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External Shocks, Structural Breaks and Unemployment Hysteresis in China

TONG Guang-rong

YANG Yan-jun[1]

Abstract: This paper aims to investigate the unemployment hysteresis hypothesis, in which the endogenously determined break points are incorporated, by using annual data of actual urban unemployment rates during 1978-2009 in China. We treat the break date as unknown and utilize recursive, rolling and sequential tests to determine the endogenous structural breaks which are caused by external shocks. Our empirical findings show that three structural breaks existed in the time series of China's actual urban unemployment rates and we can not reject the unit-root hypothesis, which is consistent with the hysteresis hypothesis of unemployment.
Key words: Structural breaks; Unemployment hysteresis; External shocks

1. INTRODUCTION

In recent decades, analysis of the fluctuation of the real unemployment rates has become a popular topic. Within existing studies two main hypotheses have been formulated: the natural rate hypothesis and the hysteresis hypothesis. The natural rate hypothesis indicates the dynamics of unemployment is a mean reverting process and the deviations of actual unemployment rate from the natural rate will not exist in a long run, which lead the unemployment rate to eventually return to the natural rate. On the other hand, the hysteresis hypothesis proposed by Blanchard and Summers (1986) states that cyclical fluctuations will have permanent effects on the level of unemployment due to labor market restrictions. Therefore, under this hypothesis, the level of unemployment is characterized as a non-stationary or unit root process.

Since the reform and opening, China's economic growth rapidly, but the levels of unemployment presented a U-trend. In the late 90's, a substantial increase in unemployment rates occurred. Previous research has, in general, concluded that the level of unemployment in China is non-stationary. The natural rate hypothesis may not be an appropriate theoretical starting point. In contrast, the hysteresis hypothesis appears to offer more promising avenues for investigation. Existing studies using standard unit-root tests generally cannot reject the null hypothesis of a unit root in unemployment rates. Dongming Yuan(2002) reviews the evolvement of the western theory of unemployment and analyze the connection of hysteresis in unemployment with the natural rate of unemployment, Phillips curve and inflation. Wang Song, Zhengsheng Zhong(2004) and Changliu Jiang(2007) analyze a panel of unemployment rates of thirty-one provinces of China by using a panel-based test, and find that the null hypothesis of a unit root can not be rejected in most of regions in China except for Inner Mongolia, Jilin, Shanghai, Shanxi and Tibet. To

[1] Economics and Management School, Wuhan University, 430072, Wuhan, Hubei, China.
E-mail: yangyanjun0221@yahoo.com.cn.
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address the significant deviations caused by the cross-section correlation, Zihui Yang(2009) base on the second-generation panel unit root tests, analyze the hysteresis hypothesis in unemployment of China. The results indicate the hysteresis hypothesis is supported for China and the shocks, such as cyclical fluctuations, will have permanent effects on the employment.

The hysteresis hypothesis of unemployment has important policy implications. It suggests that a high level of unemployment, if left by itself, may persist and continue to be a serious problem in the economy even in the long run. However the structuralist theory implies that unemployment rates should be an I(0) process around a changing or time varying equilibrium value (Papell et al. 2000). Under this theory, the empirical analysis should be done by means of unit root test. Otherwise, traditional unit root tests may fail to reject the null hypothesis in the presence of structural breaks in the deterministic components. This study will use recursive, rolling and sequential tests to determinate the endogenous structural breaks, and re-examine the hypothesis of unemployment hysteresis.

The paper is organized as follows: In Section II presents the empirical methodology, the data used, econometric techniques, empirical results and analysis are discussed in Section III. The final section concludes the paper.

2. EMPIRICAL METHODOLOGY

The empirical analysis of the hysteresis hypothesis should be done by means of unit root tests. Level stationarity supports the natural rate theories, whereas the presence of a unit root is consistent with the hysteresis hypothesis. However traditional unit root tests may fail to reject the null hypothesis of a unit root in the presence of structural breaks. Therefore, we must determine the structural breaks in the time series of unemployment rates, and then determine whether the DGP of it is a unit root process.

