

An Inquiry into the Influencing Factors of GDP Growth in Our Country since the Reform and Opening up—An Empirical Study Based on OLS Model

Xinke Feng^{1,*}, Junyi Wu², Huiyi Yu³

¹School of Finance, Anhui University of Finance and Economics, Bengbu, 233030, China

²School of Accounting, Anhui University of Finance and Economics, Bengbu, 233030, China

³School of Finance and Public Administration, Anhui University of Finance and Economics, Bengbu, 233030, China

*Corresponding author

Abstract: The reform and opening up has had a profound impact on China's economy. This paper uses the annual data from 1979 to 2021 obtained from the Flush database to study how these three factors affect China's GDP growth. The results show that investment and household consumption have a significant impact on GDP growth, while net exports have an insignificant impact on GDP growth. Specifically, household consumption contributes the most to GDP growth, followed by net exports, and investment has the lowest contribution. Therefore, the government can adopt a series of policies to increase investment, promote household consumption and increase the total import and export volume to increase GDP and drive economic development.

Keywords: GDP; Investment; Household consumption; Net exports; OLS model

1. Introduction

Reform and opening up is a major policy of China since 1978, which has had a profound impact on the Chinese economy. After reform and opening up, China has gradually liberalized its market and attracted a large amount of foreign investment and technology, which has promoted rapid economic growth. China's GDP has increased from 36.79 billion yuan in 1978 to 99.1 trillion yuan in 2019, with an average annual growth rate of 9.5%. Secondly, it promotes trade and investment. After the reform and opening up, China gradually liberalizes the restrictions on foreign trade and investment, attracting a large number of people to invest and start businesses in China, which to some extent alleviates the employment problem and promotes the net development of China. Finally, it has promoted the improvement of people's living standards. After the reform and opening up, China has gradually strengthened social security and welfare to improve people's living standards. China has become one of the largest middle-income countries in the world. In short, reform and opening up is an important milestone in China's economic development, which has had a profound impact on China's economy and promoted its rapid economic growth and modernization.

At present, China's economy has gradually entered high-quality development, and the economic form is improving, but under the current economic form, China's economy still has some problems. Many scholars have studied how to effectively promote China's rapid economic development and maintain a steady pace of development even in the face of complex environments.

Since the reform and opening up, China's economy has made great progress, and the GDP growth rate has been maintained at a high level. However, the influencing factors of GDP growth have always been a hot topic in economic research. This paper aims to explore the influencing factors of China's GDP growth since the reform and opening up by using OLS model. Specifically, this paper will analyze the impact of investment, net export and household consumption on GDP growth. Through empirical research, this paper aims to reveal the main influencing factors of China's GDP growth and provide reference for the formulation of economic policy. The results of this paper are of great significance to deeply understand the mechanism and law of China's economic growth and promote the sustainable development of China's economy.

2. Literature review

Since the reform and opening up in 1978, the economy of our country has been in a state of steady development. At the same time, the development of China's economy after the reform and opening up has always been a hot topic for scholars to study the impact of the reform and opening up on China's economy or the specific economic factors that promote the rapid development of China's economy.

In the related literature, many scholars have studied the influencing factors of China's GDP growth. Xu Mei^[1] analyzed and sorted out the process of China's capital market opening from the perspectives of analysis opening, investment opening and service opening against the background of the reform and opening up, and concluded that China should take measures such as improving laws and regulations and hedging mechanism to increase the degree of China's capital market opening up and promote the smooth progress of China's capital market opening up. Wu Chengfeng, Leng Kaijun et al^[2] found that since the reform and opening up, financial development can positively promote economic development, so it is necessary to further improve the financial system to promote the smooth development of China's economy. Based on an extended Solow model, Chen and Xu^[3] found that China's economic growth relies on traditional driving forces.

