

Analysis of Urban Heterogeneity and Influencing Factors on the Development of Commercial Health Insurance in the Yangtze River Delta Region

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Abstract:

The construction of a multi-level medical security system is an important part of the regional integration of the Yangtze River Delta. Commercial health insurance, as the third level of the multi-level medical security system, is of great significance for development. Based on the data of prefecture-level cities in the Yangtze River Delta region from 2011 to 2020, this paper uses the ridge regression model for empirical research and finds that residents' income levels have a significant impact on the development of health insurance in each city. Rural residents' income levels have a more significant impact on the development of health insurance in Tier 3 and 4 cities, and the level of health resources also has an important impact on the development of urban health insurance. At the same time, this paper divides health insurance into property health insurance and life health insurance according to the type of insurance company and finds through empirical research that urban population and network level have a more significant impact on the development of property health insurance. Based on the characteristics of the Yangtze River Delta region, this paper puts forward improvement suggestions from five aspects: economic development, residents' lives, health resources, network level, and social security.

Keywords:

Health Insurance, Property Health Insurance, Development Level Measurement, Ridge Regression Model

1. Introduction

In 2018, the Central Government officially announced its support for the development of the Yangtze River Delta regional integration as a national strategy. On August 20, 2020, Xi Jinping emphasized at a seminar in Hefei that it is necessary to deeply understand the position and role of the Yangtze River Delta region in the national economic and social development, promote the continuous achievements of the Yangtze River Delta integration development, and pointed out that it is necessary to promote the implementation of a unified basic medical insurance policy, and

gradually achieve the unification of drug catalogs, diagnostic and treatment projects, and medical service facility catalogs, and achieve the convenience and sharing of public services in the Yangtze River Delta. It can be seen that the Yangtze River Delta integration includes not only the integration of economy, technology, urbanization, and green development but also the promotion of the construction of a multi-level medical security system in the Yangtze River Delta and the deepening of medical insurance integration development. According to the Central Document No. 5 of 2020, "Opinions of the Central Committee of the Communist Party of China and the State Council on Deepening the Reform of the Medical Security System", the multi-level medical security system includes basic medical security, supplementary medical insurance, commercial health insurance, and medical mutual aid, among which commercial health insurance, as the third level, has an important position. Its development is an important link in building a multi-level medical security system in the Yangtze River Delta and promoting regional integration in the Yangtze River Delta.

Balanced development is more conducive to achieving regional integration. However, there are still significant differences in the development levels of cities in the Yangtze River Delta region. The economic and social development levels of Shanghai, Nanjing, Hangzhou, Hefei, Suzhou, and Ningbo, the five major urban agglomerations, are significantly better than other cities, and the development of commercial health insurance also has an absolute advantage. Both theory and experience show that under certain resource stock conditions, the natural effects of economic and social forces will only increase regional development disparities and imbalances. Therefore, adopting certain policy measures to guide the development of urban commercial health insurance is of great significance for promoting the balanced development of cities within the region and building a multi-level medical security system. This paper takes cities at various levels in the Yangtze River Delta region as the research object and analyzes the influencing factors of the imbalance in health insurance development in cities of different levels through data analysis and model demonstration. Combining practical situations, it explores the deep-rooted reasons and puts forward corresponding policy suggestions for the Yangtze River Delta region from the perspectives of economic development, residents' living conditions, health resources, internet, and social security.

2. Literature Review

Research on health insurance development at home and abroad is relatively mature, and there are many research results on the factors influencing health insurance demand. Jonanthan (2000) found that wages are positively correlated with health insurance premiums through studying the time series diagram of employer spending on health insurance [1]. Wang and Rosenman (2007) used a Logit model to prove that education level and residents' income promote the effective demand for health insurance [2]. Khwaja (2010) found a positive correlation between aging and health insurance demand using a dynamic random utility model, while the relationship between retirees' education level and health insurance was negative [3]. Caroline Appiah and Genevieve Aryeetey (2012) used principal component analysis to quantitatively analyze the selected data, finding that the government's demand for commercial insurance was significantly affected [4]. Liu Fangfang and Wang Xiuhua (2010) found that the improvement of China's medical insurance coverage to some extent inhibited the development of commercial health insurance [5]. Xu Yan (2016)

used the gray correlation analysis method to find that the key to improving the demand for health insurance premiums is the enhancement of people's insurance awareness [6]. Hou Shiyang and Xi Xiaoyu (2018) found that tax incentives were positively correlated with the development of commercial health insurance through the propensity score matching model and difference-in-differences model [7]. Qiu Fengmei (2021) conducted an empirical study based on the Probit model from a micro perspective, finding that the demand for health insurance for residents under 65 years old was positively correlated with age, gender, marriage, education level, income, and region, while the marital status and region of those aged 65 and over were no longer significant factors [8].

In recent years, with the continuous development of health insurance in China and the increasing attention of domestic researchers to health insurance due to the continuous tilt of national policies, more scholars have focused on the research combining the influencing factors of health insurance demand and regional development imbalance, exploring how to promote the balanced development of health insurance in different regions in a targeted manner. Suo Lingyan et al. (2015) found that the health insurance development in the eastern region was significantly better than that in the western region not entirely due to the level of economic development, by constructing a health development index and then verifying it through a fixed effects model using panel data of 31 provinces and autonomous regions [9]. Qiao Yuxing (2017) divided 31 provinces into three regions and found that per capita disposable income, urbanization level, and elderly dependency ratio had relatively significant impacts in the eastern, central, and western regions, respectively, through panel data model regression analysis [10]. Yang Bo and Jiang Ruyue (2018) found that per capita income and life expectancy had an impact on the development of health insurance in the eastern, central, and western regions through fixed-effect model empirical analysis, while the impact of medical and health level and education level were positive in the eastern and western regions, and fiscal expenditure had a significant impact in the central and western regions [11].

Some researchers have further narrowed the geographic scope, and by studying the development of health insurance within provinces, they have identified factors that contribute to the development of health insurance in that province. Li Yaguo and Song Wenjun (2017) conducted a study based on ridge regression and C-D function models, finding that economic development, population aging, residents' insurance awareness, and the degree of medical burden were positively correlated with the demand for health insurance in Jiangxi Province and were in a stage of marginal increasing growth; the complementary and substitution effects between social insurance protection and commercial health insurance were not evident [12]. Liao Hongyuan (2018) used grey relational analysis to find that the key to improving the effective demand level for commercial health insurance development in Hunan Province was to increase residents' consumption levels [13]. Liu Wenjun (2021) conducted a descriptive analysis using a questionnaire survey and added an analysis of the impact of the COVID-19 pandemic on the demand for health insurance in Hubei Province, finding that the pandemic led to a decrease in residents' income, affecting the demand for insurance; for middle and lower-income groups, the higher the monthly income, the more consumers were affected by the pandemic and purchased health insurance [14].

The innovations of this article are: (1) Previous studies mainly divided the research area into eastern, central, and western parts, and the local area was mostly based on

provinces as research units. This article innovatively selects the Yangtze River Delta region as the research area; (2) In addition to studying the overall Yangtze River Delta region, this article also divides the cities within the region into four levels, exploring the differences in the development of health insurance in different levels of cities from a city perspective; (3) This article not only focuses on the overall health insurance premiums but also innovatively classifies health insurance according to the type of insurance company into property insurance health insurance and life insurance health insurance, studying the factors affecting their development separately, and proposes targeted policy recommendations based on the research conclusions.

