

The Concept of the Employment Rate and Its Empirical Usefulness

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It is well known that the unemployment rate has some problems as it can be somehow affected by marginal participants in the labor market who normally show no consistency in their decisions to participate in the market. In this paper, we consider an alternative indicator, the employment rate or the employment/population ratio. This ratio has the advantage of enabling us to bypass the discouraged worker effect that makes the unemployment rate less reliable.

We have found that the employment rate also has empirical usefulness in some aspects. First, the employment gap rate based on the NAIRE (non-accelerating inflation rate of employment) seems to measure inflationary pressure appropriately. Second, the employment rate appears to contain useful information for explaining the recent sluggish consumption in Korea. Third, the correlation coefficient between the growth rate and the employment rate has become bigger since the 1997 currency crisis. Based on these results, we safely suggest that employment rate be used not only for various economic analyses, but also in making decisions for monetary policy.

JEL Classification Number: C51, E24, J60

Key words: employment rate, employment rate gap, NAIRE(non-accelerating inflation rate of employment), unemployment rate, inflation

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I. Introduction

In today's Korean labor market, lay-offs are frequent and job security is worsening in the process of restructuring. Because of the persistent economic recession and troubled industrial relations, companies prefer to employ workers on a temporary basis and, thus, the quality of employment is also deteriorating. In particular, as youth unemployment has become more of a structural and chronic phenomenon, it may have a negative effect on the long-term economic growth potential. Therefore, it is absolutely imperative to keep an eye on movements in the employment sector.

In general, statistics of the unemployment rate are widely used as an index to grasp the situation of the labor market but these statistics are alleged to have problems because of marginal participants. It is well known that the participation of marginal participants in the labor market is not consistent. Especially as the number of workers employed on daily, temporary and contractual bases, and of the self-employed, who all tend to be marginal participants in the labor market, increased after the financial crisis,¹⁾ it is likely that they have had a big influence on the unemployment rate.²⁾

In this paper, the concept, trend and characteristics of the employment rate (number of people in employment/population aged 15 and over)³⁾, which is not subject to the limitations of the unemployment rate, were examined. In this regard, the OECD has recommended making active use of the employment rate as well as the unemployment rate, and the European Commission is paying more attention to the employment rate than to the unemployment rate, while emphasizing life-long education, an increase in the employment of senior citizens and the relationship between economic growth and employment in order to improve labor market conditions.⁴⁾

Moreover, it was analyzed whether the employment rate is empirically useful. First, to examine the usefulness of the employment rate, non-accelerating inflation rate of employment (NAIRE), which is a concept corresponding to the

1) The ratio of workers on a daily or temporary basis increased dramatically from 41.8% in 1990 to 52.1% in 2000 and then declined somewhat to 48.5% as of November 2004. However this figure is still quite high compared with that in the past. Moreover, the number of self-employed has continuously increased, rising from 5.07 million in 1990 to 5.86 million in 2000 and 6.12 million as of November 2004.

2) As a result, the effectiveness of the NAIRU (Non-accelerating inflation rate of unemployment), which is used as a major information variable, when the central bank implements monetary policy, may have been reduced.

3) Soldiers, military public service personnel, members of the combat police force, prisoners and foreigners were excluded from population aged 15 and over.

4) European Commission, "An Inspection Report on the Lisbon Strategy," 2004.11 (internal working paper of the Bank of Korea (in Korean)).

non-accelerating inflation rate of unemployment, was estimated and then employment gap rate $\langle (\text{employment rate} - \text{NAIRE}) / \text{employment rate} \rangle$ was calculated and the usefulness of employment gap rate, as an index for inflationary pressure, was tested. In addition, we analyzed whether the employment rate is a useful explanatory variable to account for sluggish domestic demand and checked the correlations between economic growth and the employment and unemployment rates.

The structure of this paper is as describes. Firstly, Section II introduces a definition of the employment rate and describes its significance. In Section III, the current situation and trend of the employment rate in Korea are compared with those of advanced countries and the characteristics of employment are also analyzed. The usefulness of the employment rate is empirically tested in several aspects in Section IV and, lastly, Section V sets out a summary of this paper and puts forward some policy implications.

II. Definition and Significance of the Employment Rate

Even though the unemployment rate is the most widely used indicators of labor market conditions, it is well known that it cannot reflect exact labor market conditions because of statistical limitations. Recently, as the domestic economic recession persists, there are an increasing number of people who are voluntarily giving up job search, i.e. the discouraged worker effect. However, the unemployment rate does not take the discouraged worker effect into consideration.

In other words, since the unemployment rate is defined as $\langle \text{the number of unemployed} / \text{labor force} \rangle$ and people who voluntarily gave up job search such as discouraged workers are excluded from the labor force even though they are actually unemployed, the unemployment rate is liable to be underestimated.

Kim (2000) estimated that, in Korea, marginal participants,⁵⁾ who respond rather sensitively to economic fluctuations, made up about average 17% of the population aged 15 and over from 1990 to 1998. Therefore, it is possible that these marginal participants would have had a considerable impact on the

5) "Marginal workers" refers to people who participate in labor force as either the employed or the unemployed but often change to form part of the non-labor force. Therefore, they have no consistency in labor force participation. Discouraged workers are a subset of marginal workers.

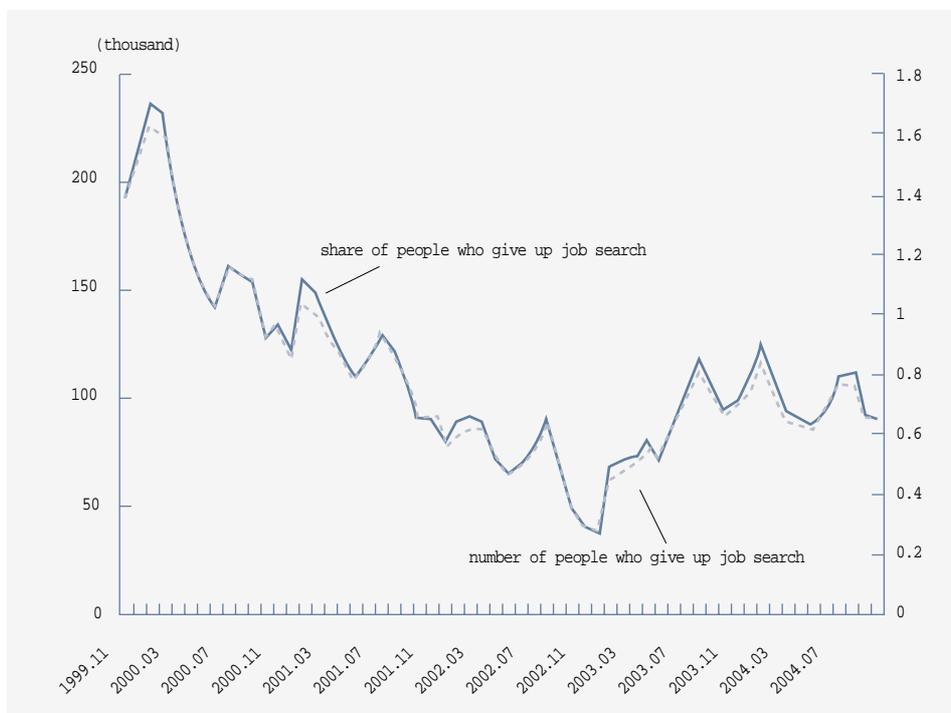
unemployment rate.