Li and Wei^[4] explored the factors affecting the GDP growth rate by constructing a VAR model, and concluded that the impact of labor productivity on GDP growth rate was less significant than that of per capita output growth and per capita income growth, so more attention should be paid to per capita output growth and per capita income growth to promote the increase of GDP growth rate. Wei Xingyu^[5] studied the impact of China's total trade on China's economy based on the C-D function model. Therefore our country should encourage foreign trade vigorously in order to promote our economy to flourish. Nie and Zhao Lei^[6] made an in-depth analysis of the trillion yuan GDP of Beijing Hading and found that the government's policy support, a large inflow of talents and a good business environment have a great impact on promoting economic development, so the steady development of China's economy cannot be promoted without policy support and talent training. Lian and Luo^[7] based on the study of the war between Russia and Ukraine, found that infrastructure would drive the development of GDP to a certain extent, so we should also pay attention to the construction of infrastructure.

In short, since the reform and opening up, China's economy has been developing steadily, and scholars have different opinions on the factors that promote economic growth.

3. Data selection and processing

Considering the availability of data, this paper selects the annual data from 1979 to 2021, a total of 31 groups of annual data as the research object. GDP, investment, household consumption and net export are denoted as GDP, I, C0 and NX respectively. The above data were obtained from the Flush iFinD database. All data processing and empirical test processes in this paper are completed through Eviews9.0.

The measurement indicators of each variable are selected as follows:

(1) Gross domestic product (GDP). Gross domestic product (GDP) is the sum of the market value of all final goods and services produced in a country or region over a certain period of time (usually one year). Gross domestic product (GDP) is an important economic indicator to measure the economic development of a country or region. This paper adopts GDP to measure the development level of China's economy. If this year's GDP has a large increase compared with last year, then the country's economy is in a process of steady development, if there is a large decrease, it indicates that the country's economy is in a state of depression. The GDP data obtained in this paper are all from the Flush database.

(2) Investment (I). Investment is the act of putting money or other resources into a certain economic activity in the expectation of obtaining future economic benefits. Investment behavior can be carried out by individuals, enterprises, and governments in order to obtain returns. Accordingly, high returns symbolize high risks, risk-loving investors like high-risk investments, and risk-averse investors prefer low-risk investments, which also represent low returns. An increase in investment can promote the economic development of a country or a region, so the state generally encourages investment.

(3) Household consumption (C0). Household consumption refers to the total expenditure on goods and services purchased by residents in a certain period of time. Household consumption is one of the most important components of the national economy and usually accounts for a considerable

proportion of GDP. Household consumption is often to meet the needs of daily life in the future, including clothing, food, housing, transportation, medical services and education. The structure of household consumption can often reflect the development level of a country or a region. The government can increase the income level of residents by raising the minimum wage standard, reducing the tax rate and other measures, and stimulate the consumption of residents by lowering the price and increasing the social security, so as to promote the economic development.

(4) Net export (NX). Net exports are the total amount of goods and services exported by a country or region over a given period minus the total amount of goods and services imported. Net exports can reflect the foreign trade of a country. If the net export is positive, it means that the total amount of goods and services exported by the country is greater than the total amount of goods and services imported. On the contrary, if the total amount of goods and services imported by a country is less than the total amount of goods and services exported, it indicates that the country's foreign trade needs to be improved, so the government should vigorously develop the country's foreign trade. Net exports have a great impact on the improvement of a country's international status as well as its economic development.

4. Model construction

In general, when an economic variable is affected by multiple factors, multiple linear regression models are commonly used to analyze socioeconomic phenomena. According to the research object, gross domestic product (GDP) is selected as the explained variable, investment index (I), household consumption index (C0) and net export index (NX) are set as explanatory variables, and other factors are set as random disturbance μ .

4.1. Descriptive statistics

The descriptive statistics of gross domestic product (GDP), investment index (I), household consumption index (C0) and net export index (NX) are shown in Table 1. The average value of net export is 1014.674 billion yuan, the average value of investment is 1888.075 billion yuan, the average value of household consumption is 14,172.74 billion yuan, and the average value of GDP is 371.288 billion yuan. Numerically, the ratio of investment to GDP is the highest, while the ratio of net export to GDP is the lowest.

