

## **Hysteresis in Metropolitan and Southeastern Areas of South Korea<sup>\*</sup>**

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This study examines metropolitan area and southeastern area of South Korea for existence of hysteresis. When an economic crisis occurs, the labor market receives a shock and these shocks have a tendency to persist after resolving the crisis. It is called 'hysteresis'. Hysteresis analysis was done in two ways of ADF unit root test and Zivot and Andrews unit root test with structural changes. The data used in this research is employment/unemployment rates of age, gender and education etc. The hysteresis of labor market in metropolitan area and southeast area is not confirmed. But we should not judge easily that these results indicate there is no need for an intervention of policy in labor market.

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## 1. INTRODUCTION

The Korean economy is expected to show a moderate growth rate of 4% in 2014. However, some have argued that Korea must take appropriate action to mitigate a potential shock in the case of some gradual tapering and tightening by the U.S. in 2014 and 2015, respectively. In the case of tapering, Korea is likely to face decreases in financial investment, exports, and demand in the real economy. This tapering is also likely to influence the labor market. In the U.S., some have suggested maintaining the policy of quantitative easing until the unemployment rate drops further from the rate seen in March 2014 (6.7%).<sup>1)</sup>

It is important to forecast economic cycles based on the economic policy and establish relevant employment policies to stabilize the labor market and boost the economy. Since the 2008 financial crisis, the Korean labor market showed the following trends.

Notwithstanding the decline in labor force participation, registered unemployment also took a hit during the first year of the crisis, impacting in particular the younger cohorts during the early stages of the crisis. While the government job-creation programs helped cushion the fall in employment, a delayed implementation of the latter stage of the program led to a temporary spike in the unemployment rate to almost 5% in early 2010 because labor force participation rose as workers signed up for the program. However, the corresponding increase in public sector employment did not take place until a few months later, which then led the unemployment rate to fall back again (Eskesen, 2010). This is a small example that show the effect of global financial crisis and post-crisis policy in labor market.

To implement appropriate policy for the current labor market, there is a need for a clear understanding of the characteristics of employment and unemployment rates. The unemployment rate can be assessed based on the natural rate hypothesis (NRH) and the hysteresis hypothesis (HH). The HH, the topic of this study, posits that economic impacts persist, not weakening

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<sup>1)</sup> The Bureau of Labor Statistics (<http://data.bls.gov>).

easily even after conditions that bring about an economic crisis ease.

Previous studies have examined the occurrence of hysteresis mainly at the country level (Arestis and Mariscal, 2000; Papell *et al.*, 2000; Roed, 2002; Feve *et al.*, 2003; Smyth, 2003, etc.). However, the occurrence and strength of hysteresis may vary according to the classification of regions and age. For example, outcomes can be different from the national average if the regional economy has distinct characteristics.

This study analyzes hysteresis in the domestic labor market by focusing on metropolitan (Seoul, Incheon, and Gyeong-Gi) and southeastern (Busan, Ulsan, and Gyeong-Nam) areas of Korea. The analysis is conducted using two measures of time series stability: the most popular ADF unit root test and the Zivot and Andrews (Z&A) unit root test, which considers structural changes. The two measures produce different results. Unlike in the case of results considering without structural changes, those with structural changes show some evidence of no hysteresis.

The rest of this study is organized as follows: sections 2 and 3 review various aspects of hysteresis and the analysis method based on a literature review. Section 4 proposes a model for analyzing the presence of hysteresis and presents the results. Section 5 presents the implications of research as the conclusions.

## 2. HYSTERESIS IN LABOR MARKET

### 2.1. Hysteresis Hypothesis

The typical hypothesis concerning the unemployment rate is that about the natural rate of employment. Until the 1960s, it was widely believed that a stable negative relation between inflation and unemployment (Romer, 2005). But nature rate hypothesis is talking about the following: people cannot accurately forecast inflation rates in the short term because of the adaptive expectation of economically active people, which moves the Philips curve

lower to the right and results in a negative relationship. In the long term, however, people can accurately forecast inflation rates. Therefore, the unemployment rate is fixed at the level of the natural rate of employment, and the Philips curve shows an upward-moving pattern in the long term. In this regard, they insist that an expansionary demand policy only induces inflation instead of reducing unemployment.

The HH opposes the natural rate of employment, insisting that an economic crisis has a permanent effect on the level of unemployment. If there is hysteresis under a recession, people face unemployment during the business cycle and cannot share benefits from improvements in the economy, remaining unemployed for a long period of time even after the business cycle recovers toward a boom.

## 2.2. Causes of Hysteresis

Blanchard and Summers (1986) suggest physical stock, human stock and insider-outsider models for factors that can explain the phenomenon of impacts from the short-term unemployment rate in the long term.

First, the physical stock model<sup>2)</sup> reduces labor demand and produces an unfavorable impact causing long-term unemployment in conjunction with a substantial decrease in labor demand resulting from decreases in the capital stock. This type of problem is often discussed in the context of Europe in the 1980s, a situation highlighting the importance of maintaining some normal production capacity in the midst of a considerably higher increase in the unemployment rate.

The debate on the human stock model describes the fact that unemployed workers lose their opportunity to maintain and develop their capability. In particular, when their unemployment status lasts a long period of time, it is difficult to ensure labor supply because of the difficulty in finding jobs by people with weak skills.