Table 1 Ratio of Population by Economic Participation

	constant participants (53.6)		marginal participants (16.9)			non-participants (29.4)
	constantly employed	experience of unemployment	employed ¹⁾	un-employed ²⁾	employed & unemployed ³⁾	
1990~98 average	50.5	3.1	14.1	0.9	1.9	29.4

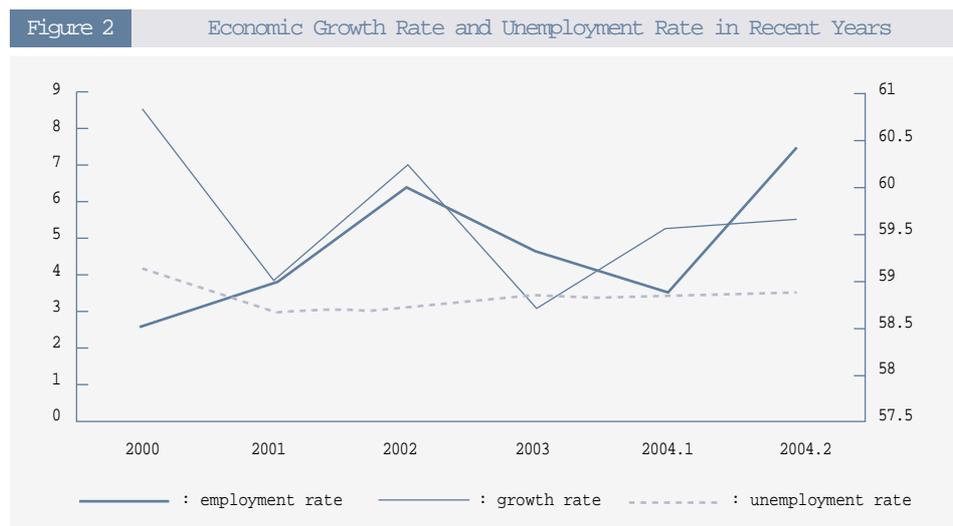
Notes : 1) The employed are assumed to give up economic participants as soon as they become unemployed.
 2) After having given up economic participants and been classed as unemployed, they resume economic activities but are not employed and thus remain classified as unemployed.
 3) They experience more than one episode of both employment and unemployment in the course of resuming economic activities after having stopped them.
 Source : Kim (2000)

Figure 1 Discouraged Workers (Number of people who give up job search)



Statistics of discouraged workers by the National Statistical Office⁶⁾ show that the number of people who had given up job search reached a peak at the end of 1999 after the financial crisis and gradually declined until the end of 2002 but increased again in 2003 as the economic slowdown persisted. The ratio of discouraged workers in the non-labor force also shows the same trend, clearly indicating that the discouraged worker effect has not been negligible in recent years.

[Figure 2] shows the recent economic growth rate and the unemployment rate. It is shown that economic growth rates have fluctuated on quite a large scale between the range of 3~8% since 2000 but the unemployment rate shows only mild fluctuations around the 3% level, and this implies that the close relationship between the economic growth rate and the unemployment rate has been reduced.



As explained above, the unemployment rate is problematic because of marginal participants. Therefore, the employment rate or the employment /population ratio can be used as an alternative to resolve the statistical problem associated with the unemployment rate.⁷⁾ The employment rate is defined as

6) The National Statistical Office has since November 1999 published statistics on the number of people who give up job-search every month.

7) Another alternative to the unemployment rate is the non-employment rate, defined as <the number of unemployed+the non-labor force>/population aged 15 and over>. Therefore, the relationship between the non-employment rate and the employment rate is as follows: <non-employment rate = (1-employment rate)>. Murphy and Topel (1997); Omori(1997); Hunt(1999); and Jones, Joyce and Thomas (2003) analyzed labor

<number of people employed/ population aged 15 and over> and, as a result, the voluntary nature of unemployment does not have by definition any impact on it. For instance, when the number of discouraged workers increases, the number of the unemployed decreases but the employment rate remains the same because the number of people in employment and the population aged 15 and over does not change. Moreover, as Cullison (1975) pointed out, the employment rate has relatively fewer standard errors than the unemployment rate.

The relationship between the employment rate and the unemployment rate can be briefly explained as follows. First, the population aged 15 and over (denoted as P) is made up of the labor force (LP) and the non-labor force (NLP). Labor force participants are then divided into the employed (E) and the unemployed (U). The unemployment rate (UR) is defined as the ratio of the number of unemployed in the labor force ($\frac{U}{LP}$), and the employment rate (ER) as the ratio of the number of people in employment among the population aged 15 and over ($\frac{E}{P}$). Lastly, the labor force participation rate (PR) is calculated as the labor force divided by the population aged 15 and over ($PR = \frac{LP}{P}$). Therefore, an equation linking the employment rate and the unemployment rate can be derived as follows: $ER = (1 - UR) \cdot PR$.⁸⁾

One might presume that the employment rate would increase(decrease) whenever the unemployment rate falls(increases) thinking that the two rates are alternative measures indicating employment condition in the labor market. From 1971 to 2003, however, employment signals in the Korean labor market frequently differed, as the unemployment rate rose even when the employment rate fell. This kind of phenomenon arose in reflection of the relative size and direction of changes in the unemployment and the labor force participation rate. More specifically, the relationship between the employment rate (ER) and the unemployment rate (UR) is as follows:

$$ER = (1 - UR) \cdot PR = \widehat{UR} \cdot PR (\text{where, } \widehat{UR} \equiv (1 - UR))$$

The above equation can be differentiated as follows:

market conditions using the non-employment rate.

$$8) \frac{E}{P} = ER = (1 - UR) \cdot PR = (1 - \frac{U}{LP}) \cdot \frac{LP}{P} = (\frac{E}{LP} \cdot \frac{LP}{P}) = \frac{E}{P}$$

$$\dot{ER} = \dot{UR} \cdot PR + \widehat{UR} \cdot \dot{PR}$$

Therefore, when the unemployment rate (UR) falls (rises), $\dot{UR} < 0$ ($\dot{UR} > 0$), in order for the ER to fall (rise), $\dot{ER} < 0$ ($\dot{ER} > 0$), the condition

$$\left(\frac{\dot{PR}}{PR}\right) < (>) - \left(\frac{\dot{UR}}{\widehat{UR}}\right)$$

must hold.

In other words, a phenomenon in which the two rates move in the same direction occurs when the growth rate of the labor force participation rate, $\left(\frac{\dot{PR}}{PR}\right)$, is smaller (bigger) than $-\left(\frac{\dot{UR}}{\widehat{UR}}\right)$, the rate of decline in $(1-UR)$ ($\equiv \widehat{UR}$).