Table 1: Descriptive statistical analysis

	NX	I	C0	GDP
Mean	10146.74	188807.5	141727.4	371288.0
Median	10209.05	97583.10	82842.37	219438.5
Maximum	29810.50	552884.2	438015.2	1149237.
Minimum	-679.4600	5595.000	10544.47	22005.63
Std. Dev.	8788.405	189652.3	130056.4	345347.8
Skewness	0.542132	0.705250	0.909020	0.810764
Kurtosis	2.159377	1.939881	2.504576	2.334909
Jarque-Bera	2.431272	4.021431	4.586338	3.967608
Probability	0.296521	0.133893	0.100946	0.137545
Sum	314548.8	5853031.	4393548.	11509929
Sum Sq. Dev.	2.32E+09	1.08E+12	5.07E+11	3.58E+12
Observations	31	31	31	31

4.2. Establishment of multiple regression model

Based on the above analysis, a multiple regression model was established.

$$GDP = C + \beta_1 I + \beta_2 C0 + \beta_3 NX + \mu$$

The data were entered into Eviews9.0 for parameter estimation.

The processed data are put into the multiple linear regression model established above, and the least square method is adopted to conduct OLS regression estimation on the data, and the results are shown in Table 2.

Table 2: Results of parameter estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2421.756	4361.019	-0.555319	0.5832
I	0.450940	0.106522	4.233319	0.0002
NX	1.565267	0.403974	3.874676	0.0006
C0	1.924023	0.153880	12.50338	0.0000
R-squared	0.998585	Mean dependent var		371288.0
Adjusted R-squared	0.998428	S.D. dependent var		345347.8
S.E. of regression	13693.72	Akaike info criterion		22.00718
Sum squared resid	5.06E+09	Schwarz criterion		22.19221
Log likelihood	-337.1112	Hannan-Quinn criter.		22.06749
F-statistic	6351.197	Durbin-Watson stat		0.633933
Prob(F-statistic)	0.000000			

According to the data in Table 2, the multiple linear regression equations among GDP, investment, consumption and net export can be preliminarily obtained:

$$GDP = -2421.75586671 + 0.450939539167I + 1.56526702872NX + 1.92402289413C0$$

$$t = (-0.5553) \quad (4.2333) \quad (3.8745) \quad (12.5034)$$

$$R^2 = 0.9986 \quad F = 6351.197 \quad DW = 0.6339$$

5. Model testing and modification

5.1. Test of economic significance

According to the estimation results of multiple linear regression model, investment index (I), net export index (NX) and household consumption index (C0) are positively correlated with gross domestic product (GDP). β_1 is about 0.4509, indicating that when investment changes by one unit, GDP will change by 0.4509 units, which is in line with expectations. β_2 is about 1.9240, which indicates that when household consumption changes by one unit, household consumption will change by 1.9240 units, which is in line with expectations. β_3 is about 1.5653, which indicates a one unit change in net exports and a 1.5653 unit change in GDP, which is in line with expectations. According to the above analysis, it can be concluded that the impact of household consumption index and net export index on GDP is relatively significant.

5.2. Statistical inference test

(1) Goodness of fit test

The goodness-of-fit test is a method used to test the degree of fit of a statistical model. It is usually used to compare the difference between a known theoretical distribution and an actually observed distribution. The basic idea of goodness-of-fit test is to compare the actual observed data with the theoretical distribution, calculate the degree of difference between the two, and then judge the degree of fit of the model according to the degree of difference.

The coefficient of determination is $R^2=0.9986$, and the revised coefficient is $R^2=0.9984$, indicating that the model has a good fit to the sample data on the whole, that is, the explanatory variables I, C0 and NX can explain most of the differences of the explained variable GDP.

(2) F-test

The F-test can be used to infer whether there is a significant linear relationship between the explained variable and all explanatory variables.

(3) t test

The t-test is a statistical method used to compare whether there is a significant difference between the means of two sets of data. Based on the sample data, it calculates the sample mean and standard deviation to judge whether the data have significant differences. The t-test is usually used for data analysis of small samples, and can be used to compare whether the difference between two groups of data is significant by calculating the t-value.

The t-test can be used to test the significance of each explanatory variable respectively.

6. Econometric test

6.1. Multicollinearity test

Multicollinearity means that when there is a high correlation between the independent variables in the regression model, it may lead to the instability and inaccuracy of the model. Multicollinearity will make the independent variable parameters in the model estimated inaccurately or imprecisely, thus affecting the predictive power and explanatory power of the model.

