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How to develop commercial health insurance in the post-epidemic era

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Abstract

With the rapid development of China's economy, people's living standards have been continuously improved, but people's physical health problems have become more and more prominent.At the same time, China has begun to enter an aging society,and pension and medical issues have also brought tremendous pressure to people.Commercial health insurance can provide health insurance products and services according to the national needs, better meet the growing and diversified needs of the nation, play an important supplementary role in the medical security system, improve the social security system and enhance the development of the health industry. The outbreak of COVID-19 epidemic in early 2020 has stimulated demand for health insurance, and commercial health insurance has ushered in development opportunities.This paper provides suggestions for the development of commercial health insurance in the post-epidemic era through an empirical analysis of the influencing factors of commercial health insurance in China.

Keywords

Post-epidemic era, commercial health insurance, multiple regression analysis.

1. Introduction

Commercial health insurance refers to insurance in which the insurance company pays the insured person due to health reasons or medical behaviors. It mainly includes medical insurance, sickness insurance, disability income loss insurance, nursing care insurance, and medical accident insurance. As a means of diversifying risks, commercial health insurance can provide comprehensive health insurance products and services in various fields including medical treatment, disease, rehabilitation, care, and childbirth according to national needs, so as to better meet the increasing diversified needs of nationals. And it can effectively reduce the payment pressure of basic medical insurance and individuals, resolve the risks of family and individual medical expenses, and play an important supplementary role in the medical security system. At the same time, commercial health insurance has multiple attributes such as medical security, financial insurance, and health industry, which is of great significance for improving the social security system, improving the development level of the health industry, and optimizing the financial insurance market.

After the reform and opening up, China's commercial health insurance started to take off. After more than 30 years of development, China's commercial health insurance is entering a brand new stage of development under the influence of national policy guidance, social and economic transformation and upgrading, continuous improvement of national health awareness, and deepening reform of medical security system.

The outbreak of COVID-19 epidemic in early 2020 became the most serious major public health emergency since the founding of New China with its rapid spread, widespread infection and difficulty in prevention and control, bringing a huge impact to most industries. The insurance industry was also inevitably hit. The epidemic further stimulated the release of national

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demand for health and protection, strengthened national awareness of health consumption, and accelerated the process of digital transformation of the commercial health insurance industry. In the post-epidemic era, commercial health insurance will have new opportunities and will show a high growth trend with an expanding industry scale.

1.1. Gross Domestic Product

As the core indicator of national economic accounting, GDP can measure the economic condition and development level of a country or region. The increase of GDP represents that the economy of a country or region is developing. With the economic development, people's income increases, health awareness increases, insurance demand is strong, and people's willingness to buy health insurance increases.

1.2. Per capita disposable income of urban households

Income is the most important and basic factor that affects the consumption structure. Increasing income levels make it possible to expand consumption both externally and connotationally. Increasing income not only increases people's demand for health insurance, but also directly affects their ability to pay for commercial health insurance expenditures. Generally speaking, the demand for commercial health insurance is relatively strong in areas with high levels of urbanisation. Therefore, the per capita disposable income of urban households is one of the most important factors influencing commercial health insurance in China.

1.3. Insurance density

Since 2011, China's health insurance premium density has continued to grow and has exceeded RMB580 per person in 2020, up 15.2% from 2019. National investment in health insurance is increasing rapidly and steadily, and demand for commercial health insurance is strong.

1.4. Older population dependency ratio

The problem of ageing in China is becoming increasingly serious.In 2019, the population over 60 years old accounted for 18.1% of the total population, of which the population aged 65 years and over accounted for 12.6%.The increasing ageing of the population will lead to a series of problems, with medical and health issues being the most prominent. On the one hand, older people are at higher risk of illness and have greater medical needs. On the other hand, as age rises, the per capita cost of healthcare rises year on year, increasing the financial burden on families and society, which can be relieved to some extent by purchasing commercial health insurance.

