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Analysis on influencing factors of total retail sales of consumer goods in Hebei Province from 2010 to 2022

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Abstract

The total retail sales of consumer products show how much people's living conditions have improved through time, as well as the extent to which their social commodity purchasing power has been realized and the state of urban consumption. In this paper, the ridge regression approach is utilized to analyze the relationship between the total retail sales of social consumer products and urban inhabitants' per capita income, rural inhabitants' per capita income, urban inhabitants' per capita consumption expenditure, rural inhabitants' per capita consumption expenditure, urbanization rate, the resident population at year-end, population density in Hebei province from 2010 to 2022. The findings indicate that urban inhabitants' per capita income has the biggest impact on the total retail sales of social consumer products in Hebei Province, while rural inhabitants' per capita consumption expenditure has the littlest effect. Finally, to sustain and healthy development of the domestic consumer market, four recommendations are made in light of the analyses' findings: (1) Encouraging businesses to actively support the co-development of the real economy and the online virtual economy. (2) The government should continue to reform the income distribution, narrow the income disparity between urban and rural regions, and promote the co-development of urban and rural regions, (3) The government should keep working to strengthen the system of social insurance and expand the coverage of social insurance, and (4) The government should create a good consumption environment, crack down on counterfeiting, punish illegal acts of counterfeiting and selling fakes, and ensure food safety.

Keywords: Hebei Province, influencing factors, total retail sales of social consumer products

Introduction

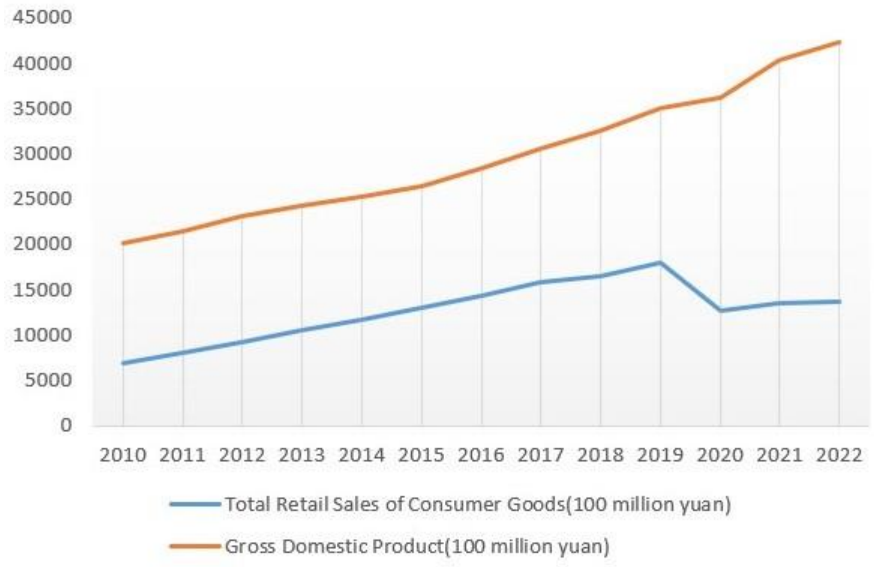
The consumption is an important part of social production. Consumption is not only the purpose of production but also the driving force of production. The functions of consumption and production are mutual (Shu, 2018). Consumption in modern society is not only a necessary means to meet people's needs for survival, but also an objective need for people to improve their quality of life. Consumption is the propeller of production. The stronger the demand, the

more active the investment and production activities. The drive behind economic development will be more sufficient the greater the demand. Under the current economic development, reasonable consumption is the foundation of economic and social success and development, and a key to maintaining the high-quality development and sustainable development of the national economy. An industry's inception and expansion can frequently be attributed to the creation of a new consumption hotspot. After the China-America economic and trade agreement in 2019, China's export trade was affected, and some enterprises' export businesses stagnated. In such an international environment, it is more important to expand domestic demand and stimulate domestic consumption. The direct indicator of domestic consumption demand is the total retail sales of social consumer products (Zou, 2016).

