



Relationship between Inflation Rate, Unemployment Rate and Wage Level in China Based on Multiple Linear Regression Model

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Abstract. Inflation and unemployment rate are both important indicators related to a country's macroeconomic development. Wage level is an essential factor reflecting the livelihood of a nation's citizens. This paper adopts the method of multiple linear regression, building an econometric model to investigate the impact of inflation and unemployment rates individually and together on wage levels in China in recent 20 years. The empirical results show that there is a significant positive correlation between the unemployment rate and the average wage. One percent increase in the unemployment rate would double the average wage. There is a slight significant negative correlation between the inflation rate and wage level. It may be due to the fact that the relationship between them is non-linear. Besides, they may be influenced by other economic factors such as the social environment and market competition.

Keywords: Wage Level, Inflation, Unemployment, Multiple Linear Regression.

1 Introduction

1.1 Research Background

As China's economy develops at high speed, it shifts from one era of rapid development to another of high-quality development. Now, as the reform and opening up progresses and socialist modernization is accomplished, the mystery of rapid development and society stability have been solved [1].

In recent years, China's inflation rate remained at a relatively low level with some fluctuations. Therefore, studying the relationship among inflation, unemployment and wage level can provide reference for policy makers.

1.2 Significance of the Research

Since most of the economic theories were discovered based on the market phenomenon of western developed countries. Different from those economies, as a socialist country with Chinese characteristics, China has insisted on developing a

socialist market economy and has achieved remarkable achievements. Thus, it is important to test if these well-known theories are still of work in China.

In real life, it is also helpful for evaluating policies governments may take. Analysis of the relationship among the three important macroeconomic indicators can therefore contribute to the scientific basis for policy-making.

1.3 Scope and Objectives of the Research

This paper aims at conducting a research of China's macroeconomic developments from the aspect of wage level. The research subject, namely the dependent variable, is wage level for recent 20 years in China. The research object, namely the explanatory variable, is China's inflation rate and unemployment rate in last 20 years. This paper adopts an empirical methodology and the main method used is multiple linear regression.

2 Literature Review

As a key indicator, wage level is one of the most accurate indicators presenting people's livelihood in a country. Wage level can be influenced by price level and employment condition. There are past researches suggesting government needs to make a trade-off between controlling inflation and maintaining full employment to formulate a monetary policy [2]. Therefore, the monetary policy can have an impact on wage level. Besides, other factors like direct transfer can also have an impact on wage level [3].

In response to the relationships of the three indicators, some scholars have conducted researches in other nationals. In the US, some scholars have found that high level of wage may hurt the employment rate, but moderate wages help the economy get out of stagnation and improve the inflationary environment without significantly reducing employment in the short term [4]. Compared to previous perceptions, there is a more complex relationship between these essential macroeconomic factors [5]. In other countries or regions, some scholars have also found very complex interrelationships between inflation, unemployment and wage rates. In Philippines, unemployment rate and wage level may interact with GDP to have an impact on inflation during 1950 to 2017 [6]. In South Sulawesi Province, economic growth is also an important factor that affect unemployment [7]. In Sumatera, researchers found that there negative association between economic growth, minimum wage and open unemployment rate, while inflation does not any significant open unemployment rate [8]. However, few of them have examined the influence of inflation and unemployment may have on the wage level.

At present, very few scholars have explored the effect of inflation and unemployment had on wage level. Scholars found that the Phillips curve does not fully match with the actual economic situation in China [9]. In order to solve the problem of unemployment, Chinese government has adopted many policies [10]. Therefore, the innovation of this paper is using wage level as an dependent variable and observe the correlation between inflation and unemployment rate on it respectively.

3 Theoretical Analysis

3.1 Variable Definition and Measurement

Inflation. Inflation is an important macroeconomic indicator, reflecting the economic development and price level of a country. Usually, the degree of inflation in a country can be measured by some indexes such as the consumer price index (CPI) and the producer price index (PPI), etc. The measure taken in this paper is the CPI.

Unemployment. The unemployment rate is an essential factor, indicating the employment condition and labour distribution in a country. In China, the main indicators used to measure unemployment condition are the urban registered unemployment rate and the urban survey unemployment rate.

There are some differences between these two indicators. The survey unemployment rate data are more objective and realistic, and they have the following benefits: greater coverage, a more rigorous statistical methodology, more frequent releases, and the capacity to more accurately reflect labor force measurement indicators. All of these factors help the government better understand the state of the labor market and labor force measurement indicators, which in turn helps it control and adjust macroeconomic policies [11].

