An Empirical Study on the Impact of China's Macroeconomic Development on Corporate Social Security Contribution Rate Based on Econometric Model

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Abstract— Social security is an important livelihood issue, and its contribution rate is mainly related to enterprise decision-making and policy. Among them, corporate social security decisions are related to economic situations and policies. This paper conducts an empirical study on the relationship between China's economic development and the number and contribution rate of social security based on the construction of urban employee insurance rate. In the process of constructing the empirical model, the co-integration test of the time series data is carried out, and the heteroscedasticity and autocorrelation tests and correction are carried out on the econometric model. Finally, the optimal model to explain the social security contribution rate by using economic development and cost reduction policy is obtained. The results show that both the macroeconomic development and the government's policy of reducing the contribution rate has a significant impact of the improvement on the corporate social security contribution rate. Macroeconomic development can enhance corporate confidence and stabilize urban employment.

Keywords: Social security cuts; econometric; economic development; enterprise insurance

1. INTRODUCTION

Social security is a livelihood issue that we all care about. As we know, the number of social security participants and total contributions are related to many factors, such as enterprise decisions and policy adjustments (e.g., adjustments on the social security contribution rate). When the social security contribution rate is lowered, the activities of SMEs will be stimulated and promoted, the number of insured people will increase, and the total amount of social security contribution will rise. The level of social security contribution rate affects whether the income and expenditure of the social security fund can maintain a balance. If the contribution rate is too low, the balance cannot be maintained; but if the contribution rate is too high, the vitality of SMEs cannot be released. Some enterprises in China have the problem of insufficient social security payment, which also exists in other countries [1]. In different economic

situations, SMEs will make different social security decisions. This study intends to explore the relationship between China's economic development and the number and contribution rate of social security.

China's social security contribution rate is formulated by the policy. Since 2015, China's social security contribution rate has been adjusted downward for several times, with the biggest adjustment in 2019, which is the biggest adjustment in China's pension system. In April 2019, in order to alleviate the burden on enterprises and continue to improve the social security system, the General Office of the State Council issued the Comprehensive Program for Reducing Social Insurance Rates. This scheme stipulates that province with unit contribution ratio of more than 16 % can reduce this ratio to 16 %, which reduces the unit contribution ratio of urban pension insurance, in order to stimulate business vitality and expand employment.

Since the data of this study ended in 2019, the author decided to select the reform of social security rate at the Executive meeting of the State Council in 2016 as a policy impact. In 2016, the government decided to reduce the social security contribution rate of enterprise employees, which can reduce the economic burden of hundreds of billions of dollars per year for enterprises. Taking into account in different periods of time, the national social security policy continues to adjust, some major adjustments such as the social security contribution rate changes may also have an impact on the number of social securities, so dummy variables can be adopted to solve the description of the rise or fall of social security contribution rate.

The core issue of this paper is whether and what kind of correlation exists between China's economic development and the number and contribution rate of social security. It is intended to assess the impact of China's economic development on the number and contribution rates of social security, so as to help policy makers better adjust social security policies such as the social security contribution rate according to China's economic situations in the future. Research on the impact of social security contribution rate on social security situation can also provide a theoretical basis for policy makers to maintain the balance of social security fund plans and measures.

2. LITERATURE REVIEW AND RESEARCH INNOVATION

For small and medium-sized enterprises, Song Hong et al. examined the two behaviors of insurance and employment at the same time and found that the effect is very significant of reducing the contribution rate of pension insurance to stabilize the employment and increase the confidence of enterprises. It can simultaneously improve the social security contribution rate of enterprises and the total contribution expenditure and maintain the fund balance. The win-win effect will increase the demand for labor. At the same time, according to the detailed enterprise tax survey data, the heterogeneity of the industry category, the scale of the enterprise and the ownership of the enterprise are studied respectively. It is found that the impact of social security fee reduction measures on the manufacturing industry is significantly greater than that of the service industry, and it has a significant impact of large or small and medium-sized enterprises. There is little difference in the degree of social security participation between private and non-private enterprises, and the employment increase of private enterprises is more significant [2].

