Decoupling of Employment Growth from Economic Growth in Korea

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Abstract

Recently, there appears to be a decoupling phenomenon between economic growth and employment in Korea beginning 2011, meaning employment growth remained high although Korea went through a slowdown in economic growth. We examine whether the unusual phenomenon is caused by labor supply side factors such as population aging and baby boom generation in population structure. In addition to providing stylized facts of demographics of population in Korea, we estimate coefficients with the Economically Active Population Survey data of Korea in the spirit of Okun (1962) and Ball et el. (2017).

The estimation results of coefficient of Okun's law related to unemployment is -0.361 for the whole period from 1990 to 2018, and -0.404 for the period from 1990 to 2010, respectively. This demonstrates the weakness of Okun's law since 2010, raising the possibility that there has been some structural change in the labor market since 2010. For the Okun's Law for employment, the coefficient of employment change for growth change is estimated to be 0.667 for the whole period, and 0.721 for the period from 1990 to 2010. The results imply that this employment inducement effect is decreasing in Korea.

To see which age groups have caused structural changes between growth and employment since 2010, we estimate the seemingly unrelated regressions (SUR) model by age groups. Our results suggest that there has been a structural change in the relationship between growth and the labor market since 2010, especially in age groups of the 20s and 60s. Our results also show that the 20s enter into the state of noneconomic activity immediately after unemployment rather than stay in the unemployment status. For the 30s, the results are still highly correlated after 2010, and the correlation has risen since 2010 implying active job search continues even after unemployment.

I. Motivation

Okun (1962) reported an empirical finding that there is a negative relationship between unemployment and economic growth: A three percent increase in economic growth followed by a one percent decrease in the unemployment. Since then, the finding, known as Okun's Law, has been a textbook rule of thumb in economics. However, there has been an ongoing debate on the validity of the Okun's Law in different contexts. For example, in their paper, Gordon (2010), Meyer and Tasci (2012), and Cazes et al. (2012) questioned the stability of the results. In contrast, Ball et el. (2017) found stability in the negative relationship in Okun (1962) for the U.S. and 20 OECD countries with updated data: from 1948 to 2011 for the U.S. and from 1980 to 2011 for the 20 OECD countries, respectively.

Interestingly, there appears to be a decoupling phenomenon between economic growth and employment in Korea beginning 2011 as shown in Figure 1.

Figure 1: Employment Growth and Real GDP Growth: Korea

During the period from 2000 to 2010, employment path generally accompanied or followed the economic growth path. However, this phenomenon has not been observed since 2011. In other words, despite the slowdown in economic growth, employment growth remains

high. In particular, despite the sharp decline in growth rates in 2011 and 2012, the number of employees increased by more than 400,000 each year.

According to a traditional economic theory, labor demand is the derivative demand of production, so production and employment might be highly correlated. This is because that in the labor demand-supply curve diagram the increase in production moves the labor demand curve to the right. However, as shown in the existing empirical analysis, the labor supply curve is relatively stable to economic fluctuations. Therefore, the increase in production due to the economic upswing generally causes the increase in labor demand, and then induces the increase in the equilibrium quantity of labor. So, there exists a high degree of co-movement between employment and production. Of course, since adjustment costs are required to increase or decrease employment, employment fluctuations may not be accompanied by economic fluctuations at the same period. According to the existing empirical analysis on Korean labor market, it is estimated that the employment change is delayed by about 6 months to the economic fluctuation in Korea.

In contrast, as we see in Figures 2-6, the employment and economic growth in major economies appear to move concurrently. Specifically, we observe the contemporaneous trends of the increase in the number of employees and real GDP growth rate in United States, Euro area, and UK since 1990. In most countries, a considerable degree of co-movement can be identified, with the co-movement being the highest in the Euro area. However, these co-movements are different from that of Korea in that they continue even after 2010. In other words, unlike Korea, the co-movement between employment and economic growth in these countries did not weaken after 2010. Therefore, the employment situation in the Korean labor market since 2011 can be regarded as a peculiar phenomenon in that it is difficult to find in other major countries.

