

EMPIRICAL RESEARCH ON US INFLATION PERSISTENCE

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ABSTRACT

Constant coefficient method is the traditional way to measure the persistence of inflation series. But this kind of method can not reflect effectively the change of breakpoint and economic situation. To the lack of the existing methods, the paper examines the breakpoint change in the coefficient of inflation persistence in the United States, and at the same time studies the changes of persistence characteristics of United States inflation rate by using time-varying coefficient model. The analysis shows that there exists breakpoint change in the inflation persistence coefficient in the United States; inflation persistence coefficient in the United States ranges from 0.7132 to 0.8826; the persistence coefficient continued to decline in the mid-2008, and etc.

Keywords: *Inflation Persistence, Breakpoint Change, Time-varying Coefficient Model*

1. INTRODUCTION

Inflation persistence is an important aspect of the inflation's dynamic characteristics. Many scholars have studied the problems of inflation persistence. Fuhrer (1995) discussed the significance of inflation persistence, and thought that the autocorrelation function provides a measure to inflation persistence, and he also discussed the influence of inflation persistence on the anti-inflationary cost [1]. Levin & Piger (2004) studied the inflation persistence characteristics of 12 industrial countries based on the univariate autoregressive model, and he thought that if breakpoint be allowed, the inflation persistence would be relatively low and high inflation persistence is not the inherent characteristics of the industrial economy [2]. Cecchetti & Debelle (2006) thought that the traditional view of the strong inflation persistence is not robust, once a breakpoint in the average inflation is allowed, and then the measured persistence is quite low[3]. Zhang (2008), Zhang & Clovis (2009) studied respectively the structural stability of the inflation persistence coefficient for the United States and China, and the researches show that the inflation persistence coefficients in the United States and China have both undergone structural changes, and in some sub-sample intervals the persistence coefficient is relatively low[4,5]. O'Reilly & Whelan (2005) [6], Zhang (2008) [7], He & Fan (2011) [8] and etc. studied respectively the inflation persistence of the euro-zone countries, China and other countries, and these studies show that these countries have strong inflation persistence. It can be seen that there has

not yet reached a unanimous conclusion in the researches on the inflation persistence. Some believe that the inflation persistence is very strong, but some others consider that the view is not robust. In addition the measuring model for inflation persistence is generally based on the constant coefficient method, and we know that many factors may change over time such as the domestic and international economic environment, the manipulating way and conducting mechanism of the policy, the forming mechanism of the inflation expectation of the public, and so on. Thus, it can not effectively and adequately measure the dynamic characteristics of inflation persistence with the changing economic conditions by the constant coefficient method. Some scholars, such as Zhao, Wang and Cai (2005)[9], He and Fan (2011)[8], use the Markov model to study the dynamic characteristics of the Chinese inflation, but they mainly pay the emphasis on the state turning and the relationship between it and the volatility of inflation. He and Fan (2011) [8] use Hamilton's (1989, 1988) [10, 11] Markov model to measure the state transition of the mean level and the volatility of Chinese inflation, but not research the state transition of the persistence coefficient. The paper applies the time-varying coefficient model, which making the persistence coefficient changing with the actual situation, to reflect and measure fully the changes of the inflation persistence coefficient in the United States.

The paper is organized as follows: the second part is the data selected and the stationary test, and the stationarity of the United States inflation series is tested by the method of ADF. The third part is

the constant coefficient model of the inflation persistence and unknown breakpoint test. The constant coefficient model of the inflation persistence is introduced and the structural change of the persistence coefficient is tested by using the unknown breakpoint inspection method. The fourth part studies the inflation persistence of the United States based on the time-varying coefficient model. Considering the insufficiency of the existing researching methods as well as the actual situation of the United States' inflation persistence coefficient, the paper uses time-varying coefficients model to research the dynamic characteristics of the United States' inflation persistence coefficient.

2. THE DATA SELECTED AND THE STATIONARY TEST

In this paper, we apply the growth rate of the consumer price index, cpi, as a measuring factor for inflation. The data are come from the United States department of labor and the processing software for data is respectively EViews6 and Matlab R2008a.

Figure 1 reflects the changing trends of the inflation rate of the United States from January 1990 to September 2011. Seen from Figure 1, the maximum value of the United States inflation rates is 6.29%, and the minimum value of them is -2.1% from January 1990 to September 2011.