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<sup>2)</sup> Blanchard and Summers, "Hysteresis and the European Unemployment Problem," NBER Macroeconomics Annual 1986, Volume 1, p. 27.

The insider-outsider model<sup>3)</sup> is considered the best possible mechanism through which the continuity of negative effects of an economic crisis on the labor market in Blanchard and Summers (1986) can be explained. Blanchard and Summers assume that, in extreme cases, all wages are determined through negotiations between the firm and its workers (insiders) and that outsiders play no role in this process. Under this assumption, insiders care more about their employment status and wages than about outsiders' guaranteed employment.

Ball (1999b) and Phelps (2008) explain hysteresis as the stigma effect,<sup>4)</sup> in which firms are not willing to hire unemployed workers even under favorable terms and conditions because they perceive these workers to have poor skills as a result of their unemployment. On the other hand, Blanchard (2002), Stockhammer and Sturn (2008) argue that the loss of jobs may arise from firms' adjustment in capital scrapping if an economic recession persists for a long period of time and that, even when the economy recovers, hysteresis in the labor market cannot immediately be removed because capital accumulation requires a long period of time (Kim, 2009).

### 2.3. Importance of Hysteresis Analysis

Based on the above discussion on the occurrence of hysteresis, the direction of the policy may vary according to the cause of hysteresis. If the natural rate of employment is assumed, employment rate and unemployment rate resulting from the economic crisis fluctuate in the short term but they return to their equilibrium in the long term. Therefore, demand management does not influence the real economy. In other words, labor

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<sup>3)</sup> Lindbeck and Snower (1986, 1988) suggested this hypothesis, which explains that insiders may gain a monopolistic advantage because of labor turnover costs (LTCs). LTCs are composed of the following three costs (Hwang, 2003).

(a) The layoff cost of insiders and the recruitment cost of outsiders.

(b) Costs associated with the case in which insiders abandon cooperation with outsiders.

(c) Implied costs with the side effect from the replacing of insiders with outsiders.

<sup>4)</sup> This originates from label theory, which posits that when people start to recognize someone as a fringer based on some social system or standard, that individual becomes a criminal in the end. This is also referred to as the labeling effect.

market intervention policies can't have substantial impact on employment rate or unemployment rate.

However, the labor market with hysteresis can be addressed in different ways depending on the cause and extent of hysteresis. Because the labor market does not move according to specific rules but follows an unstable process of change depending on the circumstance. Under this circumstance, the equilibrium unemployment rate may change depending on whether an appropriate demand management initiative is implemented to influence the actual unemployment rate. In this regard, analyzing the hysteresis in the labor market may facilitate the effective policy development on labor market based on the decision to implement an appropriate measure for demand and labor market management.

### 3. LITERATURE REVIEW

#### 3.1. Various Method for Hysteresis Analysis

Early studies of hysteresis focus only on the nonstationarity of time series, ignoring structural changes. For this, the Dickey and Fuller (1979) method has been widely used, followed by the Augmented Dickey-Fuller (ADF; 1984) test, which can address more complicated time series models. It has a negative  $t$ -statistic and can better reject the null hypothesis of a unit root if the absolute value of the  $t$ -statistic is high.

However, a unit root test without considering structural changes may show unstable time series in many cases. Therefore, later studies compare results from individual analyses by reflecting structural changes and evaluating the presence of hysteresis (Kim, 2009). There are some measures that reflect structural changes, including classic, Phillips-Perron (P-P; 1988), LM, and Z&A test methods. This study employs the last method.

The Z&A test method does not specify the time of structural changes. The result of a Z&A analysis for an oil shock can be inconsistent with that of

Perron<sup>5)</sup> in some aspects. However, these results can be different in terms of processes and calculations in selecting the timing of structural changes depending on the type of time series data.

### 3.2. Review of Related Research

Most studies of hysteresis have focused on a given country's unemployment rate or GNP. Researchers typically compare a unit root test with structural changes with that without. Then the presence of hysteresis is determined after this comparison.

Papell *et al.* (2000) employ the ADF test and some methods with structural breaks to analyze yearly time series for 16 OECD countries and find that, with one-time structure breaks applied, the unit root hypothesis can be rejected for most countries. They conduct tests with multiple structure changes. In a number of those countries for which the unit root hypothesis could be rejected in favor of a regime-wise stationary alternative, they find evidence of structural breaks. Almost all of the significant breaks are positive, reflecting a sustained rise in European unemployment.

Lee *et al.* (2009) use a panel LM test with heterogeneous structural breaks to validate hysteresis based on unemployment rates in 19 OECD countries for the 1960-2004 period and find the stationarity of unemployment rates when two structural breaks are applied, suggesting that shocks to unemployment rates are temporary and soon converge when these breaks are controlled for.

Similar to the present study, Romero-Avila and Usabiaga (2007) provide an interregional analysis domestically by analyzing all 51 states of the U.S. and find the differences in existence and nonexistence of hysteresis across these states. In addition, the time of structural changes is different in every state. This suggests that it is important to determine the occurrence of hysteresis in the labor market and establish a relevant policy for it across the

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<sup>5)</sup> This is incorporated into the model by specifying the time of structural changes in a subjective manner through the unit root test of Perron.

country and that it is necessary to recognize specific market conditions facing each state and execute appropriate policies according to those conditions.

