Asymmetric Responses to the Business Cycle in the Korean Labor Market

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Abstract

This paper analyzes the responses of the labor market to the business cycle as well as the changes in those responses after the Korean financial crisis which occurred in late 1997 and early 1998. The characteristics of the Korean labor market responses to the business cycle found in this research are as follows.

The unemployment rate responded to the business cycle symmetrically in both boom and recession before the crisis. But after the crisis, the response of the unemployment rate to the business cycle became asymmetric and the response became bigger in recession than in boom.

Each age group shows a different pattern in the responses of the unemployment rate to the business cycle. Young people in their 20's and 30's have experienced unstable employment. Their unemployment rate of those in their 30's responded symmetrically to the business cycle before the crisis and then their responses got bigger after the crisis. Even though the 40's and 50's group had enjoyed stable employment before the crisis, their employment conditions rapidly destabilized after the crisis. The size of the labor force witnessed a symmetric response to the business cycle did not change in its way of responding to the business cycle after the crisis. But the way of responding reveals a huge difference by gender. Though the male labor force does not show any systematic response in terms of its size to the business cycle, the size of female labor force fluctuates closely in line with the business cycle does. But the crisis did not bring about any change to the response of the size of the female labor force.

JEL Classification Number : E24, E32

Key words : Okun's law, Business cycle, Unemployment rate, Labor force

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The author would like to give thanks to the referees and seminar participants for their insightful comments.

I. Introduction

Output and unemployment have an important role in indicating economic conditions. The business cycle can affect unemployment rate by changing employment as well as by changing the size of the labor force. Therefore, the relationship between the output market and the labor market is complicated, running both through a direct and indirect path. Early in the 1960's, Okun (1962) published his finding that a one-percentage point reduction in the unemployment rate brings a 3.3% increase in output (Okun's Law). According to Okun's analysis, the 3.3% increase in output comes from the changes in labor force participation, in working hours, and also in labor productivity.[1] Thus, output and unemployment are directly and indirectly linked to each other.

In Korea, the financial crisis has brought a lot of changes in the labor market. Non-permanent (or temporary) employment was introduced and it has increased remarkably reducing the production costs and allowing flexible adjustment of labor input.[2] Therefore, there arises a possibility that the responses of the labor market to the business cycle have changed after the financial crisis. To investigate the change in flexibility after the crisis, this paper conducts an analysis on the relationship between business cycle and labor market responses.

Using the quarterly data from 1970 to 2006, the findings of this paper are as follows. First, the response of unemployment rate to the business cycle turns out to be symmetric regardless of the economic condition before the crisis. But it becomes asymmetric, that is, it gets bigger in recessions than in booms after the crisis.[3] Furthermore, the response of unemployment rate to the business cycle differs by age. Second, the responses of the size of the labor force to the business cycle turn out to be symmetric before and after the crisis. The responses have different patterns by gender: the business cycle does not affect the size of male labor force while it does affect the size of female labor force.

The structure of the paper is as follows. Chapter II reviews the previous literature and Chapter III presents the model specification and the result of empirical analysis. Lastly, Chapter IV summarizes the results and the implications of this research.

1) Silvapulle, *et al.* (2004) admits the theoretical significance of Okun's law, evaluating that it connects the real market and the labor market. Parachowny (1993) also assesses that Okun's law is as important as the Phillips curve in understanding the supply curve of an economy.

2) In contrast, the labor market environment of permanent workers show a tendency to become more rigid

3) 'The economy is good' represents that GDP is more than its trend while 'the economy is bad' denotes the opposite case.

II. Literature Review

As mentioned previously Okun (1962), using the quarterly data from the second quarter of 1947 to the fourth quarter of 1960, comes to the conclusion that a 1 % increase in unemployment rate leads to a 3.3% reduction in output. Okun (1962), however, assumes that the effect of output change on the unemployment rate is constant(symmetric) regardless of economic conditions.

Subsequently this symmetric assumption was mitigated by Courtney(1991) and Palley(1993). In their model, they take account of the possibility that the reaction velocity (or extent of reaction) of cyclical variation in unemployment rate differs by economic conditions. Even though there exists asymmetry in the response of unemployment rate to business cycle, an analysis with a symmetric model can underestimate (when $y^c < 0$)[4] or overestimate (when $y^c > 0$) the response of unemployment rate (Courtney 1991).

Using the data of the US from 1947 to 1999, Silvapulle, *et al*.(2004) demonstrate that the responses of the unemployment rate are estimated to be -0.61 (when $y^c < 0$), and -0.25 (when $y^c > 0$) in the asymmetric model, and -0.42 in the symmetric model, reconfirming Courtney (1991)'s argument.[5]

The previous studies explain the asymmetric responses of unemployment rate to output change as follows.[6] First, factor substitution can cause asymmetric responses of the unemployment rate to the business cycle (Courtney 1991). At the early stage of recovery, producers can extend the working hours of employees instead of hiring more employees or replace labor input by capital input. Then the employment index has no considerable change.

Second, a productivity gap or differences in sectoral growth rates can make the unemployment rate respond asymmetrically (Palley 1993). Since the increase of employment in capital-intensive industries is smaller than that in labor-intensive industries even though two industries grow at the same rate, the job creation effects on the entire industry are not substantial where the economic growth is accomplished mainly by capital-intensive industries.