Total retail sales of social consumer products refer to the retail sales of consumer products made by wholesalers, retailers, lodging and food service providers, and other businesses that are offered to residents of urban and rural areas and social groupings. Among them, the total retail sales of consumer goods to residents refer to the number of goods consumed daily by urban and rural populations. The number of items sold to organizations, social groups, troops, schools, businesses, institutions, and village committees and acquired using public funds for non-production, non-commercial usage, and public consumption is referred to as the retail sales of consumer products to social groups. The amount of social commodities available determines the overall retail sales of social consumer products, which is crucial information for analyzing changes in inhabitants' living conditions and prices (Han, 2015).

The state has placed a high priority on and provided assistance for Hebei Province's economic development as one of the key provincial cities in North China. With the rapid development of Beijing-Tianjin-Hebei integration, urban construction in Hebei Province has entered a stage of rapid development. As can be seen from Figure 1, since 2010, Hebei Province's economy has swiftly evolved and its gross domestic product (GDP) has increased. By 2022, the GDP of Hebei Province has reached about two times that of 2010. Since 2010, the total retail sales of social consumer products in Hebei Province continued to grow, which had a cumulative increase of about 689.83 billion yuan by 2022. The economy as a whole shows a rising trend, but from the specific change trend of the total retail sales of social consumer products, it can be found that it continued to grow from 2010 to 2019, and decreased in 2020. Facing the adjustments to the world economic situation in 2020, the trading situation has also undergone great changes. After that, although it increased in 2021 and 2022, it failed to return to its height in 2019.

The reduction in consumption rates of growth leads to a decline in the business vitality of enterprises. Against this background, it is important to talk about the elements influencing the shift in the total retail sales of social consumer products. Studying and analyzing the elements that affect the retail sales of social consumer products and putting forward relevant suggestions provide a reference for the government to formulate macroeconomic policies, which is also crucial for preserving the market's fundamental coordination among demand and supply and for maintaining steady economic development.



Source: Bureau of the statistic of Hebei Province

Figure 1. The retail sales of social consumer products and GDP situation on Hebei Province from 2010 to 2022

Literature review

Chen et al. (2020) analyzed the influencing factors of total retail sales of social consumer products in Heilongjiang Province from the perspectives of traditional consumption policy, the Internet, and the population. Li and Xu (2019) predicted and analyzed the retail sales of consumer products in terms of seasonal fluctuations and long-term trends through functional analysis. Zhang (2019) thinks that the main variable that impacts the retail sales of consumer products was the ratio of income of inhabitants to the urban inhabitant's income, and draws the conclusion that inhabitants' income is positively correlated with the retail sales of social consumer products.