2. Empirical Analysis

2.1. Variable selection

The development of commercial health insurance in China is influenced by many factors. As this paper focuses on the influencing factors of health insurance in China in recent years and provides effective opinions on the development of commercial health insurance in the post-epidemic era in view of the impact of the current New Crown Pneumonia epidemic on the insurance industry, the research samples selected for this paper are gross domestic product, per capita disposable income of urban households, insurance density, elderly population during the period of 2009-2019 The four variables of GDP, urban household per capita disposable income, insurance density and elderly population dependency ratio are used as explanatory variables and commercial health insurance premium income is used as the explanatory variable. By using EViews software to construct an econometric model, an empirical analysis of each influencing factor is conducted in order to understand more clearly and intuitively the direction and degree of influence of different variables on the demand for commercial health insurance in China.

Variable name	Variable symbol
Commercial health insurance premium income	Y
Gross Domestic Product	X1
Per capita disposable income of urban households	X2
Insurance density	X3
Older people dependency ratio	X4

2.2. Modelling

In order to specifically analyse the factors influencing commercial health insurance premium income in China, the explanatory variable Y is China's commercial health insurance premium income, and the explanatory variables X1-X4 are GDP, per capita disposable income of urban households, insurance density and elderly dependency ratio respectively.

The model used is as follows:

$$LNY = \beta_0 + \beta_1 LNX_1 + \beta_2 LNX_2 + \beta_3 LNX_3 + \beta_4 LNX_4 + \varepsilon$$

Among them, β_0 represents the intercept term, β_{i} represents the coefficient term, and ε represents the random disturbance term. Through the regression analysis of the model, the influence degree and direction of each variable are obtained. β_i represents that for every 1% change of the explanatory variable, the average change of the explained variable is percent.

Initial estimation of the model

Performing OLS estimation on the model, the results shown in Figure 1 can be obtained:

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX1	0.101537	0.031834	3.189525	0.0243
LNX2	-0.449492	0.400699	-1.121770	0.3129
LNX3	2.482577	0.277561	8.944247	0.0003
LNX4	-0.415731	0.460809	-0.902177	0.4083
C	2.767451	2.243687	1.233439	0.2722

R-squared	0.997862	Mean dependent var	16.82602
Adjusted R-squared	0.996152	S.D. dependent var	0.890387
S.E. of regression	0.055234	Akaike info criterion	-2.647620
Sum squared resid	0.015254	Schwarz criterion	-2.496327
Log likelihood	18.23810	Hannan-Quinn criter.	-2.813587
F-statistic	583.4401	Durbin-Watson stat	2.549664
Prob(F-statistic)	0.000001		

Figure 1 The initial estimation results of the model

$$LNY = 2.7675 + 0.1015 * LNX_1 - 0.4495 * LNX_2 + 2.4826 * LNX_3 - 0.4157 * LNX_4$$

T= (1.2334) (3.1895 (-1.1218) (8.9442) (-0.9022)

R^2=0.9979 Adj R^2=0.9962 DW=2.5497 F=583.4401

Goodness of fit: the closer the value of R2 is to 1, the better the regression line fits the observations; conversely, the closer the value of R2 is to 0, the worse the regression line fits the observations. From the data in Figure 1, we can obtain that the adjusted R-squared is 0.9962, which indicates that the model fits the sample well.

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F-test: At a significance level of 0.05, the critical values of degrees of freedom of 4 and 5 were checked in the F distribution table. From Figure 1, we can get F=583.4401>5.8345, so the original hypothesis is rejected, indicating that the regression equation is significant.

t-test: At a significance level of 0.05, the critical value of the degrees of freedom of the t-distribution table is 2.5706 for 5. As can be seen from the data in Figure 2, the effects of the LNX1 and LNX3 explanatory variables on the explanatory variables are insignificant, and none of the LNX2 and LNX4 variables are significant.

As the model fits well and the overall model significance test is passed, but there are cases where the variables are not significant, therefore, the model is tentatively judged to be cointegrated and a multiple cointegration test is performed next.

Multicollinearity test

The model was tested for multicollinearity and confirmed by two methods: the correlation coefficient matrix and the variance inflation factor.