Lu Quan (2021) proposed that the relationship between economic development and social security is complex and interactive. It is necessary to combine different stages of economic development and models to study the relationship. For example, when the mode of production is transformed from agricultural society to industrial society and then to post-industrial society, the form and system of social security have also undergone corresponding changes. At present, in China, the relationship between economic development and social security includes many aspects, including the relationship between social security and economic orientation, balanced development of economy, enterprise payment pressure, the relationship between economic growth and transformation, etc [3].

From the perspective of information asymmetry, Sun Xuejiao puts forward that there is a certain space for tax avoidance for enterprises. And the Social Security Transfer tax compresses this space by improving the degree of information disclosure of enterprises, thus promoting the collection of social security premiums of enterprises [4]. Similarly, Zhao Shaoyang et al. also mentioned the actual compliance of enterprises and the implementation strength of social security, which are important realistic factors that need to be considered in our study on social security [5]. Feng Jin believes that the social insurance increases the operating costs of enterprises to a certain extent, so the establishment of a low-level social security system is conducive to the expansion of social insurance coverage [6].

Previous studies on the relationship between economic development and social security were mainly from the perspective of economics, and mainly under the theoretical framework of neoclassicism and neo-growthism. From an economic perspective, the social security has an indirect impact on economic development mainly through factors related to economic development. For example, social security affects residents' savings, thus affecting the substitution effects and retirement effects. Combined with the theory of intertemporal budget, it has an impact of economic growth.

Starting from the policy of lowering the contribution rate of the national social security in 2016, this paper explores the impact of social security reduction on the insurance contribution rate of urban workers. The contribution rate is not a constant set, but is actually determined annually with the willingness of individual enterprises to participate, which is particularly relevant to the participation decisions of some small and medium-sized enterprises.

3. DATA COLLECTION AND EMPIRICAL RESEARCH

3.1 Data and variables

This paper chooses macroeconomic indicators to represent China's economic development. The basic employment situation can be expressed by the number of employed persons and unemployment rate. The social security situation can be represented by the number of people involved in urban basic pension insurance and medical insurance.

The author selects the GDP (constant price) (billion yuan), the GDP index (1978 = 100), the total employment (ten thousand people), the urban registered unemployment (ten thousand people), the urban registered unemployment rate (%), the urban employment (ten thousand

people), and the number of urban basic old-age insurance (ten thousand people), the seven measures of economy, whose time dimension span 1989 ~ 2019. The data are from *China Statistical Yearbook*.

Among them, the total number of employed persons (ten thousand people) can be used in the range of 1952-2019. The data of GDP (constant price) (billion yuan), GDP index (1978 = 100), urban registered unemployment (ten thousand people), urban employed persons (ten thousand people), and urban registered unemployment rate (%) are from 1978 to 2019. The number of people participating in the urban basic endowment insurance (ten thousand people) is from 1989 to 2019, so the data of 31 years from 1989 to 2019 are selected. In addition, the dummy variable is set for the time before and after the implementation of the policy.

TABLE 1. VARIABLES AND SYMBOLS

Variable	Symbol
GDP (constant price) (billion yuan)	GDP
Number of people participating in urban basic pension insurance (ten thousand)	Ins
Urban registered unemployment rate (%)	Un
Number of urban employed persons (ten thousand)	$Work$
Urban employee insurance rate (%)	$Rate$
Fee reduction policy (dummy variable)	D

The number of urban workers is related to the population and the talent market, and fluctuates every year. Therefore, the number of insured urban workers has no numerical significance, and the insurance rate (%) is used to represent the annual participation rate in social security. In the existing database, the data of insurance rate cannot be obtained directly. After analysis, it can be calculated based on the existing data, and the formula is

$$Rate = \frac{Ins_t}{Work_t} \tag{1}$$

TABLE 2. DESCRIPTIVE STATISTICS OF VARIABLES

Variable	Rate	GDP	lnGDP	D	DGDP
Min.	0.3618	10728	9.281	0	0
1st Qu.	0.5575	38689	10.562	0	0
Median	0.5992	143658	11.875	0	0
Mean	0.6619	274537	11.815	0.129	1.756
3rd Qu.	0.8053	469232	13.058	0	0
Max.	0.9828	891646	13.701	1	13.701