In this paper, we examine whether the unusual phenomenon is caused by labor supply side factors such as population aging and baby boom generation in population structure. It is known that population aging leads to an increase in the consumption period of the individual after retirement, which is an incentive for the individual to remain in the labor market while taking lower wages in order to maintain a certain level of consumption after retirement. It also comes from the small-scale start-up of the retired baby boom generation and the unemployed who have lost jobs in their 40s due to corporate restructuring. These start-up business are generally small-scaled and self-employed.

Figure 2: Employment Growth and Real GDP Growth: United States

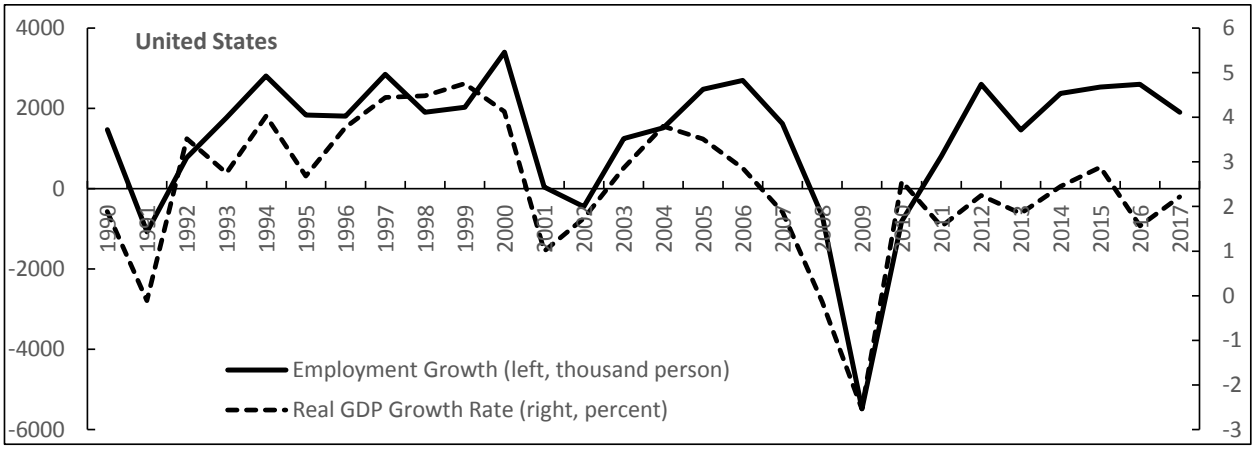


Figure 3: Employment Growth and Real GDP Growth: Euro Area

Figure 4: Employment Growth and Real GDP Growth: United Kingdom

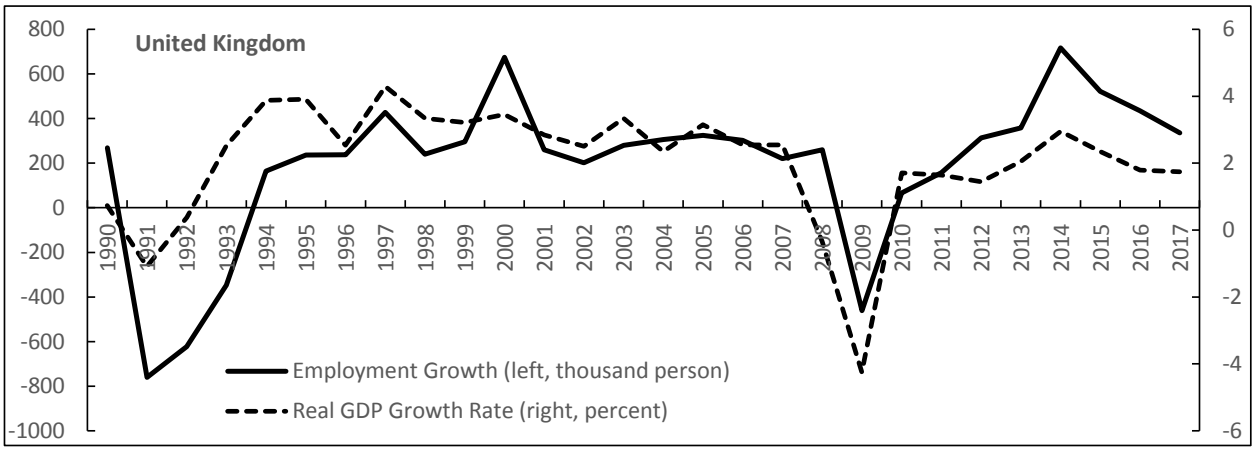


Figure 5: Employment Growth and Real GDP Growth: Japan

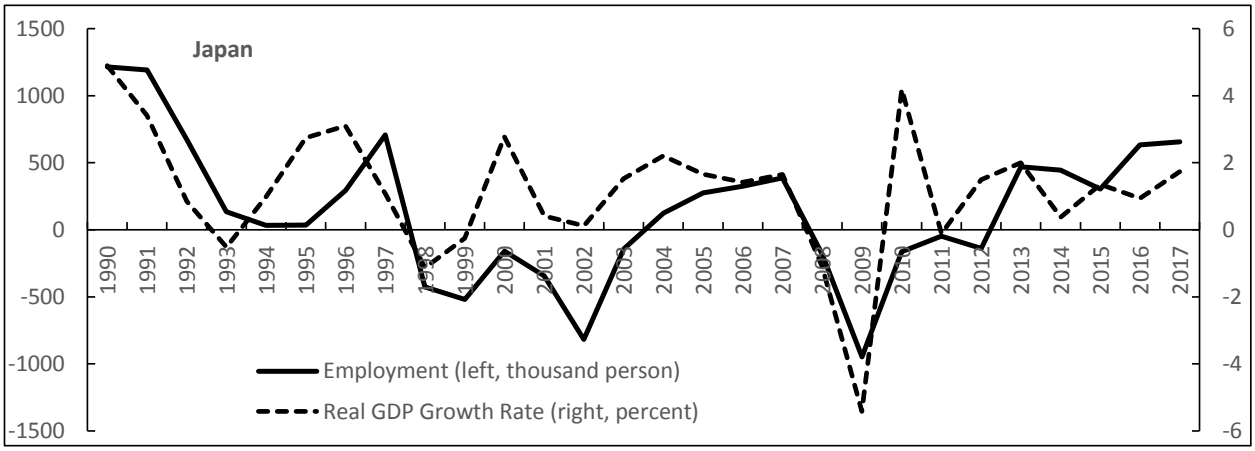
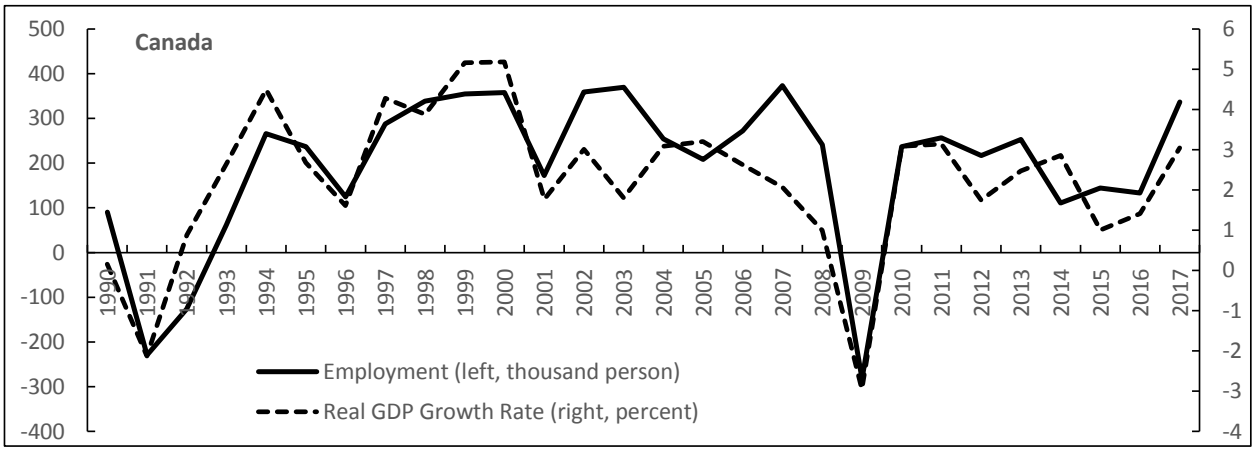