Using quarterly data from 1971 to 2003 we examined to what extent the two rates show opposite signals in the labor market. It was found that the employment rate and the unemployment rate had opposite signals for 41 quarters out of 131 quarters, representing 31% of the total period tested.⁹⁾

It should be taken into account that the unemployment rate has statistical deficiencies and the unemployment rate and the employment rate often show opposite signals about the labor market. Therefore, it seems more desirable to make good use of the employment rate as well as the unemployment rate to understand the labor market in a more precise way.¹⁰⁾

Table 2 Dissimilarity of Signals from Employment and Unemployment Rates

	same signals(A)	opposite signals(B)	share of opposite signals $\left(\frac{B}{A+B}\right)$
Total	90	41	31.3(=41/131)
Economic upswing	56	25	30.9(=25/81)
Economic downturn	34	16	32.0(=16/50)

Note : Seasonally adjusted quarterly data

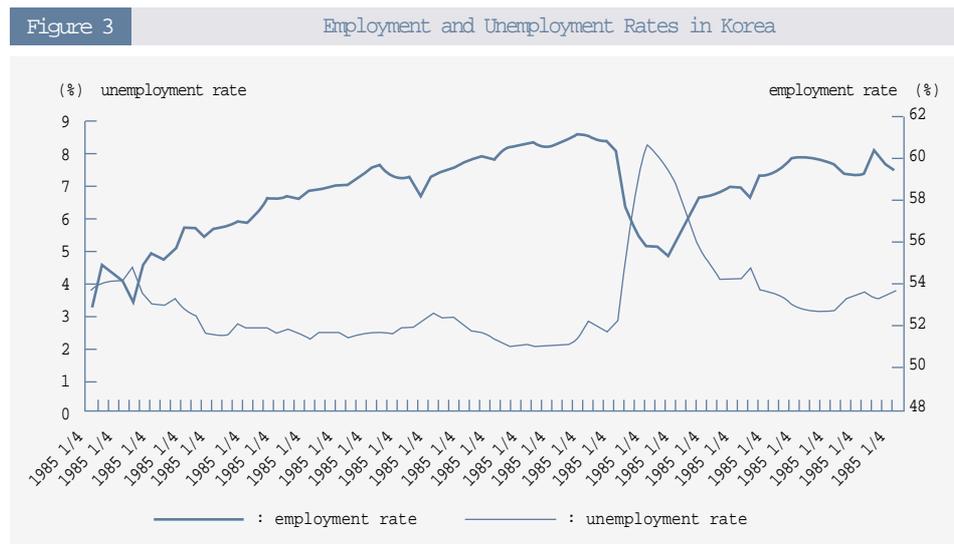
9) The pattern of opposite signals from the two rates was examined with a different time period but the results were generally similar to those from the first test. The results did not differ even when the pre- and post- financial crisis periods were considered.

10) The employment rate and the unemployment rate are complementary rather than substitutes. Notably, the unemployment rate has its own distinctive features as an index, in that it reveals the social suffering resulting from loss of employment.

III. The Employment Rate in Korea: Trend and Characteristics

1. Trend of the Employment Rate

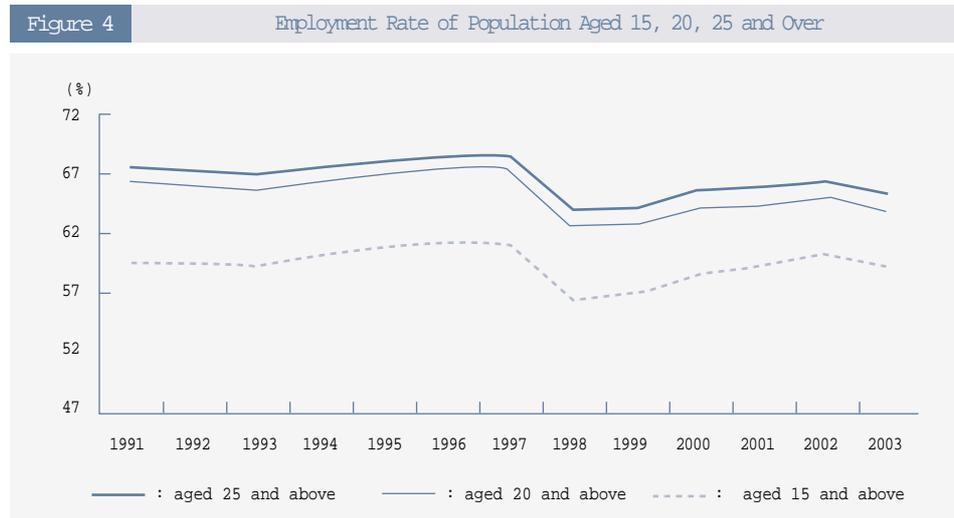
First, the trend of the employment rate on the basis of the population aged 15 and over can be briefly described as follows. [Figure 3] shows that, except for the financial crisis during which the employment rate dropped substantially by about 5 percentage points, after having steadily increased from the mid-1980s. As of the third quarter of 2004, it stood at 59.4% but had still not reached its level of just before the 1997 financial crisis (62.1%).¹¹⁾



As the level of educational attainment is increasing in Korea, the labor force participation rate of the population aged 15 to 24 is only 34.1%, and the employment rate of the population aged 15 to 24 only 31.5%. Therefore, because a considerable number of people from the age of 15 to 24 are classified as part of the non-labor force, the employment rate is likely to have a downward bias when

11) The trends of the employment and unemployment rates can be explained by the relationship between the two: $ER = (1 - UR) \cdot PR$. The labor force participation rate has continuously increased since the 1960s in Korea. Therefore, according to the equation, as long as the employment rate does not increase, the unemployment rate should rise constantly. However, the unemployment rate did not show any long-term trend because the labor force participation rate has continuously increased together with the employment rate.

this age group is taken into consideration.



In consideration of the above situation, the employment rates of the population aged 20 and over and aged 25 and over were examined and they turned out to be 64.0% and 65.3% respectively as of 2003, higher than that of the population aged 15 and over by 4.7 percentage points and 6.0 percentage points(See [Figure 4]).

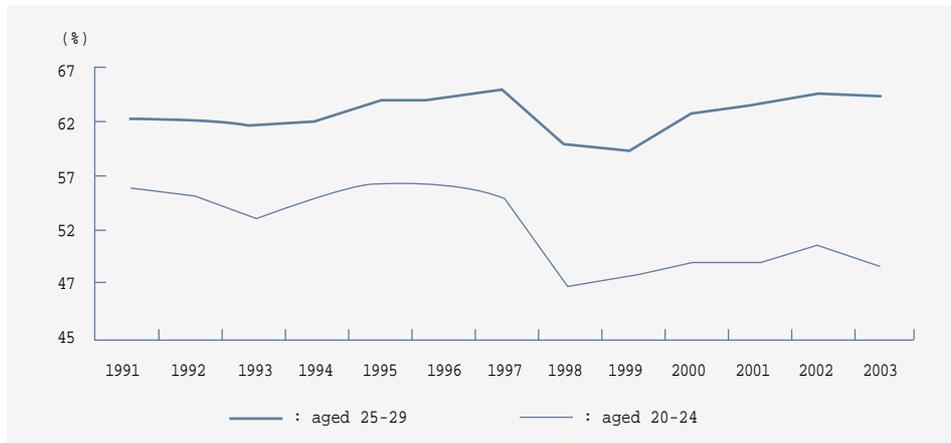
When the employment rate of those in their twenties(20~29) was looked at alone, as of 2003, it was 51.8% for those aged from 20 to 24 and 67.5% for those aged from 25 to 29. The first figure is lower by 7.5 percentage points than that of population aged 15 and over and the second one is higher by 8.2 percentage points than that of the population aged 15 and over.

However, the employment rate in Korea is found to be considerably lower than those of major advanced countries. The employment rates of working age population aged 15~64 for the UK, the US, Japan and OECD¹²⁾ respectively as of 2003 was 72.9%, 71.2%, 68.4%, and 65.0%. On the other hand, it was 63.0% in Korea as of 2003, which was a lot lower than those of major advanced countries.

In the case of the unemployment rate, it maintained 3~4 % from 1970 to the early 1980s and showed a downward trend so as to reach 2% in the late 1980s. However, since soaring to 7% right after the financial crisis, it has fluctuated

12) Employment rate in Canada and Nordic countries such as the Netherlands, Sweden are much higher than in Korea but those in France, Italy and Eastern European countries are either similar or a little lower.

Figure 5 Employment Rate of Those in Their Twenties(20~29)



around 3% level in recent years(See [Figure 3]).