In Korea, Kim (2009) examines nationwide rates of employment and unemployment by using the Z&A test. Shin (2011) investigates hysteresis by using the ARFIMA (autoregressive fractionally integrated moving average) model and shows that the unemployment rate is a time series with mean-reversion tendencies in the long term. Finally, there may be hysteresis in unemployment and employment rates in the case of an analysis by gender.

## 4. AN EMPIRICAL ANALYSIS

### 4.1. Methodology

The most widely used method for identify the existence of hysteresis is a unit root test. If a time series as the employment or unemployment rate is found to be unstable with a unit root, then there may be hysteresis in that time series.

If a time series is found to be stable, then it can be assumed to gradually follow the natural rate of unemployment back to its equilibrium level. The present study employs the ADF and Z&A tests.

### 4.2. The Augmented Dickey-Fuller Unit Root Test

The augmented Dickey-Fuller test is applied without structural changes. This is an augmented version of the Dickey-Fuller test for a larger, more complicated set of time series models. This model allows for the autocorrelation of error terms. The verification model is set as follows:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{s=1}^m \alpha_s \Delta y_{t-s} + v_t,$$



where  $y$  is the time series,  $\alpha$  is a constant,  $\beta$  is the coefficient for a time trend, and  $m$  is the lag length of the autoregressive process. Two models (one with only a constant and the other with a constant and a time trend) are estimated. The unit root test is conducted under the null hypothesis ‘the employment (or unemployment) rate has a unit root’:

$$H_0 : \gamma = 0 \quad \text{vs} \quad H_1 : \gamma < 0.$$

If  $t$ -value (test statistic) of regression coefficient is less than or equal to the  $\tau_c$  (critical value), then null hypothesis is rejected, and there is no unit root.

#### 4.3. The Zivot and Andrew Unit Root Test

The Zivot and Andrew (1992) test is applied with structural changes. The verification model is set as follows:

$$\Delta y_t = \alpha + \beta_t + \theta_1 DU_t + \theta_2 DT_t + \gamma y_{t-1} + \sum_{j=1}^k \alpha_j \Delta y_{t-1} + \nu_t,$$

$$DU_t = \begin{cases} 1 & t > TB \\ 0 & \text{otherwise} \end{cases},$$

$$DT_t = \begin{cases} t - TB & t > TB \\ 0 & \text{otherwise} \end{cases}.$$

Here  $DU$  is a dummy variable for the constant,  $DT$  is a dummy variable for the time trend, and  $TB$  is the break point. This analysis involves (a) a model applied with structural changes in the constant, (b) a model applied with structural changes in the time trend, and (c) a model applied with structural changes in both variables. The null hypothesis is the same as above.

#### 4.4. Data

An analysis is conducted for two areas in Korea: metropolitan (Seoul, Gyeonggi, and Incheon) and southeastern (Busan, Gyeongnam, and Ulsan) areas.

Sort		Period
Overall	Employment Rate Unemployment Rate	1989Q1-2013Q4 (1999Q1-2013Q4) <sup>6)</sup>
By Gender	Employment Rate Unemployment Rate	
By Age	Employment Rate	
By Employment Status	Employment Rate	
By Education Years	Employment Rate	

#### 4.5. Result

In the ADF test, there are some differences between without trends and with. There is no unit root in the constant model, but there is a unit root in the trend model for the time series of the employment rate at table 1. In addition, there is no unit root in the time series of the unemployment rate regardless of trends at table 2. The results are different between metropolitan and southeastern areas depending on trends.

In the Z&A test, there is no difference in time series and areas. The results verify no unit root for both time series at table 1 and 2. Structural changes appear from the fourth quarter of 1997 to the first quarter of 1998 in almost all time series.

<sup>6)</sup> Ulsan uses time series from 1999Q1 to 2013Q4.

**Table 1 General Employment Rates**

		ADF				Zivot and Andrews		
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point
		<i>t</i> -stat. (lag)	<i>p</i> -value	<i>t</i> -stat. (lag)	<i>p</i> -value			
Korea		-2.952(1)	0.0432	-2.951(1)**	0.1514	-4.890(2)	A	1997Q4
Metro- politan	Seoul	-3.237(1)	0.0208	-3.287(1)**	0.0746	-4.679(1)	A	1997Q4
	Incheon	-3.761(2)	0.0046	-3.739(2)	0.0243	-7.231(2)	A	1998Q1
	Gyeong- gi	-3.082(1)	0.0312	-3.181(1)**	0.0942	-4.815(2)	A	1997Q4
South Eastern	Busan	-2.841(1)**	0.0563	-3.593(1)	0.0355	-5.598(2)	A	1998Q1
	Ulsan	-1.887(0)**	0.3364	-2.304(0)**	0.4258	-6.403(0)	B	2001Q1
	Gyeong- nam	-3.197(0)	0.0231	-3.215(0)**	0.0875	-4.930(0)	A	2002Q4

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test.

