \text{Max}(q(X1), q(X2))$	The single-factor nonlinearity decreases
$q(X1 \cap X2) < \text{Min}(q(X1), q(X2))$	Nonlinearity attenuation
$q(X1 \cap X2) = q(X1) + q(X2)$	independence
$q(X1 \cap X2) > \text{Max}(q(X1), q(X2))$	Double factor enhancement
$q(X1 \cap X2) > q(X1) + q(X2)$	Nonlinear enhancement

extracted seven investor heterogeneity indicators based on the directions of the research, as shown in Table 7.

To clarify the economic meaning of the indicators mentioned in Table 7, this paper explains the following indicators: *X2* Expected investment period, *X3* Funds provided, *X4* Investment ratio. First, the term “long-term equity investment,” as defined in *X2*, relates to an investor acquiring shares in the investee company. For the investee, a higher proportion of long-term equity investment in total investment indicates greater control by the investing company. This translates to a slower withdrawal of funds, allowing the investor to enjoy a more extended expected investment term. These investments are considered non-current assets of the investee, separate from its operational activities, such as real estate investments in REITs projects. Data for this analysis was obtained from the REITs Project Financial Analysis Form. Next, the non-liability components of *X3* include long-term loans, bonds payable, long-term payables, and special payables. A lower percentage of these in total assets signals higher liquidity risk. Conversely, a higher percentage suggests that the company possesses adequate working capital and strong solvency. This data comes from the REITs project balance sheet. Lastly, in *X4*, the sources of funds for infrastructure REITs are split between institutional and individual (retail) investors. Institutional investors make up over 70% of the total share. This paper focuses on the investment proportion held by institutional investors, using data drawn from their holdings in the total share size of REITs projects.

The relevant public financial data of infrastructure REITs investment participants used in this analysis is sourced from the CAMAR database, as well as market information and enterprise ESG ratings from the Wind database. This study processed the sample data based on the following criteria: (1) Exclude unpublished financial and operational data of investment and participating enterprises. (2). Remove investor samples with abnormal

or missing data. (3) Exclude samples where the forecast net value growth or surplus is negative.

3.2.1 Driver factor detection of the infrastructure financialization project

Based on the economic resilience calculations of infrastructure REITs presented in Table 2, the continuous independent variables from the seven investor heterogeneity indexes shown in Table 7 are discretised. By substituting these variables into Eq. (4), we determined the influence of investor heterogeneity indexes on the resistance and recovery indexes of PPP-REITs and DI-REITs. The results are detailed in Tables 8 and 9. For comparative analysis, visualizations of the results are provided in Figs. 2 and 3.

Driver detection assesses how much each investor heterogeneity index explains the economic resilience of infrastructure REITs. Table 8 outlines the explanatory power of each index regarding PPP-REITs. For the resistance index, the factors rank as follows: *X4* Investment Ratio > *X7* Equity Concentration > *X2* Expected Investment Period > *X5* Risk Attitude > *X1* Nature of the Firm > *X6* ESG Rating > *X3* Funding Source. The investment ratio shows the highest explanatory power at 0.1809, indicating significant heterogeneity in the resistance index arising from differences in the investment ratios among PPP-REIT investors. Equity concentration follows as the secondary factor with an explanatory power of 0.1011, making it another key influence on the resistance index. Conversely, the funding source has the lowest explanatory power of 0.0096 for infrastructure REITs resistance.

For the recovery index of PPP-REITs, the *q*-values rank as follows: *X2* Expected Investment Term > *X7* Equity Concentration > *X4* Investment Ratio > *X3* Funding Source > *X6* ESG Rating > *X5* Risk Attitude > *X1* Firm Nature. The expected investment term has the most substantial effect on recovery, with a value of 0.1646,