To test for multicollinearity, various methods can be employed, one of the most commonly used is the variance inflation factor (VIF) test. By calculating the VIF value of each independent variable, this method evaluates whether there is a high degree of collinearity in the independent variable. In general, a VIF value greater than 10 indicates collinearity and requires some action to deal with it.

The least squares estimation method adopted in this paper is based on the premise that there is no multicollinearity, as shown in Table 3.

Table 3: Test results of variance inflation factor method

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	19018484	3.144088	NA
I	0.011347	132.1635	65.29342
NX	0.163195	4.794181	2.016530
C0	0.023679	142.7086	64.07785

Experience shows that if the variance inflation factor [VIF]_j is ≥10, it usually indicates that there is serious multicollinearity between the explanatory variable and the other explanatory variables. In order to eliminate multiple linearity, this paper adopts the stepwise regression method, as shown in Table 4.

Table 4: Results of eliminating multicollinearity

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-2421.756	4361.019	-0.555319	0.5832
C0	1.924023	0.153880	12.50338	0.0000
I	0.450940	0.106522	4.233319	0.0002
NX	1.565267	0.403974	3.874676	0.0006
R-squared	0.998585	Mean dependent var		371288.0
Adjusted R-squared	0.998428	S.D. dependent var		345347.8
S.E. of regression	13693.72	Akaike info criterion		22.00718
Sum squared resid	5.06E+09	Schwarz criterion		22.19221
Log likelihood	-337.1112	Hannan-Quinn criter.		22.06749
F-statistic	6351.197	Durbin-Watson stat		0.633933
Prob(F-statistic)	0.000000			
Selection Summary				
Added C0				
Added I				
Added NX				

The results of multiple regressions eliminating multicollinearity are presented below.

$$GDP = -2421.75586671 + 0.450939539167I + 1.56526702872NX + 1.92402289413C0$$

$$t = (-0.5553) \quad (4.2333) \quad (3.8745) \quad (12.5034)$$

$$R^2 = 0.9986 \quad F = 6351.197 \quad DW = 0.6339$$

6.2. Heteroscedasticity test

Heteroscedasticity means that in the regression model, the error variances are different, that is, there

is a correlation between the error variances and the independent variables. In this paper, the White method is used to test whether there is heteroscedasticity in the model, as shown in Table 5.

Table 5: Whitejanyan1 results

F-statistic	2.726789	Prob. F(3,27)	0.0637	
Obs*R-squared	7.208320	Prob. Chi-Square(3)	0.0655	
Scaled explained SS	9.549024	Prob. Chi-Square(3)	0.0228	
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	70201854	68430232	1.025889	0.3140
I^2	0.008216	0.003227	2.546100	0.0169
NX^2	0.277747	0.286394	0.969807	0.3408
C0^2	-0.014679	0.006072	-2.417505	0.0227
R-squared	0.232526	Mean dependent var	1.63E+08	
Adjusted R-squared	0.147252	S.D. dependent var	3.10E+08	
S.E. of regression	2.87E+08	Akaike info criterion	41.90441	
Sum squared resid	2.22E+18	Schwarz criterion	42.08944	
Log likelihood	-645.5184	Hannan-Quinn criter.	41.96473	
F-statistic	2.726789	Durbin-Watson stat	1.430090	
Prob(F-statistic)	0.063687			

In order to test whether the model has heteroscedasticity, this paper conducts the White test on the model. At significance level $\alpha = 0.05$ conditions, check χ^2 distribution table, $\chi^2(3) = 7.815$, by above knowable $[nR]^2 = 7.2083 < \chi^2(3) = 7.815$, so refuse to accept the null hypothesis, suggests that there is no heteroscedasticity model.

6.3. Autocorrelation test

When the model has autocorrelation, if the ordinary least squares is still used to estimate the parameters, it may underestimate the standard error of the coefficient, reduce the reliability of the t test, increase the estimation error, and the least squares estimation is invalid. In this paper, partial correlation coefficient is used to test the autocorrelation.