**Table 2 General Unemployment Rates**

		ADF				Zivot and Andrews		
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point
		<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value			
Korea		-3.824(1)	0.0037	-3.808(1)	0.0202	-6.470(1)	A	1997Q4
Metro- politan	Seoul	-3.885(1)	0.0031	-3.949(1)	0.0136	-7.326(1)	A	1997Q4
	Incheon	-3.066(1)	0.0325	-3.115(1)**	0.1087	-4.793(4)	A	1997Q4
	Gyeong- gi	-3.146(1)	0.0265	-3.105(1)**	0.1110	-5.811(2)	A	1997Q4
South Eastern	Busan	-2.830(1)	0.0578	-2.902(1)**	0.1665	-4.981(1)	C	2000Q4
	Ulsan	-1.703(0)**	0.4251	-1.758(0)**	0.7132	-5.280(2)	B	2001Q3
	Gyeong- nam	-3.033(1)**	0.0353	-2.999(1)**	0.1380	-5.430(1)	A	1997Q4

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test.

**Table 3 Employment Rates by Gender**

		ADF				Zivot and Andrews			
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point	
		<i>t</i> -stat. (lag)	<i>p</i> -value	<i>t</i> -stat. (lag)	<i>p</i> -value				
m e n	Korea	-2.315(1)**	0.1694	-2.786(1)**	0.2061	-5.082(2)	A	1997Q4	
	Metro- politan	Seoul	-2.105(1)**	0.2432	-2.833(1)**	0.1894	-5.392(2)	A	1997Q4
		Incheon	-1.805(1)**	0.376	-2.589(1)**	0.2863	-5.991(4)	A	1998Q1
		Gyeong- gi	-1.692(1)**	0.4322	-2.807(1)**	0.1985	-4.703(2)	A	1997Q4
	South Eastern	Busan	-1.545(4)**	0.5066	-3.313(2)**	0.0703	-4.497(4)	A	1998Q1
		Ulsan	-1.749(0)**	0.4022	-1.686(0)**	0.7459	-4.192(0)	B	2000Q3
		Gyeong- nam	-1.845(0)**	0.3567	-2.524(0)**	0.3162	-4.070(0)	A	1997Q2
	w o m e n	Korea	-2.724(2)**	0.0737	-3.917(2)	0.0149	-4.509(2)	A	1998Q1
		Metro- politan	Seoul	-1.632(1)**	0.4624	-3.514(1)	0.0434	-4.776(1)	A
Incheon			-1.690(0)**	0.4332	-3.347(1)**	0.0649	-6.748(2)	A	1998Q1
Gyeong- gi			-2.441(1)**	0.1332	-4.606(3)	0.0018	-4.090(4)	A	2003Q3
South Eastern		Busan	-4.475(2)	0.0004	-4.451(2)	0.0030	-6.047(2)	C	1998Q1
		Ulsan	-1.717(0)**	0.4181	-1.853(0)**	0.6670	-4.097(0)	B	2011Q2
		Gyeong- nam	-3.064(0)	0.0326	-3.645(0)	0.0311	-5.753(0)	C	2003Q1

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test.

The ADF test verifies a unit root for men regardless of trends at table 3. However, there is no unit root in some areas for women.

In the Z&A test, there is no difference in time series and areas. Structural changes appear from 1997 to 1998 in almost all time series.

**Table 4 Unemployment Rates by Gender**

		ADF				Zivot and Andrews			
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point	
		<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value				
m e n	Korea	-3.920(1)	0.0028	-3.891(1)	0.016	-5.925(2)	A	1997Q4	
	Metro- politan	Seoul	-3.627(1)	0.0069	-3.720(1)	0.0255	-6.692(1)	A	1997Q4
		Incheon	-3.220(1)	0.0217	-3.224(1)**	0.0858	-5.221(1)	A	1997Q4
		Gyeong- gi	-3.215(1)	0.0221	-3.175(1)**	0.0956	-5.837(2)	A	1997Q4
	South Eastern	Busan	-2.466(1)**	0.127	-2.520(1)**	0.3181	-4.002(1)	A	1997Q4
		Ulsan	-1.659(0)**	0.4467	-1.823(0)**	0.6819	-6.653(0)	B	2000Q3
		Gyeong- nam	-3.470(1)	0.0109	-3.460(1)	0.0495	-6.112(1)	A	1997Q4
w o m e n	Korea	-3.315(1)	0.0168	-3.328(1)**	0.0678	-5.567(1)	A	1997Q4	
	Metro- politan	Seoul	-3.777(1)	0.0043	-3.815(1)	0.0197	-6.703(1)	A	1997Q4
		Incheon	-2.605(0)**	0.0953	-2.567(0)**	0.2961	-4.825(3)	A	1997Q4
		Gyeong- gi	-2.506(1)**	0.1173	-2.476(1)**	0.3393	-4.778(2)	A	1997Q1
	South Eastern	Busan	-2.556(1)**	0.1057	-2.622(1)**	0.2718	-4.748(4)	C	2000Q4
		Ulsan	-2.447(0)**	0.1333	-2.895(0)**	0.1712	-4.976(0)	B	2000Q3
		Gyeong- nam	-2.480(0)**	0.1235	-2.486(0)**	0.3343	-4.300(0)	A	1998Q1

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test.