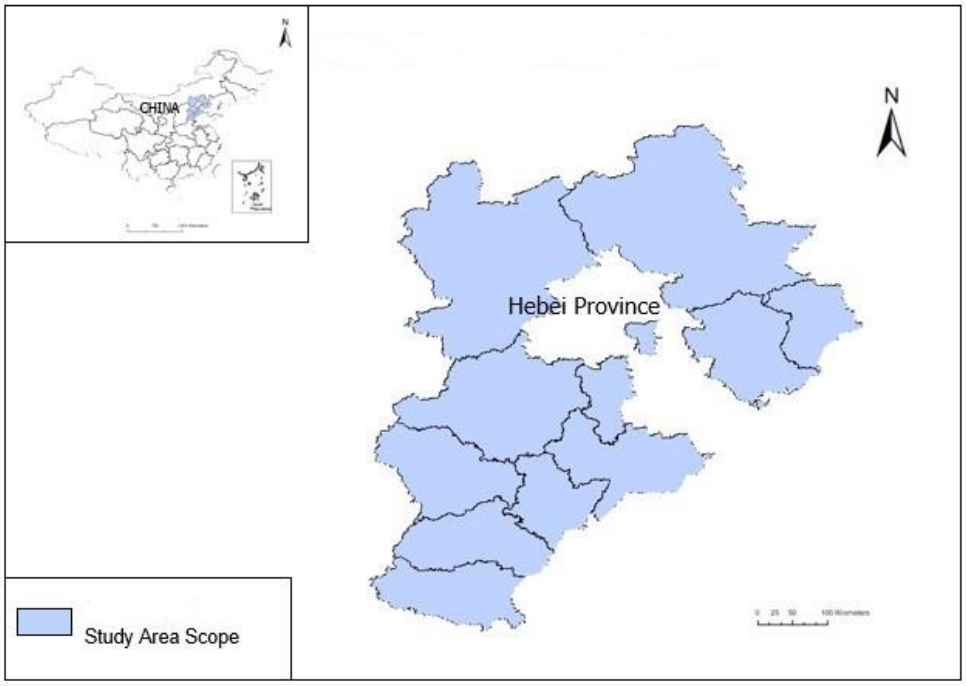
Wu (2017) used principal component analysis to analyze the primary variable that impacts the retail sales of social consumer products, such as population and price index. Ren (2016) studied the influence of money supply on the retail sales of social consumer products. Considering the national value-added tax and the location of commercial buildings as influencing factors, Zou (2016) researched the retail sales for consumer products. The impact of citizens' incomes on the retail sales of social consumer products was analyzed by Ding (2015). Kok and Monkkonen (2014) discovered that topography, employment situation and land use rules are the crucial factors of residential land price. Gao et al. (2015) conducted research on the effects of immovable asset investments and savings deposits on the retail of social consumption products. Kheir (2016) studied the influencing factors in the Arab region, and compared the social population and environmental variables by using time trend and regression analysis. Panzone et al. (2021) tested the effectiveness of landfill taxes on household waste collection using ridge regression on economic data sets from local authorities in the UK. Although the above research has achieved some results, the selected indicators are either not closely related to the retail sales of consumer products, or the selected indicators have certain

limitations, so it is difficult to objectively and perfectly reveal the changing and developing law on the retail sales of social consumer products.

Method and study region

Study region

Hebei Province is located between 36°03′N to 42°37′N, and 113°27′E to 119°50′E. It is situated in the eastern part of North China, enclosing the cities of capital city Beijing and Tianjin in the center and abutting the Bohai Sea to the east. Hebei province has 11 prefecture-level cities under its jurisdiction. Figure 2 shows the Hebei province study region. According to government documents, Hebei Province is known as "an important base for modern commerce and logistics in the country, a pilot zone for industrial transformation and upgrading, and a demonstration zone for new urbanization and urban-rural coordination." The research data comes from the Hebei Provincial Bureau of Statistics and the Hebei Province Statistical Bulletin on Economic and Social Development from 2010 to 2022.



Source: China Map Publishing House, 2015

Figure 2. The location of Hebei Province

Research method

In order to minimize the total squared amount of the distances between all of the observed values on the scatter plot and the regression straight line, the ordinary least squares (OLS) approach, the most fundamental type of regression model, needs the fewest model conditions.

The OLS method is a mathematical equation in order to determine and verify the influence of one or several independent variables (cause variables) on one dependent variable (result variables) (Jin, 2008). In other words, the goal is to minimize the sum of squared errors in order to identify the optimum function for data matching. Curve fitting is one application of the least square approach, which can also be used to represent other optimization issues by maximizing entropy or decreasing energy (Hoerl & Kennard, 1970). Using a number of predictor variables, ordinary least squares (OLS) estimate the response variable. A regression that is linear to the parameter β model is referred to as a "linear regression."

$$Y_i=\alpha+\beta x_i+\mu_i \ (i=1,2,\ldots\ldots n) \qquad (1)$$

Among them, the Y_i is the dependent variable. The independent variable is referred to as the x_i. The regression coefficient must be used to determine the parameters α and β. The term for random error is μ_i.

The ridge regression method is a biased estimation method, it is also an improvement of the ordinary least squares method, or a method specifically to solve the problem of multicollinearity. Unlike the ordinary least squares method, the residual sum of squares obtained by ridge regression analysis tends to be stable as a whole, and the result is more in line with reality (Wan, 2016).