Wage Level. The wage level is an important indicator of the rate of return to labour in a country or region, often expressed through indicators such as the average wage and the average disposable income of the population. The measurement taken in this paper is the average wage of the population.

There are many factors that can affect average wage level, such as Gross domestic product (GDP), personal income tax, the number of general graduates, research and development funding, the average sales price of commercial property and the number of unemployed people in China, etc. This paper mainly focuses on the impact of inflation and unemployment rate on wage level.

3.2 Theoretical Explanation

The causes of inflation are categorized as excessive money supply, excessive increase in aggregate demand, cost-push and so on. According to the cost-push theory, cost-push inflation is the occurrence of a persistent rise in the average level of prices for goods and services in the absence of surplus demand, which is directly caused by growing production costs like labor, raw materials, rent, and so forth [12].

In the simple Phillips curve, there is a simple negative correlation between the unemployment rate and the inflation rate, so if this simple model holds true for the Chinese economy in the last 20 years, they should have coefficients of similar size, positive and negative. This theory can also be verified in the following empirical analyses.

4 Empirical Analysis

4.1 Data Sources

In this paper, the data from China Statistical Yearbook, China Statistical Abstract and China Labour Statistics Yearbook was selected. These statistics yearbooks are compiled by National Bureau of Statistics of China and other authorities. Hence, the reliability of data can be guaranteed.

In order to study the relationship between inflation rate, unemployment rate and wage in China in the last 20 years, the data are selected from 2003 to 2022. Since the official data only disclosed the survey unemployment rate from 2018 to 2022, the urban registered unemployment rate from 2003 to 2017 and the survey unemployment rate from 2018-2022 were selected to constitute the data used in this paper.

4.2 Data Preprocessing

After importing the data, data pre-processing is needed. This includes formatting the data, converting the data of average wage to logarithmic form and so on.

Table 1. Data Table

Year	unem (%)	cpi	Wage (yuan)	lnwage
2003	4.3	101.2	13969	9.545
2004	4.2	103.9	15920	9.675
2005	4.2	101.8	18200	9.809
2006	4.1	101.5	20856	9.945
2007	4.0	104.8	24721	10.115
2008	4.2	105.9	28898	10.272
2009	4.3	99.3	32244	10.381
2010	4.1	103.3	36539	10.506
2011	4.1	105.4	41799	10.641
2012	4.1	102.6	46769	10.753
2013	4.05	102.6	51483	10.849
2014	4.09	102.0	56360	10.940
2015	4.05	101.4	62029	11.035
2016	4.02	102.0	67569	11.121
2017	3.9	101.6	74318	11.216
2018	4.9	102.1	82413	11.319
2019	5.2	102.9	90501	11.413
2020	5.2	102.5	97379	11.486
2021	5.1	100.9	106837	11.579
2022	5.5	102.0	114029	11.644

The data used in this paper is shown in above (see Table 1). The CPI, unemployment rate and the average wage in logarithmic form can be visualized as Fig.1, Fig.2 and Fig.3 respectively (see Fig.1, Fig.2 and Fig.3).

