Provincial Multi-Level Residential Vacancy Rate Measurement using Micro-Power Data- Evidence from Central H Province

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Abstract. This paper introduces the characteristics of micro-user electric big data with high credibility, wide coverage and strong timeliness, and constructs a method for measuring the residential vacancy rate of provincial residents based on the general theoretical definition of residential vacancy rate. By splitting the spatiotemporal dimensions, the annual vacancy rate of existing commercial residential buildings and the monthly vacancy rate of existing urban and rural housing are measured. And the measurement indicators cover different dimensions such as prefectures, cities, towns villages, and residential lots, which can accurately characterize the overall and structural characteristics of the supply and demand situation of the provincial stock residential market.

Keywords: vacancy rate; power consumption data; commercial residential buildings; urban and rural area

1 Introduction

As a pillar industry of the national economy, the healthy development of the real estate market plays an important role in the smooth operation of the economy and society. On the one hand, the real estate industry at the end of the industrial chain has a strong pulling force, directly affecting upstream manufacturing industries such as steel, nonferrous metals, machinery manufacturing, chemical industry, construction industry, and other terminals such as home appliances, furniture, and building materials related to housing The development of manufacturing and decoration services. Currently, relevant literature has explored real estate analysis based on big data; however, the application of big data in the power sector still has certain deficiencies[1-3].

This article attempts to effectively fill in the above gaps. Give full play to the characteristics of high credibility, wide coverage and strong timeliness of micro power big data[4,5], and measure the long-term and short-term vacancy status of stock commercial residential buildings in different residential areas and stock urban and rural housing in different prefectures and cities, and the measurement process is efficient and convenient, and the measurement indicators covered can be timely It reflects the supply and demand situation of the provincial real estate market, and is convenient to locate the reasons for changes in supply and demand.

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The structure of the rest of this paper is as follows:

First, summarize the current definition and statistical practice of residential vacancy and residential vacancy rate at home and abroad;

Second, introduce the calculation method of this paper, including the data source and the specific measurement process of the vacancy rate of commercial residential buildings and urban and rural housing;

Third, analyze the characteristics of the calculation results of commercial residential buildings and urban and rural housing vacancy rates;

Finally, summarize the full text.

2 Related concepts and statistical methods

In the United States, the residential vacancy rate is divided into rental vacancy rate and homeowner vacancy rate, which are used to measure the vacancy of rental housing and sold homes[6], as given by equation (1) and equation (2), respectively:

$$\mathrm{RVR} = \frac{\mathrm{YVRO}}{\mathrm{ROH+YVRUH+YVRO}} \tag{1}$$

Where:

RVR:Rental Vacancy Rate

YVRO:Year-round Vacant Rent-Only Housing

ROH:Rented Occupancy Housing

YVRUH:Year-round Vacant Rented Unoccupied Housing

$$\mathrm{VHS} = \frac{\mathrm{VFSY}}{\mathrm{HO+VHSY+YFS}} \tag{2}$$

Where:

VHS:Vacancy rate of homes sold

VFSY:Vacant houses only for sale throughout the year

HO:Houses already occupied

VHSY:Vacant houses sold throughout the year

VFS:Vacant homes for sale

The residential vacancy rate [7] in most EU countries is calculated by equation (3):

$$\mathrm{OORV} = \frac{\mathrm{NVD}}{DS} \times 100\% \tag{3}$$

Where:

OOVR:Owner-occupied dwelling vacancy rate

NVD:Number of vacant dwellings

DS:Dwelling stockVFS：Vacant homes for sale

At present, China only has a definition of the vacancy rate for incremental commercial residential buildings, and the vacancy rate of commercial residential buildings is calculated in the "China Real Estate Market Report" [8] published by the Chinese Academy of Social Sciences as equation (4):

$$\mathrm{CRVR} = \frac{\mathrm{CV}}{\mathrm{TCA}} \times 100\% \tag{4}$$

Where:

CRVR:Commercial Residential Buildings Vacancy Rate

CV:Current Commercial Residential Vacant Area

TCA:The Completed Area of Commercial Residential Buildings in the Past Three Years

For the vacancy rate of existing housing, some scholars have proposed the definition of the vacancy rate of commercial residential buildings as equation (5): [9]

$$\mathrm{CRVR} = \frac{\sum SV}{\sum SS} \times 100\% \tag{5}$$

Where:

SV:survey sample vacancies

SS:survey sample supply

There is currently no uniform standard for obtaining data on residential vacancy through electricity data. In the patent "An Evaluation Method for Housing Vacancy Rate Based on Electric Power Service Management Platform" [10], the China Electric Power Research Institute proposed the determination method of vacant housing: the characteristics of zero-power users were analyzed through the electric energy service management platform to obtain the screening conditions for vacant houses, mainly including: the time when the residence was put into use, the type of town to which it belongs, and the degree of newness and oldness of the community; Then, according to the filter conditions, the target users are filtered layer by layer, and the households below the threshold are defined as vacant houses according to the target user filter threshold, that is, the average monthly electricity consumption is less than 10 kWh.