If there are k independent variables X_i satisfying the condition of $\lambda_1X_1+\lambda_2X_2+\lambda_kX_k+\varepsilon\approx0$, then they have a collinearity relationship. Among them, k is a constant number, but not at the same time zero; ε is the random error or variance of the measured variable. And $X\in[0,\infty)$. When $\varepsilon=0$, it is complete collinearity; when $\varepsilon\to0$, the collinearity is more serious; When $\varepsilon\to\infty$, the variables are completely uncorrelated. The calculation method of ridge regression is to calculate the ridge regression coefficient after independent element matrix X and dependent element Y are standardized (Guo, 2014), the formula is:

$$B(k)=(X'X+k)^{-1}X'Y \quad \cdots\cdots\cdots\cdots (2)$$

Among them, X is a standardized matrix. The B(k) represents the regression coefficient vector's ridge regression prediction., and k is a given normal number. If $k\to\infty$, then $B(k)\to0$, the trajectory formed by the change of B(k)with λ is called the ridge trace diagram.

Using the ridge trace method to select the ridge regression coefficient k value, there are generally several principles: the ridge trace curve of the respective variables in the results obtained tends to be stable, and the regression coefficient conforms to the actual meaning. Ridge regression is widely used, and its other application fields are social sciences (Pasha, 2004), engineering ((Jing et al., 2007), and medicine (Cule, 2011), etc.

From the overall research, the principle of influencing factors selection is divided into the principle of comprehensive analysis, the principle of dominant factors, and the principle of regional differentiation. Because there are gap dimensions and magnitude orders of each variable, before influencing factor analysis, the data of each variable should be standardized and then analyzed later.

Results and discussion

Construction of an index system of influencing factors

The retail sales of social consumer products are influenced by a variety of factors, and the sources of these factors are also different. Political factors, economic factors, and social factors all impact the total retail sales of consumer products. Urban income distribution system, social insurance system, bank interest rate, and tax policy are political factors. Residents' income and consumption, price index, and monetary policy are economic factors. Consumers' living habits, consumption habits, physical health, and urban population are social factors. There are abstract factors and concrete factors, some of which can be quantified and some of which cannot be quantified. From an operational and quantifiable point of view, the most direct and concrete factors impacting the retail sales of consumer products are economic factors, especially the income and consumption level of inhabitants. The higher the income of residents, the stronger their spending power and willingness, which will promote the retail sales of consumer products. The consumption quota of inhabitants is not the same as the retail sales of social consumer products. Because residents' consumption expenditure includes intangible non-commodity consumption besides specific commodity consumption, such as consumption in various cultures and entertainments. China has a large population base, and the population factor is also one of the indicators that influence the total retail sales of consumer products.

Through the literature analysis approach and connecting with reality, the income, consumption, and population of Hebei Province are examined. The flow chart for analyzing the influencing factors is shown in Figure 3. The urban inhabitants' per capita income (X_1), rural inhabitants' per capita income (X_2), urban inhabitants' per capita consumption expenditure (X_3), rural inhabitants' per capita consumption expenditure (X_4), urbanization rate (X_5), the population at the end of the year (X_6) and population density (X_7) are included in the research category, and their influence of the retail sales of social consumer products (Y) is studied, which makes the research results more comprehensive and more comprehensive.

The index system of influencing factors is displayed in Table 1, in which the income indicators include the urban inhabitants' per capita income and the rural inhabitants' per capita income. Consumption includes the urban inhabitants' per capita consumption expenditure and rural inhabitants' per capita consumption expenditure. Population indicators include the urbanization rate, the population at the end of the year, and population density.