Correlation Probability	LNY	LNX1	LNX2	LNX3	LNX4
LNY	1.000000 -----				
LNX1	0.079300 0.8276	1.000000 -----			
LNX2	0.977638 0.0000	0.109940 0.7624	1.000000 -----		
LNX3	0.996715 0.0000	0.020686 0.9548	0.980042 0.0000	1.000000 -----	
LNX4	0.956387 0.0000	0.152486 0.6741	0.954257 0.0000	0.957134 0.0000	1.000000 -----

Figure 2 Correlation coefficient matrix

According to the correlation analysis, most of the explanatory variables have a high degree of correlation, and many of the correlation coefficients are higher than 0.8 or 0.9. Therefore, the multicollinearity of the model is high. In order to further confirm the collinearity of the variables, test the variance expansion factor of the model:

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LNX1	0.001013	577.1315	1.476864
LNX2	0.160559	55754.17	32.05960
LNX3	0.077040	13996.46	41.63896
LNX4	0.212344	4958.302	15.22352
C	5.034132	16500.99	NA

Figure 3 Variance inflation factor test (VIF test)

Through testing, when the variance expansion factor VIF>=10, it often indicates that there is serious multicollinearity between this explanatory variable and the other explanatory variables. Since the VIF values of all the other explanatory variables are greater than 10 except for LNX1, the collinearity between the variables is relatively high, so a stepwise regression is performed on the variables.

Unary regression:

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX1	0.100459	0.446482	0.225002	0.8276
C	15.50357	5.885082	2.634384	0.0300

R-squared	0.006288	Mean dependent var	16.82602
Adjusted R-squared	-0.117926	S.D. dependent var	0.890387
S.E. of regression	0.941424	Akaike info criterion	2.894011
Sum squared resid	7.090236	Schwarz criterion	2.954528
Log likelihood	-12.47005	Hannan-Quinn criter.	2.827624
F-statistic	0.050626	Durbin-Watson stat	0.113559
Prob(F-statistic)	0.827619		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX2	3.345877	0.254457	13.14910	0.0000
C	-17.60207	2.619039	-6.720814	0.0001

R-squared	0.955776	Mean dependent var	16.82602
Adjusted R-squared	0.950248	S.D. dependent var	0.890387
S.E. of regression	0.198601	Akaike info criterion	-0.218177
Sum squared resid	0.315540	Schwarz criterion	-0.157660
Log likelihood	3.090886	Hannan-Quinn criter.	-0.284564
F-statistic	172.8988	Durbin-Watson stat	1.036954
Prob(F-statistic)	0.000001		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.073351	0.059565	34.80795	0.0000
C	1.413161	0.443457	3.186691	0.0129

R-squared	0.993440	Mean dependent var	16.82602
Adjusted R-squared	0.992620	S.D. dependent var	0.890387
S.E. of regression	0.076488	Akaike info criterion	-2.126513
Sum squared resid	0.046803	Schwarz criterion	-2.065996
Log likelihood	12.63256	Hannan-Quinn criter.	-2.192900
F-statistic	1211.594	Durbin-Watson stat	2.369664
Prob(F-statistic)	0.000000		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX4	5.462473	0.589857	9.260668	0.0000
C	2.268922	1.574347	1.441183	0.1875

R-squared	0.914676	Mean dependent var	16.82602
Adjusted R-squared	0.904010	S.D. dependent var	0.890387
S.E. of regression	0.275862	Akaike info criterion	0.439022
Sum squared resid	0.608798	Schwarz criterion	0.499539
Log likelihood	-0.195112	Hannan-Quinn criter.	0.372635
F-statistic	85.75997	Durbin-Watson stat	0.899596
Prob(F-statistic)	0.000015		

It can be seen that the t-test of the LNX3 variable is passed, and the goodness of fit of LNX3 is higher, so other variables are added based on LNX3.

Binary regression:

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.070824	0.043888	47.18410	0.0000
LNX1	0.074371	0.026728	2.782523	0.0272
C	0.452912	0.475194	0.953110	0.3723

R-squared	0.996885	Mean dependent var	16.82602
Adjusted R-squared	0.995996	S.D. dependent var	0.890387
S.E. of regression	0.056345	Akaike info criterion	-2.671332
Sum squared resid	0.022223	Schwarz criterion	-2.580557
Log likelihood	16.35666	Hannan-Quinn criter.	-2.770913
F-statistic	1120.236	Durbin-Watson stat	1.874477
Prob(F-statistic)	0.000000		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.031273	0.319918	6.349364	0.0004
LNX2	0.070638	0.526342	0.134205	0.8970
C	0.999115	3.121287	0.320097	0.7582