3. Current Status and Analysis of Commercial Health Insurance Development in Yangtze River Delta Cities

3.1. Basis and Results of City Level Division

This article refers to the “City Business Attractiveness Ranking” released by the “First Finance·New First-tier City Research Institute” in 2022 to divide the city levels in the Yangtze River Delta region. Among the five major indicators used for city business attractiveness rankings, the weight of economic development level is the largest. There are a total of 41 cities in the Yangtze River Delta region, including 6 first-tier cities, 8 second-tier cities, 16 third-tier cities, and 11 fourth-tier cities. The city level division is shown in Figure 1 below:

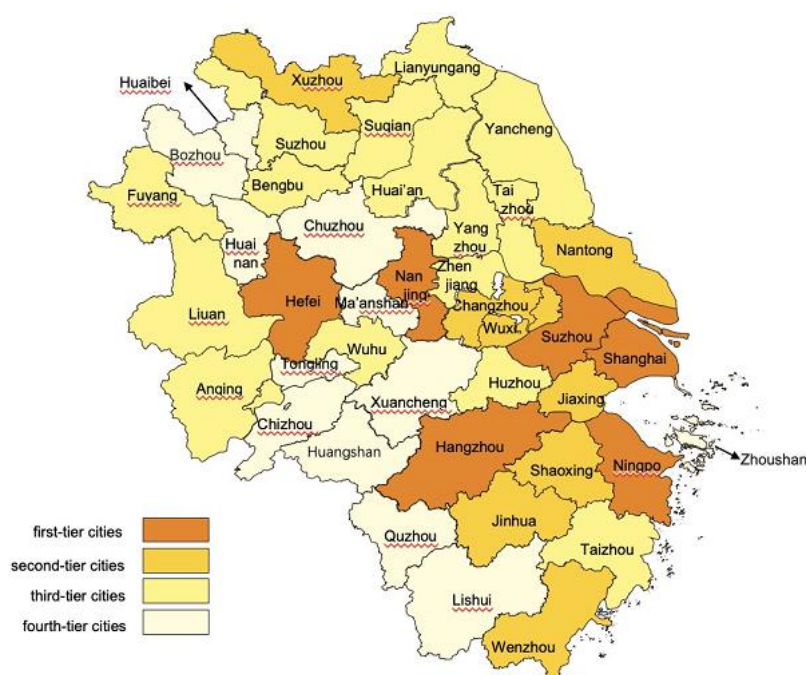


Figure 1. Urban Hierarchy Classification in the Yangtze River Delta Region.

Data sources: "City Business Attractiveness Ranking", arranged by the author.

Figure 2 shows the proportion of health insurance premiums in various levels of cities in the Yangtze River Delta region in 2020. As can be seen from Figure 2, there is a correlation between the level of urban health insurance development and city tiers. Although there are only 6 first-tier cities, their health insurance premiums account for nearly 50% of the premium ratio of all cities in the Yangtze River Delta region; third-tier cities have an absolute advantage in terms of quantity, but their health insurance premium share is basically on par with second-tier cities, and the total amount of

health insurance premiums does not fully reflect their development level; fourth-tier cities have the lowest proportion of health insurance premiums, which is consistent with their city classification.

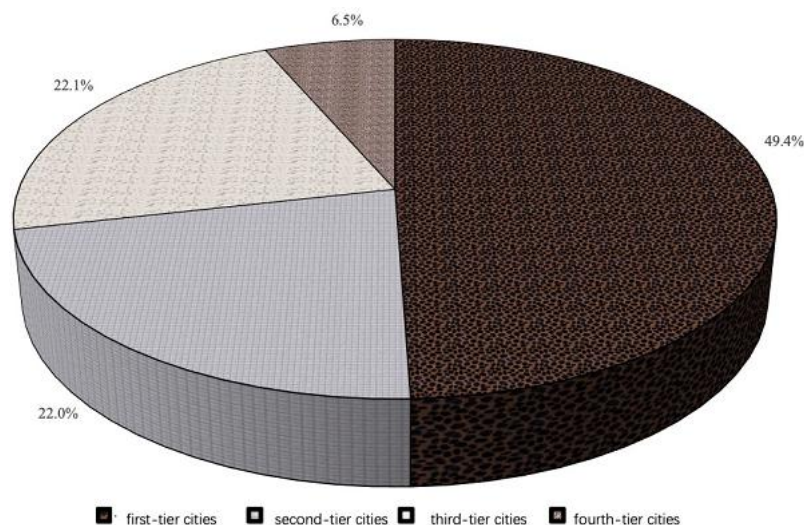


Figure 2. Proportions of Health Insurance Premiums in Different Levels of Cities in the Yangtze River Delta Region (2020).

Data source: China Insurance Statistical Yearbook, Author's calculations.

3.2. Construction of Health Insurance Development Level Measurement Indicators

Since the number of cities at each level is uneven, measuring the development of health insurance in cities at various levels based on the total amount of health insurance premiums has certain limitations. This paper constructs a simple health insurance development level measurement indicator to represent the development level of urban health insurance, taking into account the number of cities at each level, and using the average health insurance premiums of cities at each level to represent the development level of urban health insurance. The indicator formula is:

$$M_t = \frac{\sum_{i=1}^n (C_{it})}{n} \quad (1)$$

Where C_{it} represents the annual premium for each city, n represents the number of cities, and M_t represents the average premium size of cities at each level in each year. The indicator calculated using formula (1) avoids the impact of the number of cities on health insurance premiums. The higher the value of the indicator, the higher the overall development level of health insurance in cities at that level.

3.3. Analysis of the Current Status of Health Insurance Development Levels in Cities at Various Levels

According to the constructed health insurance development level measurement indicators, the development levels of health insurance in cities at various levels in the Yangtze River Delta region from 2011 to 2020 are calculated and ranked. It is found that the higher the city level, the higher the annual health insurance development level. Therefore, combining the city division criteria, using the corresponding values of the health insurance development level measurement indicators for first, second, third,

and fourth-tier cities, the annual health insurance development level of cities at various levels is described using the line chart below.

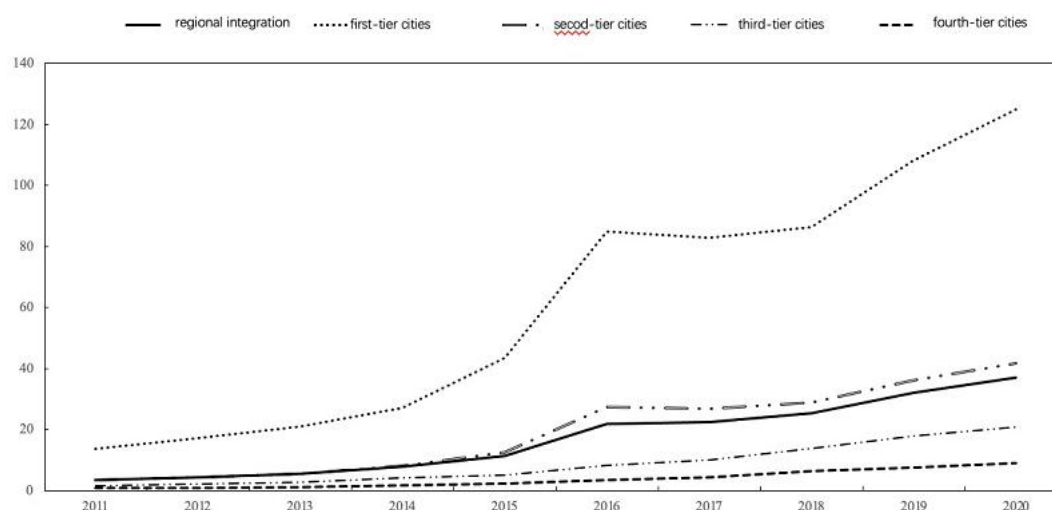


Figure 3. Line chart of Health Insurance Development Levels in Cities of Different Levels in the Yangtze River Delta Region (unit: 100 million yuan).