3.2 Models and Results

A series of econometric tests are needed to determine the best regression model. First draw the images of $Rate$, GDP and the overall relative diagram.
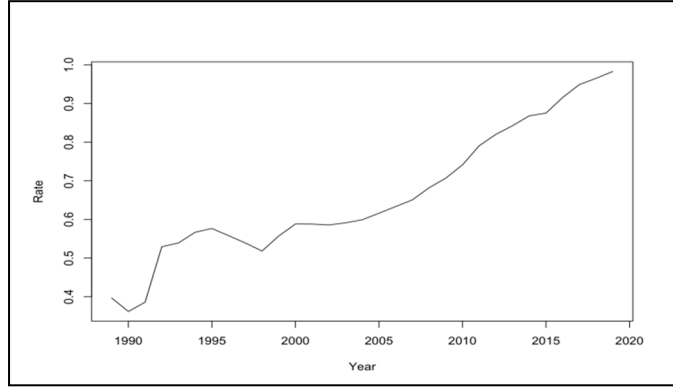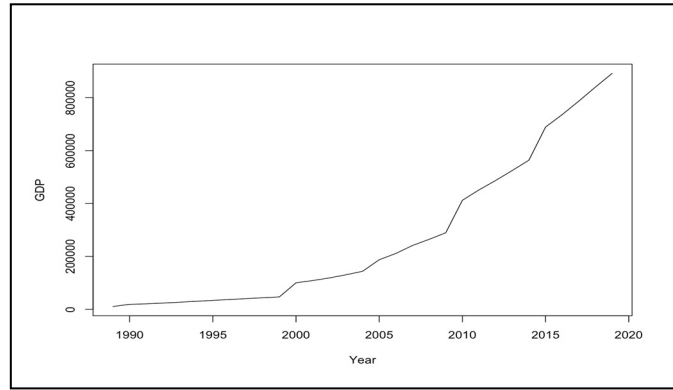
Figure 1. Insurance Rate
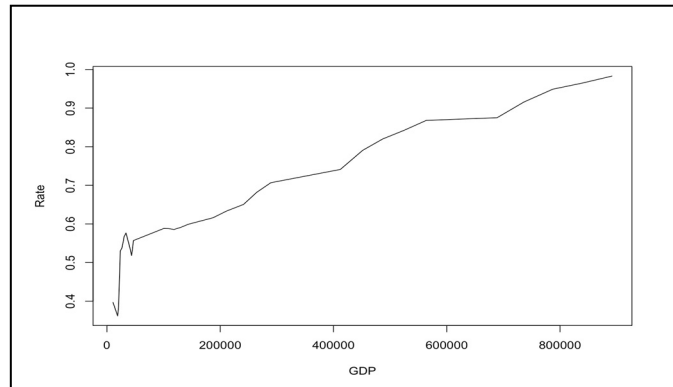

Figure 2. GDP (Constant Price)

Figure 3. Relationship between Insured Rate and GDP

It can be seen from Figure 2 that GDP at the constant price generally increases exponentially over time, so the logarithm is taken in the econometric model for research. This paper mainly focuses on the relationship between the social security contribution rate and economic development and the policy, so the main explanatory variables include the logarithm of constant GDP, the dummy variable which indicates the fee reduction policy established in 2016, and the product of the two. Regenerate the logarithmic columns in the software, named $lnGDP$. The initial measurement model is as follows.

$$Rate = \alpha + \beta_1 lnGDP + \beta_2 D_t \times lnGDP + \beta_3 D_t + \varepsilon \tag{2}$$

Among them, $lnGDP$ represents the logarithmic constant price of GDP, representing the overall development of China's economy. D_t is a dummy variable for the implementation of the policy. $D_t = 0$ means that before the implementation of the policy. After investigation, the country has not implemented a large-scale policy to reduce the contribution rate. $D_t = 1$ means that after the implementation of the policy, that is, 2016 and later.