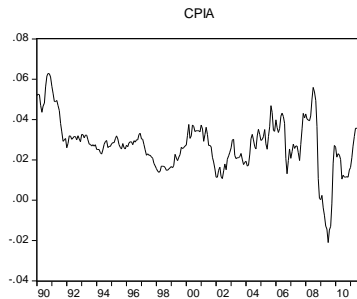


Figure 1: The Changing Character Of The United States' Inflation Rate (From January 1990 To September 2011)

We apply the method of ADF to test the stationarity of the United States inflation series, and the testing result show that the United States inflation series is stationary.

3. THE GENERAL MODEL OF INFLATION PERSISTENCE AND THE TEST FOR UNKNOWN BREAKPOINT

Inflation persistence which is an important feature of inflation has important monetary policy

implications. The following autoregressive model is usually used to measure the inflation persistence (Zhang, 2008; He and Fan, 2011) [4, 7, 8]:

$$cpi_t = \alpha + \beta cpi_{t-1} + \sum_{k=1}^{n-1} \chi_k \Delta cpi_{t-k} + \varepsilon_t \quad (1)$$

Where cpi_t represents the inflation rate at time t ; α , β and χ_k represent the parameters to be estimated; n represents the maximum number of lagged terms, which can generally be determined according to the AIC information criterion or the method of "approaching significance"; ε_t represents the residual term; $\Delta cpi_{t-k} = cpi_{t-k} - cpi_{t-k-1}$; the coefficient β in the equation (1) represents the inflation persistence.

The domestic and international economic environment, the political manipulation model, the political transmission mechanism and the formation mechanism of the public's inflation expectation are likely to change with the time going, and thus it is necessary to test whether there is structural change in the inflation persistence coefficient of the United States. The Chow breakpoint test is often applied to inspecting the structural change. But this method should pre-set the possible breakpoint, and then determine whether the point is a breakpoint through the statistics test. Breakpoint test of Andrews (1993) [12] can detect automatically whether there exist one or more unknown breakpoints in the equation in the entire sample space. Usually, the both ends of the sample should be removed 15% samples, namely 70% samples in the middle will be used as the search field, and within the search field taking that model coefficient has no structural change as the null hypothesis, and F statistic for every possible breakpoint is calculated, and then the maximum F statistic in the entire search area is calculated, and if the maximum F statistic has statistical significance, we can determine that model coefficient within the search field has structural change, and the corresponding date is the breakpoint date (Zhang, 2008)[7]. Andrews (1993) [12] researched the true distribution of these statistics and Hansen (1997) [13] provides the approximate asymptotic p-values for them. By comparing the p-value with the corresponding significant level, whether the coefficient has structural change within the search field can be judged directly. Testing method of Andrews (1993) [12] for unknown breakpoint is used to carrying on the breakpoint test in the following part. The paper carries on the breakpoint test of the United States' inflation rate by using data from January 1990 to September 2011 based on equation (1). The maximum lagged item which we use "n" to



represent is determined by method of “approaching significance”. To avoid excessive parameters to be estimated, we firstly take the maximum lagged item, n, equating 12 to represent using the information within one year, and then give regression on all lagged items of Δcpi_{t-k} up to $k=11(12-1)$. If the coefficient χ_{11} is significant, then take $n = 12$. If not, then n is reduced by 1 until the coefficient is significant. In the paper we determine $n=11$ and the testing results are as follows in Table 1.

Table 1 The Results Of Unknown Breakpoint Test

Testing coefficient	Testing p-value	Possible breakpoints
All coefficients	1	November 2007
Constant term	0.0795	July 2008
Coefficient of cpi_{t-1}	0.0315	July 2008
$\sum_{k=1}^{11} \Delta cpi_{t-k}$	1	November 2007

Table 1 shows that the persistence coefficient of the U.S. inflation rate has a structural change at July 2008, while the intercept, the overall structural coefficients of the model, and the overall coefficients of the differential lagged items have not structural changes at the 5% significance level. Obviously, it is likely to have a breakpoint change in the United States inflation persistence coefficient. But when differential lagged terms are involved in the inflation persistence equation, it does not lead to the change of the overall structure. The reason is that the overall coefficients of the differential lagged terms does not change, so it is limited that the influence of the change of persistence coefficient to the overall structure of the persistence equation.