Table 7 Definition table of investor heterogeneity indicators

Number	Index name	Pointer symbol	Variable definition and value method	Bibliography
<i>X1</i>	Enterprise nature	Nat	State-owned and collectively-owned enterprises take 1, and private enterprises take 0	Acharya et al. (2022); Anguelov (2024); Mai and Casady (2023); Davis and Friske (2013); Sun et al. (2022); Zhang et al. (2022)
<i>X2</i>	Expected investment term	EIP	The proportion of the corporate long-term option investment to the total assets	Gonçalves (2021); Hartman et al. (2020); Ng et al. (2007); Kim (2022); Guo et al. (2016)
<i>X3</i>	Funds provided	Fun	The proportion of non-debt partial funds of investors	Reeves and Palcic (2017); Cabral and Silva (2013); Han et al. (2024); Md Lasa et al. (2018)
<i>X4</i>	Investment ratio	Pro	Proportion of business investment in infrastructure REITs	Liu and Jiang (2019); Liu et al. (2020); Anderson et al. (2021); Bangura and Lee (2024)
<i>X5</i>	Risk attitude	Att	The lower the proportion of enterprise risk reserve to owner’s equity, the more preferred the risk	Gao and Liu (2020); Park et al. (2020); Ko et al. (2023); Dalton et al. (2020); Caliendo et al. (2010)
<i>X6</i>	ESG grade	ESG	Enterprises are rated by ESG in Wind database, divided into 7 grades from CCC~AAA, with a corresponding value of 1~7	Zhao et al. (2023); Drobetz et al. (2024); Erol et al. (2023); Chininga et al. (2023); Michalski and Low (2024)
<i>X7</i>	Equity concentration	Top1	The largest shareholder of the enterprise	Matthew (2022); Hashmi et al. (2023); Zhu and Lizieri (2024); Torres et al. (2024); De Biasio and Murray (2017)

Table 8 Detection results of investor heterogeneity index of PPP-REITs

Number	Index name	Indicator symbol	Resistance	Recovery
X1	Enterprise nature	Nat	0.0198	0.0138
X2	Expected investment term	EIP	0.0773	0.1646
X3	Funds provided	Fun	0.0096	0.0997
X4	Investment ratio	Pro	0.1809	0.1379
X5	Risk attitude	Att	0.0399	0.0695
X6	ESG grade	ESG	0.0191	0.0817
X7	Equity concentration	Top1	0.1011	0.1570

Table 9 Detection results of q-values of DI-REITs

Number	Index name	Indicator symbol	Resistance	Recovery
X1	Enterprise nature	Nat	0.0490	0.0457
X2	Expected investment term	EIP	0.2322	0.2349
X3	Funds provided	Fun	0.2229	0.1593
X4	Investment ratio	Pro	0.2890	0.1757
X5	Risk attitude	Att	0.2373	0.1848
X6	ESG grade	ESG	0.1294	0.0525
X7	Equity concentration	Top1	0.2513	0.1661

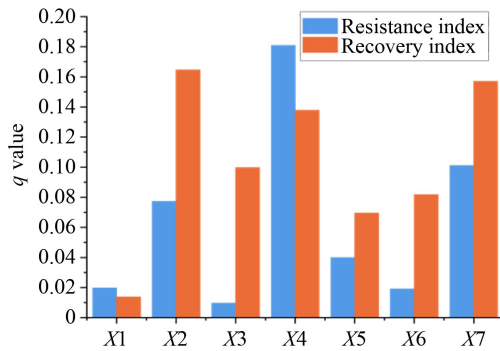


Fig. 2 Comparison of investor heterogeneity in PPP-REITs.

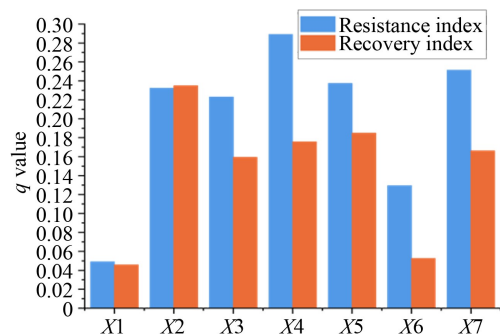


Fig. 3 q value comparison plots of DI-REITs.

while the nature of the firm contributes the least, at just 0.0138. The other indexes with *q*-values exceeding 0.1 are X4 and X7, indicating that the investment ratio and equity concentration significantly influence the recovery

of PPP-REITs following a shock.