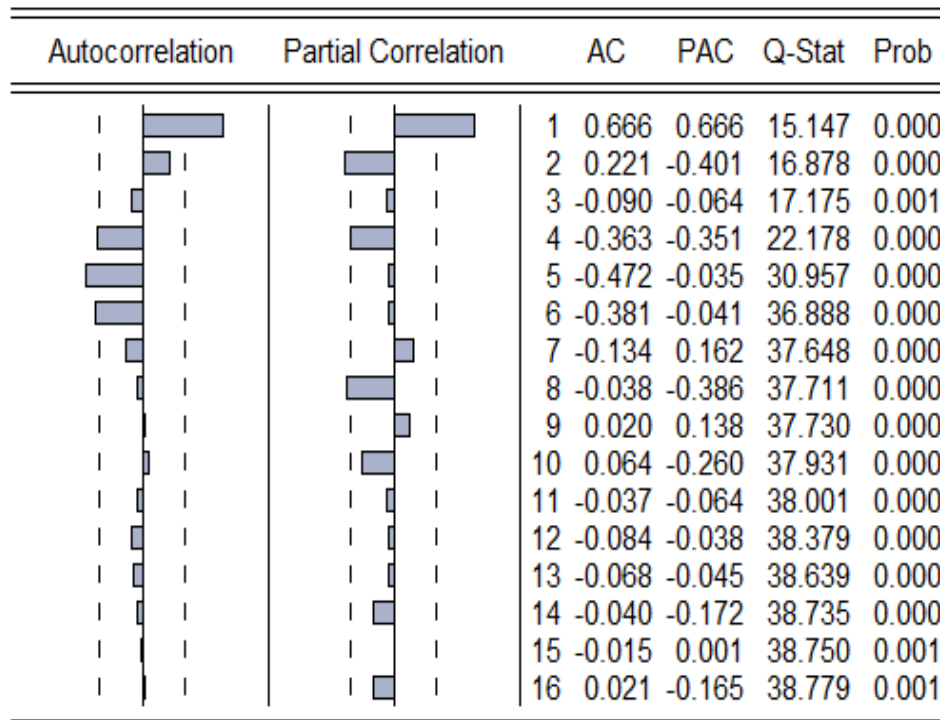


Figure 1: Partial correlation coefficient test results

It can be seen from the figure 1 above that $2/\sqrt{31}=0.3592$, and when the order is 1 to 16, the PAC values of the first, second and eighth orders are all greater than 0.3592, so there is autocorrelation. Therefore, the autocorrelation should be eliminated next, as shown in Table 6.

Table 6: Test results of eliminating autocorrelation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5353.995	9919.678	-0.539735	0.5946
I	0.344042	0.231201	1.488063	0.1503
NX	0.552339	0.393482	1.403718	0.1738
C0	2.178402	0.327184	6.658039	0.0000
AR(1)	1.051636	0.241362	4.357096	0.0002
AR(2)	-0.427753	0.239029	-1.789544	0.0867
AR(8)	-0.273331	0.214142	-1.276398	0.2146
SIGMASQ	42868920	13408352	3.197180	0.0040
R-squared	0.999629	Mean dependent var		371288.0
Adjusted R-squared	0.999516	S.D. dependent var		345347.8
S.E. of regression	7601.306	Akaike info criterion		21.04501
Sum squared resid	1.33E+09	Schwarz criterion		21.41507
Log likelihood	-318.1977	Hannan-Quinn criter.		21.16564
F-statistic	8842.985	Durbin-Watson stat		1.868869
Prob(F-statistic)	0.000000			
Inverted AR Roots	.91-.34i	.91+.34i	.48+.78i	.48-.78i
	-.20+.77i	-.20-.77i	-.67+.32i	-.67-.32i

The above regression results are expressed in normative form as follows:

$$GDP = -5353.99474726 + 0.344042000228*I + 0.552338548952*NX + 2.17840244315*C0 + [AR(1)=1.05163641199,AR(2)=-0.42775322159,AR(8)=-0.273330963851,UNCOND]$$

$$t = (-0.5397)(1.4881)(1.4037)(6.6580)$$

$$R^2 = 0.9996 \quad F = 8842.985 \quad DW = 1.8689$$

The partial correlation coefficient of the revised model is tested again, as shown in Figure 2, and it can be clearly seen that the revised model no longer has autocorrelation.