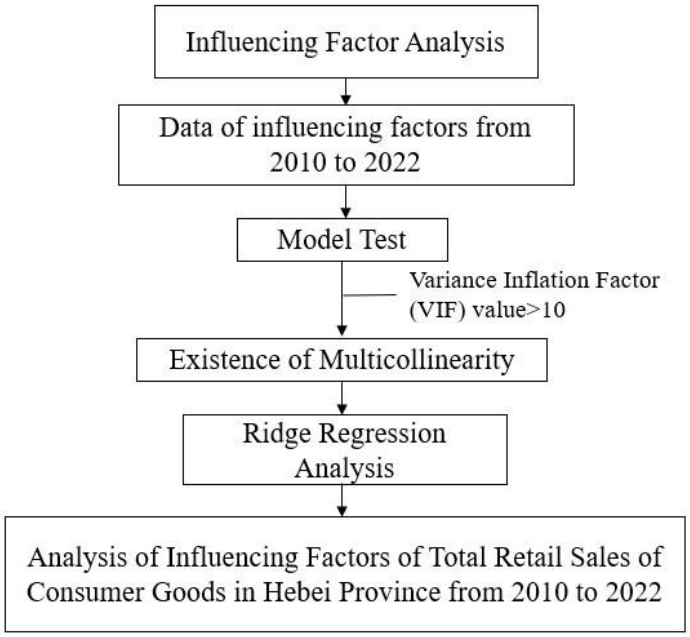


Figure 3. The analysis process of influencing factors

Table 1. Index system of influencing factors

Indicator layer	Factor layer
Residents' income situation	Urban inhabitants' per capita income (Yuan)(X_1)
	Rural inhabitants' per capita income (Yuan) (X_2)
Residents' consumption situation	Urban inhabitants' per capita consumption expenditure (Yuan) (X_3)
	Rural inhabitants' per capita consumption expenditure (Yuan) (X_4)
Urban population situation	Urbanization rate (%) (X_5)
	Population at the end of the year (Ten thousand people) (X_6)
	Population density (Person/km^2) (X_7)

An analysis of the factors that influence total retail sales of consumer goods

Table 2 displays the results of the OLS analysis. The findings show that the model's R square is 0.996, the adjusted R square is 0.899, the F value is 176.473, and the $P < 0.05$, which shows that the fitting result of the model is good. However, if there is multicollinearity between variables, the variance of regression coefficient estimation will increase, the estimated parameters will not pass the significance test, and the positive and negative correlation between the estimated parameters and the actual situation will not match. The model with multicollinearity is no longer stable, so it is necessary to analyze the collinearity between variables. Through the analysis of the variance expansion factor method, we can know that the variance inflation factor (VIF) in the model data analysis results is greater than 10, indicating that there is multicollinearity. Looking at the collinearity diagnosis results in Table 3, the eigenvalues of dimensions 6 and 7 are close to 0, the conditional indices of dimensions 5 to 7 are greater than 30, and the variance ratios of the 7 variables are greater than 0.5 in different dimensions. These results prove that there is serious multicollinearity between independent variable data. Therefore, to accurately analyze the influencing factors, the ridge regression

method can be used to solve it.

Table 2. Regression coefficient table

Model	Non-standardized coefficient		T	Significance	Collinear statistics	
	B	Standard error			Tolerance	VIF
1 Constant	-6.696E-15	.027	.000	1.000	-	-
X1	3.958	2.798	1.415	.216	.000	9705.947
X2	-4.491	2.783	-1.614	.167	.000	9598.660
X3	-2.134	.787	-2.711	.042	.001	768.448
X4	2.589	1.002	2.585	.049	.001	1243.497
X5	.059	.552	.107	.919	.003	378.370
X6	-.198	.611	-.324	.759	.002	462.348
X7	1.284	.493	2.607	.048	.003	300.749

Table 3. Collinear diagnosis table

Dimension	Feature value	Conditional index	Variance proportion							
			Constant	X_1	X_2	X_3	X_4	X_5	X_6	X_7
1	6.224	1.000	.00	.00	.00	.00	.00	.00	.00	.00
2	1.000	2.495	1.00	.00	.00	.00	.00	.00	.00	.00
3	.745	2.891	.00	.00	.00	.00	.00	.00	.00	.00
4	.020	17.472	.00	.00	.00	.00	.02	.05	.00	.00
5	.006	32.591	.00	.00	.00	.00	.00	.02	.18	.24
6	.004	37.747	.00	.01	.01	.09	.01	.07	.02	.00
7	.001	72.665	.00	.01	.00	.58	.12	.44	.00	.11
8	4.726E-5	362.887	.00	.99	.99	.33	.85	.41	.80	.65

Table 4. Correlation coefficient table

	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y Pearson correlation	1	.756**	.719**	.844**	.742**	.737**	.993**	.986**
Significance	-	.003	.006	.000	.004	.004	.000	.000