R-squared	0.993457	Mean dependent var	16.82602
Adjusted R-squared	0.991588	S.D. dependent var	0.890387
S.E. of regression	0.081664	Akaike info criterion	-1.929082
Sum squared resid	0.046683	Schwarz criterion	-1.838307
Log likelihood	12.64541	Hannan-Quinn criter.	-2.028663
F-statistic	531.4451	Durbin-Watson stat	2.370775
Prob(F-statistic)	0.000000		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.016458	0.218697	9.220315	0.0000
LNX4	0.163207	0.600478	0.271795	0.7936
C	1.401156	0.473658	2.958160	0.0212

R-squared	0.993509	Mean dependent var	16.82602
Adjusted R-squared	0.991654	S.D. dependent var	0.890387
S.E. of regression	0.081341	Akaike info criterion	-1.937010
Sum squared resid	0.046314	Schwarz criterion	-1.846235
Log likelihood	12.68505	Hannan-Quinn criter.	-2.036591
F-statistic	535.7031	Durbin-Watson stat	2.357440
Prob(F-statistic)	0.000000		

Since the goodness of fit of adding LNX1 is the highest, and the t test is passed, other variables are added on the basis of LNX3 and LNX1.

Triple regression:

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.358414	0.237271	9.939734	0.0001
LNX1	0.090433	0.028900	3.129156	0.0203
LNX2	-0.483707	0.392666	-1.231854	0.2641
C	3.080794	2.181999	1.411913	0.2077

R-squared	0.997514	Mean dependent var	16.82602
Adjusted R-squared	0.996271	S.D. dependent var	0.890387
S.E. of regression	0.054371	Akaike info criterion	-2.696802
Sum squared resid	0.017737	Schwarz criterion	-2.575768
Log likelihood	17.48401	Hannan-Quinn criter.	-2.829576
F-statistic	802.5377	Durbin-Watson stat	1.913294
Prob(F-statistic)	0.000000		

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX3	2.232335	0.168675	13.23451	0.0000
LNX1	0.088052	0.030105	2.924775	0.0265
LNX4	-0.464656	0.468513	-0.991768	0.3596
C	0.310453	0.496963	0.624700	0.5552

R-squared	0.997324	Mean dependent var	16.82602
Adjusted R-squared	0.995986	S.D. dependent var	0.890387
S.E. of regression	0.056411	Akaike info criterion	-2.623138
Sum squared resid	0.019093	Schwarz criterion	-2.502104
Log likelihood	17.11569	Hannan-Quinn criter.	-2.755912
F-statistic	745.4026	Durbin-Watson stat	2.278872
Prob(F-statistic)	0.000000		

It can be seen that the newly added variable t test failed. Therefore, LNX1 and LNX3 are used as the final regression results.

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Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX1	0.074371	0.026728	2.782523	0.0272
LNX3	2.070824	0.043888	47.18410	0.0000
C	0.452912	0.475194	0.953110	0.3723

R-squared	0.996885	Mean dependent var	16.82602
Adjusted R-squared	0.995996	S.D. dependent var	0.890387
S.E. of regression	0.056345	Akaike info criterion	-2.671332
Sum squared resid	0.022223	Schwarz criterion	-2.580557
Log likelihood	16.35666	Hannan-Quinn criter.	-2.770913
F-statistic	1120.236	Durbin-Watson stat	1.874477
Prob(F-statistic)	0.000000		

Figure 4 Stepwise regression results

Heteroscedasticity test

Next, use White's test to test the heteroscedasticity of the variables to test whether there is heteroscedasticity in the results after stepwise regression:

Heteroskedasticity Test: White

F-statistic	3.300790	Prob. F(5,4)	0.1352
Obs*R-squared	8.049156	Prob. Chi-Square(5)	0.1535
Scaled explained SS	1.668852	Prob. Chi-Square(5)	0.8928

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
C	-1.802100	2.369448	-0.760557	0.4893
LNX1^2	-0.015687	0.009680	-1.620627	0.1804
LNX1*LNX3	0.009314	0.018898	0.492839	0.6480
LNX1	0.319763	0.373681	0.855713	0.4404
LNX3^2	-0.003516	0.019418	-0.181063	0.8651
LNX3	-0.053301	0.067031	-0.795166	0.4710