The data used in the study belong to time series data. The software used is Eviews. In order to prevent pseudo regression, the cointegration test of the explained variable $Rate$ and explanatory variable $lnGDP$ should be carried out in advance. First, the ADF test is performed on $Rate$ and $lnGDP$ to check the stationary sequence of several orders. The empirical analysis on economic growth [7] provides the principle of the ADF test.

TABLE 3. ADF TEST OF ORIGINAL SEQUENCE

Level	p-value(Rate)	p-value(lnGDP)
Trend and Constant	0.7967	0.2344
Constant	0.8554	0.4202
None	0.9965	1.0000

TABLE 4. ADF TEST OF THE FIRST-ORDER DIFFERENCE SEQUENCE

1st difference	p-value(Rate)	p-value(lnGDP)
Trend and Constant	0.0035	0.0000
Constant	0.0005	0.0000
None	0.6515	0.0001

The unit root test results of the two variables show that the sequence $Rate$ and the sequence $lnGDP$ are both first-order stationary sequences, belonging to the same-order stationary. The cointegration test results show that:

TABLE 5. COINTEGRATION REGRESSION OF SIMPLE MODEL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.118971	0.015109	7.874026	0.0000
C	-0.733970	0.180808	-4.059390	0.0004

The result of simple model regression is

$$Rate = -0.7340 + 0.1190 lnGDP \qquad (3)$$

Cointegration regression results show that $lnGDP$ and constant regression coefficients are significant, $lnGDP$ has a positive impact of the rate of insurance participation, indicating that economic development will improve the rate of social security participation. The adjustment R^2 of the simple model reached 85.80 %.

TABLE 6. EG TEST OF SIMPLE MODEL

	Value	Prob.*
Engle-Granger tau-statistic	-1.409483	0.7969
Engle-Granger z-statistic	-4.811282	0.7284

*MacKinnon (1996) p-values.

The corresponding EG co-integration test results showed that the tau test p value was 0.7969, indicating that $Rate$ and $lnGDP$ did not have a co-integration relationship at the level of 5 % aboriginality. In the absence of co-integration relationship, regression will have problems. Therefore, the co-integration test is carried out on the econometric model with three explanatory variables preliminarily set.

Before testing the preliminary setting model, a new sequence is generated, named $DGDP$, which is the product of $lnGDP$ and the dummy variable symbolizing the policy release. Regression was performed on the preliminary set econometric model.

TABLE 7. REGRESSION RESULTS OF INITIAL SETTING MODEL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.097309	0.013482	7.217710	0.0000
DGDP	0.166332	0.554055	0.300209	0.7664
D01	-2.126864	7.538495	-0.282134	0.7801
C	-0.500583	0.157656	-3.175164	0.0038
$\bar{R}^2 = 0.901658$				

The result of the initial model cointegration regression is as follows

$$Rate = -0.5006 + 0.0973 lnGDP + 0.1663 D_t \times lnGDP + -2.1269 D_t \qquad (4)$$

Table 7 shows $lnGDP$ has a positive contribution to the enterprise social security contribution rate, indicating that with the economic development, the enterprise social security contribution rate increases, and impact of policy impact dummy variables is negative, while the product effect is positive. The regression results are difficult to be explained economically. The predicted effect of this model is better than that of the simple model, because $\bar{R}^2$ reaches 90.16 %. However, among the four coefficients, $D_t \times lnGDP$ and D_t coefficients are not

obvious, and the p values are as high as 0.7, indicating that the model is not good enough. The EG test was carried out on the model.