4. RESEARCH ON US INFLATION PERSISTENCE BASED ON THE TIME-VARYING COEFFICIENT MODEL

Generally, the existing research is based on the autoregressive model of constant coefficients to measure the inflation persistence. However, due to the changes in international economic situation, the macro-economic environment as well as monetary policy, the assumption that the coefficient of the model is unchanged is unreasonable. Time-varying coefficient model can better measure such changes, and thus time-varying coefficient model is applied to research United States inflation persistence in the following part.

4.1 Model Building

The breakpoint method is applied to research United States inflation persistence in the previous section, and the empirical test shows that there is a breakpoint in the persistence coefficient, and this indirectly shows that the traditional constant coefficient model can not reflect fully the dynamic characteristics of United States inflation persistence coefficient.

At the same time, the international economic situation is volatile, the world economic crisis has occurred often, and the monetary policy adopted by countries in response to the crisis is changing often and in a dynamic adjustment, and thus the persistence coefficient maybe also is constantly changing. The time-varying coefficient model is applied to study the dynamic characteristics of United States inflation persistence coefficient in the following part to fully measure the situation in which the United States inflation persistence changes with the change of the economic environment.

According to the former breakpoint test, as to United States inflation persistence model, the persistence coefficient has breakpoint change, while the constant term and the overall coefficients of the differential lagged items have not structural changes at the 5% significance level. And thus only the persistence coefficient is time-varying, and the constant term and the differential coefficient is not time-varying in the following time-varying coefficient model.

Based the auto-regression model which is often used to measure the inflation persistence, the following time-varying coefficient model is constructed to measure the inflation persistence (Zhang, 2008; He and Fan, 2011; Gao, 2009) [4, 7, 8, 14]:

$$cpi_t = \alpha + \beta_t \cdot cpi_{t-1} + \sum_{k=1}^{n-1} \chi_k \Delta cpi_{t-k} + \varepsilon_t \quad (2) \quad \begin{pmatrix} \varepsilon_t \\ v_t \end{pmatrix}$$

$$\beta_t = \delta + \gamma \cdot \beta_{t-1} + v_t$$

$$\sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\varepsilon^2 & 0 \\ 0 & \sigma_v^2 \end{pmatrix} \right)$$

Where α represents constant term, β_t represents the time-varying persistence parameter which reflects the dynamic changing process of the inflation persistence over time, χ_k and δ are constant parameters, ε_t and v_t represent residual terms, σ_ε^2 and σ_v^2 represent residual variances.

4.2 Empirical Research

Based on equation (2), we get the corresponding parameter using the data of United States inflation rate. In order to save on length, only time-varying values of United States inflation persistence are given in Figure 2.

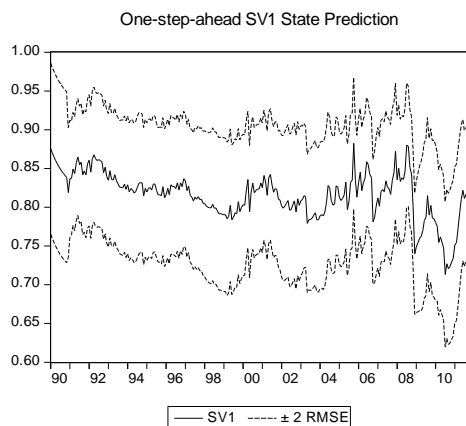


Figure 2 The Dynamic Changing Characteristics Of United States Inflation Persistence

According to Figure 2, the inflation persistence coefficient of the United States ranges from 0.7132 to 0.8826 and the persistence coefficient continued to decline since the mid-2008.

5. CONCLUSION

Considering the insufficiency of the existing researching methods as well as the actual situation of the United States' inflation persistence coefficient, the paper uses unknown breakpoint inspection method and time-varying coefficients model to research the dynamic characteristics of the United States inflation persistence coefficient. The analysis shows that there exists breakpoint change in the inflation persistence coefficient in the United States; inflation persistence coefficient in the United States ranges from 0.7132 to 0.8826; the persistence coefficient continued to decline in the mid-2008, and etc.

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