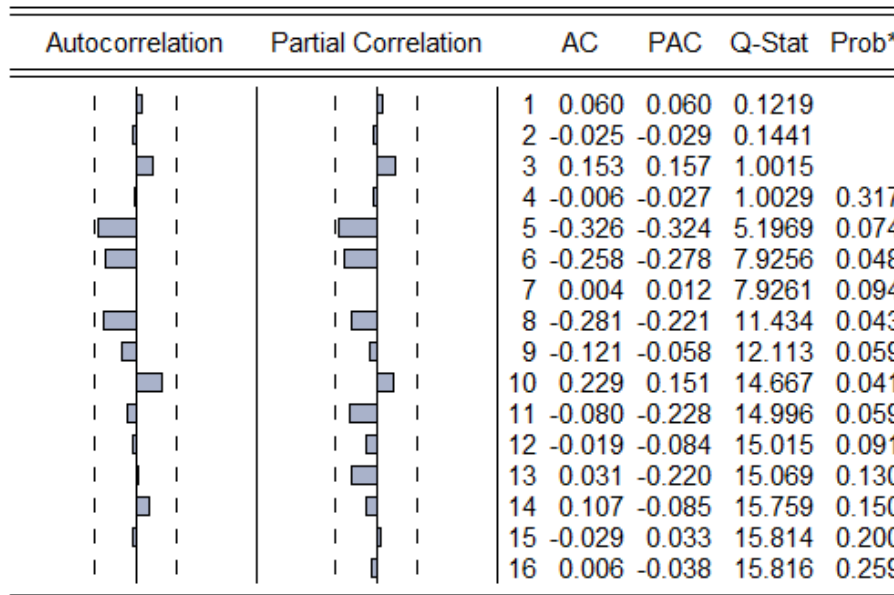


Figure 2: The partial correlation coefficient

In Figure 2, the revised model is tested again for the number of biased relations

Therefore, the final results of the model are as follows:

$$GDP = -5353.99474726 + 0.344042000228*I + 0.552338548952*NX + 2.17840244315*C0 + [AR(1)=1.05163641199,AR(2)=-0.42775322159,AR(8)=-0.273330963851,UNCOND]$$

$$t = (-0.5397)(1.4881)(1.4037)(6.6580)$$

$$R^2 = 0.9996 \quad F = 8842.985 \quad DW = 1.8689$$

Investment indicator (I), net export indicator (NX) as well as household consumption indicator (C0) have a positive relationship with gross domestic product (GDP). β_1 is about 0.3440, which indicates that when investment changes by one unit, GDP will change by 0.3440 units, which is in line with expectations. β_2 is about 2.1784, which indicates that when household consumption changes by one unit, household consumption will change by 2.1784 units, which is in line with expectations. β_3 is about 0.5523, which indicates that net exports change by one unit and gross domestic product changes by 0.5523 units, which is in line with expectations. According to the above analysis, it can be concluded that the household consumption index has the most significant impact on the GDP, in other words, the household consumption index has the largest contribution rate to the GDP.

7. Conclusions and recommendations

This paper studies the influencing factors of GDP from an empirical perspective, using the annual time series data from 1991 to 2021 and using the measurement model method based on OLS, and draws the following conclusions: the contribution rate of household consumption index to GDP is the largest, followed by net export, and the lowest is investment.

There are three ways to calculate GDP:

1) Production method:

$$GDP = \text{total output} - \text{intermediate inputs}$$

2) Income method:

$$GDP = \text{labor compensation} + \text{net production tax} + \text{depreciation of fixed assets} + \text{operating surplus}$$

3) Expenditure method

$$GDP = \text{final consumption expenditure} + \text{gross capital formation} + \text{net exports of goods and services} \\ = (\text{household consumption expenditure} + \text{government consumption expenditure}) + (\text{Gross fixed capital formation} + \text{increase in inventories}) + (\text{Exports of goods and services} - \text{imports of goods and services})$$

Based on the above empirical results and analysis, this paper puts forward the following suggestions:

7.1. Raising people's income

When people's income level increases, they will not only meet the minimum living needs of clothing, food, housing and transportation, but also turn to the pursuit of spiritual enrichment and increase consumption. Therefore, the increase of residents' income level will promote consumption to a certain extent. The government can increase the income level of residents by increasing social security, raising the minimum wage standard, lowering the tax rate and other measures, thus increasing their purchasing power, and thus driving economic growth.