Third, a change in the size of labor force can also be attributed to the asymmetry of responses of the unemployment rate (Palley 1993). When an economy is on its recovery from a recession, better economic conditions and

4) y^c is a cyclical variation of GDP denoting the deviation of GDP from its trend.

5) Lee (2000), Harris and Silverstone (2001), Viren (2001), Silvapulle, *et al*. (2004), Holmes and Silverstone (2006), besides Courtney (1991) and Palley (1993) apply asymmetry in their analysis.

6) The explanation of the asymmetric responses of unemployment rate to the business cycle is well organized in Silvapulle *et al*. (2004).

more job opportunities attract more people to participate in the labor force. The rise in the labor force participation rate acts to slow down the declining velocity of the unemployment rate. Mayer and Viren (2002) argue that discrepancy of labor demand and labor supply between regions and industries can cause asymmetry in the response of the unemployment rate to the business cycle and raise the unemployment rate above the equilibrium level in a recession. Lastly, the asymmetry of the responses of the unemployment rate can also be demonstrated by the psychological factor that producers have a tendency to believe bad information (on a recession) more easily than good information (on a boom) (Silvapulle *et al*. 2004).

Meanwhile, Moosa (1997) analyzes G7 countries and Lee (2000) and Viren (2001) examine OECD countries and they find that the responses of the unemployment rate differ by country.[7] With regard to this, Moosa (1997) shows that differences in the relationship between the labor market and then output market by country stem from the difference in the degree of rigidity of the labor market across countries. This implies that the flexibility of the labor market may also have a significant impact on the response of the unemployment rate to the business cycle.

Using Korean data from the first quarter of 1973 to the fourth quarter of 1997, Hahn (1999) conducts an analysis on the relationship between output and the unemployment rate. According to his research, the responses of the unemployment rate to the business cycle are estimated to be -0.066 in the model using the gap between the actual and natural unemployment rate as the unemployment cycle, and -0.076 in the model using the gap between the actual unemployment rate and its trend as the unemployment cycle.[8]

7) According to Silvapulle, *et al.* (2004) using the US data from the first quarter of 1947 to the fourth quarter of 1999, when the cyclical variations of output are positive or negative, the responses of unemployment rates are -0.22 and -0.21 respectively. In Moosa (1997) using the annual data during the period of 1960 to 1995, the responses of the unemployment rate are estimated as -0.49 in the US, -0.12 in Japan, -0.62 in Germany, -0.44 in France, and -0.48 in the UK.

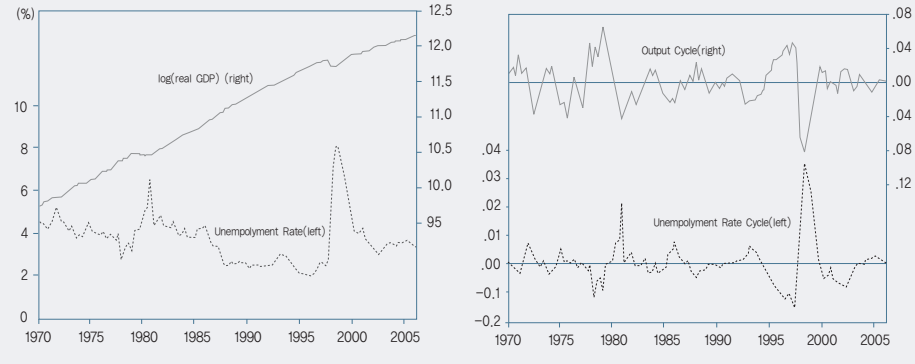
8) The presented result is the figure calculating the long-term effect using the estimation of Hahn (1999). Park & Yu (2006) estimate the responses of the unemployment rate to the business cycle using unemployment rates and industrial production indexes in the regions (16 metropolitan cities and provinces) from the first quarter of 1989 to the second quarter of 2005. In the case of Seoul, the estimated responses of the unemployment rate are -7.10 in the economic upturns and -11.72 in economic downturns. Park & Yu (2006) unlike Hahn (1999), who uses GDP, conduct the analysis using industrial production indexes.

III. Empirical analysis

1. Data

The research analyzes the relationship between the labor market and output change from the first quarter of 1970 to the second quarter of 2006. The output cycle is the difference between the log of real GDP and its HP-filtered trend. As labor market indicators, the unemployment rate and the size of labor force are analyzed as dependent variables in this research.[9] The Economically Active Population Survey by National Statistical Office is the main source of labor market variables. The unemployment cycle is a deviation of the unemployment rate from its HP-filtered trend. Cyclical variation of the size of labor force is the difference of log of the size of labor force and its HP-filtered trend. Seasonal variation in all quarterly data are filtered out.[10] Figure 1a shows the log-value of constant-price real GDP (at 2000 prices) and the unemployment rate, and Figure 1b indicates the cyclical variations of real GDP and unemployment rates.

Figure 1 **Real GDP (in log) and Unemployment Rates (Quarterly Data)**



(a) Real GDP and Unemployment Rate (b) HP-filtered Cycles

9) The unemployment rate is a statistic based on a one week job-seeking period. However, the National Statistics Office also presents unemployment statistics based on a 4 week job-seeking period from June of 1999.

10) The seasonal adjustment is performed by using BOK-X12 of the Bank of Korea or Census-X12. Since BOK-X12 is based on Census-X12, there is no considerable difference in the seasonal adjustment between the two methods.