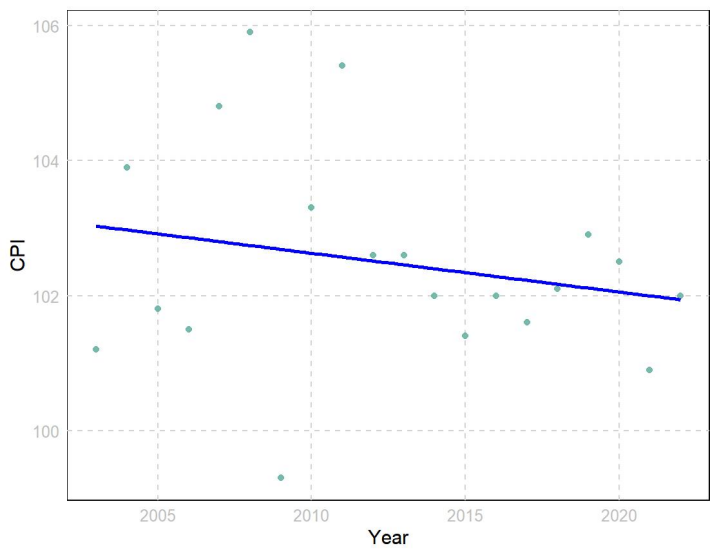


Fig. 1. CPI from 2002 to 2022 in China



Fig. 2. Unemployment Rate from 2002 to 2022 in China

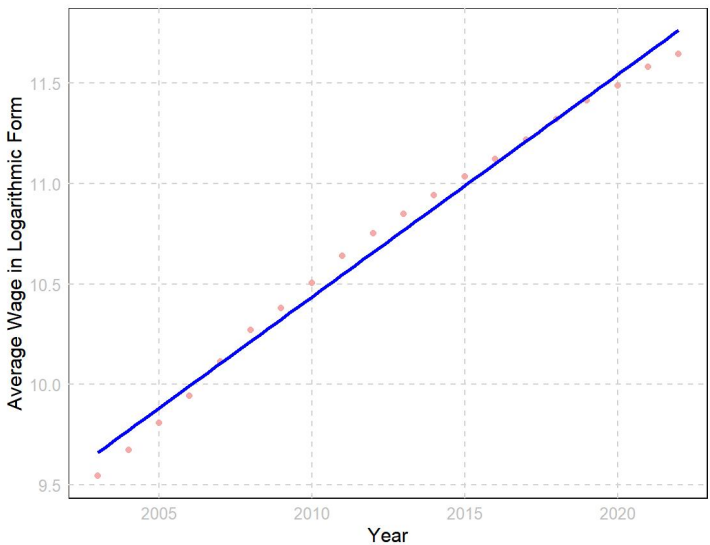


Fig. 3. Average Wage in Logarithmic Form from 2002 to 2022 in China

4.3 Descriptive Statistics

The step after pre-processing is to describe the statistical characteristics of the sample, such as showing the mean and standard deviation of each variable in the sample. Through descriptive statistics, we are able to easily understand the distribution of data. The descriptive statistics are shown as below (see Table 2).

Table 2. Descriptive Statistics

Variables	(1) N	(2) mean	(3) sd	(4) min	(5) p50	(6) max
unem	20	4.380	0.493	3.900	4.150	5.500
cpi	20	102.5	1.572	99.30	102.1	105.9
wage	20	54,142	31,614	13,969	49,126	114,029
lnwage	20	10.71	0.658	9.545	10.80	11.64

4.4 Empirical Model

Given to the relationship of Inflation, unemployment rate and wage level, I established an multiple linear regression model.

First, inflation and unemployment are regressed separately on the wage level using the following models.

$$lnwage_i = \beta_{01} + \beta_1 unem_i + \varepsilon_i \tag{1}$$

$$lnwage_i = \beta_{02} + \beta_2 cpi_i + \varepsilon_i \tag{2}$$

The following basic regression model is then built to explore the effect of the two factors together on the average wage level.

$$\ln wage_i = \beta_0 + \beta_1 unem_i + \beta_2 cpi_i + \varepsilon_i \quad (3)$$

Apart from the single effects of inflation and unemployment, with the aim of studying the impact of their interaction on wage levels further, this paper introduces a cross term for unemployment and inflation, and defines it as *un_cpi*, which is regressed in the following model.

$$\ln wage_i = \beta_{03} + \beta_3 un_cpi_i + \varepsilon_i \quad (4)$$

In these models, β_1 represents the effect on wage level of a one-unit change in the unemployment rate. β_2 represents the influence on wage level of a one-unit change in CPI. β_3 represents the influence of the interaction effect of the two on wage level. β_0 and β_{0i} stand for the effect of other factors, and ε_i shows the random error that may be caused by the sample data ($i = 1, 2, 3$).

4.5 Results

The results of the basic regressions are shown in the table below (see Table 3).

Table 3. Results of Basic Regressions

VARIABLES	(1) lnwage	(2) lnwage	(3) lnwage	(4) lnwage
unem	0.789*** (0.254)		0.769*** (0.264)	
cpi		-0.0776 (0.0970)	-0.0360 (0.0827)	
un_cpi				0.00762*** (0.00255)
Constant	7.257*** (1.118)	18.67* (9.938)	11.03 (8.748)	7.292*** (1.153)
Observations	20	20	20	20
R-squared	0.349	0.034	0.356	0.331

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The result shows that the unemployment rate is highly correlated with the average wage level in China in last 20 years. One unit change in the unemployment rate raises *lnwage* by about 0.769 units. That is, 1 per cent increase in the unemployment rate raises the wage level by $e^{0.769}$ times on average, which is equal to 2.16 times. It means that 1 per cent rise in unemployment rate will roughly double the average wage.