7.2. Pay attention to talent training and talent introduction

We should cultivate and introduce talents from all aspects. To implement the strategy of rejuvenating the country through science and education, education is the foundation for a country to achieve considerable development. Only by cultivating, introducing and retaining talents can our country have better expectations for its future development. So our country government should enlarge to the education expenditure, must perfect talent introduction policy, must raise talented person treatment.

7.3. Investment Aspect

From the perspective of production law and income law, the Chinese government should increase investment in infrastructure construction to improve productivity and efficiency. At the same time, we will encourage and support innovation and entrepreneurship to promote new economic growth. Increase education and skill training for workers, improve the skill level of labor force, reduce structural unemployment, help college students and other new labor force to obtain employment, train

job skills, reduce frictional unemployment, improve employment rate and increase product production and supply. The government can also promote green development and sustainable development, which will promote the long-term high-quality development of the Chinese economy.

7.4. Consumption Aspect

From the perspective of expenditure law, strengthening consumer protection and improving the consumption environment will promote consumption growth. At the same time, we will encourage and promote the upgrading of the consumption structure and encourage the consumption of high-quality and high value-added products, so as to improve the international competitiveness of Chinese products. The government can promote the integration of offline and online shopping and encourage consumers to shop together through online stores and offline physical stores. Governments can also encourage cross-border e-commerce to make it easier for consumers to buy overseas products.

7.5. Import and Export

China should stick to its opening-up policy, lower the threshold for foreign investment, and strengthen IPR protection so as to attract more foreign enterprises to enter the Chinese market and promote trade balance and mutual benefit. At the same time, China should further expand foreign trade channels and strengthen cooperation and exchanges with international trading partners.

In terms of imports, China can further reduce import tariffs and expand the import market, which will improve international competitiveness and promote the upgrading of domestic industries. The government can also encourage enterprises to acquire high and new technologies through international cooperation to improve their technological level. In terms of export, China can strengthen foreign economic and trade cooperation and actively participate in international market competition. China can also strengthen support for small and micro enterprises and encourage them to participate in international market competition. Governments can also facilitate trade and reduce trade frictions, making it easier for businesses to export.

7.6. Strengthen infrastructure construction

The Chinese government can increase investment in infrastructure, build roads, Bridges, airports and so on, to create a good environment for the development of enterprises, so as to help the smooth development of enterprises, and then stimulate the development of China's economy.

7.7. Foster a favorable business environment

On the one hand, good business environment will attract a lot of foreign investment; on the other hand, it will create a healthy environment for the development of Chinese enterprises and contribute to output. A good business environment will promote the healthy development of a country's economy to a certain extent.

References

- [1] Xu M. *Review and Prospect of Our country's capital market expansion since reform and opening up* [J]. *Circulation of the national economy*, 2020, No. 2660 (28): 73-75.
- [2] Wu C., Leng K. & Guo J. *et al. An Empirical Study on China's Financial Development and Economic Growth under the Reform and Open Policy: Bootstrap ARDL Model* [J]. *Journal of Hubei University of Economics (Humanities and Social Sciences Edition)*, 2019, 16(10):48-52.
- [3] TAO M Y, Xu B. *Empirical Research on China's economic growth Momentum and Sustainability from 1978 to 2016: an extended Solow Model* [J]. *Journal of Business Research*, 2019, 26(02):15-22.
- [4] Li J. & Wei Q. Yan. *Based on the VAR model an empirical analysis of the factors affecting the GDP growth rate* [J]. *China business theory*, 2023, No. 877 (6) : 15 to 17.
- [5] Wei Xingyu. *Total trade's impact on economic growth in China* [J]. *Journal of finance*, 2023, No. 645 (02): 27-29.
- [6] Nie R. & Zhao L. *Interpretation of "Haidian Code" behind trillion-dollar GDP* [J]. *Zhongguancun*, 2023, No. 237(02):12-17.
- [7] Lian P. & Luo H. *Can Infrastructure Investment effectively drive GDP? Enterprise Observer*, 2022, No. 134(11):64-68.