2. Model

In the literature, the relationship between the unemployment rate and output change is analyzed mainly by the following four methods. The first method is to use the deviation of the unemployment rate from the natural rate of unemployment and the deviation of output from potential GDP. This method requires to estimate the natural rate of unemployment and potential GDP additionally. The second method is to use deviations of the unemployment rate and output from their long-term trend. The third method is a vector auto-regression model(VAR). Disturbance terms from a VAR model of output and from a VAR model of unemployment rate are used to estimate the relationship between the unemployment rate and output. The fourth method uses the first-order difference of unemployment rate and output to estimate the relationship between them.

The methods mentioned above except the VAR model employes the following equation as a basic equation estimating the relationship between output and unemployment rate;

$$u_t - u^* = \alpha(y_t - y^*) + \beta Z_t + \varepsilon_t \tag{1}$$

where Z_t is a vector including independent variables and lags of dependent variables, u denotes unemployment rate, y represents real GDP, and ε is an error term. If u^* and y^* are defined as the natural unemployment rate and potential real GDP respectively, equation (1) becomes the first method using the deviation of the natural unemployment rate and potential real GDP. If u^* and y^* are defined as long-term trends of unemployment rate and GDP respectively, equation (1) becomes the second method using the deviations of unemployment rate and GDP from their trends. In addition, if u^* and y^* are defined as u_{t-1} and y_{t-1} respectively, equation (1) becomes the fourth method using the first-order difference. Attempting to analyze the relationship between output and unemployment rate using the deviations from their long-term trends, this paper sets up the estimation equation as follows;

$$u_t^c = \alpha + \{\beta_0^+ y_t^{c+} + \beta_0^- y_t^{c-}\} + \sum_{j=1}^{p} \gamma_j u_{t-j}^c + \varepsilon_t \tag{2}$$

where, $u_t^c(=u_t - u^*)$ and $y_t^c(=y_t - y^*)$ denote the unemployment rate cycle and output cycle respectively, y_t^{c+} represents the case where $y_t^c \geq 0$, and y_t^{c-} stands for the

case where $y_t^c < 0$.[11] Equation (2) adds lagged dependent variables into Equation (1). This is not only for resolving the problem of autocorrelation of error terms, but also for distinguishing the long-term effect from the short-term effect of the cyclical variation of real output on unemployment rate.[12] β_0^+ and β_0^- denote short-term effects when $y_t^c \geq 0$ and when $y_t^c < 0$, respectively. To get the long-term effect of output cycle on unemployment cycle, set the expectations on Equation (2). Then Equation (3) is obtained with u^E, y^{E+}, and y^{E-} which are the expected values of u_t^c, y_t^{c+}, y_t^{c-} respectively. Thereby the long-term effect can be expressed as Equation (4);

$$u^E = \alpha + \{\beta_0^+ y^{E+} + \beta_0^- y^{E-}\} + \sum_{j=1}^{p} \gamma_j u^E \tag{3}$$

$$\frac{\partial u^E}{\partial y^{E+}} = \frac{\beta_0^+}{\left\{1 - \sum_{j=1}^{p} \gamma_j\right\}} \quad \text{or} \quad \frac{\partial u^E}{\partial y^{E-}} = \frac{\beta_0^-}{\left\{1 - \sum_{j=1}^{p} \gamma_j\right\}} \tag{4}$$

To find out whether a structural break occurred in the relationship between output and unemployment rate after the financial crisis, a dummy variable indicating the post-crisis period is added into Equation (2).[13] The estimation model with the post-crisis dummy variables is as follows;

$$u_t^c = \alpha + \{\beta_0^+ y_t^{c+} + \beta_0^- y_t^{c-}\} + \{\beta_F^+ y_t^{c+} d_F + \beta_F^- y_t^{c-} d_F\} + \sum_{j=1}^{p} \gamma_j u_{t-j}^c + \varepsilon_t \tag{5}$$

A dummy variable, d_F, is 1 in or after the year of 1998, and is 0 before 1998. If the labor market has become flexible since the crisis, β_F^+ and β_F^- will be statistically significant negative values.[14]

11) The trend of time series is derived by HP filter. $\{\beta_0^+ y_t^{c+} + \beta_0^- y_t^{c-}\}$ in equation 2 is used as $\{\beta_0^+ y_t^c d_y + \beta_0^- y_t^c (1 - d_y)\}$ in the real model, and d_y is a dummy variable denoting $y_t^c \geq 0$.

12) Researchers might include lagged variables of GDP cycle and unemployment cycle together in the model.

13) The Labor Market Advancement Committee (2004) insists that given the fact that the speed of employment adjustment became faster after the crisis than before the crisis, the flexibility of the Korean labor market rose after the crisis.

14) From 1970 to 1997, the responses of unemployment rate are β_0^+ or β_0^-, respectively, depending on the sign of GDP cycle. After 1998, the responses of unemployment rate are $(\beta_0^+ + \beta_F^+)$ or $(\beta_0^- + \beta_F^-)$, respectively.