Table 9 illustrates the explanatory power of various factors influencing the heterogeneity of investors in DI-REITs. For the resistance index, the factors ranked by *q*-value are as follows: X4 (investment ratio) > X7 (equity concentration) > X5 (risk attitude) > X2 (expected investment period) > X3 (funds provided) > X6 (ESG rating) > X1 (corporate nature). The investment ratio demonstrates the highest explanatory power at 0.2890. Equity concentration follows as the second most significant factor, with an explanatory power of 0.2513. In contrast, the nature of the enterprise has the lowest explanatory power at only 0.0490.

Regarding the recovery index for DI-REITs, the factors are ranked as follows: X2 (expected investment horizon) > X5 (risk attitude) > X4 (investment ratio) > X7 (equity concentration) > X3 (funding source) > X6 (ESG rating) > X1 (firm nature). The expected investment term holds the greatest influence, with an index value of 0.2349, while the nature of the enterprise again shows the least explanatory power at 0.0421. X5 and X4, both with *q*-values above 0.17, indicate that risk attitudes and investment ratios significantly influence the resilience of DI-REITs following shocks.

By comparing the *q*-values of the same index on both the resistance and recovery indexes across the four groups, a pattern emerges. The investment ratio (X4) consistently exhibits the highest explanatory power regarding the resistance index for both PPP-REITs and DI-REITs. A larger investment ratio signifies a more stable capital structure in infrastructure REITs. However, a higher proportion of ‘retail investors’ also increases the

risk of capital withdrawal, adversely affecting the resilience of these REITs when facing market risks. Thus, the investment ratio’s strong explanatory power aligns with trends observed in the fund market. Conversely, the expected investment term ($X2$) is most influential for the recovery index of both PPP-REITs and DI-REITs. A longer expected investment horizon indicates a delayed capital exit from PPP-REITs, providing more time for recovery in response to market shocks. This supports the notion that allowing infrastructure REITs adequate time to recover is essential for managing market risks effectively, further reinforcing the expected investment horizon’s significance in the recovery index.

3.2.2 Exploration of risk areas of infrastructure financialization projects

According to the collected data on investor heterogeneity and the economic recovery index of PPP-REITs and DI-REITs, Eqs. (5) and (6) determine the highest risk index for the resistance and recovery of various types of REITs. The results are presented in Table 10.

The calculations indicate that all 25 single infrastructure REITs exhibit high-risk classifications across multiple indicators of investor heterogeneity. For PPP-REITs, the main factors influencing resistance are the expected investment term and investment ratio. In contrast, the recovery of PPP-REITs is largely driven by the investment ratio and equity concentration. For DI-REITs, resistance is influenced by four key indicators: expected investment term, funds provided, investment ratio, and ESG rating. This suggests that all four dimensions of DI-REITs resistance are at high-risk levels, significantly impacting their economic resilience. For DI-REITs recovery, the primary indicators are expected investment term, funds provided, and ESG rating. The results demonstrate a significant correlation between resistance and recovery of infrastructure REITs and the investor heterogeneity index. This indicates the presence of a ‘barrel effect’, meaning that any low score in the investor heterogeneity index can restrict the evaluation of the economic resilience of infrastructure REITs.

3.2.3 Interaction detection of infrastructure financialization projects

This section investigates whether the interaction of

Table 10 High-risk areas for the economic resilience of PPP-REITs and DI-REITs

Type	High risk area
PPP-REITs resistance	EIP、Pro
PPP-REITs recovery	Pro、Top1
DI-REITs resistance	EIP、Fun、Pro、ESG
DI-REITs recovery	EIP、Fun、ESG

multiple investor heterogeneity indicators affects the resistance and recovery indices of PPP-REITs and DI-REITs. The effect size of each indicator’s interaction is illustrated in Figs. 4 to 7 using ORIGIN software. The data show that the interaction effect of any two investor heterogeneity indicators exceeds the explanatory power of a single indicator on both the resistance and recovery indices. All interactions display a nonlinear or two-factor enhancement effect.