2 Characteristics of the Korean Labor Market in Terms of Employment

The employment rate in Korea is significantly lower than in advanced countries because female labor force participation in the labor market is relatively smaller. To improve that persistently low employment rate, a high level of economic growth should continue but, since the effects of economic growth on job creation have been reduced in recent years, it is hard to expect that the strong growth of the employment rate would necessarily be accompanied by an economic recovery.

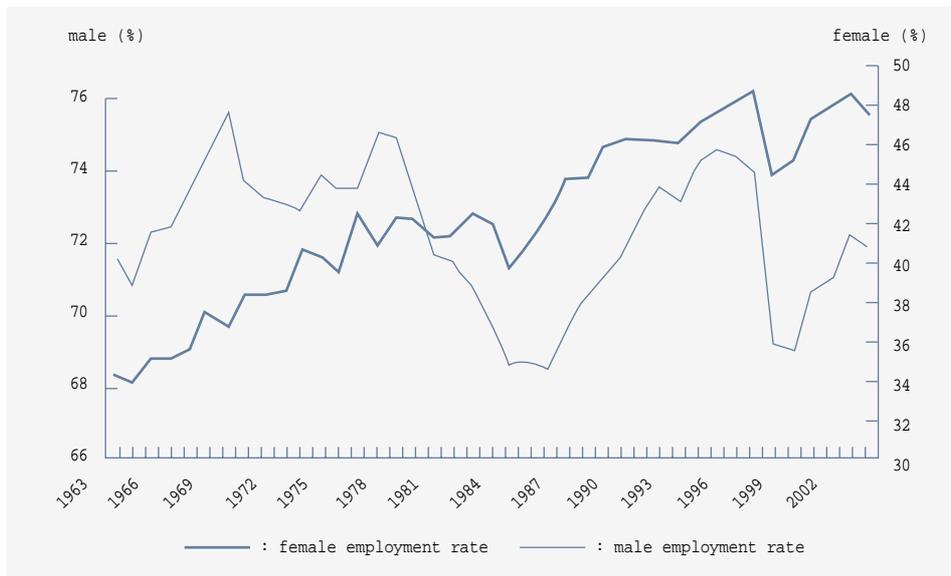
First, [Figure 6] shows that the female employment rate in Korea has continuously increased from the early 1960s except for a dramatic drop by 4 percentage points during the financial crisis. On the other hand, the male employment rate does not show a specific trend as it fluctuates around the 70% level in general.

The employment rate of females aged 15~64 in Korea was compared with that of other countries. As of 2003, it registered 51.1% in Korea but this was some 15 percentage points lower than the US and the UK, whose female employment rate fluctuated around 65% and it was even lower than Japan's 56.8%.¹³⁾

13) If the employment rate is calculated on the basis of the population aged 15~64, students and senior citizens, whose labor force participation rate is likely to be very low, are included in the statistics. Thus, for the purpose of the study, in its calculation only the population aged 25~54 was considered, but it still turned out that the

On the other hand, the difference between male employment rate in Korea and that in advanced countries was found to be relatively smaller than in the case of the female employment rate. As of 2003, Korea's male employment rate was only 2~5 percentage points lower than that of the advanced countries. Consequently, the gender gap between employment rates in Korea is quite similar to that in Japan but more than twice as wide as that in the US and the UK(See [Table 3]).

Figure 6

Employment Rates of Female and Male Workers
(aged 15 and over)

employment rate in Korea was some 15 percentage points lower than that of advanced countries, a result that does not show a big difference from that using the first approach.

International Comparison of Employment Rate of Females Aged 25~54

(as of 2003)

	Korea	U.S	UK	Japan	OECD avg.
female	56.8	72.0	74.1	64.4	63.7
male	88.9	85.9	87.6	92.0	86.7

Source: OECD (2004)

Table 3 International Comparison of Female Employment Rates and Gender Gaps in the Employment Rate (population aged 15~64, as of 2003)

	Korea	U.S.	UK	Japan
Female(A)	51.1(47.4)	65.7(56.1)	66.4(53.2)	56.8(45.9)
Male(B)	75.0(71.9)	76.9(68.9)	79.3(67.1)	79.8(70.1)
(B-A)	23.9(24.5)	11.2(12.8)	12.9(13.9)	23.0(24.2)

Note : () refers that Korean and Japanese statistics are based on age groups over 15 but those for the US and the UK on age groups over 16.
Source : OECD (2004), ILO and labor statistics DB in each country

When the female employment rate (aged 25~64) was examined by educational attainment, with those having graduated from high school representing the lowest education group, it emerged that the higher educational attainment women have, the higher employment rate is likely to be. However, it was still far lower than that of most advanced countries. In contrast with advanced countries, it is noticeable that the employment rate of female workers, who do not have high school diplomas, was the highest in Korea(See [Table 4]).

Table 4 International Comparison of Female Employment Rate by Educational Attainment (as of 2002)

	Korea	U.S.	UK	Japan	OECD average
Above university graduate	55.8(88.9)	78.2(88.3)	85.6(89.7)	64.0(93.8)	74.8(88.7)
High School Diploma	52.8(86.8)	68.3(80.1)	73.3(84.4)	59.8(89.1)	64.5(81.9)
No High School Diploma	60.3(81.6)	45.0(68.0)	47.5(59.1)	53.4(79.3)	41.5(73.5)

Note : Male employment rate in parentheses
Source : OECD (2004)

Considering that augmenting the employment rate is a very important issue nowadays when employment rate has not recovered to the level of the past, we briefly examined whether economic growth and export promotion would be able to improve it.

Input-Output analysis (The Bank of Korea, 2003) shows that a 1 percentage point rise in economic growth induced the additional employment of 112,000 people in 1990 but this number had fallen to 96,000 by 2000, implying we cannot expect economic growth to bring about a large increase of the employment rate.¹⁴⁾

Table 5 Employment Inducement Effect of Economic Growth

	1990	1995	2000
Employment inducement coefficient (number of persons/billion won)	26.8	18.1	12.4
Number of employees in all industries (ten thousand persons)	1,028.2	1,132.6	1,067.3
Number of induced employees in case of a one percentage point rise in economic growth (ten thousand persons) (ratio, %)	11.2(0.71)	10.5(0.61)	9.6(0.58)

14) The effects of export growth on economic growth and employment are important to identify because the Korean economy relies mainly on exports to promote economic growth. However, the Bank of Korea (2003) showed that the employment inducement coefficients of exports declined constantly during the 1990s and it seems that the employment inducement by exports is hard to expect as compared to the past.

Moreover, the employment inducement coefficients of the five major export industries, mainly as semiconductors, automobiles, mobile phones, computer, and ship building have seen a substantial decline. Even though major export items differ from year to year, those items were considered into analysis to reflect the current export situation. Most notably, the employment inducement coefficient of IT sector was far lower, 5~9 persons/billion won as of 2000, than the average for all manufacturing industries of 14.4 persons/billion won in 2000. Therefore, there is little likelihood that favorable export performance by the IT sector will improve employment in Korea.