3. Unemployment rate model

In this chapter, the responses of the unemployment rate to the business cycle are estimated. Two lagged variables of the unemployment rate cycle are included in the estimation. For the purpose of comparison, a symmetric model and asymmetric basic models without lag variables are estimated as well.[15)]

The first column in Table 1 is the result of the symmetric model only with a constant and GDP cycle. When real output increases(decreases) by 1%, the unemployment rate turns out to decrease(increase) by 0.23%p. The second column in Table 1 is the result of a symmetric model with lagged variables of the unemployment rate cycle. The model with a lagged dependent variable has a less sensitive response of the unemployment rate to the business cycle than the model without a lagged unemployment rate cycle.[16)] When the lag variables of the unemployment rate cycle are included in the estimation, the impact of output can be divided into short-term and long-term effects. When output increases(decreases) by 1%, the unemployment rate decreases(increases) by 0.10%p in the short run, but decreases(increases) by 0.25%p in the long run. This calculated long-run effect is similar in size to the coefficient estimated in the symmetric model without a lagged dependent variable, which is in the first column. In other models in Table 1, the short-run effect of output variation on unemployment rate is smaller but the long-run effect is similar to the estimate of the response of the unemployment rate in the model without a lagged unemployment rate cycle.

In the third and the fourth column of Table 1, models separate the economic conditions into two cases where output is more than or lower than its long-run trend and estimate the responses for each case. The estimation result shows that unemployment rates respond more sensitively in cases where the output cycle is negative than in cases where it is positive. This pattern is kept up as well when the lagged variables of the unemployment rate cycle are added. The Wald test rejects at the 1% significance level the null hypothesis that the responses of the unemployment rate to the business cycle in booms or in recessions do not differ from each other in the third and the fourth models. This means that the unemployment rate responds to the business cycle asymmetrically. A comparison of the first and

15) The number of lag variables is decided as the minimum number in which serial autocorrelation does not exist in error terms after the estimation of the model. Whether serial correlation exists or not is verified by 'Serial correlation LM test (Eviews)'.

16) If lagged variables of unemployment rate cycle are included, the estimated responses of unemployment rate to business cycle denotes a short-term effect.

Table 1 **Estimation Results of Unemployment Rate Model**

Co-efficient	Independent variable	Unemployment Rate Model (1)	(2)	(3)	(4)	(5)	(6)
		Dependent variable: Cyclical variation of unemployment(u^c)					
β	y^c	-.2288*** (.0314)	-.1040*** (.0255)				
β_0^+	y^{c+}			-.1169*** (.0334)	-.0361 (.0281)	-.1529*** (.0343)	-.0676** (.0316)
β_0^-	y^{c-}			-.3290*** (.0523)	-.1806*** (.0355)	-.1552*** (.0521)	-.0854* (.0487)
β_F^+	$y^{c+} \cdot d_F$					-.1392* (.0732)	-.0868** (.0423)
β_F^-	$y^{c-} \cdot d_F$					-.2549*** (.0707)	-.1751*** (.0632)
γ_1	$u^c(-1)$		.7775*** (.1715)		.6855*** (.1592)		.5383*** (.1490)
γ_2	$u^c(-2)$		-.1983 (.1374)		-.1277 (.1161)		-.0340 (.1012)
R^2		.5657	.7846	.6179	.8069	.7019	.8419
Wald test (p-value)							
$\beta_0^+ = \beta_0^-$				rejected (.0044)	rejected (.0035)	not rejected (.9752)	not rejected (.8020)
$\beta_F^+ = \beta_F^-$						not rejected (.2245)	rejected (.0924)
$\beta_0^+ + \beta_F^+ = \beta_0^- + \beta_F^-$						not rejected (.2309)	rejected (.0339)
Long-run effect							
$\partial u^E/\partial y^E$			-.2472				
$\partial u^E/\partial y^{E+}$					-.0816		-.1364
$\partial u^E/\partial y^{E-}$					-.4084		-.1723
$\partial u^E/\partial y^{E+}$(Post-crisis period)							-.3115
$\partial u^E/\partial y^{E-}$(Post-crisis period)							-.5255

Notes : 1) The data is detrended by HP filter. A constant is included in the estimation but omitted in the presentation. d_F is a dummy variable having 1 in the post-crisis period starting from the first quarter of the year of 1998. The figures in parenthesis are standard errors. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The rejection of the Wald test is determined at the 10% significance level.

the third columns in Table 1 bears out the argument of Courtney (1991) and Silvapulle *et al*. (2004), which is that a symmetric model can overestimate or underestimate the unemployment rate's responses to the business cycle when there is asymmetry in the relationship between the unemployment rate and output change.

For considering the structural breaks existing within the model, the fifth and sixth model of Table 1 have a post-crisis dummy variable in the estimation.[17)18)] According to the estimation results, there exists a difference in the responses of the unemployment rate before and after the currency crisis. In the fifth column, before the currency crisis, the response of the unemployment rate is -0.15 when $y_t^c \geq 0$ and -0.16 when $y_t^c < 0$, indicating that the responses of the unemployment rate are similar (or symmetric). After the crisis, however, the response of the unemployment rate become -0.29 with $y_t^c \geq 0$ and -0.41 with $y_t^c < 0$, showing that the size of the unemployment rate response has substantially increased.[19)] However, Wald test cannot reject the null hypotheses of $\beta_0^+ = \beta_0^-$, $\beta_F^+ = \beta_F^-$, and $\beta_0^+ + \beta_F^+ = \beta_0^- + \beta_F^-$. This might arise from the serial correlation of disturbance terms of the fifth model. So, the sixth model adds the lagged unemployment rate cycle to resolve the problem of serial correlation. According to the estimation result of the sixth model, the relationship between the unemployment rate and output, β_0^+ and β_0^-, before crisis do not show any significant difference and the Wald test cannot reject $\beta_0^+ = \beta_0^-$. After the currency crisis, however, the relationship between the unemployment rate and output changes into an asymmetric pattern. The Wald test rejects $\beta_F^+ = \beta_F^-$, and $\beta_0^+ + \beta_F^+ = \beta_0^- + \beta_F^-$. A 1% change of GDP brings 0.07%p unemployment rate changes in a boom or 0.09%p in a recession before a crisis. The response of the unemployment rate to the same change in output becomes 0.15%p in a boom or 0.26%p in a recession after the crisis, which is 2.1 times or 2.9 times higher than the pre-crisis responses, respectively. The