Figure 6: Employment Growth and Real GDP Growth: Canada



II. Literature Review

1. Labor Supply Side Story

The response of employment to economic fluctuations depends on the relative movement of the labor supply curve and labor demand curve. In general, the labor supply curve is relatively stable over the business cycle, but the labor demand elasticity with respect to production is so large that equilibrium employment is mainly determined by labor demand shocks.

Demand for labor is determined by the profit-maximization process of a firm. The labor demand is derived by the demand for products such as goods and services. Therefore, if the demand for products decreases as the economy falls, the labor demand curve shifts to the left. The labor supply curve, on the other hand, is determined according to the utility maximization decision of an individual or a household. Individual or household decides whether to participate in the labor market at a level that maximizes his utility, given market wages and his preference for leisure and income. However, it is known that there are two conflicting effects on the shift of the labor supply curve to economic fluctuations, such as the added-worker effect and the discouraged worker effect.

According to the added-worker effect of Becker (1985) and Lundberg (1985), as the economy improves if an unemployed household member get a job or household income increases, other household members who make a living make for their family exit the labor market to concentrate on domestic work or take a rest. In this case, even when the economy improves, labor supply may decrease. On the contrary, as the economy falls if household member becomes unemployed or household income decreases, other household members in the same household may enter the labor market to make money. In this case, as the economy deteriorates, labor supply will increase.

On the other hand, according to the discouraged worker effect of Benati(2001) and Arpaia and Nicola(2010), if the vacancy increases as the economy rises, the possibility of employment increases, so individuals who are inactive in labor market such as discouraged workers will enter the labor market to find jobs. On the other hand, when the economy falls, the low possibility of employment may induce the job seekers to exit the labor market.

Thus, over the business cycle, the amount of equilibrium employment depends on the relative size of the added-worker effect and the discouraged worker effect. For example, if the added-worker effect is greater than the discouraged worker effect, labor supply curve will shift to the right as the economy declines. But if the discouraged effect is greater than the added-worker effect, labor supply curve will shift to the left as the economy declines. These theoretical arguments suggest the possibility that employment may increase even if labor demand declines during an economic downturn.

2. Labor Demand Side Story: Jobless Growth and Artificial Intelligence

The term "Jobless Growth" is used to refer to the phenomenon in which employment growth is not accompanied by economic recovery. The view on the causes of this phenomenon is still divided into several branches. Among them a group of economists think that productivity gains from technological innovation lead to “employment-free growth”. Furthermore, it is argued that employment may be shrinking due to technological innovation. The argument that technological innovation causes the decline in employment is based on the fact that the employment is decreasing rapidly in manufacturing industry which has benefited greatly from technological innovation. And technology in manufacturing has been innovated in a capital-intensive and labor-saving way.

Recently, more attention has been focused on the changes that the rapid development of artificial intelligence will bring to the labor market. In the past, factory automation was applied on the standardized work, in which specific procedures are given. However, rapid development of artificial intelligence and improved analytical ability based on Big Data are changing the boundaries of what can be automated. In other words, things that were once thought only human beings could do are becoming more and more computer-enabled. In more areas, computers have a potential to replace human labor.

It is true that research on the effects of technological innovation on the job market sometimes presents conflicting results based on methodology and data they used in their research. For example, Frey and Osborne (2013) estimated the probability of computerization for 702 detailed occupations in US job market and then concluded that the development of artificial intelligence could replace most irregular tasks with computers. According to their estimates, about 47 percent of total US employment is susceptible to computerization.