Employment Inducement Coefficient by Final Demand Items

(Unit :# of persons/billion won)

sector	Year	1990	1995	2000	growth rate(%)	
					1990~1995	1995~2000
Consumption		48.2(48.6)	33.5(47.8)	24.0(49.3)	-7.0	-6.5
Investment		27.8(28.9)	20.3(29.6)	16.1(22.4)	-6.1	-4.5
Export		46.3(22.5)	25.8(22.6)	15.7(28.2)	-11.0	-9.5
Semiconductors		34.5	10.1	5.3		
Mobil phones		51.7	20.2	8.4		
Automobiles		42.8	22.1	14.1		
Computers		47.9	24.4	9.2		
Ship Building		50.0	23.5	14.3		
Manufacture (average)		39.0(42.7)	25.1(27.9)	14.4(20.1)		
Average		41.4	27.7	19.9	-7.7	-6.4

Note : share of final demand items in parentheses
Source: The Bank of Korea(2003)

15) Cullison (1975) argued that an employment-related index is necessary to understand the labor market. That is, he pointed out that a kind of pressure index, which is different from the unemployment rate, is needed because of the discouraged worker effect on the unemployment rate and rapidly increasing labor force participation rate.

IV. An Analysis on the Usefulness of the Employment Rate

In this section, we analyzed to what extent the employment rate is empirically useful. First, the non-accelerating inflation rate of employment (NAIRE)¹⁵⁾ was derived and the explanatory power of the NAIRE on inflation was compared with NAIRU of the unemployment rate. Moreover, we examined whether the employment rate has a relationship with private consumption because sluggish domestic demand is often attributable to the deterioration of job stability. Lastly, we analyzed how the correlation between employment rate and economic growth has changed in the pre and post financial crisis periods.

1. The Employment Gap Rate and Inflation

1-1. Definition and Estimation of the NAIRE

(1) Model

The central bank draws on the NAIRU, or the natural rate of unemployment, as an inflationary pressure index when it establishes and implements monetary policy. The NAIRU or the natural rate of unemployment means the long-term trend of structural and frictional unemployment. However, as the unemployment rate is affected by marginal participants, estimated NAIRU, which is based upon the unemployment rate, can be problematic. In other words, even though marginal participants including discouraged workers are statistically categorized as part of the non-labor force when they are unemployed, this kind of unemployment is frictional and structural. Therefore, the estimated NAIRU, based on the real unemployment rate, can differ from the conceptual NAIRU.

As was pointed out, the employment rate, which is not influenced by marginal participants, can be utilized and the NAIRE, which corresponds to the NAIRU, can be estimated and used because the above problems can be avoided with the NAIRE. As a result, when the concept of the NAIRU is applied to the employment rate, the NAIRE can be defined as that employment rate level at which the inflation rate does not accelerate in the long term when there is no

The NAIRE in this paper, being an employment-related index, can be used as an analytical tool to grasp labor market conditions.

The NAIRE can be defined as "an employment rate level at which the inflation rate is not accelerated" and like the NAIRU it is also a kind of inflationary pressure index in the labor market. There are many papers in which a more detailed explanation of the natural rate of unemployment or the NAIRU can be found.

economic disturbance on the supply side.¹⁶⁾

In order to estimate NAIRE, the model of the natural rate of unemployment developed by King, Stock and Watson (1995), and Kuttner (1994) was employed.¹⁷⁾ To take into consideration the stochastic trend, a multi-variable model was employed for the NAIRE estimation model, comprising three observable variables, the labor force participation rate, the employment rate and the inflation rate, and two unobservable variables, the natural labor force participation rate and the NAIRE. In the estimation model of this paper, the labor force participation rate was used as an endogenous variable¹⁸⁾ in order to consider changes in the employment rate resulting from the supply side of the labor market. In addition, the labor force participation rate was divided into a long-term trend component and a cyclical component and the natural labor force participation rate was classified as a long-term trend. The employment rate was also separated into a long-term trend component and a cyclical component and NAIRE was regarded as a long-term trend component and made explicable by the labor force participation rate. Lastly, inflation is explained by the employment rate gap (employment rate – NAIRE) and the imported price of raw materials as a factor of supply shocks and the economic growth rate as a factor on the demand side were included in the inflation equation. The estimation model of NAIRE is set out in more detail in the next section. The data in the model are all quarterly data, running from the first quarter of 1970 to the third quarter of 2004.

(a) Labor Force Participation Rate

In general, a non-stationary I(1) variable¹⁹⁾ with unit root can be separated into a random walk process and a cyclical component. Because the participation rate (PR_t) is a non-stationary I(1) variable with unit root, the random walk process was regarded as a long-term trend component and the natural labor force

16) Since marginal participants are likely to respond sensitively to business fluctuations, they are often regarded as factors of cyclical components of unemployment rate. However, because marginal participants, especially discouraged workers, can be viewed as structural and frictional unemployment, it can be said changes in the activities of marginal participants prompted by business fluctuations are not necessarily related to the cyclical fluctuation of unemployment. Notably, marginal participants are likely to affect estimation of the natural rate of unemployment, by serving as a measurement error.

17) The GDP gap and employment rate gap are widely used as inflationary pressure indexes. In the case of Korea, along with the model of King, Stock and Watson (1995), Chang (1997) and Kim and Moon (2000) adopted the GDP gap as a pressure index while Moon(2003) used the unemployment gap as the pressure index.

18) The equation relating the employment rate and the labor force participation rate, $ER = (1 - UR) \cdot PR$, holds.

19) [Table 7] refers to the results of the unit root test against the labor force participation rate and the employment rate.

participation rate was denoted as such in equation (1). ν_t^{PR*} is white noise in equation (1):

$$PR_t^* = PR_{t-1}^* + \nu_t^{PR*} \quad (1)$$

The participation rate gap ($PR_t - PR_t^*$) was included as an explanatory variable in equation (2), the equation for the labor force participation rate, because it was assumed that the labor force participation rate would return to the natural labor force participation rate in the long term although diverging from the natural labor force participation rate in the short term. In addition, the economic growth rate (X_t) was added to equation (2) because it can have an influence on labor force participation rate. ε_t^{PR} is white noise in the equation and is assumed to be mutually independent of ν_t^{PR*} in the first equation.

$$\Delta PR_t = \sum_{i=1}^{p1} \alpha_i (PR_{t-i} - PR_{t-i}^*) + \sum_{j=1}^{p2} \beta_j \Delta PR_{t-j} + \sum_{k=1}^{p3} \gamma_k X_{t-k} + \varepsilon_t^{PR} \quad (2)$$

(b) Employment Rate

Just as in equation (1), to consider that the employment rate (ER_t) is a non-stationary I(1) variable with unit root, the NAIRE(ER_t^*) was employed as a kind of trend in equation (3).

$$ER_t^* = ER_{t-1}^* + \nu_t^{ER*} \quad (3)$$

Equation (4) is an equation for the employment rate and the employment rate gap ($ER_t - ER_t^*$) was included in the equation as an independent variable because it was assumed that the employment rate would return to the NAIRE in the long term just like the labor force participation rate. Moreover, the labor force participation rate and the economic growth rate (X_t) were used as explanatory variables because they can affect the employment rate. Lastly, ν_t^{ER*} in the equation (3) and ε_t^{ER} in equation(4) are white noise and assumed to be mutually independent:

$$\Delta ER_t = \sum_{i=1}^{q1} \delta_i (ER_{t-i} - ER_{t-i}^*) + \sum_{j=1}^{q2} \kappa_j \Delta PR_{t-j} + \sum_{k=1}^{q3} \lambda_k X_{t-k} + \varepsilon_t^{ER} \quad (4)$$

(c) Inflation

Equation (5) is an equation for inflation and shows that the inflation rate will

20) Therefore, equation (5) can be viewed as an error correction model about inflation.

change whenever the employment rate and the NAIRE have disparities.²⁰⁾ In addition, the growth rate of imported raw material prices (IMP_t) and the economic growth rate (X_t) were included as explanatory variables considering that inflation is influenced by external supply shocks and demand side factors:

$$\Delta \pi_t = \sum_{i=1}^{r1} \phi_i (ER_{t-i} - ER_{t-i}^*) + \sum_{j=1}^{r2} \psi_j \Delta \pi_{t-j} + \sum_{k=1}^{r3} \tau_k IMP_{t-k} + \sum_{l=1}^{r4} \omega_l X_{t-l} + \varepsilon_t^\pi \quad (5)$$

where ε_t^π is white noise.