Under the hysteresis hypothesis, the natural rate is a function of the past actual unemployment rate. According to the basic principles proposed by Frank and Yangru (1998), we assume that the function can be described as:

$$U_t^* = U_{t-1}^* + \theta(U_{t-1} - U_{t-1}^*) \tag{1}$$

Where U_t^* is the current natural rate of unemployment, U_{t-1}^* is the past unemployment rate U_t is the current actual unemployment rate, θ is a constant parameter. Equation (1) means if the actual rate is different from the natural rate in the previous period, the natural rate will adjust partially in the direction of the actual unemployment rate and we have:

$$U_t = U_t^* + \xi_t \tag{2}$$

Where ξ_t is a white noise error term which indicates the deviation of actual unemployment rate from natural rate. Substituting Equation (2) into (1) yields:

$$U_t = U_{t-1} + \xi_t + (\theta - 1)\xi_{t-1} \tag{3}$$

Our purpose of proving hysteresis hypothesis lies on testing whether the unemployment rate in Equation (3) contains a unit root. The unit root test statistic can be estimated by regression in a more standard form as follows:

$$\Delta U_t = c + \rho U_{t-1} + \varepsilon_t \qquad t = 1, \cdots, T \tag{4}$$

Where ε_t is an error term. When equation (4) is estimated by OLS, the t statistic testing $\rho = 0$, which is the parameter of the unemployment rates in the previous period, is the standard Dickey-Fuller (1979) test for a unit root against a trend-stationary alternative. If the DF test value is above the threshold, the actual unemployment rates U_t contains a unit root, which implies that, once disturbed, the unemployment rates tend to wander around without returning to a mean value, which is consistent with the hysteresis hypothesis. Otherwise, the time series of actual unemployment rates is a stationary process.

3. EMPIRICAL RESULTS

3.1 Data

In this paper, we estimate the actual urban unemployment rates, for the sake of that the efforts of the external shocks concentrate on urban unemployment, by the data published by National Bureau of Statistics of China. According to the definition of unemployment rate, we have:

$$U_t = \frac{L_u - E_u}{L_u} \tag{5}$$

Where U_t is the estimated actual urban unemployment rates, L_u is the urban economically active population, E_u is urban employment. In fact, due to the rural household contract system, in our public statistics, rural labors can be considered to be either non-agricultural labor or agricultural employment. The rural unemployment level is quite low (Cai Fang, 2005).We can approximately estimate the urban economically active population by:

$$L_u = L - E_r \tag{6}$$

Where L is the sum of the economically active population in urban and rural, E_r is the sum of employment in rural. According to the identity of labor participation, unemployment and employment proposed by Summers(1990), we can approximately estimate the actual unemployment rates in China, which can be described by figure 1:

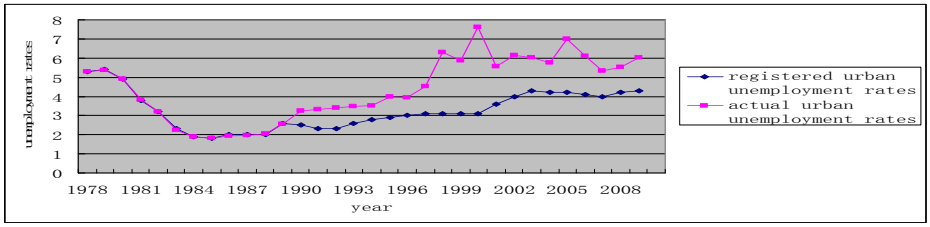

Figure 1: The unemployment rates in China during 1978-2009

3.2 The DGP of the actual urban unemployment rates in China

Before determinate the structural breaks of China's urban unemployment rates, we need to degrade the DGP of the series to test whether the data is I (0) after degradation and determinate the DGP of China's urban unemployment rates is generated from a unit root process or a trend stable process. We have:

$$\begin{gathered} U = 2.475 + 0.115 * T + \hat{e} \\ (5.245) \quad (4.592) \\ R^2 = 0.413, F = 21.094, DW = 0.364 \end{gathered} \tag{7}$$

The constant and time trend terms are very significant. We apply standard ADF tests to the degraded series of unemployment rates $\hat{e}_t$ as follows:

$$\Delta\hat{e}_t = -0.253\Delta\hat{e}_{t-1} \tag{8}$$

Where $ADF=-2.527>-2.641(1\%)$. We can not reject the null hypothesis of a unit root even at the 10% level. It indicates that $\hat{e}_t$ still have a unit root after degradation and China's actual urban unemployment rates U_t do not have the property of trend stability. In order to test whether U_t have a unit root, we test U_t with ADF unit root tests which contain the constant and trend term respectively, we have:

$$\Delta U_t = 0.374 - 0.082U_{t-1} - 0.152\Delta U_{t-1} \quad (9)$$
$$(0.910)(-0.913)(-0.789)$$

$$\Delta U_t = 0.383 + 0.046T - 0.253U_{t-1} \quad (10)$$
$$(1.061)(2.482)(-2.525)$$

Where $ADF_1 = -0.913 > -2.621$, $ADF_2 = -2.525 > -3.215$,Which are larger than the critical value. We can draw the conclusion that the China's actual urban unemployment rates have a unit root, which indicates, without considering structural breaks, the U_t is non-stationary.