Arntz et el. (2016), on the other hand, did not agree with Frey and Osborne (2013) for overestimating computerization risks. Arntz et el. (2016) argued that artificial intelligence would replace some of the tasks that make up the job rather than replace the job itself. Their results showed only 9% of jobs in the United States are high-risk jobs. The wave of computerization by artificial intelligence is still in its infancy. So it is difficult to estimate its impact accurately at this stage. But there is no doubt that automation will increase productivity and crowd out employment to some extent.

Therefore, technological innovation can cause decoupling of employment and economic growth, in that it can lead to an increase in production without increasing employment. However, unlike the labor supply side story, the labor demand side story such as technological innovation

cannot explain the phenomenon that employment is increasing despite of the stagnant economic growth,

III. Korean Labor Market

1. Employment Trend by Age

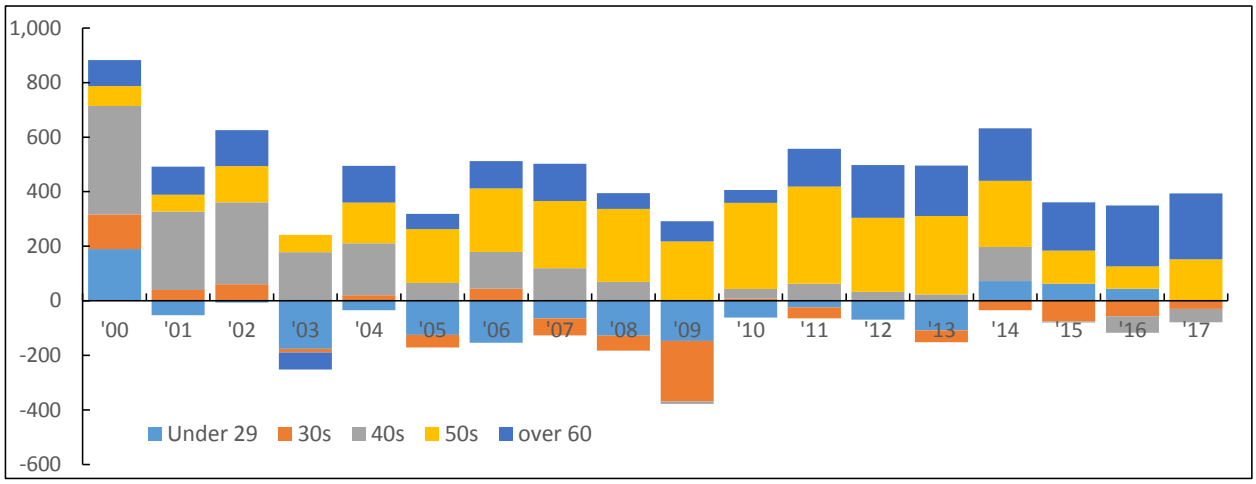
A striking feature of the Korean labor market is that the number of employees over 50 years old is increasing rapidly. As shown in Figure 7, in the early 2000s, the increase in the number of employees in their 40s was the largest among age groups. Specifically, the number of employees in their 40s increased by 328,000 on average each year during 2000-2002. Of course, the number of employees in other age groups increased, but the number of employees in their 40s was the biggest increase.

However, since 2003, the increase in the number of employees in their 40s has gradually decreased, while the number of employed workers in their 50s has begun to increase rapidly. The number of employees in the 50s increased by 64,000 in 2003, 233,000 in 2005, and 247,000 in 2007. This increase in the number of employees in their 50s since 2005 has been influenced by the baby boom generation. In Korea, the generation is referred to those generally born from 1955 to 1963. And 2005 is the year Baby Boomer, born in 1955, turns 50 years old.