R-squared	0.804916	Mean dependent var	0.002222
Adjusted R-squared	0.561060	S.D. dependent var	0.002155
S.E. of regression	0.001428	Akaike info criterion	-9.981799
Sum squared resid	8.15E-06	Schwarz criterion	-9.800248
Log likelihood	55.90900	Hannan-Quinn criter.	-10.18096
F-statistic	3.300790	Durbin-Watson stat	2.847065
Prob(F-statistic)	0.135242		

Figure 5 White test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.395148	Prob. F(2,5)	0.6929
Obs*R-squared	1.364863	Prob. Chi-Square(2)	0.5054

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX1	-0.019550	0.038880	-0.502837	0.6364
LNX3	0.015113	0.051343	0.294357	0.7803
C	0.148050	0.565263	0.261914	0.8038
RESID(-1)	-0.244112	0.520982	-0.468561	0.6591
RESID(-2)	-0.458298	0.522840	-0.876555	0.4208

R-squared	0.136486	Mean dependent var	-2.94E-15
Adjusted R-squared	-0.554325	S.D. dependent var	0.049691
S.E. of regression	0.061951	Akaike info criterion	-2.418078
Sum squared resid	0.019190	Schwarz criterion	-2.266785
Log likelihood	17.09039	Hannan-Quinn criter.	-2.584045
F-statistic	0.197574	Durbin-Watson stat	1.789161
Prob(F-statistic)	0.929334		

Figure 6 LM inspection

It can be seen that Obs*R-squared is 8.0492, and the corresponding prob value is 0.1535, 0.1535>0.05. At the significance level of 0.05, the null hypothesis of the same variance of the residuals is accepted, that is, the model does not have heteroscedasticity.

Autocorrelation test

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For a model with a sample size of n=10 and two explanatory variables, at the significance level of, check the DW distribution table to obtain the critical value. Therefore, it is judged that there is no first-order autocorrelation in the model. In order to test whether the variable has second-order autocorrelation, use the LM test method to test:

It can be seen that Obs*R-squared is 1.3649, and the corresponding prob value is 0.5054, 0.5054>0.05. At the significance level of 0.05, the null hypothesis that there is no second-order sequence correlation is accepted. Therefore, there is no second-order sequence in the model. Related.

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
LNX1	0.074371	0.026728	2.782523	0.0272
LNX3	2.070824	0.043888	47.18410	0.0000
C	0.452912	0.475194	0.953110	0.3723

R-squared	0.996885	Mean dependent var	16.82602
Adjusted R-squared	0.995996	S.D. dependent var	0.890387
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Log likelihood	16.35666	Hannan-Quinn criter.	-2.770913
F-statistic	1120.236	Durbin-Watson stat	1.874477
Prob(F-statistic)	0.000000		

Figure 7 Final regression results

The final result of the model

The final model is as follows:

$$LNY = 0.4529 + 0.0744 * LNX_1 + 2.0708 * LNX_3$$

T= (0.9531) (2.7825) (47.1841)

R^2=0.9969 Adj R^2=0.9960 DW=1.8745 F=1120.236

Economic significance test

The estimated results of the model show that, assuming that other variables remain unchanged, on average, for every 1% increase in GDP, China's commercial health insurance premium income increases by 0.0744%; for every 1% increase in insurance density, China's commercial health insurance Premium income increased by 2.0708%.

Statistical inspection

Goodness of fit: From the data in Figure 7, the modified coefficient of determination is, which shows that the model fits the sample well.

F test: at a significance level of 0.05, check the critical values of 2 and 7 degrees of freedom in the F distribution table. From Figure 7 we can get F=1120.236>4.7374, so the null hypothesis is rejected, indicating that the regression equation is significant.

t test: at the significance level of 0.05, check the critical value of 2.3646 where the degree of freedom of the t distribution table is 7. It can be seen from the data in Figure 7 that the LNX1 and LNX3 explanatory variables have a significant impact on the explained variables.

Forecast.

Therefore, the model prediction is relatively accurate, and the model prediction in this article is relatively reliable.

Through the above empirical analysis we can find that GDP and insurance density have a great role in promoting the demand for commercial health insurance in China.