**. There is a significant association at the 0.01 level

*. There is a significant association at the 0.05 level

Table 4 shows the findings of the correlation analysis. The Pearson coefficient is a statistical metric with a dimensionless value range of $-1 \leq r \leq 1$. The Pearson coefficient is a negative correlation when it is less than 0, a positive correlation when it is greater than 0, and no correlation when it is equal to 0. The greater the absolute value of the Pearson correlation, the stronger the connection between the two variables. According to the analysis results, the selected influencing factors have a strong correlation with the dependent variable, and the relationship is positive. Pearson coefficient among variables can only show the degree of data correlation between variables and cannot be used to determine causality. The judgment of causality must be based on the actual situation and the applicable logic of variables.

Ridge regression is used to evaluate the data in order to tackle the problem of multicollinearity. Ridge regression estimation is carried out with the help of data statistics tools. In the ridge regression analysis, k ranges from 0 to 1, the step size is set to 0.05, and 21 k values

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are obtained. K is a ridge parameter. When k=0, its regression coefficient is the parameter result obtained by the ordinary least square (OLS) method, and the rest are ridge regression coefficients. In the analysis, the data of seven influencing factors to be studied are taken as independent variables and the total retail sales of social consumer products as dependent variables.

In accordance with the Ridge trace figure (Figure 4), when k increases gradually, the coefficients of each variable are generally stable, and the iterative result is k=0.6, indicating that k=0.6 is the optimal ridge regression parameter. As indicated in the ridge regression model fitting degree table (Table 5), the coefficient of regression analysis represents the contribution of each independent variable to the dependent variable, that is, it represents the influence degree of influencing factors on the residential land price. At this time, the R square value of the model is 0.933. The adjusted R square value is 0.839. The f value is 9.963, and the significance probability is smaller than 0.05. The model achieved the significance assessment, indicating that it has a high fitting level and that the analysis results of each variable are relatively accurate.

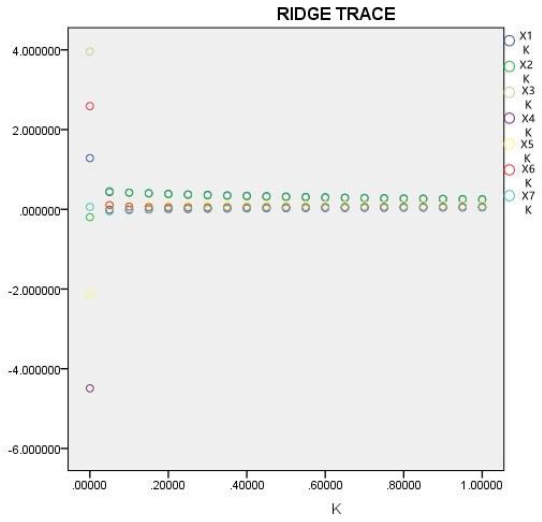

Figure 4. Ridge trace figure

Table 5. Model fitting degree

Model	R	R Square	Adjusted R Square	F value	Sig.
1	.965	.933	.839	9.963607400	.011

The coefficients of the ridge regression method objectively reflect the impact of their respective variables of dependent variables. Figure 5 is the schematic diagram of ridge regression coefficients. Through the coefficient, it can be shown that the order of the influence degree of the seven factors influencing the total retail sales of social consumer products in Hebei Province is: urban inhabitants' per capita income, rural inhabitants' per capita income, urbanization rate, the resident population at year-end, urban inhabitants' per capita consumption expenditure, population density and rural inhabitants' per capita consumption expenditure. Among them, the ridge regression coefficient of urban inhabitants' per capita income in income indicator is 0.303, which has the most influence on the overall retail sales of

social consumer products. The ridge coefficient of the rural inhabitants' per capita consumption expenditure is 0.034, which has the least influence. This is consistent with the economic and social situation of Hebei Province. The income of urban inhabitants in Hebei Province is high, which has the greatest impetus for the retail sales of social consumer products in Hebei Province. Rural inhabitants' per capita consumption expenditure is mainly the consumption of some basic daily necessities, which are not expensive and account for a small proportion of the overall retail sales of social consumer products, and have the least impact on the retail sales of social consumer products in Hebei Province.