In the ADF test, there is no unit root in men's total unemployment rate, whereas it is observed in women's total unemployment rate based on the trend model at table 4. For regional unemployment data, there is a unit root in four areas for men according to the trend model, and there is a unit root in all areas except for Seoul for women regardless of trends.

The results of the Z&A test verify no unit root in any series and areas. Structural changes appear from 1997 to 1998 in all time series except for Ulsan.

**Table 5 Employment Rates by Age**

		Age	ADF				Zivot and Andrews				
			Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point		
			<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value					
Korea		20-29	-2.690(2)**	0.0794	-3.930(2)	0.0143	-4.913(3)	A	1998Q1		
		30-39	-3.175(2)	0.0245	-3.878(2)	0.0166	-6.836(2)	A	1998Q1		
		40-49	-2.696(1)**	0.0784	-2.722(1)**	0.2303	-6.924(1)	A	1998Q1		
		50-59	-1.195(1)**	0.6743	-1.082(1)**	0.9263	-8.430(1)	C	1998Q1		
		60+	-2.982(1)	0.0402	-2.983(1)**	0.1423	-4.966(1)	C	1998Q1		
Metro- politan		Seoul		20-29	-2.016(1)**	0.2796	-3.118(1)**	0.1079	-5.016(2)	A	1998Q1
				30-39	-2.422(0)**	0.1382	-2.500(0)**	0.3277	-5.668(2)	A	1998Q1
				40-49	-1.650(1)**	0.4533	-3.080(1)**	0.1169	-4.499(1)	A	1998Q1
				50-59	-1.862(0)**	0.3487	-2.197(0)**	0.4856	-6.444(0)	C	1998Q1
				60+	-2.052(0)**	0.2644	-2.779(1)**	0.2087	-4.544(1)	C	1998Q1
		Incheon		20-29	-2.265(0)**	0.1852	-2.668(0)**	0.2521	-3.842(4)	C	2009Q1
				30-39	-3.792(2)	0.0041	-4.174(2)	0.007	-6.119(2)	A	1998Q1
				40-49	-2.292(0)**	0.1766	-2.377(0)**	0.3891	-7.134(3)	A	1998Q1
				50-59	-1.884(0)**	0.3388	-2.326(0)**	0.4161	-5.819(0)	A	1998Q1
				60+	-0.692(0)**	0.843	-1.856(1)**	0.6698	-5.885(1)	A	1998Q1
		Gyeong- gi		20-29	-2.341(1)**	0.1615	-3.443(1)**	0.0517	-3.505(4)**	A	1997Q4
				30-39	-3.171(1)	0.0248	-4.214(2)	0.0062	-5.212(2)	A	1997Q4
				40-49	-3.313(1)	0.0169	-3.381(1)**	0.0599	-6.008(1)	C	1997Q4
				50-59	-1.847(0)**	0.3559	-2.425(0)**	0.3644	-5.381(0)	C	1998Q1
				60+	-3.411(0)**	0.0128	-3.835(0)	0.0186	-5.444(0)	A	1998Q1
South Eastern		Busan		20-29	-2.481(2)**	0.1232	-4.016(2)	0.0112	-4.930(3)	A	1998Q1
				30-39	-1.908(0)**	0.3275	-4.046(1)	0.0103	-5.072(1)	A	2003Q2
				40-49	-2.974(0)	0.0409	-2.994(0)**	0.1393	-6.087(2)	A	1998Q1
				50-59	-1.838(1)**	0.3602	-2.170(1)**	0.5004	-6.325(4)	C	1998Q1
				60+	-2.483(0)**	0.1226	-2.398(0)**	0.3784	-3.682(4)	C	1998Q1
		Ulsan		20-29	-2.968(0)	0.0435	-2.998(0)**	0.1411	-4.963(0)	A	2002Q1
				30-39	-2.851(1)**	0.0571	-3.409(1)**	0.0594	-4.382(1)	C	2010Q4
				40-49	-2.585(1)**	0.1015	-2.651(1)**	0.2603	-4.209(1)	C	2002Q4
				50-59	-1.345(0)**	0.6032	-2.435(0)**	0.3588	-6.141(0)	B	2001Q4
				60+	-2.560(0)**	0.1068	-2.829(0)**	0.1927	-4.134(0)	A	2003Q2
		Gyeong- nam		20-29	-2.275(0)**	0.1822	-4.662(0)	0.0015	-5.184(3)**	A	2000Q2
				30-39	-3.645(0)	0.0065	-3.829(0)	0.0189	-4.412(0)	A	2002Q4
				40-49	-2.151(0)**	0.2257	-2.206(0)**	0.481	-3.479(0)	A	1998Q2
				50-59	-3.850(0)	0.0034	-4.853(0)	0.0008	-7.129(0)	A	1993Q1
				60+	-3.782(0)	0.0043	-3.902(0)	0.0155	-5.456(0)	A	2009Q2

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test.