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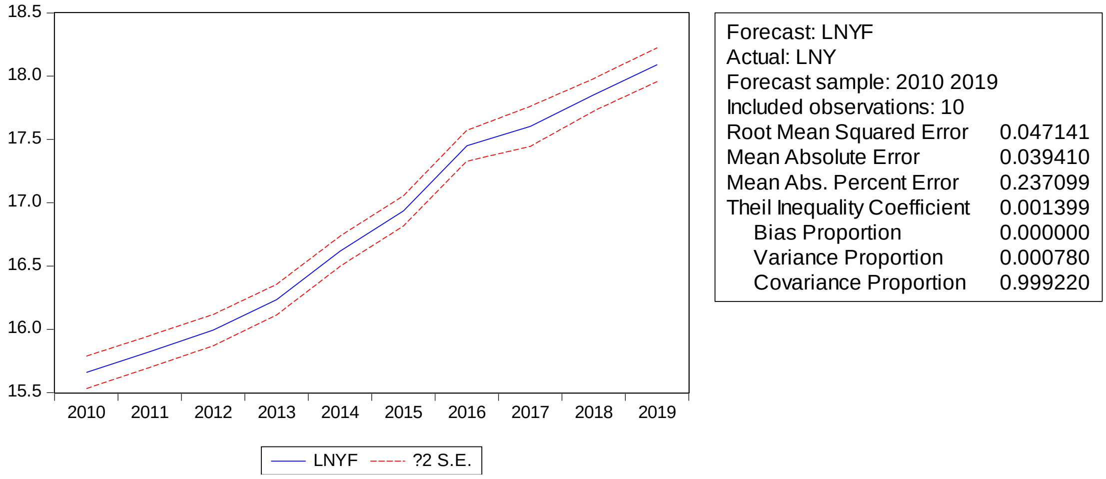

It can be seen that the relative prediction error percentage is 0.2371%, which is less than 5%.

3. Conclusion

3.1. Economic development promotes commercial health insurance to enter a new stage of development

The report of the 19th Party Congress pointed out that the main contradiction of Chinese society has transformed into the contradiction between the people's growing demand for a better life and unbalanced and insufficient development. China's rising GDP and sustained medium-to-high economic growth are conducive to promoting the upgrading of the consumption structure, enhancing the ability to pay for insurance and stimulating the nation's demand for insurance. This has laid a solid economic foundation for the maintenance of national health, created a broad space for the development of the health industry, and laid a favourable cornerstone for the development of commercial health insurance.

3.2. The national strategy level encourages and supports the rapid development of commercial health insurance

The introduction of the "Health China 2030" planning outline reflects the fact that national health as an important national strategy has been integrated into various policies. From top-level design to concrete implementation, the State has introduced a series of policies to support and guide the development of commercial health insurance. For example, the Opinions on Promoting the Development of Commercial Insurance in Social Services jointly issued by the China Banking and Insurance Regulatory Commission and 13 other departments in January 2020 states that it strives to bring the market size of the health insurance market to over RMB 2 trillion by 2025. This provides more opportunities for the development of health insurance and is conducive to encouraging commercial health insurance to play a more active role in the multi-level medical protection system. Against the backdrop of the release of the policy dividend of universal health, China's commercial health insurance will break through the development lag and reform from the supply side in order to better address the contradiction between the people's growing demand for health protection and the unbalanced and inadequate supply of health insurance, better meet the people's aspiration for a healthy and better life, and explore a path for the development of commercial health insurance that is in line with China's national conditions.

3.3. COVID-19 epidemic provides new development opportunities for commercial health insurance

COVID-19 epidemic has not only raised the nation's concern about medical protection and commercial health insurance and stimulated the demand for commercial health insurance, but

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also accelerated the innovation of technology. Technologies such as big data, 5G communication, artificial intelligence and cloud computing have played an important role in the prevention and control of the epidemic. Among them, big data technology has played an important supporting role in epidemic surveillance and analysis, virus tracing, prevention and treatment, and resource deployment, further reinforcing the importance of healthcare big data as a fundamental strategic national resource. Big data has enabled the datafication of massive amounts of user behaviour, which has greatly contributed to the data precipitation of insurance companies, and the quantitative changes brought about by the accumulation of massive amounts of data are also brewing qualitative changes, stimulating new business changes and vitality.

With the continuous development of new technologies and the outbreak of the epidemic, the acceptance of consumers to purchase insurance on the Internet is rapidly increasing, and a large number of users are beginning to take out insurance policies online.

The rapid development and application of emerging technologies will profoundly change the development mode and business model of commercial health insurance, bringing new momentum to the transformation of commercial health insurance.

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