We perform recursive and rolling tests using sub-samples of China's actual unemployment rates during the period of 1978-1984，1978-1985，…，1978-2009 and 1978-1984，1979-1985，…，2003-2009. The results are as follows:

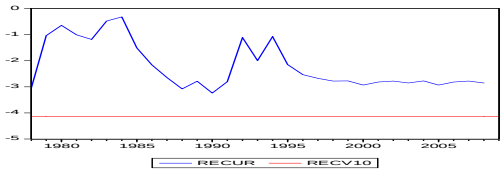

Figure 2: The results of recursive test

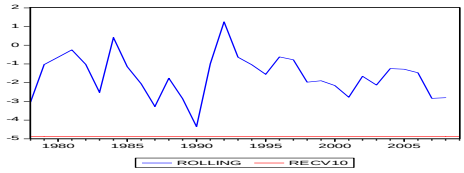

Figure 3: The results of rolling test

The sequential test is computed sequentially using the full sample. It allows for a single shift or break in a deterministic trend at an unknown date. The results are as follows:

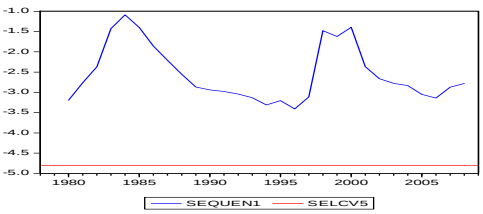

Figure 4: Sequential test with a single shift

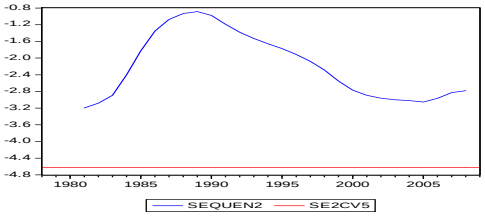

Figure 5: Sequential test with a break in trend

Test results are shown in figure2-5. we can not reject the null hypothesis of a unit root even in considering structural breaks, which means the DGP of China's actual urban unemployment rates U_t is a unit root process with structural beaks.

Table 1: Recursive, rolling and sequential estimators

Variable	the ADF series of recursive test		the ADF series of rolling test		the ADF series of sequential test (shift)		the ADF series of sequential test (trend)	
U_t	Min value	Break point(year)	Min value	Break point(year)	Min value	Break point(year)	Min value	Break point(year)
	-3.237	1990	-4.355	1990	-3.409	1996	-3.195	1981

Table 1 presents the test results. It is found that three structural breaks occurred in China's actual urban unemployment rates at the location of 1981, 1990 and 1996 due to external shocks. The structural break occurred in 1981 was a break in a deterministic trend, which induced the decline of unemployment rates. The structural break occurred in 1990 reversed its course and triggered the increase of the unemployment

rates. The structural break occurred in 1996 was a break with a single shift, a marked increase occurred and peaked around 2000.

To measure the impact of external shocks on China's unemployment rates, we introduce six dummy variables $D_1,D_2,D_3,DT_1,DT_2,DT_3$ to represent the external shocks occurred in 1981, 1990 and 1996 respectively:

$$D_1=\begin{cases}0, & t\le T_{1981}\\ 1, & t>T_{1981}\end{cases};D_2=\begin{cases}0, & t\le T_{1990}\\ 1, & t>T_{1990}\end{cases};D_3=\begin{cases}0, & t\le T_{1996}\\ 1, & t>T_{1996}\end{cases}$$

$$DT_1=\begin{cases}t-3, & t>T_{1981}\\ 0, & t\le T_{1981}\end{cases};DT_2=\begin{cases}t-12, & t>T_{1990}\\ 0, & t\le T_{1990}\end{cases};DT_3=\begin{cases}t-19, & t>T_{1996}\\ 0, & t\le T_{1996}\end{cases}$$

Where the dummy variables D_1,D_2,D_3 are breaks in level, and he dummy variables DT_1,DT_2,DT_3 are breaks in trend. Equation (11) reports the results for the regression:

$$\begin{aligned}U &= 5.562 - 0.19T - 1.804D_1 + 1.557D_2 + 1.49D_3 + 0.038DT_1 + 0.275DT_2 - 0.059DT_3\\ &\quad (0.073)\quad (2.112)\quad (1.959)\quad (-1.523)\quad (1.407)\quad (-0.331)\end{aligned} \tag{11}$$

$$\text{Adjusted } R^2=0.815 \quad F=20.547 \quad DW=1.63 \quad AIC=2.39$$

Where the variables D_1、DT_3 are not significant, removing these two variables, we have:

$$\begin{aligned}U &= 6.671 - 0.855T + 0.659DT_1 + 1.842D_2 + 0.264DT_2 + 1.657D_3\\ &\quad (8.043)\ (-3.256)\quad (2.055)\quad (3.033)\quad (2.637)\quad (2.843)\end{aligned} \tag{12}$$

$$\text{Adjusted } R^2=0.813 \quad F=27.821 \quad DW=1.545 \quad AIC=2.362$$

The adjusted equation is much more significant than the former. We perform the unit root test to see if we can reject the null hypothesis of a unit root in unemployment rates after degradation. Specifically, we extract the residual series $\hat{e}_t$ of China's actual urban unemployment rates, we have:

$$\Delta\hat{e}_t=-0.7478\hat{e}_{t-1} \tag{13}$$

The t-test values for $\gamma=0:t_{(\gamma)}=-4.238$, the distribution of which is different from the standard ADF distribution. Its asymptotic distribution has a relationship with the residuals and the location of structural breaks. The critical value of $t_{(\gamma)}$ at the significance level of 5 % is -4.91 as provided in Lee and Strazicich (2003) and $t_{(\gamma)}=-4.238>-4.91$. We can draw the conclusion that the DGP of China's actual urban unemployment rates is a unit root process with structural breaks, which is consistent with hysteresis hypothesis.

3.3 Empirical results analysis

Re-checking for the models above, we can find that, since reform and opening, there have been three structural breaks in China's actual urban unemployment rate series at the location of 1981, 1990 and 1996 due to external shocks.

During the initial period of reform and opening, China's economy nearly collapsed after 10 years of economic turmoil. The new graduate students and just back to the city's educated youth faced employment difficulties. The registered urban unemployment rate once reached 5.9%. The problem of unemployment in urban areas had been serious. To ease the growing pressure of unemployment, the government put forward the "three combinations" employment policy, which means the transformation of the employment policy guideline from the single track of accommodating unemployment rely on the planned economy to the

multi-track system of encouraging urban residents volunteer to employment and self-employment. At the same time, the acceleration of economic growth improved the employment condition, the unemployment rate declined significantly. With the declining of surplus labor force, the unemployment rate has gradually declined after 1981. The main feature of the employment in this phase is "low wages, increasing employment opportunities". The structural break occurred in 1990 reversed its course and triggered the increase of the unemployment rates. With the deepening of rural land contract system reform and the fading out of household registration system, the surplus labor force which was covered under the policy of "low wages, extensive employment" in the past separated gradually, the disguised unemployment became real unemployment, which caused the dramatic increase of unemployment level. A marked increase occurred in 1996, which was a structural break with a single shift of unemployment rate series. During this period, China implemented radical reform of state-owned enterprises and industrial restructuring, in which state-owned enterprises began to "increase efficiency by downsizing" and industry experienced a "capital deepening" process too, the unemployment rate sharply raised and peaked around 2000. It is also found that the unemployment hysteresis hypothesis is strongly supported by the data of China. It indicates that a high level of unemployment, if left by itself, may persist and continue to be a serious problem in the economy even in the long run.

4. CONCLUSION

This paper re-examines the hypothesis of unemployment hysteresis, we apply recursive, rolling and sequential tests to determinate the structural breaks in the urban unemployment rate series in China. And discover several critical economic affairs which cause the breaks since reform and opening.

First, there have been three structural breaks in China's actual urban unemployment. Since reform and opening, the structural breaks occurred at the location of 1981, 1990 and 1996 due to external shocks. The one in 1981 was a break in a deterministic trend, which induced the decline of unemployment rates. The one in 1990 reversed its course and triggered the increase of the unemployment rates. And the one in 1996 was a break with a single shift, a marked increase occurred and peaked around 2000.

Second, several critical economic affairs, which caused the breaks, were induced by domestic economic policies. Although China has experienced the Asian financial crisis in 1998 and the global financial crisis in 2008, these shocks occurred from the effects of the global economy do not cause structural breaks in China’s unemployment rates.

Third, the unemployment hysteresis hypothesis is strongly supported in China. We can not reject the null hypothesis of a unit root in the actual urban unemployment rates, which means that China's natural rate of unemployment is not fixed. The actual unemployment rate depends not only on the current variety of factors that generate unemployment, but also on the unemployment situation in the past. A high level of unemployment, if left by itself, may persist and continue to be a serious problem in the economy even in the long run.

Persistent unemployment has important policy implications. The stabilization of labor and macroeconomic policies do have long lasting effects on the unemployment rates. So, to solve the unemployment problem in China, government must take active measures to block the transmission mechanism of unemployment hysteresis, and gradually solve the problem of unemployment.

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