17) In order to identify whether there is a structural break in the responses of unemployment rate to the business cycle, we conduct a Chow test using the estimation results from the first to the fourth column in Table 1. Chow tests indicate a structural break in the first quarter of 1998.

18) One of the referees suggests the estimation excluding the early years of the crisis by pointing out that the estimation of the post-crisis period may be affected by the responses of the early years of the currency crisis. In the case of estimation excluding the early years and using monthly industrial production indexes, however, the consistency of the paper might deteriorate and the data is not sufficient. The substantial fluctuation of unemployment rate in the early years of the crisis seems to arise from the sizable width of the economic fluctuation and therefore there does not exist a sufficient foundation that the response of the early years of the crisis is different from that of the post-crisis period in a structure.

19) Since the estimate of dummy variable denotes the additional response arising after the crisis, the response of unemployment rate after the crisis equals the sum of the responses of the pre-crisis and the additional response of post-crisis periods.

responses of the unemployment rate, which were symmetric to the business cycle before the financial crisis, have in general increased in the scale of fluctuations, and have become bigger in a recession than in a boom, turning in an asymmetric direction. The changes in the economy, especially in the labor market triggered by the financial crisis brought changes in the relationship between unemployment rate and output. As employment in non-permanent jobs has increased since the currency crisis, the flexible operation of human resources in firms has become feasible and then labor market flexibility has become higher. Compared to the pre-crisis period, as a result, the responses of the unemployment rate seem to have become more sensitive in the post-crisis period. This change in unemployment rate-output relationship resulting from the change in the labor market shows that the argument of Moosa (1997) that the rigidity of the labor market affects the relationship between output and the unemployment rate (Okun's coefficient) is also proved in the Korean data.

The reasons why the responses in the labor market have become asymmetric after the crisis are as follows. After the crisis, the Korean labor market has had a dual structure; permanent and non-permanent jobs. As non-permanent jobs and the dispatch of workers have become legal, the labor market has become generally more flexible, but employment in permanent jobs has been evaluated as being overprotected by law.[20] Permanent workers, feeling the instability of job security due to an increase in non-permanent workers with unstable job security have endeavored to secure the job security, leading to hostile labor relations.[21] Conflicts between labor and management, and the excessive legal protection of permanent jobs become a factor in firms declining to recruit actively in a boom. Hence, even if the economy becomes better, no substantial recruitment takes place, and non-permanent staff and dispatched workers can get laid off in a recession, showing the asymmetric pattern in the responses of unemployment rate. In addition, continuous improvement of labor productivity seems to affect the asymmetric responses. When labor productivity rises, the inducement of employment is not as large as economic growth in a boom, and the inducement of dismissal becomes larger in a recession.

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20) Lay-offs as stipulated in the Labor Standards Act must satisfy four factors: imminent management problem, employer's endeavors to avoid dismissal, rational selection of workers and genuine discussion with the workers' representatives.

21) According to the result surveyed by the IMD (International Institute for Management Development) in 61 countries to identify whether labor relations are cooperative, Korea has the most non-cooperative labor relations (as of 2006).

4. Unemployment Rate Model by Age

In recent years in Korea, youth unemployment has been extensively discussed. Table 2 indicates that the unemployment rate of the youth aged 20-29 is two times higher than that of 30-39 or 40-49 age groups. The 30-39 age group has a slightly higher unemployment rate than the 40-49 age group and the age group of those in 50's turns out to have a lower unemployment rate than other groups.

The responses of the labor market by age group to the business cycle can differ because labor demand varies by age, and labor supply incentives also differ depending on the structure of labor market. Thus, investigating how the unemployment rates by age group respond to the business cycle may be the essence of understanding the movements of the labor market and the recent youth unemployment. Accordingly, the responses of the unemployment rate to the business cycle by age group are estimated with the same specification as the unemployment rate model estimated previously but with the dependent variable substituted by the cyclical variation of unemployment rate by age group. The analysis is done on the period from the first quarter of 1980 to the second quarter of 2006 because of the availability of unemployment data by age group. In conjunction with the analysis period, the cyclical variation of GDP is obtained by applying the HP filter from the first quarter of 1980.