However, the correlation between the CPI and the average wage level is not significant. The insignificant results may be due to the following reasons. Possibly, because of the influence of social environment, competitive pressures, policy guidance and other factors, the direct impact of inflation is relatively limited [13]. It could also possible that the relationship between CPI and average wage is complex and nonlinear, so that the result of this particular regression model is not so significant.

The result of the interaction effect of inflation and unemployment on the wage level is significant. It indicates that although CPI is not correlated with wage level, it is significantly correlated with average wage when interacting with the unemployment rate.

At the same time, this result also shows that the simple Phillips curve does not hold in Chinese economy in the last 20 years. There is a more complex interplay between these three factors.

5 Heterogeneity Analysis

This paper aims to analyse the relationship between inflation rate, unemployment and wage level, as well as the interaction effect of the two factors may have on wage level. Therefore, the interaction term of inflation and unemployment rate is introduced. The interaction term method is used to perform the heterogeneity test, which can also be used to can also be used to test the moderating effects between variables. The regression model is built as below.

$$\ln wage_i = \beta_{04} + \beta_1 unem_i + \beta_2 cpi_i + \beta_3 un_cpi_i + \varepsilon_i \tag{5}$$

The regression results are shown as the table below (see Table 4).

Table 4. Results of Heterogeneity Analysis Regression

VARIABLES	(5) lnwage
unem	0.0714*** (0.0132)
cpi	-0.00862** (0.00349)
lngdp	0.936*** (0.00955)
Constant	-18.22*** (0.473)
Observations	20
R-squared	0.999

It can be seen that after the introduction of the interaction term, compared with the significant result of regression (4), this regression result become insignificant. This indicates that under the current model and data, there is no heterogeneous effect between the two independent variables *unem* and *cpi*. The effects of unemployment and inflation on wage level are relatively independent and there is no significant interaction. At the same time, the original model setup is sufficiently accurate and there is no need to consider additional interaction effects. However, this does not exclude the possibility of heterogeneous effects in other contexts. Therefore, further research may be needed to explore the existence and manifestation of heterogeneous effects.

6 Robustness Check

In addition to inflation and unemployment rate, Gross Domestic Product (GDP) is an important macroeconomic indicator as well, measuring the economic development level of a country. According to its definition, it can be inferred that there is a close relationship between GDP and wage level. In order to verify the robustness of the current model, this paper introduces the factor GDP and turn it into logarithmic form as *lngdp_i*. The regression model is as below.

$$\ln wage_i = \beta_{05} + \beta_1 unem_i + \beta_2 cpi_i + \beta_4 lngdp_i + \varepsilon_i \quad (6)$$

The regression results are shown in the table below (see Table 5).

Table 5. Results of Robustness Check Regression

VARIABLES	(6) lnwage
unem	0.0714*** (0.0132)
cpi	-0.00862** (0.00349)
lngdp	0.936*** (0.00955)
Constant	-18.22*** (0.473)
Observations	20
R-squared	0.999

It can be seen that after the introduction of the new variable GDP, the regression results of all variables become significant, but the coefficient of *lngdp* is relatively large, and the other two are small, which indicates that the correlation between GDP's

and the wage level is significantly higher than the inflation rate and unemployment rate. Also, this verifies the robustness of the model. Even when more factors such as GDP are taken into account, the model is still able to maintain a significant explanatory power for wage level.

7 Conclusions

In summary, the impact of inflation and unemployment on wage levels is big in China over the past two decades. Unemployment rate is positively correlated with wage levels and it is significant. That is probably because of the changes in supply and demand in the labour market. The inflation rate has a slight negative correlation with the wage level, which is not so significant. The direct impact is relatively limited possibly due to factors such as the social environment, competitive pressures, policy guidance and so on.

There are also some limitations to this study. Firstly, since the survey unemployment rate has not been published since 2003, the unemployment data used in this paper may deviate from the real situation. Secondly, as there is few literature available to study the relationship among these three elements in China, there may be other econometric models that are more suitable to study the relationship. In the future, scholars can use other models to further explore the non-linear relationship between inflation, unemployment and wage levels in China in the last two decades.

Given the conclusions drawn from this study, the government can take consideration to the complex changing relationship of the three factors in future decision-making process, and formulate the policy that best suits China's situation.

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