The spatial distribution of the PPP-REITs resistance index shown in Fig. 4 highlights that $X4 \cap X6$ has the most significant influence, with an interaction index of 0.4104. This indicates a strong connection between the investment ratio and ESG ratings, greatly affecting the PPP-REITs resistance index. Other notable interactions exceeding 0.25 include $X4 \cap X7$, $X4 \cap X5$, $X3 \cap X4$, and $X2 \cap X4$, with $X4$ occurring most frequently. This further highlights the positive impact of the investment ratio on the resistance index of infrastructure REITs.

Regarding the recovery index of PPP-REITs in Fig. 5, $X4 \cap X7$ is the most influential factor, with an interaction index of 0.6113. This suggests that the investment ratio and equity concentration have a significant effect on the recovery index of PPP-REITs. Additionally, most interaction indices involving $X4$ and various investor heterogeneity indicators are above 0.35. By improving the investment ratio, a more positive contribution to the recovery index of PPP-REITs can be achieved, assuming other indicators remain constant.

In Fig. 6, the DI-REITs resistance index reveals that $X3 \cap X5$ is the most dominant interaction, with an index of 0.9234. This suggests that the funds provided and risk attitude substantially drive the DI-REITs resistance index. Interactions greater than 0.60 include $X3 \cap X4$, $X2 \cap X5$, $X4 \cap X6$, and $X5 \cap X6$, indicating a strong coupling effect between the investment ratio, ESG ratings, and other factors, all positively impacting the DI-REITs resistance index.

For the DI-REITs recovery index presented in Fig. 7,

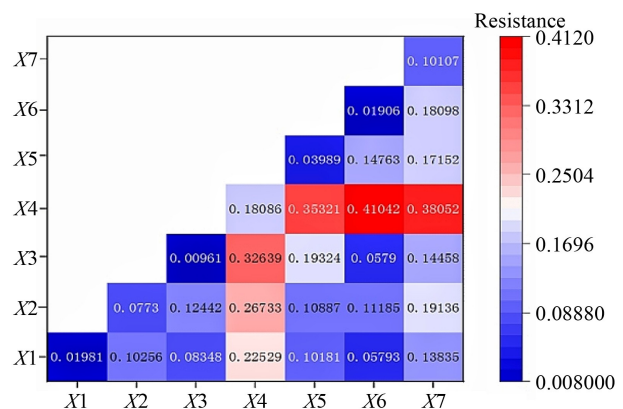


Fig. 4 Interactions of investor heterogeneity indicators on the influence of PPP-REITs resistance index.

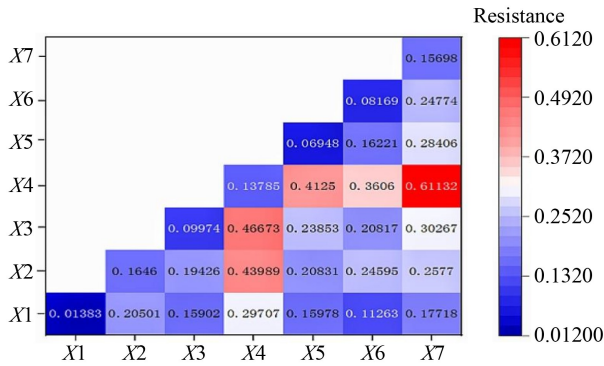


Fig. 5 Interactions of investor heterogeneity indicators on the recovery index of PPP-REITs.