Table 2 Unemployment Rate by Age

(%)

	1980	1985	1990	1995	1998	2000	2005	2006
All Ages	5.2	4.0	2.4	2.1	7.0	4.1	3.5	3.3
20-29	8.1	7.1	4.9	4.3	11.4	7.1	7.4	7.3
30-39	3.8	2.8	1.6	1.4	5.7	3.4	3.2	2.9
40-49	2.9	2.3	1.2	1.1	5.6	3.3	2.4	2.2
50-59	2.5	1.6	1.1	0.9	5.3	2.9	2.3	2.1

Source: National Statistical Office (Korea Statistical Information Service)

Estimation results by age groups are reported in Table 3. For the group of 20-29, the response of unemployment rate to the business cycle ie estimated to be -0.16 (when $y^c \geq 0$) and -0.22 (when $y^c < 0$) before the currency crisis.[22)]

22) The estimation result means that a 1% increase in GDP leads to a 0.16%p fall in the unemployment rate in a boom, and a 1% reduction in GDP generates a 0.22%p rise in the unemployment rate.

The two responses before the crisis do not differ from each other in statistical significance. After the crisis, additional responses of the unemployment rate are statistically significant only when $y^c < 0$. However, the Wald test cannot reject the null that $\beta_F^+ = \beta_F^-$ as well as the null that $\beta_0^+ + \beta_F^+ = \beta_0^- + \beta_F^-$. There seems to be little evidence to support the proposition that the labor market response for the group of 20-29 has changed since the crisis.

Table 3 **Estimation Result of Unemployment Rate Model by Age**

Coefficient	Independent variable	Unemployment Rate Model by Age			
		20-29	30-39	40-49	50-59
		Dependent variable: Cyclical variation of unemployment rate(u^c)			
β_0^+	y^{c+}	-.1602*** (.0431)	-.1060*** (.0237)	-.1386*** (.0288)	-.1133*** (.0240)
β_0^-	y^{c-}	-.2241*** (.0637)	-.0926*** (.0342)	-.0265 (.0409)	-.0305 (.0340)
β_F^+	$y^{c+} \cdot d_F$	-.0665 (.1016)	.0030 (.0562)	-.0679 (.0677)	-.0863 (.0579)
β_F^-	$y^{c-} \cdot d_F$	-.1115* (.0615)	-.1436*** (.0344)	-.2111*** (.0428)	-.1997*** (.0358)
γ_1	$u^c(-1)$	.6768*** (.0891)	.4786*** (.0782)	.4792*** (.0860)	.5107*** (.0799)
γ_2	$u^c(-2)$	-.1726** (.0725)	.1593* (.0838)	.0116 (.0717)	.1379 (.0916)
γ_3	$u^c(-3)$		-.2613*** (.0838)		-.1840** (.0912)
γ_4	$u^c(-4)$		.1189* (.0622)		.0794 (.0641)
R^2		.8956	.9146	.8806	.9217
Wald test (p-value)					
$\beta_0^+ = \beta_0^-$		not rejected (.4550)	not rejected (.7785)	rejected (.0534)	rejected (.0864)
$\beta_F^+ = \beta_F^-$		not rejected (.6903)	rejected (.0212)	rejected (.0586)	rejected (.0738)
$\beta_0^+ + \beta_F^+ = \beta_0^- + \beta_F^-$		not rejected (.3379)	rejected (.0356)	not rejected (.6811)	not rejected (.6272)

Note: The data is detrended by HP filter. A constant is included in the estimation but omitted in the presentation. d_F is a dummy variable having 1 in the post-crisis period starting from the first quarter of the year of 1998. The figures in parenthesis are standard errors. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The rejection of the Wald test is determined at the 10% significance level.

The responses of unemployment rate to the business cycle of the 30-39 age group are estimated to be -0.11 (if $y^c \geq 0$) and -0.09 (if $y^c < 0$) before the crisis. Pre-crisis responses do not differ from each other by the Wald test. The responses of the unemployment rate of those in their 30's are smaller than those in their 20's. That is, the labor market for those in their 30's is less influenced by the business cycle and is more stable than that of those in 20's.

After the financial crisis, the additional responses of unemployment rate to the business cycle (coefficients of dummy variables) is statistically significant only when $y^c < 0$ and the responses of unemployment rate of the 30's to the business cycle are estimated -0.11 (when $y^c \geq 0$) and -0.23 (when $y^c < 0$). The Wald test reject the null of the same responses of unemployment rate after the crisis as the responses before the crisis. This indicates that the responses of unemployment rate of the 30's to the business cycle is symmetric before the crisis and turn into asymmetric after the currency crisis.

For the 40-49 group, the responses of unemployment rate before the currency crisis are estimated statistically significant only in a boom (when $y^c \geq 0$), and not statistically significant in a recession (when $y^c < 0$). In the case of the 40's with a more stable position in society than younger groups, employment rises in a boom but employment adjustment does not occur when the economy turns into a recession. Given the results of the 20's and 30's, this can be interpreted as meaning that employment adjustment took place mainly in the youth group before the crisis.[23] By contrast, the responses of the unemployment rate for those in their 40's after the currency crisis are estimated as -0.14 in a boom (when $y^c \geq 0$), and -0.21 in a recession (when $y^c < 0$). According to the Wald test, the responses of the unemployment rate of those in their 40's even turn symmetric after the crisis. This result may be attributable to the fact that workers in their 40's having enjoyed a stable employment environment before the crisis have had a deteriorating employment environment due to the structural change in the labor market through the currency crisis.