From the chart above, it can be seen that health insurance in cities at all levels shows an upward development trend, and the values are in different ranges according to city tiers. The difference in health insurance development levels among cities at various levels was not significant in 2011, but as the years increased, the gap in health insurance development levels among cities at various levels gradually widened. Health insurance in first and second-tier cities entered a rapid development stage in 2014, experienced a brief slowdown in development from 2016 to 2018, and re-entered a high-speed development stage in 2018, maintaining an overall growth trend, with first-tier cities having a more significant growth rate than second-tier cities; third and fourth-tier cities have always maintained a stable and modest growth trend, and the gap has gradually widened since 2014. It can be seen that developed cities have an absolute advantage in health insurance development levels, but there are also certain differences in the development trends and growth rates of health insurance in cities at all levels. In addition to being related to the level of economic development, there must also be other factors affecting these differences. It is not realistic for cities at all levels to leapfrog city tiers and surpass the development level of higher-level cities, but analyzing the factors influencing the development of health insurance in cities at various levels can help promote targeted development of health insurance in cities at all levels, achieving breakthroughs at different levels of development.

3.4. Analysis of factors affecting health insurance and research hypotheses

Economic development level. From the classification of urban levels and the line charts of health insurance development in various urban levels, the economic development level may be the most important factor affecting the differences in the development of urban health insurance. However, studies by Luo Lingyan et al. (2015)[9] and Yang Bo and Jiang Ruyue (2018) [11] found that economic factors are not the decisive factors affecting the development of health insurance. Therefore, this paper continues to study the impact of economic development level on health insurance development. The aim is to verify whether economic development level has an impact on the development of health insurance in the Yangtze River Delta region, how significant the impact is, and the differentiated impact on various urban levels.

H1: There is a certain relationship between the economic development level and the development of health insurance, but the degree of impact varies among cities of different levels.

Living standards of residents. The living standard of residents mainly analyzes the impact on the development of health insurance from a micro perspective. The current research results mostly show that the living standards of residents are positively correlated with health insurance demand. Wang and Rosenman (2007)[2] and Qiu Fengmei (2021)[8] both found that an increase in residents' income helps promote the development of health insurance. However, Yang Bo and Jiang Ruyue (2018) [11] found that the impact of residents' income on health insurance varies among regions, and is not significant for low-income western regions, and not the most significant for high-income central regions, but rather most significant for the central regions with moderate income.

H2: The living standard of residents is positively correlated with the overall development of health insurance in the region, but the impact on the development of health insurance in cities of different levels varies.

Health resource level. Health resources, as the premise and foundation of commercial health insurance development, are inseparable from health insurance development. Research by Luo Lingyan et al. (2015) [9] shows that the level of health resources ownership is significantly positively correlated with the development of health insurance. Yang Bo and Jiang Ruyue (2018) [11] found that the number of beds has a significant impact on health insurance demand.

H3: The health resource level in the region has a positive impact on health insurance demand.

Network level. He Xingqiang and Li Tao (2009) ^[16] believe that social networks mainly promote commercial insurance demand by increasing individual social trust or increasing the cost of individual dishonesty. Du Xia and Yao Yi (2021) ^[17] expanded the impact of family network effects on commercial health insurance demand. In addition to the promotion of social relationship networks on the development of health insurance, theoretically, the improvement of network hardware and software levels will also promote the development of health insurance. With the development of the Internet, the marketing of commercial health insurance is no longer limited to offline sales models, and online sales are becoming more and more normal. The development of regional networks helps the spread of health insurance products and promotes demand growth.

H4: The network level has a positive impact on the development of commercial health insurance.

Social security level. The relationship between the social security level and commercial health insurance development involves both substitution and complementarity. Relevant papers on this aspect of research have inconsistent conclusions. Liu Fangfang and Wang Xiuhua (2010) and Wang Xiannan (2011) found that social medical insurance has both positive and negative effects on health insurance development. Xia Jiao and Suo Roman (2012) employed the OLS model, fixed-effects model, and random-effects model to estimate the impact of the number of insured individuals in urban medical insurance on the demand for health insurance. The results across all three models indicated that this impact was not significant. Although there is some controversy surrounding the effect of this factor on

commercial health insurance, establishing a social security level with unique Chinese characteristics is a direct and practical issue concerning the people's interests. Studying the impact of social security levels on the development of health insurance in the Yangtze River Delta region holds significant implications for improving the lives of the region's residents and providing valuable references for other regions across the country.

Considering that the Yangtze River Delta is currently in a critical phase of constructing a multi-level regional medical insurance system, this paper posits the following hypothesis:

H5: There is a positive influence of the social security level on the development of health insurance in the Yangtze River Delta region.

4. Materials and Methods

4.1. Variable definition and data source

Similar to the established health insurance development level measurement index, the dependent variable in this study is still based on health insurance premiums, using the health insurance premiums of each city for each year as the dependent variable. At the same time, the premiums of property insurance health insurance and life insurance health insurance are further analyzed separately as dependent variables. This is mainly because the total premium scale of property insurance health insurance and the single business premium are relatively low, while life insurance has accumulated more individual and high-net-worth customers due to its long-term involvement in personal business, making its premium price and overall scale higher than the property insurance industry. Analyzing the factors that affect their development in different levels of cities separately will provide a more comprehensive theoretical basis for policy recommendations.

This study has 12 explanatory variables, covering five aspects: city economic development level, residents' living standard, health resource level, network level, and social security level. The variables representing the city's development level include permanent population, urban population, and regional GDP. The more permanent residents a city has, the higher the proportion of urban population and the higher the regional GDP, indicating a better economic development level of the city, which can retain labor force and provide more employment. Variables representing residents' living standards include per capita income for urban residents and rural residents. This study does not use the total urban and rural per capita disposable income as a variable as other studies do but analyzes urban and rural residents' per capita disposable income separately, aiming to find the differences between urban and rural residents in health insurance development. Variables representing the health resource level include the number of beds; variables representing the network level include the number of mobile phone users and the number of internet broadband users; and variables representing the social security level include the number of insured urban workers for basic pension insurance and basic medical insurance.

Table 1. Variable Definitions.