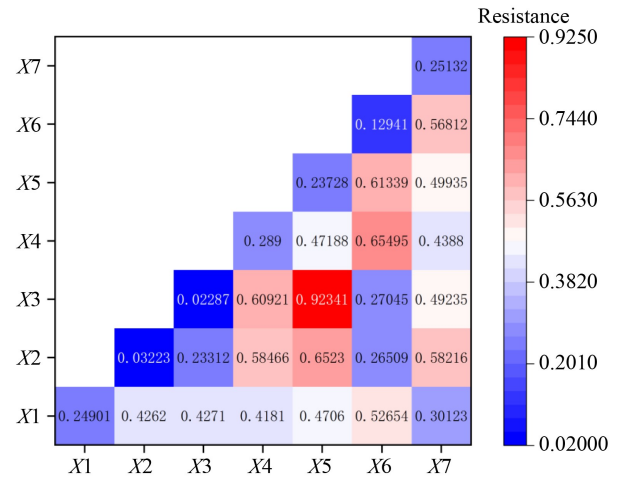


Fig. 7 Interactions of investor heterogeneity indicators on the recovery index of DI-REITs.

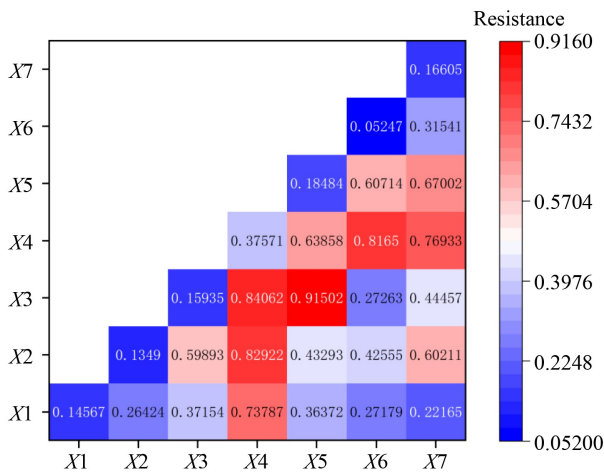


Fig. 6 Interactions of investor heterogeneity indicators on the influence of DI-REITs resistance index.

$X3 \cap X5$ remains the leading influence, with an interaction index of 0.9150. This reinforces the significant role of the investment ratio and equity concentration on the recovery index. Interactions exceeding 0.75 include $X2 \cap X4$, $X3 \cap X4$, $X4 \cap X6$, and $X4 \cap X7$, with $X4$ occurring frequently. The interaction index of $X3 \cap X4$, at 0.8406, is a crucial factor, second only to $X3 \cap X5$. This highlights the positive effect of the coupling effect between the investment ratio ($X4$) and funding sources ($X3$) on the DI-REITs recovery index.

From the analyses in Figs. 4 to 7, it can be concluded that the economic resilience of PPP-REITs is jointly influenced by various indicators of investor heterogeneity. The explanatory power of the index is significantly greater when two heterogeneity indicators are combined, compared to using a single indicator.

4 Discussion

The allocation of underlying assets for infrastructure REITs requires thorough due diligence. It's essential that

the property rights, asset scope, and related operating rights are clearly defined. Additionally, there must be no interbank competition or connected transactions between underlying assets, original equity holders, and related parties. For assets operated under the PPP model, they must be transitioned into user-payment-based compliant REITs as a pilot program. Direct-issue REITs rely on cash flow generated from end-user fees rather than government subsidies. In China, fees for infrastructure REITs are typically set by the government, leading to relatively stable cash flows and returns. These returns generally align with other bond and equity funds in the market, and sometimes exceed those from alternative REIT projects. Although this does not automatically equate to high-quality assets, the analysis from this paper indicates that successful REIT projects display strong $X5$ risk attitudes and notable $X2$ expected investment terms. These factors help mitigate short-term return fluctuations and enhance resilience. Moreover, to maximize profits, original equity holders often direct their investments toward the most promising REIT projects. This approach can accelerate internal restructuring within relevant industries through mergers and acquisitions, leading to optimal resource allocation. In cases of low-return REIT projects, if the underlying assets are of high quality, we can identify prominent heterogeneous indicators, which can be leveraged to promote the projects.