The main factor affecting the retail sales of social consumer products is urban inhabitants' income. When residents' income increases, the potential consumption power will increase, which will promote the retail sales of social consumer products. In the income composition of residents, urban inhabitants have a high income, strong consumption power, and new consumption concepts. However, rural residents have low income, backward consumption concepts, and weak consumption power. The mobility of people from rural areas to cities will also change their consumption power, so the urbanization rate will indirectly affect the retail sales of social consumer products.

The ridge regression coefficient of the rural inhabitants' per capita income is 0.291, and its influence on the overall retail sales of social consumer products in Hebei Province ranks second. On the one hand, the consumption power in rural areas is generally weak, and the rich farmers are eager to change their original living conditions, and the demand for general commodities is large, and consumption accounts for most of their income. On the other hand, it also indicates that the rural residents' wealth is not high, and most of the income of rural inhabitants is used for the consumption of goods, but not for other aspects such as savings and insurance.

The ridge regression coefficients of the urbanization rate and population at the year-end and population density in the population situation indicator are 0.109, 0.056, and 0.041 respectively. The population has a certain influence on the retail sales of social consumer products. In the population index, the factor with the largest impact on the overall retail sales of social consumer products is the urbanization rate. The population is concentrated in cities, and income and consumption are consistent with the standards of cities. The greater the rate of urbanisation, the larger the total retail sales of social consumer products. Under the condition that other conditions remain unchanged, the more population there is, the more demand for commodities will drive the retail sales of social consumer products to increase. Subsistence consumption is the basic consumption of people, and the increase in resident population and population density at the end of the year also has an impact on the overall retail sales of social consumer products.

The ridge regression coefficient of urban inhabitants' per capita consumption expenditure in the indicator of inhabitants' consumption situation is 0.053. Its influence on the retail sales of social consumer products in Hebei Province ranks behind, mainly because urban inhabitants are relatively rich and their consumption forms are upgraded. Urban inhabitants are not only used for material consumption but also for emerging consumption such as health care needs and entertainment. Besides physical consumption, there is still money left for personalized consumption and enjoyment consumption. The difference in ridge coefficients of the seven factors is relatively small, which shows that they are all important forces to promote the

expansion of total retail sales of social consumer products in Hebei Province.

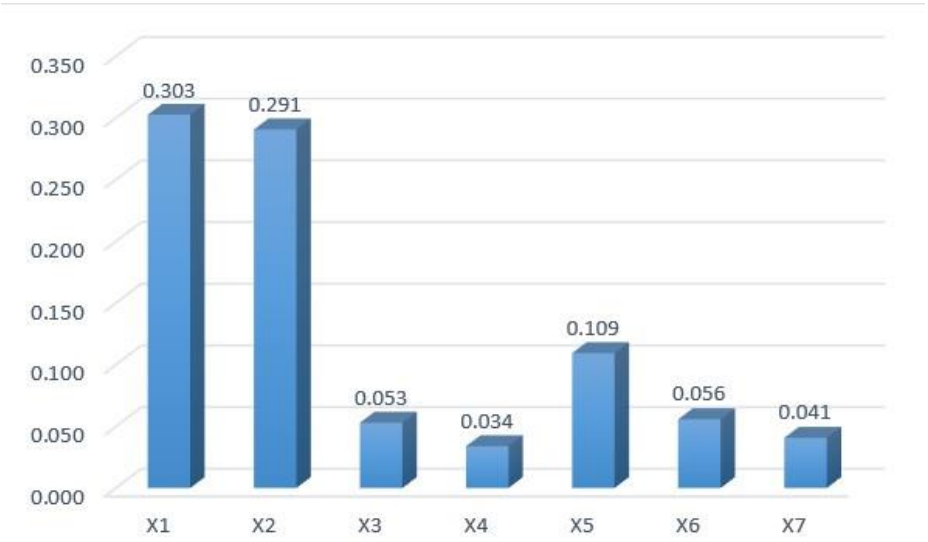

Figure 5. Ridge regression coefficients

Suggestion

Hebei Province has recently implemented essential steps to actively develop domestic demand and encourage consumption. After further studying the statistical bulletin issued by Hebei Province, some potential problems are also found, such as the decline of sales in traditional consumer places such as supermarkets and the sluggish export trend. According to the analysis results and these practical problems, the related suggestions are put forth.