	Variable	Definition	Unit	Estimated Impact
dependent	zs	Total health insurance premiums	Ten thousand yuan	

variable	cs	Total health insurance premiums of property insurance companies	Ten thousand yuan	
	sx	Total health insurance premiums of life insurance companies	Ten thousand yuan	
explanatory variables	pep	Number of urban permanent residents	Ten thousand people	±
	urb	Number of urban population	%	±
	gdp	Indicators measuring the economic status and development level of cities	Ten thousand yuan	±
	cinc	Disposable income of urban residents available for discretionary spending	Yuan (unit of currency)	+
	ninc	Disposable income of rural residents available for discretionary spending	Yuan (unit of currency)	+
	bed	Total number of hospital beds in cities	Piece	+
	tel	Number of mobile phone users	Ten thousand households	+
	bro	Number of broadband internet users	Ten thousand households	+
	eld	Reflecting the level of social insurance	Ten thousand people	±
	med	Reflecting the level of social insurance	Ten thousand people	±

Data source: China Insurance Statistical Yearbook, Author's calculations.

The data analyzed in this study covers the period from 2011 to 2020. Due to the rapid development of health insurance in recent years, it is believed that using data from the past decade can better reflect the current situation and level of health insurance development, making the data more timely.

4.2. Descriptive analysis of the dependent variables

Table 2 shows the data for total health insurance premiums, property insurance health insurance, and life insurance health insurance. From the data, we can see that the average value of property insurance health insurance premiums in each city is 18,874,367 yuan, and the average value of life insurance health insurance premiums is 152,062,040 yuan, with a significant gap between them. Life insurance health insurance premium scale is significantly higher than property insurance health insurance. In terms of per capita premium, property insurance health insurance has a lower per capita premium, only 29.23 yuan. This confirms that the price of property insurance health insurance products is lower than that of life insurance health insurance, and property insurance health insurance has a more inclusive price. It also indirectly shows that property insurance companies are at a disadvantage in terms of customer resources and sales in the health insurance line, which is the reason for the separate analysis in this study.

In practice, property insurance companies only sell short-term health insurance products with a one-year term. The premium price of these products varies according to age and physical condition. Except for cases where the insured has chronic diseases, no social insurance, or high-end demands, the average selling price of a single policy is generally maintained at around 1,000 yuan. Life insurance companies' health insurance products are divided into long-term and short-term products, with prices generally higher than those of property insurance companies. In particular, long-term health insurance products have longer insurance terms and do not have the issue of non-guaranteed renewal that short-term health insurance products face, resulting in

relatively higher prices. Although many property and life insurance companies have jointly developed health insurance products for sale, these cooperative products are mostly concentrated in customized urban health insurance products with lower prices. For example, Xihu Yilianbao in Hangzhou is jointly underwritten by China Life Insurance, PICC Property Insurance, Taikang Life Insurance, and Ping An Property Insurance, with an annual premium of 150 yuan. Yikangbao in Wenzhou is jointly underwritten by PICC Property Insurance, China Life Insurance, Pacific Life Insurance, Ping An Annuity, and Dadi Insurance, with an annual premium of 180 yuan. These figures do not conflict with the reality that property insurance health insurance products have lower average premiums than life insurance health insurance products. The data in the table accurately reflects this phenomenon.

Table 2. *Commercial Health Insurance Premium Scale.*

Variable	Obs	Mean	Std. Dev.	Min	Max
zs	410	170905.99	320845.67	2276.16	2810000
$\overline{zs}$	410	248.786	237.956	11.163	1250.234
cx	410	18874.367	44797.221	38	538663
$\overline{cx}$	410	29.23	33.461	0.201	221.842
sx	410	152062.04	283633.06	2210.16	2463029
$\overline{sx}$	410	219.631	219.948	9.589	1101.406

Data source: *China Insurance Statistical Yearbook*, Author's calculations, where, $\overline{zs}$, $\overline{cx}$, $\overline{sx}$ represent per capita premiums.

4.3. Descriptive analysis of explanatory variables

Table 3 shows the descriptive analysis of the explanatory variables. After mitigating the impact of the year, the following analysis can be made: looking at the data of the resident population, urban population, and regional GDP, the proportion of urban population reaches 65% on average, indicating a high level of urbanization in the Yangtze River Delta region. The distribution of GDP across different cities varies greatly, indicating a significant disparity in economic development levels and an unbalanced urban economic development within the region. In terms of per capita income levels, urban residents have significantly higher incomes than rural residents, with an average data gap of more than 50%. There is a clear income disparity between urban and rural populations. The gap between the highest per capita income levels for urban and rural populations is not significant, with the urban level being 18% higher than the rural level. However, the lowest per capita income in rural areas is 65% lower than that in urban areas, indicating that some rural residents have extremely low incomes. It is essential to increase the income of this part of the rural population to reduce the wealth gap in the region. Looking at the interval range of the number of beds, mobile phone users, and broadband internet users, there is also an unbalanced development of medical and network levels in different cities. In terms of the number of participants in pension insurance and medical insurance, the differences in their average performances are not significant, accounting for 32% and 33% of the resident population, respectively, both exceeding half. This indicates that the overall level of social security in the Yangtze River Delta region still needs improvement.

Table 3. *Descriptive Statistical Analysis of Explanatory Variables*

Variable	Obs	Mean	Std. Dev.	Min	Max
pep	410	534.724	383.93	73.134	2488.36

urb	410	347.715	339.662	54.778	2222.105
gdp	410	43305230	52220911	3724900	3.870e+08
cinc	410	36507.614	12920.813	14971.771	76437
ninc	410	17737.126	8095.374	5100.49	62596
bed	410	23391.617	20570.982	3649	143600
tel	410	609.067	591.919	56.98	4277.62
bro	410	136.932	154.343	9.303	1249.354
eld	410	170.5641	241.5557	9.9064	1616.67
med	410	180.5528	257.2247	13.2648	1678.51

Data source: Statistical Yearbooks of Various Provinces and Cities in the Yangtze River Delta Region

4.4. Model setting and regression analysis

4.4.1. Unit root test and model setting

To reduce data volatility, this paper takes the logarithm of the explanatory variables and the dependent variables and uses the LLC test to perform a unit root test on the individuals in the panel data. By observing the P-value, we can determine whether there is a unit root. The closer the P-value is to 0, the more stable the data, and no unit root is present. If the P-value is greater than 0.1, it indicates that the null hypothesis cannot be rejected, and the panel data is not stable. Through the STATA software, a unit root test found that the P-value of the explanatory variables and dependent variables is less than 0.1 (as shown in Table 4), indicating that there is no unit root, the data is stable, and regression analysis can be performed.