As of June 2024, the top five REITs with the best economic performance are 3, 8, 10, 15, and 34. Each of these REITs boasts high-quality underlying assets. Their solid operating revenues and expenses support the financialization of their projects. Among these, REITs 3, 15, and 34 are transport REITs. These projects exhibit relatively low price volatility after listing, a high dividend payout ratio, and overall stability, making them attractive to long-term investors. Additionally, they have a strong completion rate for ESG disclosures. They report on

carbon emissions, air quality, labor rights and safety, accident management, corporate governance structures, supply chain management, and environmental risks and opportunities during construction and operation. This commitment not only fosters sustainable project development but also provides additional policy incentives for management companies. REITs 8 and 10 show favorable project investment ratios, leading to higher tenant concentrations and stable performance in rental levels, occupancy rates, and tenant mixes. Furthermore, the expected investment term indicators are promising, with remaining lease terms averaging around five years. The operating performance of these REITs has steadily improved since their issuance. This growth is closely related to key indicators such as enterprise nature ($X1$), expected investment term ($X2$), and funds provided ($X3$), highlighting their economic resilience.

The economic resilience of the five underperforming REITs is strongly linked to the heterogeneity indicator. Notably, 20 and 21 of these projects focus on guaranteed rental housing ($X1$). The service levels of the leasing organizations vary due to the absence of established industry standards. According to this study's assessment of investor heterogeneity indicators, these projects display poor funding source indicators ($X3$). Limited financing options are coupled with high operating costs, leading to unstable project development. Furthermore, the completion of ESG indicators ($X6$) is lacking. The companies do not disclose quantitative ESG metrics such as energy savings, water savings, electricity consumption, occupancy rates, tenant satisfaction, and renewal rates. Transparency in these indicators could enhance the asset value of the projects. Regarding park REITs ($X1$), investment risks are difficult to assess ($X5$). The high uncertainty surrounding the parks' attractiveness, geographic trends, and main industry development significantly lowers institutional investors' enthusiasm, resulting in weaker economic performance relative to other REIT types. Project 5, a high-quality transport REIT ($X1$), had a placing ratio of just 0.84%. However, it emerged as the largest REIT by issuance scale in 2022 and received strong market recognition, ranking second in subscription multiples among the six existing franchise REITs that year. Despite this, transport REITs face limited growth in operating income and more stable income, resulting in a bias toward high dividend yields but smaller secondary price increases compared to equity REITs ($X7$). Consequently, they do not achieve the high yield levels characteristic of equity REITs. Additionally, the project's projected annualized distribution rate for FY2023 fell below that of similar highway REITs already listed, making its pricing appear inflated and leading to unexpected valuation volatility. Although the primary market subscription rate was high during its offering, the project's pilot operation performed below expectations. Coupled with external factors such as changes in highway traffic flow and tax

policy adjustments, the overall return on the project was low, which indirectly reduced investor enthusiasm for REITs in the transportation and construction sectors.

The public REITs examined in this paper primarily focus on infrastructure assets. The cash flow generated from these assets is crucial in determining the intrinsic value of REIT projects. The disparity between the cash flows from the underlying assets and the market valuation of the REITs reflects the most straightforward spread return for investors, indicating the potential for project appreciation. Over time, the market price of public REITs is expected to align with the intrinsic value of the assets, ultimately resulting in consistency between the two. Currently, investors tend to prioritize short-term 'stock characteristics' of REITs, which leads to some high-quality projects underperforming. This focus detracts from the fundamental essence of REIT product value.

This paper utilizes geodetector factor detection to assess seven indicators of investor heterogeneity. Investors should prioritize the returns of underlying REIT assets and take into account secondary market gains. It is essential to consider the project investment ratio and anticipated investment period while monitoring the distribution rate and internal rate of return from a long-term holding perspective. Emphasizing both income sources is vital, as is the adoption of a project value investment approach to rationally assess the market value of REIT products. Additionally, infrastructure REITs are sensitive to shifts in infrastructure-related policies and laws; consequently, policy support greatly influences investor interest. Policymakers should promote sustainability to foster a scientific and efficient REIT market. This could involve optimizing the investment environment and supporting ESG-rated firms to enhance their earnings and reputational value while minimizing information gaps and agency risks in REIT transactions. Furthermore, establishing long-term investment incentives—such as tax breaks, lower lending rates, and protections like extended land use rights and guaranteed returns—will help reduce corporate financing costs and barrier to entry in the REIT market. Such measures can also mitigate investment risks and extend the expected investment horizons for companies.