Statistically less significant variables were excluded from the NAIRE model and the final model for real estimation is as follows:²¹⁾

$$PR_t = PR_{t-1} + \nu_t^{PR*} \quad (1)'$$

$$\Delta PR_t = \alpha(PR_{t-1} - PR_{t-1}^*) + \beta_1 \Delta PR_{t-1} + \beta_2 \Delta PR_{t-2} + \gamma X_{t-1} + \varepsilon_t^{PR} \quad (2)'$$

$$ER_t^* = ER_{t-1}^* + \nu_t^{ER*} \quad (3)'$$

$$\Delta ER_t = \delta (ER_{t-1} - ER_{t-1}^*) + \kappa \Delta PR_{t-1} + \lambda X_{t-1} + \varepsilon_t^{ER} \quad (4)'$$

$$\Delta \pi_t = \phi (ER_{t-1} - ER_{t-1}^*) + \psi \Delta \pi_{t-1} + \tau IMP_t + \varepsilon_t^\pi \quad (5)'$$

(2) NAIRE Estimation Result

Equations (1)' ~ (5)' were estimated by Kalman Filter²²⁾ using a latent component model, which is expressed as state space model.²³⁾ [Table 6] illustrates the estimation results of the above models and it turned out that most

Table 6 Estimation Results of the NAIRE Model

coefficients	estimates	t value	coefficients	estimates	t value
α	-0.999***	141.00	ψ	-0.704***	3.99
β_1	-0.015	0.23	τ	0.031***	7.14
β_2	0.068	0.98	σ^{PR*}	0.348***	6.03
γ	-0.049***	2.56	σ^{ER*}	0.562***	11.26
δ	-0.994***	128.14	$\sigma^{\nu ER*}$	0.485***	6.47
κ	-0.037	0.53	$\sigma^{\nu PR*}$	0.611***	9.76
λ	-0.095***	3.92	$\sigma^{\varepsilon \pi}$	2.934***	16.11
ϕ	-0.139***	9.36			

Note : *** indicate significance at the 1% level.

21) The economic growth rate was excluded from the inflation equation in the estimation model because of its low statistical significance.

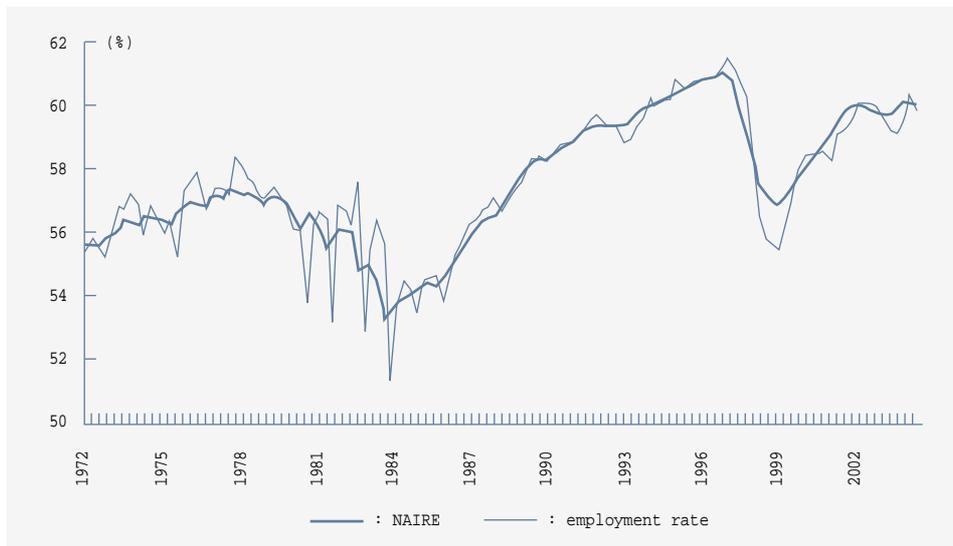
22) GAUSS OPTMUM procedure was used as the optimization procedure for estimating the models.

23) More detailed explanation concerning the latent component model and the state space model can be found in Chang (1996) or Kuttner (1994).

of coefficients are highly statistically significant.

The NAIRE was estimated by the above empirical estimation model and [Figure 7] shows that it averaged 59.8% after the financial crisis, specifically from the first quarter of 2001 to the second quarter of 2004. In addition, the employment gap rate was calculated from the estimated NAIRE and, using the employment gap rate, inflationary pressure from the labor market was examined. The employment gap rate showed negative signs for most of the estimation period after the financial crisis and the analysis found that there had been no inflationary pressure from the labor market(See [Figure 8]).²⁴⁾

Figure 7 Employment Rate and NAIRE(1972. 1/4~2004. 3/4)



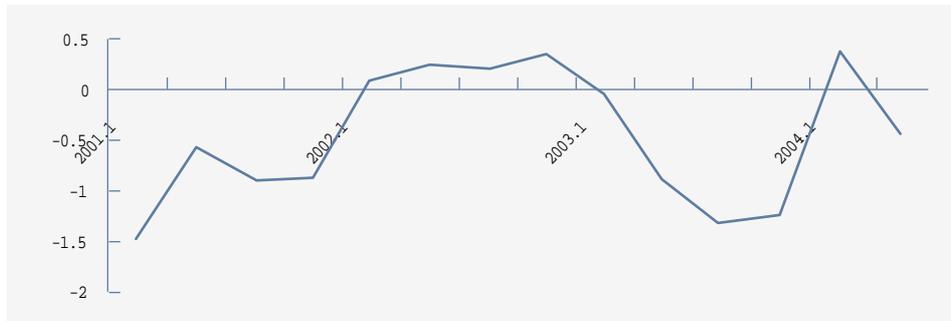
24) Since the existing NAIRU does not take into account changes in the labor force participation rate, adjusted NAIRU was calculated as follows, using the relation among the unemployment, employment, and the labor force participation rate, $UR^* = (1 - ER^*/PR^*)$ in consideration of the estimated natural labor force participation rate in this paper.

Unemployment Rate and the NAIRU (2001.1/4~2004.2/4)



It is shown that the recent unemployment rate level has been higher than the NAIRU. Therefore, even in terms of the unemployment rate, it seems that there has been almost no inflationary pressure from the labor market.

Figure 8

Employment Gap Rate
(2001. 1/4 ~ 2004. 2/4)

1-2. The Usefulness of NAIRE

We examined whether the estimated NAIRE in the previous section can explain the movements of real inflation. The inflation model was tested, using the employment gap rate,²⁵⁾ unemployment gap rate,²⁶⁾ as kinds of inflationary pressure indexes, and the growth rate of broad money (a new version of M2),²⁷⁾ and economic growth rate as explanatory variables. Before the estimation, it was examined with unit root test whether each variable is a stationary I(0) variable and it turned out that every variable is stationary.²⁸⁾ On the basis of this, OLS (Ordinary Least Square) was used for the estimation of the inflation model. To test the usefulness of NAIRE in recent years, the estimation period was limited from the first quarter of 1990 to the third quarter of 2004.