The responses of the 50-59 age group have a very similar pattern to those of 40-49 age group. The unemployment rate responds asymmetrically before the crisis. Then after the currency crisis, it is transformed into a symmetric pattern. In the case of those in their 50's, the stable employment environment deteriorated after the currency crisis.

23) Although changes in the unemployment rate to the business cycle are caused by changes in employment and in labor force, I assume changes only in employment for easy understanding.

5. Labor Force Model

The statistics of the labor market are compiled based on the population over the age of 15. The population over 15 is classified into two groups: participants in the labor force and non-participants in the labor force. The labor force is again classified into employees and the unemployed. The unemployment rate as an index denoting the ratio of the unemployed to the labor force is influenced both by the change of the number of the unemployed itself and the size of labor force. In other words, the asymmetric responses of unemployment to the business cycle, which were previously analyzed, can be caused by change in the size of labor force or change in the number of the unemployed. Therefore, to identify the source of asymmetric responses of the unemployment rate to the business cycle, investigation of the size of the labor force is critical to grasp the movement of labor market.[24)]

The growth rate of population over the age of 15 slowed down from 3.4% per year in the 1970s to 1.2% per year in the 2000s. The labor force, however, has continuously grown except in 1984 and 1998, bringing an increase in the labor force participation rate from 57% in 1970 to 62% in 2006.

The male labor force increased at an annual rate of 3.4% in the 1970s, 2.0% in the 1980s, 1.7% in the 1990s, and 1.2% in the 2000s, indicating a slowing

Table 4 **Labor Force Participation Rate**

(%)

	1970	1975	1980	1985	1990	1995	1998	2000	2005	2006
Total	57.6	58.3	59.0	56.6	60.0	61.9	60.6	61.0	61.9	61.7
Male	77.9	77.4	76.4	72.3	74.0	76.4	75.1	74.2	74.4	74.0
Female	39.3	40.4	42.8	41.9	47.0	48.4	47.1	48.6	50.0	50.2

Source: The National Statistical Office(Korean Statistical Information Service)

growth. Strikingly, after the crisis, the labor force increased annually by only 0.9%, remaining almost static. In contrast, the female labor force rose annually by 4.2% in the 1970s, 3.4% in the 1980s, 1.9% in the 1990s, and 1.6% in the 2000s, showing that the slackening in the growth rate of the female labor force is

24) Some researchers emphasize the ratio of employment to population as an indicator of economic conditions. Given that the decision to participate in the labor market or not is one of the important decisions reflecting economic conditions and willingness to work, those analyses that ignore the change in the size of labor force may not provide sufficient information to understand the labor market dynamics.

not severe relative to that of the male labor force. After the crisis, the female labor force increased annually by 1.3%. Consequently, the share of females in the labor force has increased constantly from 36.7% in the 1970s, the 38.7% in the 1980s and 41.3% in the 2000s.

Table 5 presents the estimation results of the responses of the size of labor force to the business cycle. The estimation model is the same as the model previously used, in which only the dependent variables are replaced by the cyclical variation of labor force. Since the number of the population over 15 does not respond to the business cycle, the analysis is conducted not on the labor force participation rate but on the labor force itself. The cyclical variation of the labor force, the dependent variable of the model, is calculated as a log deviation of the seasonally-adjusted labor force from its HP-filtered trend.[25)]

A 1% change in output causes a 0.12% change in the labor force size by a symmetric model without any lagged dependent variable. To check whether the responses of labor force to the business cycle are asymmetric, we estimate asymmetric models in columns (2) and (3). The responses of labor force to business cycle proves to be symmetric by the Wald test in column (2). To investigate the impact of the financial crisis on the response of the size of labor force, dummy variables indicating the post-crisis period are included in the estimation. The estimates of dummy variables are not statistically significant, which means that there is no structural break caused by the crisis in the response of the labor force. Therefore, the response of labor force to the business cycle seems to be symmetric before and after the crisis.

25) The data for the labor force from the first quarter of 1970 to the second quarter of 2006 are used and the trend is calculated by applying the HP filter.

Table 5 **Estimation Result of Labor Force Model**

Co-efficient	Independent variable	Total Labor Force (1)	Total Labor Force (2)	Total Labor Force (3)	Male (4)	Male (5)	Female (6)	Female (7)
		Dependent variable: Cyclical variation of labor force(lf^c)						
β	y^c	.1192*** (.0379)			−.0085 (.0291)			
β^+_0	y^{c+}		.1201* (.0707)	.1323* (.0726)		.0329 (.0566)	.2843** (.1458)	.2725* (.1497)
β^-_0	y^{c-}		.1184* (.0642)	.0601 (.0966)		−.0455 (.0523)	.3994*** (.1380)	.4668** (.2090)
β^+_F	$y^{c+} \cdot d_F$			.0292 (.2585)				−.0788 (.5418)
β^-_F	$y^{c-} \cdot d_F$			.0863 (.1063)				−.0943 (.2245)
γ_1	$lf^c(-1)$	.2112** (.0837)	.2112** (.0840)	.2107** (.0844)	.2135** (.0840)	.2027** (.0851)	.1986** (.0837)	.1955** (.0846)
γ_2	$lf^c(-2)$	−.0023 (.0814)	−.0024 (.0821)	−.0017 (.0826)	.0411 (.0825)	.0270 (.0843)	−.0681 (.0801)	−.0703 (.0808)
Wald test (p-value)								
$\beta^+_0 = \beta^-_0$			not rejected (.9877)	not rejected (.6110)		not rejected (.3958)	not rejected (.6202)	not rejected (.5149)
$\beta^+_F = \beta^-_F$				not rejected (.8334)				not rejected (.9782)
$\beta^+_0 + \beta^+_F = \beta^-_0 + \beta^-_F$				not rejected (.9584)				not rejected (.7679)
R^2		.1410	.1410	.1435	.0517	.0566	.1949	.1960

Note: The data is detrended by HP filter. A constant is included in the estimation but omitted in the presentation. d_F is a dummy variable having 1 in the post-crisis period starting from the first quarter of the year of 1998. The figures in parenthesis are standard errors. *, ** and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively. The rejection of the Wald test is determined at 10% significance level.