**Table 6 Employment Rates by Employment Status: Korea**

	E.S.*	ADF				Zivot and Andrews		
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point
		<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value			
Korea	N	0.336(0)**	0.9791	-1.516(0)**	0.8178	-4.099(4)	B	2002Q1
	S	-0.075(1)**	0.9484	-1.287(1)**	0.8852	-3.957(1)	B	2003Q4
	UF	-0.439(0)**	0.8971	-3.077(0)**	0.1176	-4.458(4)	A	2003Q2
	W	-0.818(1)**	0.8095	-2.292(1)**	0.4342	-7.440(2)	A	1998Q1
	R	-0.516(2)**	0.8823	-1.216(2)**	0.9013	-5.388(2)	C	1997Q3
	C	-1.877(1)**	0.3418	-0.816(1)**	0.96	-3.739(1)	B	2004Q2
	D	-0.271(4)**	0.924	-1.019(4)**	0.9359	-5.076(4)	A	1998Q3

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test. 4) E.S.\*: Employment Status; N (non-wage labor), S (Self-employed), UF (Unpaid Family worker), W (Wage labor), R (Regular worker), C (Casual worker), D (Day laborer).

In the ADF test, there is a unit root for people between the ages in 40 and 60 in all areas except for Gyeonggi and Gyeongnam. In the Z&A test, however, there is no unit root except for people in twenties of Gyeonggi and Gyeongnam. This indicates larger differences across age groups in Gyeonggi and Gyeongnam than in other areas. Structural changes appear from 1997 to 1998 in all areas except for Gyeongnam.

In the ADF test, there is a unit root in all time series, but in the Z&A test, there is no unit root in any time series. Structural changes appear at different times according the employment status. For wage earners, these changes appear in 1997 and 1998 except for casual workers. For non-wage earners, they appear in 2002 and 2003. There is a credit card crisis during this period in Korea.

**Table 7 Employment Rates by Employment Status:  
Metropolitan Areas**

	E.S.*	ADF				Zivot and Andrews			
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point	
		<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value				
Metro- Politan Areas	Seoul	N	1.113(0)**	0.9974	-1.066(0)**	0.9289	-2.835(0)	B	1995Q2
		S	0.423(0)**	0.983	-0.910(0)**	0.9501	-2.878(0)	B	2002Q2
		UF	0.036(0)**	0.959	-2.380(0)**	0.3876	-5.333(0)	A	1993Q1
		W	-0.621(1)**	0.86	-1.796(1)**	0.6996	-7.449(2)	C	1998Q1
		R	0.388(2)**	0.9815	0.094(1)**	0.9969	-4.809(3)	C	1997Q2
		C	-1.645(1)**	0.456	-1.713(1)**	0.7383	-4.596(1)	B	2002Q4
		D	-0.843(4)**	0.8019	-1.093(4)**	0.9243	-4.055(4)	A	1998Q3
	Incheon	N	-1.800(1)**	0.3786	-2.455(1)**	0.3495	-3.820(1)	A	1995Q1
		S	-2.494(1)**	0.12	-2.322(1)**	0.418	-3.865(1)	B	2000Q4
		UF	-0.948(0)**	0.7689	-2.889(1)**	0.1706	-4.385(1)	A	2003Q2
		W	-1.727(1)**	0.4144	-1.950(1)**	0.6209	-8.435(4)	C	1998Q1
		R	-1.432(2)**	0.5637	-1.220(2)**	0.9003	-4.456(2)	C	1997Q4
		C	-0.939(0)**	0.7718	-0.452(0)**	0.9842	-2.328(4)	A	1997Q2
		D	-0.843(0)**	0.8021	-2.013(0)**	0.5871	-4.679(4)	C	1999Q2
	Gyeong- gi	N	-0.763(0)**	0.8248	-1.939(0)**	0.6268	-5.202(0)	C	2001Q1
		S	-1.440(1)**	0.5595	-1.968(1)**	0.6111	-5.599(1)	C	2001Q1
		UF	-1.037(0)**	0.7376	-3.562(0)	0.0384	-4.912(0)	C	1992Q4
		W	-1.976(1)**	0.2968	-2.600(1)**	0.2816	-7.687(4)	A	1998Q1
		R	-0.227(1)**	0.9303	-0.669(1)**	0.9722	-4.608(2)	A	1995Q3
		C	-1.883(1)**	0.3392	-1.697(1)**	0.7454	-4.480(1)	A	1995Q3
		D	-0.996(0)**	0.7526	-2.777(0)**	0.2092	-5.820(4)	C	1999Q2

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test. 4) E.S.\*: Employment Status; N (non-wage labor), S (Self-employed), UF (Unpaid Family worker), W (Wage labor), R (Regular worker), C (Casual worker), D (Day laborer).

In the ADF test, there is a unit root for almost all metropolitan areas. In the Z&A test, however, there is no unit root. Structural changes appear in 1997 and 1998 in almost all time series. These changes coincide with the credit card crisis for some data.