Table 4. Unit Root Test Results

Variable	Adjusted t*	p-value	Variable	Adjusted t*	p-value
lnpep	-12.3943	0.0000	lnbro	-15.5480	0.0000
lnurb	4.1545	0.0000	lneld	-16.1942	0.0000
lngdp	-6.6699	0.0000	lnmed	-28.5223	0.0000
lncinc	-4.1696	0.0000	lnzs	-15.8684	0.0000
lnninc	-9.1135	0.0000	lnsx	-8.8370	0.0000
lnbed	-3.3059	0.0005	lnsx	-16.2451	0.0000
lnel	-26.6299	0.0000	—	—	—

According to the variables mentioned above, this paper sets the following model:

$$\ln X_{it} = \beta_0 + \beta_1 \ln pep_{it} + \beta_2 \ln urb_{it} + \beta_3 \ln gdp_{it} + \beta_4 \ln cinc_{it} + \beta_5 \ln ninc_{it} + \beta_6 \ln bed_{it} + \beta_7 \ln el_{it} + \beta_8 \ln bro_{it} + \beta_9 \ln eld_{it} + \beta_{10} \ln med_{it} + \varepsilon_{it} \quad (2)$$

In this context, X_{it} represents ZS_{it} , CX_{it} , SX_{it} , denoting the premiums of overall health insurance, property and casualty health insurance, and life health insurance in a city at level i during year t , respectively. In the right-hand side of equation (2), β_0 stands for the intercept term, while $\beta_1 - \beta_{10}$ represent the magnitudes of the impact of the corresponding variable changes on the related indicators. ε_{it} is the residual term.

4.4.2. Multiple regression and multicollinearity test

This paper first performs a multiple linear regression on the dependent variable's overall health insurance based on the overall data. The adjusted R^2 is 0.921, indicating a good overall fit of the data. The correlation coefficients of the 9

explanatory variables have P-values less than 0.01 in the t-test, which means they are highly significant. Considering the rigor, this paper conducts a multicollinearity test on the variables based on the regression analysis and uses the variance inflation factor (VIF) as a measurement index. According to experience, if the test result shows that the VIF value of the explanatory variable exceeds 10, it means that there is multicollinearity among the variables in the model. In this study, we conducted a variance inflation factor (VIF) test on the dependent variable, overall health insurance (ZSit), based on the overall data. We found that, apart from the explanatory variables of the number of broadband internet users (bro) and the number of participants in urban employee basic medical insurance (med), the VIF values of the remaining explanatory variables were all greater than 10, indicating the presence of multicollinearity. The specific results can be seen in Table 5.

Table 5. Multiple Regression and Variance Inflation Factor

Lnzs	Coef.	St.Err.	t-value	p-value	VIF	1/VIF
Lnpep	0.622***	0.2	3.11	0.002	46.66	0.021431
Lnurb	0.291	0.22	1.32	0.186	71.68	0.013950
Lngdp	0.369***	0.105	3.53	0	28.50	0.035082
Lncinc	1.713***	0.234	7.32	0	19.10	0.052353
Lnninc	0.693***	0.179	3.88	0	18.72	0.053424
Lnbed	0.868***	0.105	8.23	0	14.79	0.067600
Lntel	-0.599*	0.126	-4.76	0	28.95	0.034541
Lnbro	0.117***	0.06	1.96	0.051	8.67	0.115371
Lneld	-0.326***	0.074	-4.39	0	15.86	0.063054
Lnmed	-0.238***	0.052	-4.59	0	7.90	0.126513
Constant	-27.976***	1.616	-17.31	0	—	—
R-squared=0.921	F-test=464.815		Prob > F=0.000		*** $p<.01$, ** $p<.05$, * $p<.1$	

In the presence of multicollinearity among variables, we usually eliminate collinearity by excluding variables, increasing sample size, or using stepwise regression. To ensure the integrity of the variables, this paper employs the biased estimation method of ridge regression for parameter estimation. Although ridge regression analysis may make it difficult to satisfy the unbiased estimation of regression coefficients, it can reduce the variance of parameter estimation and help solve the problem of multicollinearity in the variables of this paper. Using STATA for ridge regression has certain limitations, so this paper uses R software for ridge regression analysis. The common form of ridge regression is as follows:

$$\hat{\beta}(k) = (X^T X + kI)^{-1} X^T Y \quad (2)$$

In equation (2), $\hat{\beta}(k)$ is the ridge regression estimate of the regression parameter, and k is the ridge parameter. The trajectory of $\hat{\beta}(k)$ changing with k is called the ridge trace. We will use R software to plot the ridge trace and find an appropriate ridge parameter k , which will be incorporated into the regression equation to obtain more stable regression coefficients. The regression results are shown in Figures 4-5 and Tables 6-7.

5. Results and Discussion

5.1. Analysis of Factors Affecting Health Insurance Premiums

5.1.1. Plotting ridge trace

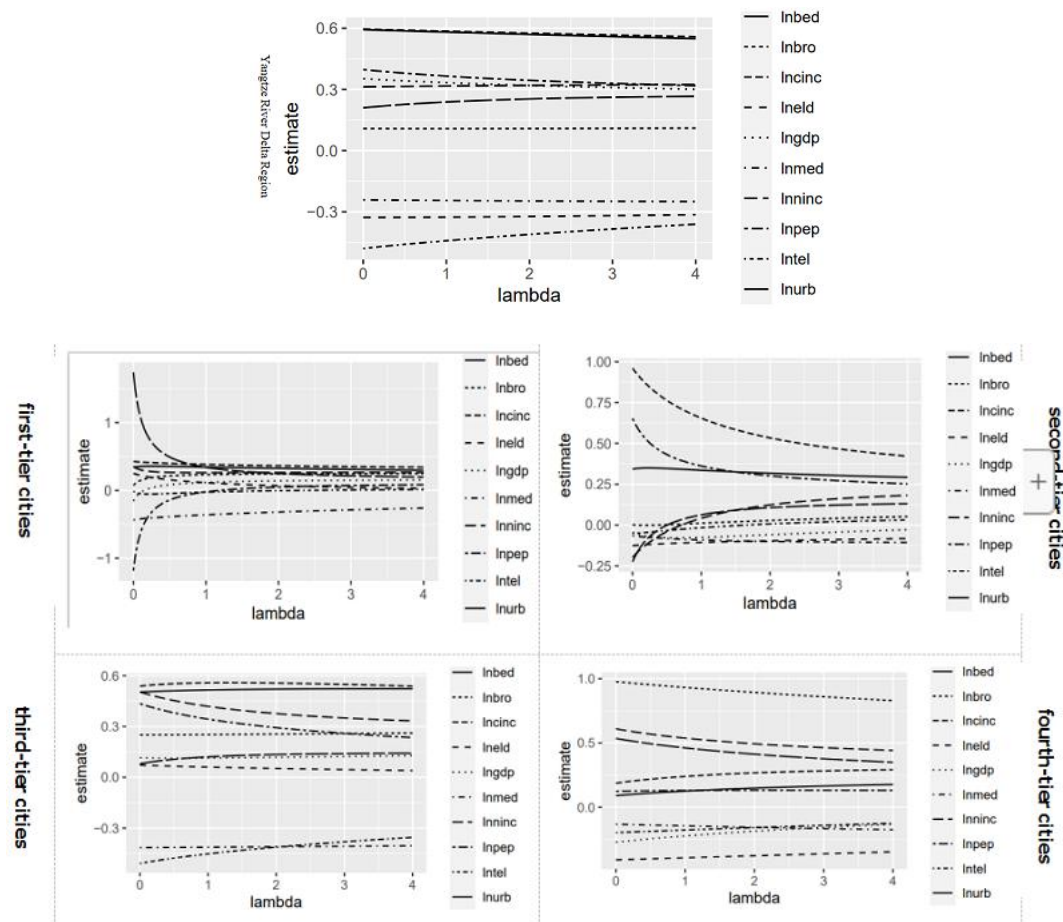


Figure 4. Ridge Trace Plot of Overall Health Insurance in the Yangtze River Delta Region and Different Levels of Cities, Where, the horizontal axis “lanmbda” represents the k value, the vertical axis “estimate” represents the regression coefficient.