The estimated inflation equation can be written more specifically as equation (6).²⁹⁾

$$\pi_t = \alpha + \beta EGAP_{t-1} + \gamma X_t + \delta M_t + \varepsilon_t \quad (6)$$

In the equation, π_t is the inflation rate, $EGAP_t \left(= \left[\frac{ER_t - ER_t^*}{ER_t} \right] \right)$ is the

25) The employment gap rate is calculated as the employment rate gap divided by real employment rate.

26) To compare and analyze the NAIRE and NAIRU in a more precise way, the NAIRU should be estimated with an elaborate model as the NAIRE but in this paper, natural rate of unemployment was calculated with HP filter (Hodrick-Prescott filter) as a matter of convenience.

27) Broad money (a revised version of M2) was used as a money variable because reserve money or narrow money (a new version of M1) has limitations on reflecting liquidity in the market and in case of M3, timeliness can be problematic because of its late statistical publication.

28) It is possible that growth rate of Broad money may be an I(1) variable but at the 10% level, it turned out to be stationary. Therefore, although it is marginal, it was regarded as an I(0) variable.

29) 1 was used for the time lag of the employment gap rate because the time lag for the employment rate gap, an explanatory variable in the inflation equation of the NAIRE estimation model was 1.

Table 7 Result of Unit Root Test
(1990.1/4 ~ 2004.3/4)

variables	ADF	PP	KPSS
Inflation	-5.49(0.00)***	-5.61(0.00)***	0.35
Employment rate	-2.45(0.13)	-2.25(0.19)	0.50**
Labor force participation rate	-2.06(0.26)	-2.22(0.20)	0.87***
Employment gap rate	-4.64(0.00)***	-3.26(0.02)**	0.14
Unemployment gap rate	-3.41(0.01)**	-3.25(0.02)**	0.08
Growth rate of Broad Money	-2.81(0.06)*	-2.81(0.06)*	0.80***
Economic growth rate	-5.72(0.00)***	-5.73(0.00)***	0.10
Growth rate of imported raw Material prices	-6.69(0.00)***	-7.57(0.00)***	0.08

Note : 1) ADF stands for Augmented Dicky-Fuller, PP for Phillips-Perron, and KPSS for Kwiatkowski-Phillips-Schmidt-Shin.
 2) Optimal lag length is based upon Schwarz's Information Criterion.
 3) The null hypothesis for ADF and PP is that unit root exists and that for KPSS is that unit root does not exist.
 4) *, **, *** mean significance at the 10%, 5% and 1% levels, respectively.
 5) P-value in parentheses.

employment gap rate, X_t is the economic growth rate, M_t is the growth rate of Broad money (a new version of M2).

Aside from this, equation (7) was estimated using the employment gap rate, which is similar to the equation (6) and its results were compared with that of the equation (6):

$$\pi_t = \alpha' + \beta'UGAP_{t-1} + \gamma'X_t + \delta'M_t + \nu_t \quad (7)$$

$UGAP_t \left(\equiv \left[\frac{UR_t - UR_t^*}{UR_t} \right] \right)$ refers to the unemployment gap rate in the above equation.

The inflation equation was estimated with different combination of variables. First, the employment gap rate (or unemployment gap rate) and the growth rate of imported raw material prices were included in every model and the growth rate of Broad money and economic growth rate were included either separately or together to the model. According to the estimation results, the employment gap rate showed high statistical significance in most models and signs consistent with the theory.³⁰⁾ On the other hand, the significance of the unemployment gap rate proved to be very low and it was found that the employment gap rate is a

30) In the case of model 2 in which the growth rate was used as an explanatory variable, the statistical significance of the growth rate turned out to be low. It is expected that, if the output gap were to be used as an explanatory variable, it would be more significant. However, since it is hard to measure, the output gap was not considered in this paper.

more useful pressure index for inflation than the unemployment gap rate(See [Table 8]).

Moreover, using the simple J test of Davidson and MacKinnon (D-M),³¹⁾ we examined which variable is more effective in explaining inflation, the employment gap rate or the unemployment gap rate. For the purpose of D-M's J test, equations (8) and (9) were used.

Table 8 Estimation Results of Inflation Equation(1990. 1/4-2004. 3/4)

variables	Employment rate model			Unemployment rate model		
	Model1	Model2	Model3	Model1	Model2	Model3
Constant	0.74*** (4.08)	1.25*** (9.58)	0.69*** (2.92)	0.59*** (3.86)	1.22*** (8.33)	0.51** (2.28)
Employment gap rate	0.22** (2.00)	0.28** (2.35)	0.21* (1.91)	—	—	—
Unemployment gap rate	—	—	—	-0.001 (0.36)	-0.003 (0.53)	-0.001 (0.30)
Growth rate of Broad money	0.12*** (2.91)	—	0.13*** (2.91)	0.15*** (3.41)	—	0.15*** (3.44)
Economic growth rate	—	-0.03 (0.50)	0.01 (0.36)	—	-0.08 (1.15)	0.01 (0.59)
Growth rate of imported raw material prices	0.05*** (3.10)	0.04** (2.57)	0.05*** (3.08)	0.06*** (3.87)	0.05*** (2.90)	0.06*** (3.82)
D.W.	1.80	1.53	1.78	1.69	1.13	1.66
R^2	0.43	0.34	0.43	0.38	0.28	0.39

Note: 1) *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.
2) t-value in parentheses.

$$\pi_t = \alpha + \beta EGAP_t + \gamma(\hat{\pi}_t^u) + \varepsilon_t \quad (8)$$

$$\pi_t = \delta + \theta UGAP_t + \lambda(\hat{\pi}_t^e) + \eta_t \quad (9)$$

where, $\hat{\pi}_t^u = \hat{a} + \hat{b} UGAP_t$ and $\hat{\pi}_t^e = \hat{c} + \hat{d} EGAP_t$.

By testing the null hypothesis of equation (8) $H_0: \gamma=0$ and that of equation (9) $H_0: \lambda=0$, we can determine which variable is more suitable for explaining inflation, the employment gap rate or the unemployment gap rate. While the null hypothesis of equation (8) was accepted, that of equation (9) was rejected. Therefore, the employment gap rate turned out to be superior to the unemployment gap rate as an inflationary pressure index. As a result, it can be concluded from these tests that the employment gap rate is a more effective

index of inflationary pressure than the unemployment gap rate.³²⁾

null hypothesis	estimates	t value (p value)
$H_0: \gamma = 0$	-1.48	1.07(0.14)
$H_0: \lambda = 0$	1.32	2.61(0.00)

2. Employment Rate and Private Sector Consumption

To examine the usefulness of the employment rate, we analyzed to what extent it can explain the sluggishness of private sector consumption, which has been blamed for the slowdown of the Korean economy. Apart from the employment rate and unemployment rate as explanatory variables of private sector consumption, Gross National Income (GNI), and the interest rate (yield on corporate bonds) were included as in previous theories and empirical studies (Campbell and Mankiw(1990), Ludvigson(1999), Kim & Moon (2001), the Bank of Korea (2004), and Chang & Hwang (2004)). Moreover, private sector debt and redemption capacity were added to the model because households' debt

Variables	Tests	ADF	PP	KPSS
Δ real private sector consumption		-5.20(0.00)***	-5.20(0.00)***	0.19
Δ employment rate		-4.36(0.00)***	-4.40(0.00)***	0.06
Δ unemployment rate		-4.28(0.00)***	-3.10(0.03)**	0.06
Δ real private sector debt		-4.18(0.00)***	-4.11(0.00)***	0.16
Δ redemption capacity of private sector		-5.50(0.00)***	-5.57(0.00)***	0.13
Δ yield on corporate bonds		-5.79(0.00)***	-4.44(0.00)***	0.09
Δ real GNI		-6.10(0.00)***	-6.10(0.00)***	0.22

Note: 1) ADF stands for Augmented Dicky-Fuller, PP for Phillips-Perron, and KPSS for Kwiatkowski-Phillips-Schmidt-Shin.
 2) Optimal lag length was based upon Schwarz's Information Criterion.
 3) The null hypotheses for ADF and PP are that unit root exists while that for KPSS is that a unit root does not.
 4) **, *** represent significance at the 5% and 1% levels respectively.
 5) p-value in parentheses.