(1) Encourage the co-development of the actual economy and the online virtual economy. From the above analysis, shows that the rural inhabitants' per capita consumption expenditure has the least effect on the total retail sales of social consumer products, the consumption power of rural inhabitants is weak and the market space is large, which shows that the consumption potential of Hebei Province has yet to be exploited. The consumption form of rural residents is mainly survival consumption, mainly to meet the necessary daily needs. This reflects that although Hebei's economy has increased and people's living standards have improved, the economic difference between urban and rural regions still exists, the rural residents are not rich, and their income needs to be further improved. To fully recognize how important consumer spending is to economic growth, the income of rural inhabitants must be increased and further release their consumption potential. Under the background of the rapidly expanding of online commerce, and after the period of closed management of Covid-19, the online shopping and takeaway industry has developed rapidly. Promoting and selling agricultural products through the internet is an effective way to stimulate rural economic development and enhance rural inhabitants' standards of living. The real economy should also break its own limitations and promote the integration of online and offline sales methods. At the same time, the government should improve the relevant appropriate market system and strive to accomplish overall consideration of the two marketing modes.

(2) The government should continue to reform the income distribution, narrow the income

disparity among urban and rural regions, and promote the balanced development of urban and rural regions.

Although the urban inhabitants' per capita income has the greatest influence on the retail sales of social consumer products in Hebei Province, the urban inhabitants' per capita consumption expenditure has a relatively low impact, indicating that the consumption potential of urban inhabitants has not been fully released. Therefore, in order to stimulate the consumption potential of urban inhabitants, we must make efforts from both supply and demand, provide consumers with better products and services in improving supply, cultivate new consumption hotspots, and adapt to the rising consumption demand of the people.

(3) The government should strengthen the insurance system and expand social insurance coverage. The population indicators also have an influence of the retail sales of social consumer products. Therefore, it is important for the economy's long-term and harmonious development to formulate relevant policies on population flow reasonably and maintain the healthy growth of the population. To provide effective social welfare for residents, the vast majority of residents have medical care, housing subsidies, and the guarantee of old-age life. Only in this way can residents' willingness to save be reduced, their consumption potential be released, and domestic demand be increased.

(4) The government should create a good consumption environment, severely punish illegal acts of counterfeiting and selling fakes, and ensure food safety. Solidly promote the implementation of relevant policies for a stable economy, explore the development potential, expand consumer demand, and promote the recovery and development of the consumer goods market.

Conclusion

Depending on Hebei Province's statistical data from 2010 to 2022, taking the total retail sales of social consumer products as the explanatory variable, this paper selects the relevant influencing factors and analyzes them by regression method. The main factors affecting the retail sales of social consumer products are estimated by quantitative analysis. Through the analysis, shows that urban inhabitants' per capita income has the most influence, while rural inhabitants' per capita consumption expenditure has the least influence.

As one of the world's largest consumer markets, China holds a significant position in global social consumer goods retail sales. Therefore, researching the Chinese consumer market can provide valuable insights into global consumption trends. Due to the rapid growth and immense potential of the Chinese consumer market, studying China's social consumer goods retail sales can offer crucial market outlook and trend predictions for investors, businesses, and policymakers, aiding them in devising appropriate strategies and policies.

Government agencies in Hebei Province typically release a plethora of data regarding social consumer goods retail sales, which are often highly reliable and timely. Researchers can utilize this data for in-depth analysis, thus obtaining more comprehensive and accurate conclusions.

The value of consumption to economic growth is increasing as a result of domestic consumption playing a larger role in China's economic growth and taking the lead as the main

engine of that growth. Under the new international economic situation, Hebei's economy should also change its development mode, from relying mainly on investment and exports to expanding domestic demand, so as to realize the transformation of old and new kinetic energy, make consumption a new engine of Hebei's economic growth, put the foothold of development on consumption and actively develop the consumer economy.

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