5.1.2. K value, regression coefficients, and analysis

Table 6. Summary of Ridge Regression Coefficients for Various Variables of Property and Health Insurance Total Premiums

lnzs	Variable	lnpep	lnurb	lngdp	lncinc	lnninc	lnbed	lnrel	lnbro	lneld	lnmed	Constant term
Regional	K	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_0
Yangtze River Delta Region	0.73	0.58	0.32	0.35	1.69	0.70	0.85	-0.56	0.12	-0.33	-0.24	-19.10
first-tier cities	0.13	-1.65	1.18	0.79	1.74	-0.11	1.74	-0.46	0.26	-0.50	-0.02	-29.93
second-tier cities	0.62	-0.15	0.58	0.42	2.49	0.09	1.55	-0.38	-0.09	-0.86	-0.26	-32.39
third-tier cities	0.53	2.32	-0.46	0.68	0.99	1.75	0.03	-1.06	0.22	-0.31	-0.27	-31.64
fourth-tier cities	0.78	0.65	0.01	0.01	1.21	0.82	1.21	-0.62	0.54	-0.21	-0.11	-22.35

From Table 6, it can be observed that when the entire sample is used for analysis, all variables except the number of mobile phone users, the number of urban workers covered by basic pension insurance, and the number of urban workers covered by basic medical insurance have a positive effect on health insurance premiums. The coefficients are: urban resident per capita income (1.69) > number of beds (0.85) > rural resident per capita income (0.7) > permanent resident population (0.58) > GDP

(0.35) > urban population (0.32) > Internet broadband access user (0.12). Among these variables, the number of urban workers covered by basic medical insurance and basic pension insurance, which represent the level of social security, have a negative impact on health insurance, reflecting the substitution effect of social security on commercial health insurance. When looking at cities of different levels:

a. Economic development level

The urban permanent population only has a positive effect on the development of health insurance in third- and fourth-tier cities and has a negative impact on first- and second-tier cities. This may be because most people choose to live and work in more developed first- and second-tier cities, where companies pay more attention to employee protection. The demand for commercial health insurance decreases as the population grows due to the availability of alternatives, and the decline is more evident in more developed cities. In contrast, enterprises in third- and fourth-tier cities are mostly small and medium-sized, with inadequate employee benefits. The growing population urgently needs commercial supplementary insurance to make up for the lack of protection, thus promoting the development of commercial health insurance. The permanent population impact coefficient of third-tier cities is significantly higher than that of fourth-tier cities, which may be due to the fact that residents of fourth-tier cities are mainly rural immigrants with weak insurance awareness and relatively low income levels, and they do not choose to purchase health insurance.

The number of urban residents has a relatively strong positive effect on the health insurance of first- and second-tier cities, while the impact on third- and fourth-tier cities is not significant. This may be because the level of urbanization in first- and second-tier cities has increased more significantly, and the data more accurately reflects the improvement in their economic and social development levels, which plays a greater role in the development of health insurance. In contrast, the level of urbanization in third- and fourth-tier cities develops more slowly, and the increase in the urban population may simply represent population growth rather than an increase in the city's development level, which does not promote the development of health insurance.

Regional GDP has different degrees of promoting effects on the development of health insurance in first-, second-, third-, and fourth-tier cities. Among them, the impact coefficient of health insurance development in fourth-tier cities is very low, approaching 0. This may be because the economic development level of fourth-tier cities is relatively low, and the growth is flat, which has a weak effect on the development of health insurance.

Through the above analysis, it is found that the regression results are consistent with the research hypothesis H1 of this article. There is a certain relationship between the level of economic development and the development of health insurance, but the impact on different levels of cities varies. To develop health insurance in third- and fourth-tier cities, efforts should be made to attract and promote the influx of permanent residents, take measures to effectively promote the improvement of urban economic levels, and make urbanization a result of economic development rather than merely pursuing data improvement.

b. Residents' Living Standards

Residents' per capita income levels are divided into urban residents' per capita income and rural residents' per capita income levels. Urban residents' income level is positively correlated with the development of health insurance in first-, second-, third-, and fourth-tier cities, with coefficients generally above 1, indicating that increasing urban residents' income plays a significant role in promoting the development of health insurance. On the other hand, rural residents' income level only has a significant impact on third- and fourth-tier cities, possibly because less developed cities have a higher proportion of rural population. The improvement of rural residents' income level indicates a higher living standard for urban residents, and since low-income earners are mostly rural residents, their income level improvement is crucial for narrowing the urban-rural income gap and improving the overall living standard of urban residents. When residents have purchasing power, they will increase their demand for insurance coverage.

Through the above analysis, the regression results align with research hypothesis H2. Residents' living standards are positively correlated with the overall development of health insurance in the region, especially the increase in urban residents' income, which positively correlates with the development of health insurance in all levels of cities. However, the improvement of rural residents' income level only has a more significant impact on third- and fourth-tier cities. This shows that improving the living standards of urban residents should be a goal for the development of health insurance in regions and cities of all levels, with a focus on boosting urban residents' income. Attention should also be paid to the improvement of rural residents' income level in third- and fourth-tier cities, increasing support for low-income earners, reducing the urban-rural gap, and making insurance affordable for more people to enjoy insurance protection.

c. Health Resources Level

The number of beds has a positive impact on the development of health insurance in first-, second-, third-, and fourth-tier cities, particularly in first-, second-, and fourth-tier cities. This may be because the increase in beds in first- and second-tier cities with large populations and developed economies mostly comes from large hospitals, representing an increase in doctors and hospitals, which provides a better foundation for the development of health insurance. In contrast, fourth-tier cities have lower economic development, fewer people, and fewer hospitals. Due to the low base and level, the elasticity of bed numbers to health insurance demand is higher.

Through the above analysis, the regression results align with research hypothesis H3. There is a positive impact of regional health resource levels on health insurance demand. Therefore, regardless of city size or development level, promoting health insurance development should involve improving health resource levels, supporting the construction of medical and health systems in less developed cities, and providing better services and protection for residents.

d. Network Level

The number of mobile phone users has a negative impact on the development of health insurance in first, second, third, and fourth-tier cities, particularly in third and fourth-tier cities. This may be because people in third and fourth-tier cities primarily purchase mobile phones for convenient communication. Customized health insurance products in cities are mostly purchased online. However, residents in underdeveloped cities have limited knowledge and are less likely to search online or learn about health

insurance products through the internet. Consequently, the increase in mobile phone users has a negative impact on health insurance development. In terms of coefficients, the number of mobile phone users also has a certain negative impact on first and second-tier cities. This may be because the growth in mobile phone users in developed cities primarily reflects the growth of urban population mobile phones. Many workers who migrate to cities choose to purchase new phone numbers or even new phones to facilitate better living in new circles. These groups of people generally have higher incomes and education levels and have more choices in terms of medical insurance. The increase in mobile phone users does not significantly affect the demand for health insurance.

The number of internet broadband users does not have a significant impact on the development of health insurance in first, second, third, and fourth-tier cities.