TABLE 8.   EG TEST OF INITIAL SETTING MODEL

	Value	Prob.*
Engle-Granger tau-statistic	-2.213684	0.8038
Engle-Granger z-statistic	-8.647028	0.8140

The results of regression and EG cointegration test are not ideal. Based on the above results, it is decided to remove the D item and carry out the cointegration regression and EG test again. At this time, the model form is

$$Rate = \alpha + \beta_1 lnGDP + \beta_2 D_t \times lnGDP + \varepsilon \qquad (5)$$

TABLE 9.   MODEL REGRESSION RESULTS WITHOUT D

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.097260	0.013258	7.336210	0.0000
DGDP	0.009949	0.003631	2.739924	0.0108
C	-0.499974	0.155032	-3.224977	0.0033
$\bar{R}^2 = 0.904004$				

The regression result is

$$Rate = -0.5000 + 0.0973 lnGDP + 0.0099 D_t \times lnGDP \qquad (6)$$

The regression result of this model is good, $\bar{R}^2$ reaches 90.4 %, which is higher than that of the previous models, and the coefficients of all variables are significantly, indicating that the effects of $lnGDP$ and $D_t \times lnGDP$ on $Rate$ are significant, that is, economic development and fee reduction policies have significant impacts on the insurance rate of enterprises. The theoretical hypotheses of this study are proved by data. Next, the EG cointegration test is carried out on the model.

TABLE 10.   MODEL EG TEST WITHOUT D

	Value	Prob.*
Engle-Granger Tau-statistic	-2.309892	0.5971
Engle-Granger z-statistic	-9.373711	0.5792

Although the results of the EG test still showed that it is not co-integrated at the significance level of 5%, the p value of the Tau statistic is very close to the significance level of 5%. Therefore, the author tries to use the ECM short-term error correction model to modify the

original model. The least square method is used to solve the model, land the residual sequence is left for error correction.

TABLE 11. SCREENING OF ECM CORRECTION MODEL

Model	Rate(-)	lnGDP(-)	AIC	SC	HQ
A	0	0	-4.055473	-3.868646	-3.995705
B	1	0	-4.157347	-3.921606	-4.083516
C	1	1	-4.122039	-3.839150	-4.033442

According to the information criteria of AIC, SC and HQ, model B is selected for correction. The model form is

$$Rate_t = \alpha + \beta_1 lnGDP + \beta_2 D_t \times lnGDP + \beta_3 Rate_{t-1} + e_{t-1} + \varepsilon \tag{7}$$

The multiple coefficients of model regression are not significant, indicating that the original model will lead to greater problems after ECM modification. That is to say, the above attempt on ECM did not achieve better results. Therefore, the original model is still used in the subsequent study, and the conclusion above is retained with the D_t term removed. The formula is

$$Rate = \alpha + \beta_1 lnGDP + \beta_2 D_t \times lnGDP + \varepsilon \tag{8}$$

Perform least squares estimation. The regression result is

TABLE 12. REGRESSION RESULT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.102883	0.007937	12.96322	0.0000
DGDP	0.009019	0.002313	3.899551	0.0005
C	-0.569458	0.092170	-6.178341	0.0000
$\bar{R}^2 = 0.914430$				

That is, the model is solved as

$$Rate = -0.5695 + 0.1029lnGDP + 0.0090D_t \times lnGDP \tag{9}$$

The model achieved better results than the above attempts, $\bar{R}^2$ reached 91.44 %, and the coefficients of all explanatory variables strongly rejected the null hypothesis. It can be seen from the coefficient that the macroeconomic development and the policy of lowering the premium rate have significant positive impacts on the insurance contribution rate of enterprises. This conclusion is not only consistent with the research hypothesis and economic logic, but also supported by the results in the econometric sense. This study believes that the mechanism of macroeconomic development promoting the contribution rate of enterprises is that economic development makes enterprises better, especially small and medium-sized enterprises, and thus tends to achieve social security participation and payment compliance. At the same time, macroeconomic development promotes the increase in residents' income, thus

increasing the proportion of social security fees paid, increasing the government fund income, reducing financial pressure, and further promoting economic development.

The White test of heteroscedasticity for the regression shows no heteroscedasticity, so no further correction is required.

TABLE 13. WHITE TEST

F-statistic	1.647175	Prob. F(4,26)	0.1925
Obs*R-squared	6.267502	Prob. Chi-Square (4)	0.1800
Scaled explained SS	1.876917	Prob. Chi-Square (4)	0.7584

The existence of autocorrelation can be judged from the DW statistic in the regression results. When the sample size is 31 and the number of explanatory variables is 2, the critical values are 1.297 and 1.57. The DW value is 1.0525, less than the critical value 1.297, falling in the positive correlation area, indicating that this model is likely to have a positive correlation.