3 This topic describes the statistical methods

3.1 Data Sources

This paper uses electricity consumption data with wide coverage, high availability, and high reliability for vacancy rate measurement. The data sources are mainly the user file table, user electricity record table and power supply area file table of State Grid H Provincial Electric Power Co., Ltd. Among them, the vacancy rate of commercial residential buildings is calculated on an annual basis, and the monitoring time is from 2016 to 2021, and the sample covers city A, city B, and city F 1,761 residential districts, 1.35 million households, and more than 80 million electricity records in Hedi City G;

3.2 Statistics on the vacancy rate of commercial residential buildings

The vacancy rate of commercial residential buildings in this paper is an indicator to measure the vacancy status of commercial residential buildings in previous years by district, county and prefecture respectively, and its calculation process is shown in Figure 1, which includes four main steps:

(1) establish a community-power supply area-user matching table;
(2) Count the number of empty households in T year;
(3) Count the total number of households in T year;
(4) Measure the vacancy rate of commercial residential buildings in T year.

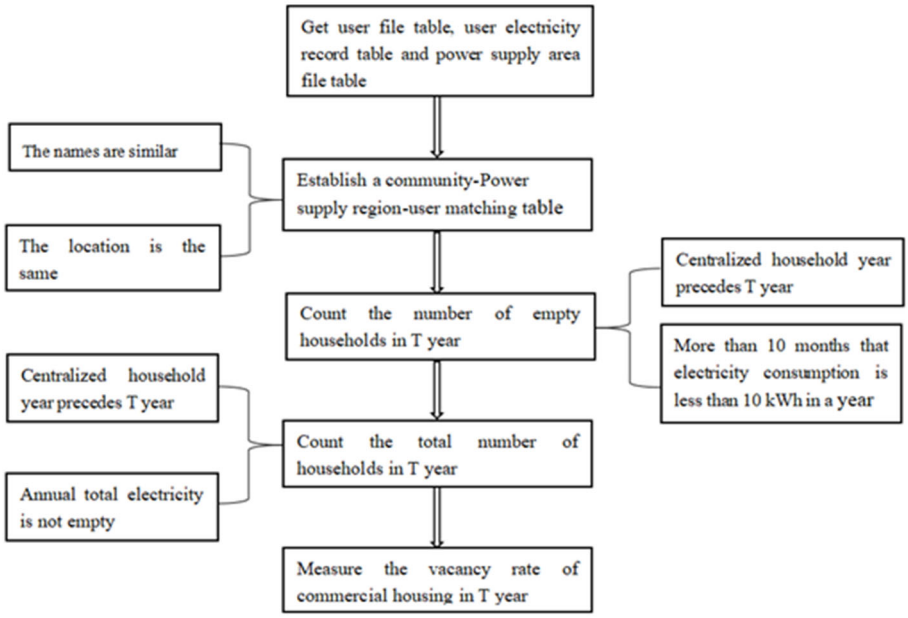

Fig. 1. Calculation process of vacancy rate of commercial residential buildings

This paper retrieved and obtained a total of 1761 community information of prefecture A, prefecture B, prefecture F and prefecture G through online public channels, including the name of the community, the city to which it belongs, the county to which it belongs, the time of construction, the property company, the developer, etc.

4 Analysis of statistical results

4.1 Feature analysis

Figures 2 and 3 reveal three main characteristics in the urban-rural comparison:

First, the vacancy rate of urban housing is smaller than that of rural housing. Except for the fact that in early 2020, due to the difficulty of residents returning to the city due to the

epidemic, the vacancy rate of urban housing briefly exceeded that of rural areas, since 2016, the average monthly vacancy rate of rural housing in Province H has been 27.79%. The average monthly vacancy rate of urban residential buildings was 24.19%.

Second, the gap between the vacancy rate of urban housing and the vacancy rate of rural housing is narrowing. In 2016, the average monthly vacancy rate of urban housing and rural housing in Province H was 24.84%, and the average monthly vacancy rate of rural housing was 29.77%, and the difference between the two was 4.93 percentage points, compared with 2021 The average monthly vacancy rate of urban housing was 24.60% and the average monthly vacancy rate of urban residential buildings was 27.27%, and the difference between the two narrowed to 2.67 percentage points, which shows H The gap between urban and rural development in the province is constantly narrowing.

Third, the vacancy rate of rural housing is more volatile than that in urban areas. Since 2016, the standard deviation of rural and urban residential vacancy rates in Province H has been 1.35% and 0.93%, respectively, indicating that the fluctuation range of rural residential vacancy rates is greater. At the same time, the vacancy rate of rural housing shows a more obvious cyclicality: the vacancy rate will drop significantly during the winter and summer vacations, and it can also be found that the vacancy rate during the Spring Festival at the beginning of the year is much larger than in the middle of the year.