5 Conclusions

Projects of infrastructure are often characterized by enormous capital investment. Financializing these projects by means of various instruments and markets can be used to raise funds, diversify risks and more efficiently utilize resources. This leads to better project feasibility and attractiveness, creates more attractive public services, and stimulates technological innovation. As the heterogeneous characteristics of multiple investors will influence the formation of asset prices and market volatility, investiga-

tion of the association between investor heterogeneity and the economic resilience of financial products for infrastructure projects is of importance. This essentially provides a means through which project risk assessment can be refined and effective risk mitigation strategies can be designed. For this study, data from 25 single infrastructure REIT transactions occurred between June 2021 and June 2024 were analyzed. We assessed their economic resilience and classified investor heterogeneity indicators into seven categories: Investment purpose, expected investment period, provided funds, investment ratio, risk attitude, ESG rating and equity concentration. This study analyzed how these indicators of heterogeneity affect the financial market resilience of infrastructure projects by applying the geodetector model.

Previous studies have investigated return characteristics of REITs from analyses in terms of taxation, regulatory structure and operational efficiency. Controlling for non-taxation elements such as global capital flows, our research shows that tax incentives, tax credits, and double taxation avoidance have a positive impact on market returns of the REITs market. Furthermore, a positive correlation exists between the market performance of international REITs and their regulatory framework. This is good evidence that firm returns are quite responsive to strengthening the rights of shareholders, enhancing leverage restrictions, and enacting development and legal restrictions. Evidence from the perspective of REIT efficiency, operational performance, risk, and stock returns suggests that more efficient REITs will also have better operational results. Moreover, on average, low-risk REITs with reduced credit risk tend to do better than higher-risk counterparts (Xu and Yiu, 2017; Ghosh and Petrova, 2021; Beracha et al., 2018). Unlike existing research on the mature REITs market, related with revenue and corporate efficiency, and the correlation between REITs' taxation, regulation, and operating markets, this study has its own more contemporary significance to the development stage of the Chinese REITs market development from the behavioral aspect of the investors and the market potential. It presents a potential risk management in the financial market for REITs and the correlation the relationship between the economic resilience of the project and the heterogeneity of the investor base. This study not only contributes to expanding the theory of financial market resilience evaluation, but also suggests improvements in financial market risk management in infrastructure projects. The main research conclusions include: (1) It is the high-risk zone of the resistance and recovery indexes that exhibits the highest rate of observed investment ratios and the expected investment terms with the investment ratio index explaining most variance in the infrastructure REITs' resistance index. (2) The expected term for investment shows the strongest explanatory power for the recovery index and is therefore a crucial measure of the economic sustainability

of infrastructure finance. (3) The economic resilience of financial products in relation to infrastructure projects shows uniformity with investor heterogeneity. The substantially more explanatory power in the index for the model accommodating the heterogeneity of investors lends credence to this divergence with economic resilience. This hints at a pronounced 'barrel effect' of investor heterogeneity in financial products linked to infrastructure, in which lesser evaluations of any heterogeneity indicator may influence the evaluation of economic resilience.

This study investigates whether seven heterogeneous characteristics of investors have an influence on assessing the resilience of infrastructure REITs. However, the market for infrastructure REITs is still nascent in China, and available data in relation to it is therefore limited. Therefore, the findings of this paper are thus beset with limitations. Future research may further improve indicators of positive economic resilience of infrastructure REITs based on more extensive actual data. In addition, they may compare return performance of the Chinese market against global markets and investigate pathways to sustainable development in relation to financialized infrastructure projects.

Competing Interests The authors declare that they have no competing interests.

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