In the estimation of the responses of the male labor force to the business cycle, the male labor force does not react to the business cycle both in the symmetric model and in the asymmetric model.[26] The female labor force, however, is

26) Although it was not presented in Table 5, the male labor force does not react to the business cycle as well in the case including currency-crisis dummy.

estimated to be affected by the business cycle.[27] The sixth column in Table 5 shows that the response of the female labor force changes in accordance with the sign of the output cycle. A 1% increase in GDP generates a 0.28% growth in the female labor force in a boom ($y^c \geq 0$), and a 1% reduction in GDP leads to a 0.40% fall in the female labor force in a recession ($y^c < 0$). It seems that the female labor force reacts more substantially in a recession than in a boom. However, the difference between two coefficients is not statistically significant.

The seventh column in Table 5 adds the currency-crisis dummy variable. Given that the coefficient of the currency-crisis dummy variable is not statistically different from 0, the response of the female labor force to the business cycle after the crisis seems not to differ from that before the crisis. Thus, the response of the female labor force to the business cycle can be concluded to be symmetric both before and after the currency crisis.

To sum up the analysis results of the labor force, the male labor force does not react to the business cycle but the female labor force does respond to the business cycle, which means that there is a difference between male and female behavior within the economy. Men, mainly as householders, enter a profession or search for jobs regardless of the economic conditions whereas women participate in the labor market in a boom when employment is available, and do not participate in the labor market in a recession when employment is not available. Hence, the female unemployment rate appears to keep always staying lower than the male's.[28]

IV. Conclusion

Employment has been raised as a matter of grave concern since the currency crisis in Korea as the unemployment rate has risen rapidly and real GDP has considerably declined. At present, though the currency crisis has been overcome, the unemployment rate has remained at a higher level relative to the pre-crisis period. There seem to have been the structural changes in the labor market especially an increase in non-permanent employment and in youth unemployment. This paper shows how the relationship between the business

27) The result in which the response of female labor force to the business cycle is analyzed by the symmetric model shows a 1% increase(decrease) in GDP generates a 0.34% rise(fall) in the female labor force.

28) The female unemployment rate during the period of 1970 to 2006 is 1.76%p lower than the male unemployment rate.

cycle and the unemployment rate has been changing due to the structural changes in the labor market after the currency crisis. In this process, the paper also estimates the responses of the unemployment rate and the responses of the size of labor force to the business cycle.

The findings are as follows. First, the responses of the unemployment rate to the business cycle have become larger since the crisis, and have changed into a asymmetric pattern depending on economic conditions. The result implies that since the crisis, the domestic labor market has become more flexible and firms operate and adjust employment in a more flexible way upon output fluctuations.

Second, in the analysis of the responses of the unemployment rate to the business cycle by age, the responses of the unemployment rate differ by age group and these responses changed after the currency crisis. In the case of those in their 20's, the response was symmetric before the crisis, and has remained symmetric since the crisis. In the case of those in their 30's, the response had a symmetric pattern before the crisis but changed into an asymmetric pattern after the crisis. In the case of those in their 40's and 50's, the unemployment rates reacted to the business cycle only in booms before the crisis showing an asymmetric pattern, but their response of the unemployment rate changed into a symmetric pattern after the crisis. This fact signifies that the job security of those in their 40's and 50's deteriorated in the course of currency crisis and its resolution.

Third, the responses of the size of labor force to the business cycle are estimated to be similar before and after the crisis, and show a symmetric pattern during both periods.

Fourth, the analysis results in which the responses of the size of labor force to the business cycle are divided by gender shows that the male labor force size does not respond to the business cycle at all while the female labor force size reacts to the business cycle sensitively. The result is attributable to the fact that supporting a family is a traditional role of a man, and that a woman's labor participation is closely related to employment opportunities. That is, as soon as a woman loses her job, she immediately exits the labor force. Due to this behavior, the response of the female labor force size to the business cycle is bigger than that of the male labor force size, and therefore the female unemployment rate has remained lower than that of the male.

To sum up, given that the size of labor force reacts to the business cycle symmetrically, the asymmetric responses of the unemployment rate to the business cycle is attributable to the asymmetric pattern of employment

adjustment. Although there are many reasons why employment adjustment is asymmetrical in its response to the business cycle, the followings are the major among them; the strong demand for job security by permanent workers, which has been threatened by the recent increase in non-permanent workers translates into hostile labor-management relations and makes firms hesitant to increase employment even in booms; firms can easily fire non-permanent workers in recessions; and improvements in productivity change firms' incentive to take on additional workers especially in booms.

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