Therefore, the LM test is used to determine the autocorrelation.

TABLE 14. LM TEST

Lags	AIC	SC	HQ	p-value
1	-3.636156	-3.451125	-3.451125	0.0000
2	-3.593599	-3.362311	-3.518205	0.0002
3	-3.534573	-3.257027	-3.444100	0.0006
4	-3.505970	-3.182167	-3.400419	0.0014

Through the LM test of different lag orders from 1 to 4, the first order of lag is selected by the information criterion. From the p-value result, the model strongly rejects the null hypothesis that there is no autocorrelation, indicating that the model has first-order autocorrelation. Next, the Cochrane-Orcutt method was used to correct autocorrelation.

TABLE 15. REGRESSION RESULTS OF AUTOCORRELATION CORRECTION MODEL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.101286	0.028124	3.601358	0.0013
DGDP	0.004601	0.004762	0.966176	0.3429
C	-0.536030	0.338737	-1.582438	0.1256
AR(1)	0.775732	0.201793	3.844194	0.0007
SIGMASQ	0.001091	0.000266	4.101032	0.0004

From the regression results, the coefficients of the constant term and the $D_t \times lnGDP$ term are not significant. Since $D_t \times lnGDP$ is the core explanatory variable, no adjustment is made first, and the least square estimation is performed again after removing the constant term.

TABLE 16. REGRESSION RESULTS WITHOUT CONSTANT TERMS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.058367	0.012141	4.807321	0.0001
DGDP	0.003205	0.024118	0.132903	0.8953
AR(1)	0.960103	0.089254	10.75693	0.0000
SIGMASQ	0.001092	0.000241	4.537851	0.0001

TABLE 17. Q TEST

Autocorrelation	Partial Correlation	Lags	Q-Stat	Prob*
. |* . |	. |* . |	1	1.4432	-
. *| . |	. **| . |	2	2.6025	0.107
. *| . |	. | . |	3	3.0600	0.217
. *| . |	. *| . |	4	3.3049	0.347
. | . |	. | . |	5	3.4128	0.491
. | . |	. | . |	6	3.4166	0.636

After modification, it is reported from Table 16 and Table 17 that the $D_t \times lnGDP$ coefficient is still not significant, and the p value is at a large level. Other coefficients strongly reject the null hypothesis. Both the DW test and the Q test showed that there was no autocorrelation. It can be seen that both the modified autocorrelation and the product coefficient are difficult to achieve. But in general, the model of this study has achieves good interpretation and prediction results.

4. CONCLUSIONS

This study proves that China's economic development and the government's policies of lowering the enterprise social security contribution rate have a significant impact on the rise of enterprise social security contribution rate. Reducing the enterprise social security contribution rate can alleviate the payment pressure to a certain extent, which is conductive to improving the cash flow status of the company and the business development of the company. Moreover, the change of the social security contribution rate mainly affects small and medium-sized enterprises, because such enterprises are lack standardization and are more likely to make insurance decisions from the perspective of enterprise burden, which is greatly affected by the social security contribution rate stipulated by the government, that is, it is flexible. According to the previous research, China's social security levy policy is relatively loose, resulting in a relatively low proportion of compliant enterprises. In provinces and cities with stricter social security levy, the general contribution rate will be relatively low in order to maintain a relatively stable overall burden of enterprises.

However, we also need to be flexible about the policy of lowering the social security contribution rate, because the calculation and payment of endowment insurance is not adjusted accordingly with the contribution rate. Therefore, for the government, generally reducing the

social security contribution rate of enterprises will lead to the reduction of fiscal revenue and increase the pressure on social welfare. Under the background of sound economic development, it is reasonable to believe that the government has low financial pressure and sufficient pension balance, so it can maintain the original contribution rate and even reduce the contribution rate to promote enterprise vitality.

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