32) Considering that the first lagged variable was used when the NAIRE and the inflation equation were estimated, the J test was conducted with the lagged variable of 1st lag but the result was not significantly different.

34) Since publication of the GNI data occurs later than that of GDP data, the analysis period was adjusted to the second quarter of 2004.

and redemption capacity have a huge influence on private sector consumption. Before the estimation, a unit root test against 1st differenced variables of each variable was conducted and it was found that all the variables are stationary(See [Table 10]).

The estimation model for private sector consumption is as follows:

$$\Delta RCONS_t = \alpha + \beta \Delta ER_t + \gamma \Delta RPD_t + \delta DR_t + \kappa \Delta Y_t + \lambda \Delta CBR_t + \varepsilon_t \quad (10)$$

$$\Delta RCONS_t = \alpha' + \beta' \Delta UR_t + \gamma' \Delta RPD_t + \delta' DR_t + \kappa' \Delta Y_t + \lambda' \Delta CBR_t + \eta_t \quad (11)$$

In the above equations, $RCONS_t$ refers to real private sector consumption, ER_t to the employment rate, UR_t to the unemployment rate, RPD_t to real private sector debt, DR_t to the redemption capacity of the private sector, Y_t to real GNI and lastly CBR_t to the yield on corporate bonds maturing in 3 years. Private sector debt was divided by the consumer price index and transformed into real values.

When all explanatory variables were included, the estimation result showed that the employment rate proved to be statistically significant as did the unemployment rate. However, since redemption capacity turned out to be not significant, the model excluding the variable was estimated and the results were not much different from those with the variable.

Table 11 Estimation Result of Private Sector Consumption

variables ⁵	Employment rate model		Employment rate model	
	Model 1	Model 2	Model 1	Model 2
Employment rate(ER)	0.38** (2.05)	0.41** (2.17)	–	–
Unemployment rate(UR)	–	–	–0.001*** (2.85)	–0.001*** (3.25)
Real private sector debt(RPD)	0.20*** (2.86)	0.28*** (2.71)	0.17** (2.40)	0.28*** (2.89)
Redemption capacity of private sector(DR)	–	–0.12 (0.98)	–	–0.19 (1.63)
Interest rates(CBR)	–0.003*** (2.63)	–0.003** (2.50)	–0.003** (2.53)	–0.002** (2.34)
Real GNI(Y)	0.83*** (8.23)	0.82*** (8.09)	0.78*** (7.81)	0.75*** (7.50)
D.W.	2.34	2.37	2.28	2.39
R ²	0.84	0.83	0.85	0.85

Note: 1) ** and *** represent significance at the 5% and 1% levels, respectively.
2) t-value in parentheses.

3. Employment Rate and Economic Growth Rate

Finally, to test the usefulness of the employment rate, we examined how the relationship between employment rate and economic growth rate had changed. It was found that the correlation between the two has become bigger in recent years, having registered 0.30 in 1990~97 before the financial crisis, but 0.50 in 2000. 1/4~2004. 3/4. On the other hand, the correlation between the unemployment rate and economic growth proved to have deteriorated, having registered -0.50 in the pre-crisis period and -0.33 in the post-crisis period, showing a significant drop(See [Table 12]).³⁵⁾

Period	1990.1/4~1997.4/4	2000.1/4~2004.3/4
Employment rate	0.30	0.50
Unemployment rate	-0.50	-0.33

On the other hand, the Granger causality test between employment rate and economic growth rate was analyzed and it was found that the economic growth rate affects employment rate while the employment rate does not have an influence on the economic growth rate.³⁶⁾ This is because, in terms of the business cycle, economic growth affects labor demand with a certain time lag and, thus, employment trails economic growth with a considerably long time lag.³⁷⁾

Null hypothesis	F - statistic	p - value
employment rate \rightarrow growth rate	0.31	0.58
growth rate \rightarrow employment rate	6.58	0.01

35) This seems to reflect the fact that economic growth fluctuate widely and the employment rate shifts a considerable extent but the unemployment rate did not appear to move as much([Figure 2] in section II).

36) Schwartz's Information Criterion was used for optimal lag length and the first lag proved to be the optimal one.

37) It seems that the low correlation coefficients between the economic growth rate and changes in both the employment and unemployment rates are attributable to this.

V. Summary and Policy Implications

In the current Korean labor market, lay-offs are frequent and job security is worsening in the process of restructuring while, because of the protracted domestic economic downturn and troubled labor-management relations, companies prefer to employ workers on a temporary basis so that the quality of employment is also deteriorating. Notably as youth unemployment has become a more structural and chronic phenomenon, it may have a negative effect on the long-term economic growth potential. Therefore, it is absolutely vital to keep a close watch on movements in the employment.

In general, unemployment rate is widely used as an index to grasp the situation of the labor market but it is blamed to have problems because of marginal participants, whose participation in the labor market is not consistent. In this paper, we examined the concept, trend and characteristics of the employment rate (number of persons in employment/population aged 15 and over), which is not subject to the limitations of the unemployment rate. In this regard, the OECD recommended making active use of the employment rate in addition to the unemployment rate and the European Commission is now paying more attention to the employment rate than the unemployment rate.

The Korean employment rate had shown continuous increase from the mid-1980s but, after having fallen substantially by about 5 percentage points during the financial crisis, it has still not recovered to its level of immediately before the crisis (62.1% in 1997), registering 59.4% in the third quarter of 2004. When the Korean employment rate (based upon the population aged 15~64) was compared with that of major advanced countries, it turned out to be rather low, standing at 63.0% in 2003, as against 72.9% in the UK, 71.2% in the US and 68.4% in Japan. Moreover, while there was little difference from advanced countries in terms of the male employment rate, the Korean female employment rate proved to be markedly low compared with that of advanced countries irrespective of age or educational attainment. It was noticeable, however that the employment rate for females in Korea was higher among those who had not graduated from high school.

In addition, it was analyzed whether the employment rate is empirically useful or not. First, using the employment rate, we estimated the NAIRE (non-accelerating inflation rate of employment), which corresponds to the NAIRU (non-accelerating inflation rate of unemployment). Then, the employment gap rate $((\text{employment rate} - \text{NAIRE}) / \text{employment rate})$ was calculated and an analysis made of the usefulness of the gap as an index for inflationary pressure.

It turned out to be far superior for this purpose to the unemployment gap rate.

Moreover, it was ascertained that the employment rate is a useful variable for explaining sluggish domestic demand and, it emerged that, since 1990, the correlation between the employment rate and the economic growth rate has increased dramatically, while the correlation between the unemployment rate and the economic growth rate has substantially declined. Therefore, it is strongly advocated that the employment rate be used in economic analysis as well as in establishment and conduct of monetary policy.

Finally, an analysis on the impact of structural change in the labor market on both the employment rate and the estimation of the NAIRE in Korea is required, since it is highly likely that the 1997 financial crisis brought about structural changes in the labor market. This research topic should constitute part of the future research agenda.

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