**Table 8 Employment Rates by Employment Status:  
Southeastern Areas**

		E.S.*	ADF				Zivot and Andrews		
			Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	break point
			<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value			
South Eastern Areas	Busan	N	-0.622(0)**	0.8598	-1.536(0)**	0.8106	-4.358(4)	B	1997Q1
		S	-1.719(0)**	0.4188	-1.749(0)**	0.7218	-3.646(0)	B	1996Q3
		UF	0.042(0)**	0.9595	-1.879(0)**	0.6579	-3.977(0)	C	2002Q2
		W	-2.268(1)**	0.1844	-2.149(1)**	0.512	-6.625(2)	C	1998Q1
		R	-0.245(2)**	0.9277	-0.939(0)**	0.9467	-4.600(1)	C	1997Q1
		C	-1.320(0)**	0.6181	-4.162(1)	0.0073	-5.300(1)	A	2007Q3
		D	-1.382(4)**	0.5881	-0.443(4)**	0.9846	-2.658(4)	A	1999Q2
	Ulsan	N	-1.555(0)**	0.4992	-3.272(0)**	0.0803	-3.950(0)	A	2005Q2
		S	-1.577(0)**	0.4885	-2.892(0)**	0.1722	-3.364(4)	A	2005Q2
		UF	-1.739(1)**	0.4071	-3.311(0)**	0.0738	-4.836(1)	A	2003Q1
		W	-1.185(0)**	0.6758	-2.022(0)**	0.5782	-4.322(4)	C	2005Q1
		R	0.272(0)**	0.975	-2.610(0)**	0.2773	-2.936(4)	A	2011Q3
		C	-2.586(1)**	0.1013	-0.665(0)**	0.9712	-3.444(2)	A	2011Q3
		D	-0.864(0)**	0.7934	-1.820(0)**	0.6831	-3.607(0)	A	2003Q1
	Gyeong- nam	N	-1.441(0)**	0.5592	-1.750(0)**	0.7212	-6.726(1)	A	1998Q1
		S	-1.099(0)**	0.7141	-1.212(0)**	0.9022	-4.843(1)	C	1998Q1
		UF	-1.916(0)**	0.324	-3.235(0)**	0.0836	-7.719(0)	C	1998Q1
		W	-1.452(0)**	0.554	-1.671(0)**	0.7568	-6.431(1)	A	1998Q1
		R	-0.795(1)**	0.8159	-1.128(1)**	0.9185	-6.337(2)	A	1997Q3
		C	-2.773(0)**	0.0659	-2.227(0)**	0.4694	-4.696(0)	C	2007Q4
		D	-1.185(0)**	0.6788	-1.859(0)**	0.6682	-5.475(3)	A	1998Q4

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test. 4) E.S.\*: Employment Status; N (non-wage labor), S (Self-employed), UF (Unpaid Family worker), W (Wage labor), R (Regular worker), C (Casual worker), D (Day laborer).

In the ADF test, there is a unit root for almost all southeastern areas. In the Z&A test, however, there is no unit root. Structural changes appear in 1997 and 1998 except for Ulsan, which is 2000s. This implies some other structural changes during the credit card crisis or the global financial crisis.

There are no structural changes in 1997 and 1998 for wage earners, regular worker, and day workers. However, there are some differences in structural changes for other workers. This result may be due to some characteristics of the employment status.

**Table 9 Employment Rates by the Level of Education**

		ADF				Zivot and Andrews			
		Without Trend		With Trend		<i>t</i> -stat. (lag)	Model	Break Point	
		<i>t</i> -stat. (lag)	<i>p</i> - value	<i>t</i> -stat. (lag)	<i>p</i> - value				
Korea	E	-0.244(0)**	0.928	-4.706(0)	0.0013	-4.930(3)	A	1998Q1	
	M	-0.350(0)**	0.9122	-2.330(0)**	0.4137	-4.085(3)	A	2007Q2	
	H	-3.668(2)	0.0061	-4.169(2)	0.0071	-5.564(2)	A	1998Q1	
	C	-2.967(1)	0.0416	-3.354(1)**	0.0638	-6.112(2)	A	1998Q1	
	U	-1.880(1)**	0.3404	-2.596(1)**	0.2834	-8.168(3)	C	1998Q1	
Metro- politan	Seoul	E	-0.857(0)**	0.7979	-3.723(0)	0.0253	-5.256(4)	A	1996Q2
		M	-1.102(0)**	0.7128	-2.581(0)**	0.2901	-3.782(0)	A	2006Q3
		H	-2.478(1)**	0.1239	-3.104(1)**	0.1111	-5.095(2)	A	1997Q4
		C	-3.828(0)	0.0037	-3.806(0)	0.0202	-4.185(4)	A	1998Q1
		U	-2.298(1)**	0.1746	-2.835(1)**	0.1886	-5.689(1)	A	1998Q1
	Incheon	E	-1.655(0)**	0.4508	-1.539(0)**	0.8096	-3.280(0)	A	1997Q2
		M	-0.680(0)**	0.846	-3.014(1)**	0.1338	-5.583(2)	A	1997Q4
		H	-4.033(2)	0.0019	-4.745(2)	0.0011	-5.905(3)	A	1998Q1
		C	-4.949(0)	0.0001	-5.200(0)	0.0002	-6.260(0)	A	1997Q4
		U	-2.231(0)**	0.1967	-2.337(0)**	0.4104	-7.817(1)	C	1998Q1
	Gyeong- gi	E	-0.824(0)**	0.8077	-4.556(0)	0.0021	-5.575(0)	C	1999Q4
		M	-0.841(0)**	0.8028	-3.200(0)**	0.0904	-4.396(3)	A	2004Q2
		H	-1.872(1)**	0.344	-3.129(1)**	0.1055	-4.768(2)	A	1998Q1
		C	-2.788(1)**	0.0636	-3.492(1)	0.0458	-4.616(1)	A	1993Q1
		U	-1.529(0)**	0.515	-1.646(0)**	0.7675	-4.399(4)	A	1997Q4
South Eastern	Busan	E	-0.954(0)**	0.7668	-2.486(0)**	0.3346	-5.597(4)	C	1998Q1
		M	-1.315(0)**	0.6203	-2.714(0)**	0.2335	-3.977(1)	A	1999Q4
		H	-2.051(1)**	0.2649	-4.401(2)	0.0035	-5.262(2)	A	1998Q1
		C	-3.462(0)	0.0111	-3.959(0)	0.0132	-5.750(0)	A	1998Q1
		U	-2.317(0)**	0.1687	-3.265(1)**	0.0782	-5.174(2)	C	1998Q1
	Ulsan	E	-1.011(0)**	0.7445	-2.501(0)**	0.3267	-3.479(0)	A	2009Q3
		M	-1.430(0)**	0.5623	-2.165(0)**	0.5001	-3.422(0)	B	2001Q1
		H	-3.474(0)	0.0119	-3.640(0)	0.0343	-6.349(0)	C	2003Q2
		C	-3.957(0)	0.003	-3.962(0)	0.015	-4.767(1)	A	2005Q4
		U	-2.443(0)**	0.1345	-2.383(0)**	0.3845	-3.296(0)	A	2001Q3
	Gyeong- nam	E	-0.621(0)**	0.8601	-3.298(0)**	0.0726	-4.087(0)	A	2001Q2
		M	-0.699(1)**	0.8414	-2.543(0)**	0.3072	-3.824(4)	B	2004Q3
		H	-3.417(0)	0.0126	-3.514(0)	0.0434	-5.454(0)	B	1999Q2
		C	-2.910(0)	0.0477	-2.987(0)**	0.1411	-6.252(0)	C	1998Q2
		U	-3.039(0)	0.0348	-3.054(0)**	0.1232	-3.909(0)	A	2006Q4