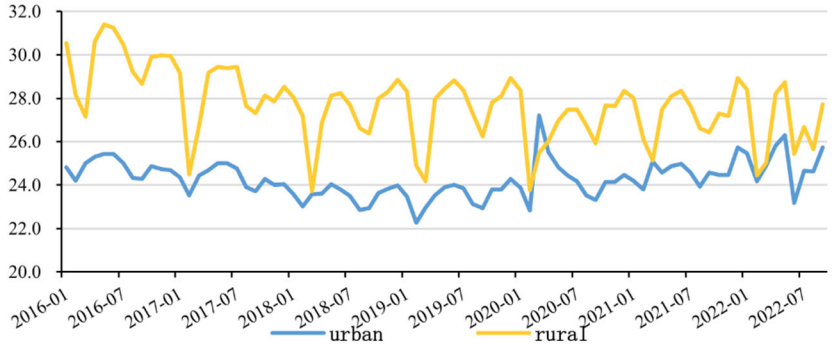

Fig. 2. Vacancy rates of urban and rural dwellings in H province

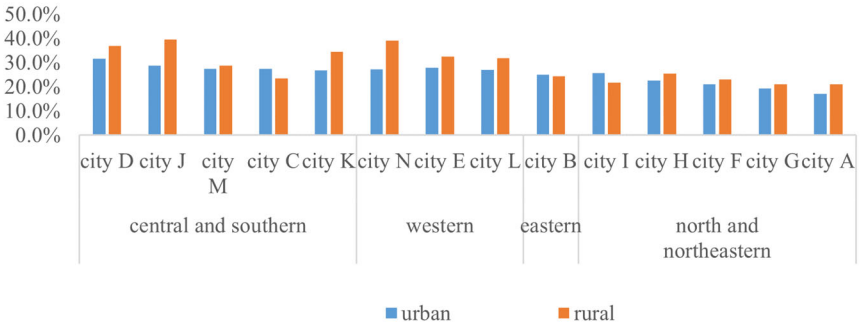

Fig.3. Residential vacancy rates in different cities in Province H

From the perspective of the distribution of prefectures and cities, the differences between different regions of Province H are more obvious. The residential vacancy rates in the central and southern and western regions are greater than those in the eastern, northern and northeastern regions. The average residential vacancy rate in the western, central and southern cities and towns was 29.56%, and the vacancy rate of rural housing was 32.78%. The average vacancy rate of urban housing in the eastern, northern and northeastern parts was 22.24%, and the vacancy rate of rural residential housing was 23.62%. The gap between urban and rural vacancy rates in the central and southern and western parts was greater than that in the eastern, northern and northeastern regions, among which the gap between urban and rural vacancy rates was the largest in prefecture N, prefecture J and prefecture K, while prefecture B and prefecture M The urban-rural difference in prefecture G is the smallest.

4.2 Cause analysis

The different characteristics of urban and rural residential vacancy rates in Table 1 are a direct reflection of the difference between urban and rural development. First, the employment opportunities and population attractiveness of cities and towns are generally greater than those in rural areas, and the agglomeration of rural population to cities and towns is a long-term trend, which makes the vacancy rate of urban housing generally smaller than that of rural areas. Second, the impact of the epidemic in recent years has made it difficult for some rural residents to migrate to the city to work, and choose to return to their hometowns, while with the vigorous promotion of rural revitalization, employment opportunities in rural areas have also increased, which has led to the difference in the housing vacancy rate between urban and rural areas after 2020 Distance acceleration shrinks.

The difference in the residential vacancy rate in the prefecture is to some extent related to the level of regional economic development. Considering that the housing prices in a region can be regarded as a comprehensive reflection of the local economic development level, this paper compares and analyzes the regional housing prices with the residential vacancy rate. From Table 1, it can be seen that there is a clear negative correlation between residential vacancy rates and regional housing prices: the vacancy rates in the eastern, northern and northeastern regions where housing prices are relatively high are significantly lower than those in relatively low housing prices Western, central and southern.

Table 1. Urban and rural residential vacancy rates and housing prices in 14 cities in Province H in 2021

region	Cities	% of urban residential vacancy rate	Rural dwelling vacancy rate%	Room price (RMB/sqm)
Central and Southern	City D	33.47	37.54	5586
	City J	29.50	40.73	6092
	City E	29.92	29.19	5052
	City M	28.36	23.99	5963
	City C	28.75	35.37	5716
	City K	33.47	37.54	5946
Western	City N	29.10	38.53	5092

region	Cities	% of urban residential vacancy rate	Rural dwelling vacancy rate%	Room price (RMB/sqm)
Central and	City D	33.47	37.54	5586
	City E	29.66	32.42	5052
	City L	28.03	31.85	5353
Eastern	City B	25.56	25.19	6572
	City I	26.67	22.92	6286
	City H	23.46	25.61	6640
North and Northeast	City F	21.41	24.47	6474
	City G	20.57	22.24	6251
	City A	17.18	21.56	12399

5 Conclusion

The calculation results of this paper show that:

(1) The vacancy rate of commercial residential buildings in Province H is currently in a reasonable range, and the vacancy rate of commercial residential buildings in 2021 is 17.7%, and it shows a downward trend year by year;

(2) The vacancy rate of commercial residential buildings is negatively correlated with local economic development at the macro level, and is affected by factors such as community location and developer at the micro level;

(3) The gap between urban and rural housing vacancy rates in Province H is narrowing year by year, indicating that the pace of rural development is accelerating and urban and rural more coordinated development.

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