Through the above analysis, it is found that the regression results do not completely align with hypothesis H4. Mobile phones do not promote the development of health insurance in cities at various levels, and the internet broadband access level also has no significant impact on health insurance development. This suggests that, in addition to improving urban network development levels, attention should be paid to improving residents' cultural quality and network technology skills to better leverage the role of network development.

e. Social Security Level

The coefficients for the number of urban workers participating in basic pension insurance and medical insurance are both negative and have relatively small absolute values. This may be because the current health insurance products overlap considerably with the coverage of basic pension insurance and medical insurance for urban workers. As a result, urban workers with existing basic insurance have a lower demand for commercial health insurance. Another possibility is that urban workers have relatively stable incomes at a medium to high level and can choose other types of insurance products for coverage, which can also provide protection.

Through the above analysis, it is found that the regression results are completely opposite to hypothesis H5. The improvement of social security levels does not promote the development of health insurance but rather generates some negative impacts. This suggests that residents tend to view commercial health insurance as a substitute for social insurance rather than a complement. Therefore, efforts should be made to improve this situation from the perspectives of product offerings and residents' perceptions to enhance the supplementary role of commercial health insurance in the medical insurance system.

5.2. Analysis of Influencing Factors of Health Insurance in Property and Casualty Insurance

5.2.1. Plotting ridge trace

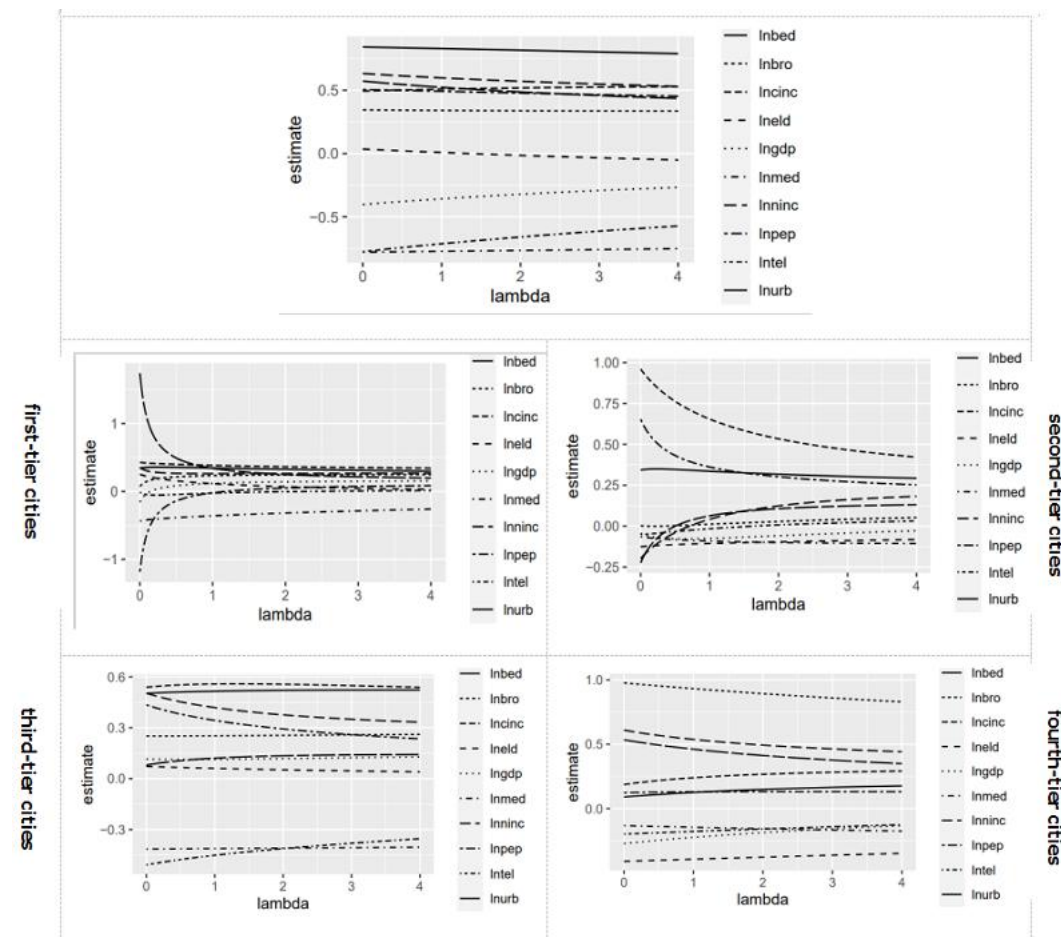


Figure 5. Ridge Trace Plot of Overall Health Insurance in the Yangtze River Delta Region and Different Levels of Cities. Where, the horizontal axis “lanmbda” represents the k value, the vertical axis “estimate” represents the regression coefficient.

5.2.2. K value, regression coefficients, and analysis

Table 7. Summary of Ridge Regression Coefficients for Various Variables of Property and Health Insurance Premiums

Lncx	Variable	lnpep	lnurb	lngdp	lncinc	lnninc	lnbed	lnintel	lnbro	lneld	lnmed	Constant term
Regional	K	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_0
Yangtze River Delta Region	1.47	0.76	0.70	-0.36	1.47	1.30	1.20	-0.86	0.37	0.00	-0.76	-21.66
first-tier cities	0.26	-0.73	1.41	0.08	1.43	0.74	0.78	-0.12	0.33	0.28	-0.63	-25.87
second-tier cities	0.64	1.41	0.08	-0.21	2.52	-0.03	1.14	-0.12	0.01	-0.31	-0.24	-31.22
third-tier cities	3.47	0.90	0.55	0.24	1.75	0.82	1.70	-1.13	0.40	0.08	-0.74	-38.41
fourth-tier cities	2.73	0.29	0.98	-0.43	0.97	1.18	0.42	-0.35	1.50	-0.63	-0.28	-16.82

As can be seen from Table 7, the influence coefficients of urban residents' income level, rural residents' income level, and the number of hospital beds are all above 1, and the absolute values of the regression coefficients of other variables are higher than those of overall health insurance. This indicates that the influence of each variable on property and casualty health insurance is more significant. It is found from the data in

the table that the impacts of residents' living standards, the number of hospital beds, and the number of mobile phone users on the development of property and casualty health insurance are quite similar to those of overall health insurance. In the following, this paper mainly elaborates on the differences between property and casualty health insurance and overall health insurance:

a. Economic Development Level

Population factors still have a significant impact on the development of property and casualty health insurance in cities of all levels, but the impact of GDP is not significant, and the coefficients are relatively low. This may be because health insurance in property and casualty insurance companies accounts for a lower proportion in overall health insurance, and the development level is slow, which is closely related to the business direction and customer accumulation of property and casualty insurance companies. In addition, the premiums of property and casualty health insurance are relatively low, and even residents of cities with lower economic development can afford them, so the relationship with the level of economic development is relatively weak.