Notes: 1) Unit root was evaluated at the 0.05 significance level. 2) MacKinnon (1996) one-sided *p*-values. 3) Model was selected by Schwarz Information Criterion in Z&A test. 4) E.L.Y.\*: Education Levels; E: elementary school, M: middle school, H: high school, C: college, U: university.

In the ADF test, there are some differences according to the level of education and the area depending on trends. In the Z&A test, however, there is no unit root in any time series. Structural changes appear in 1997 and 1998 in all areas except for Ulsan. There are differences across three levels of education for structural changes in Gyeongnam. In other areas, structural changes are verified for middle school.

## 5. CONCLUSION

The effectiveness of a policy varies according to whether the labor market follows the natural rate of employment or the hysteresis hypothesis. To determine an appropriate employment policy for Korea's labor market, which has experienced various economic crises in the past, including the Asian currency crisis of 1997 and the global financial crisis of 2008, this study analyzes the occurrence of hysteresis. Because of some differences in regions' industrial structure, economic power, and propensity to consume, the study compares and analyzes metropolitan and southeastern areas of Korea based on the conjecture that effects of an economic crisis on the labor market can vary across regions.

According to the ADF results, there is a unit root in most time series. However, the null hypothesis is rejected in most times series based on the Z&A analysis. That is, given structural changes, the results indicate no hysteresis in the labor market. In addition, structural changes based on the Z&A analysis occur in 1997 and 1998, the period of the Asian currency crisis. In these years, the basic structure of the labor market goes through profound long-term changes. The reason for this lack of hysteresis can be conjectured as follows:

First, the Korean labor market undergoes substantial changes during those years, as indicated by the overlap between the Asian currency crisis and the time of structural changes. Before the Asian currency crisis, lifetime employment is dominant in Korea, but afterward, there are heavy

restructuring efforts in various sectors of the economy for business stability, changing the structure of the labor market. In recent years, flexible employment plays a central role in the labor market, resulting in the growing problem of temporary employees. Thus, we need to consider the structural changes which are caused by economic crisis in labor market.

Second, there are no significant differences between metropolitan and southeast areas. It may be due to the relatively free transfer of the workforce across regions. Even the main industry varies across regions and is not specialized enough to prevent job seekers from moving across regions because the barrier is not very high and easy transportation allows for living in any part of metropolitan and southeastern regions.

Third, the current standard for the unemployment rate is very narrow and thus does not closely reflect the reality.<sup>7)</sup> This study's data on unemployment/employment rates do not include much accurate information, such as a number of people preparing for jobs and potential job seekers, because such individuals are classified as economically inactive. In this regard, the National Statistical Office of Korea is developing a labor underutilization index based on international standards for a subindex of unemployment suggested by the International Labor Organization. Different results may be obtained if a wider, more detailed unemployment situation is understood and relevant data are calculated using this index.

The results reject the null hypothesis of the presence of hysteresis. However, various researchers continue to examine the labor market in the context of hysteresis. Finally, there is a need for more effective activation plans for the labor market that appropriately combine the economic environment with the labor market structure.

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<sup>7)</sup> In November 2014, the government introduced the 'secondary employment indicator' and announced an unemployment rate according to ILO standard. The figure is approximately 10.1% (Statistics Korea). It is about 3 times of the employment rate used in this paper.

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