Through the above analysis, it is found that the regression results are not entirely consistent with hypothesis H1. Pure population growth plays a more significant role in promoting urban health insurance development than GDP growth, which is related to product prices and property and casualty insurance companies.

b. Network Level

The number of internet broadband users has a certain positive impact on the development of property and casualty health insurance in cities of all levels, but it is not significant overall, mainly having a more significant impact on the development of health insurance in fourth-tier cities. For every additional household accessing the internet via broadband, 1.5 residents are encouraged to purchase health insurance products. This may be because the level of internet penetration in fourth-tier cities is not high, and currently, customized health insurance products such as Huimin Insurance for urban residents are mainly marketed through the internet, which has become the main influencing factor for low-priced health insurance products.

Through the above analysis, it is found that the regression results of the number of internet broadband users are consistent with hypothesis H4, having a positive effect on the development of commercial health insurance, especially in fourth-tier cities. This indicates that the level of internet penetration in cities at all levels, particularly in underdeveloped cities, should be enhanced so that more residents can have access to property and casualty health insurance products.

c. Social Security Level

The social security level still has no significant impact on the development of property and casualty health insurance in cities of all levels, but the coefficients of the variables of the number of urban workers participating in basic medical insurance in first and third-tier cities are positive. Although the impact coefficients are not significant, this indicates that some urban residents use property and casualty health insurance as a supplement to social insurance, which may be related to the relatively low price of property and casualty health insurance, so purchasing it does not impose an economic burden on residents.

Through the above analysis, it is found that the regression results of the number of urban workers participating in basic medical insurance overlap with hypothesis H5 to some extent, indicating that product price is an essential factor influencing the supplementary role of commercial health insurance in the medical insurance system.

5.3 Analysis of Influencing Factors on Life and Health Insurance

By statistically analyzing the total premiums of health insurance in various cities, it was found that over 80% of the health insurance premiums in all levels of cities were life and health insurance, and the proportion reached 90% in developed cities. According to the regression results, the influence of various factors on the development of life and health insurance in cities is highly similar to that on the total health insurance premiums. Therefore, this part will not be further elaborated.

6. Conclusions

6.1. Research Findings and Implications

The study found that regardless of the price of health insurance products, urban population, residents' income, and health resources are important factors affecting the development of health insurance in cities of all levels, but the impact on different cities varies. For low-cost health insurance products, improving the network level, network skills, and residents' awareness has a greater impact on their development. Therefore, differentiated measures can be taken for different levels of cities to promote the development of health insurance in corresponding cities and better play the role of health insurance products in the medical security system.

Specifically: First, cities at all levels should accelerate economic construction and have more policy support in encouraging population inflow and promoting urbanization. However, they should not pursue population blindly. The focus should be on developing the economy, ensuring that new urban residents have jobs, income, and security; second, encouraging enterprises in third and fourth-tier cities, especially small and medium-sized enterprises, to pay social insurance for their employees, allowing them to enjoy insurance benefits and improve the social security system in less developed cities; third, promoting health insurance in cities should raise residents' income levels, both urban and rural residents' income should be increased, paying particular attention to the employment and income status of rural residents and low-income residents in less developed cities, raising their income levels, and reducing income disparities; fourth, improving urban health resource levels, developing large public hospitals in large cities to meet the growing urban population, and avoiding blind investment in small cities with fewer people and low economic development levels. The scale and number of large hospitals should be matched with their development levels. The residents of small cities can enjoy the medical resources of large cities through the development of inter-city transportation and the popularization of medical insurance sharing; fourth, strengthening the construction of urban network hardware and software infrastructure, focusing more on improving network levels and residents' network skills, especially for less developed cities and rural residents; fifth, government involvement in connecting resources, improving product credibility, allowing commercial health insurance products to play a complementary role with basic social medical insurance; sixth, insurance companies designing health insurance products should emphasize differentiation, with low-premium products allowing people in various areas to afford health insurance, better play a supplementary role,

and promote the diversified development of health insurance products, providing residents with more product choices.

6.2. Policy Recommendations for the Development of Health Insurance in the Yangtze River Delta Region

Considering the characteristics of the Yangtze River Delta region, suggestions are proposed from the perspectives of economic development level, residents' living standards, health resources, network level, and social security:

6.2.1. Enhance economic development and leverage the radiating influence of central cities

The Yangtze River Delta is a well-developed economic region in China, but there are significant disparities among cities within the region. Central cities such as Shanghai, Nanjing, Hangzhou, Hefei, Suzhou, and Ningbo have a higher level of economic development and commercial health insurance coverage than other cities. The region should leverage the radiating influence of these central cities on secondary cities through industrial relocation, talent transfer, and other means to drive economic development, population growth, and urbanization in the surrounding cities. By improving the level of economic development, we can promote the development of health insurance.

6.2.2. Increase residents' income and narrow the urban-rural gap

Descriptive analysis of explanatory variables reveals significant income disparities between urban and rural residents in the Yangtze River Delta region. This income gap inevitably leads to an imbalance in the development of commercial health insurance. To promote coordinated regional development, governments should attract enterprises through diversified industrial structures and investment promotion, creating more job opportunities and increasing overall income levels. Moreover, attention should be paid to rural economic development, promoting the development of characteristic industries and providing guidance on technology and policies to enhance rural residents' income.

6.2.3. Improve healthcare resource levels and promote resource sharing

Healthcare resources are essential for improving medical services and developing commercial health insurance. The relevant departments in the Yangtze River Delta region should strengthen medical facility construction, implement President Xi's policy requirements for a "one-card" system based on social security cards, and facilitate residents' access to medical services. In response to the unbalanced development of healthcare resources within the region, priority should be given to improving the healthcare resources in third and fourth-tier cities. By facilitating cross-city medical reimbursement and constructing multi-level rail transit systems, the developed cities' healthcare resources can benefit residents in underdeveloped areas and promote cross-regional development of health insurance.

6.2.4. Strengthen internet penetration and enhance residents' online skills

As more insurance products are being marketed online and offline, the development of commercial health insurance is limited by low levels of internet penetration, especially for inclusive commercial health insurance products primarily sold online. Therefore, governments should prioritize improving regional internet development,

particularly broadband accessibility in smaller cities, which will boost the development of low-premium health insurance products. Additionally, efforts should be made to improve internet skills among residents with lower educational levels, rural residents, and middle-aged and elderly residents by offering free lectures and encouraging insurance companies to include such services in their sales process. Furthermore, it is recommended to establish government-backed insurance websites that provide a preliminary selection of health insurance products for residents to build trust and purchase desire.

6.2.5. Diversify product offerings to meet different needs

The analysis shows that while the social security level does not significantly impact the overall development of health insurance, the number of urban employees covered by basic pension insurance promotes the development of commercial health insurance products in some cities, particularly low-priced and inclusive products. Insurance institutions should be encouraged to develop more inclusive health insurance products, such as “Hui Bao”, with affordable prices and government involvement to increase credibility. At the same time, health insurance products should provide more comprehensive coverage to compensate for lower social security levels in underdeveloped cities. In first- and second-tier cities, there are more high-income people. On the basis of developing inclusive health insurance products, efforts should be made to encourage the development of more high-end products to meet the diverse needs of different groups. In addition, the seventh national census shows that the proportion of elderly population in the Yangtze River Delta region has exceeded 20%, entering the stage of moderate population aging. The related protection for the elderly should be taken seriously. Regional governments should encourage the development of medical insurance and nursing insurance products for the middle-aged and elderly people, providing them with more health insurance options and promoting the stable development of health insurance for the middle-aged and elderly people.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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