Since 2011, the percentage of people over 60 is growing at the fastest rate. The number of employees aged 60 or older increased by an annual average of 79,000 during the period from 2000 to 2010, but increased by an annual average of 193,000 during the period from 2011 to 2017. On the other hand, the number of under-40s has slightly increased or decreased since 2010. Since 2013, the number of employees in their 30s has decreased by an annual average of 48,000, and the number of employed workers in their 40s has increased by 0.7 million at most. However,

the number of employees in their 50s increased by 177,000, and the number of employees in their 60s increased by 20.4 million on average each year.

Figure 7: Increase in the number of employees by age group (year-to-year change, thousand people)



In addition to the increase in the number of employed workers, in Table 1, the employment rate also shows a noticeable rise in the age group of 50 or older since 2010. Comparing the rise in the employment rate from 2000 to 2010 and the increase in the employment rate from 2010 to 2017, high employment rates in the age group of 50 and over can be found. The employment rate of 50s rose by 4.4 percent point, which is the highest. And also in the case of those aged 60 and over, it dropped by 1.4 percent point in 2000-2010, but increased by 3.7 percent point in 2010-2017.

Table 1: Employment Rate by age group since 2000 (%, %p)

	2000(A)	2005	2010(B)	2015	2017(C)	B-A	C-B
20s	60.2	61.2	58.4	57.9	57.6	-1.8	-0.8
30s	72.5	72.4	72	74.4	75.3	-0.5	3.3
40s	76.5	77.2	77.9	79.1	79.4	1.4	1.5
50s	66.5	68.2	70.9	74.4	75.3	4.4	4.4
Over 60	37.6	37.1	36.2	39	39.9	-1.4	3.7

2. Demographic drivers of labor market change

2.1 Population aging and Extending Life Expectancy

In Table 2, we see the proportion of elderly persons aged 65 or older in the total population was 3.1% in 1970, but it is expected to rise to 15.7% in 2020. This trend is expected to continue for some time in the future, rising to 24.3% in 2030 and 37.4% in 2050. In particular, the proportion of the elderly population aged over 85 is expected to rise from 0.9% in 2013 to 2.5% in 2030 and 7.7% in 2050.

Table 2: Share of Population by age group (%)

		1970	1990	2000	2013	2020	2030	2040	2050
Total		100	100	100	100	100	100	100	100
0~14		42.5	25.6	21.1	14.7	13.2	12.6	11.2	9.9
15~64		54.4	69.3	71.7	73.1	71.1	63.1	56.5	52.7
Over 65		3.1	5.1	7.2	12.2	15.7	24.3	32.3	37.4
	65~74	2.3	3.5	4.9	7.3	9.0	14.6	15.8	15.3
	75~84	-0.8	-1.6	2.0	4.0	5.1	7.2	12.4	14.4
	Over 85	-	-	0.4	0.9	1.6	2.5	4.1	7.7

Note: 1) over 75 years old in parentheses
Source: Statistics Korea

The population aging trend in Korea is very rapid when compared with other developed countries that have already experienced the population ageing. In Table 3, it is shown that the period of time spent from an aging society where the proportion of elderly people aged 65 or older accounts for more than 7% of the total population to an aged society where the proportion of elderly people over 65 years old is more than 14% of the total population. In Korea, it takes 18years and it is shorter than that of France, Germany, and UK.

Such an aging pace is faster than Japan, which has been known to suffer from severe aging problem in the past decades. Furthermore, according to the Statistics Korea, it is expected that the trend of aging to date will continue in the future. It is estimated that Korea in 2026 will

be a super-aged society where the elderly population aged 65 and over will be more than 21% of the total population.

Table 3: Years Reaching Aging Society, Aged Society, and Super-aged Society

		Korea	Japan	France	German	UK	Sweden	US
Year	7%[1)]	2000	1970	1864	1932	1929	1887	1942
	14%[1)]	2017	1994	1979	1972	1976	1972	2013
	21%[1)]	2026	2006	2020	2012	2021	2012	2028
Time	7%→14%	18	24	115	40	47	85	71
	14%→21%	9	12	41	40	45	40	15

Note: 1) percentage of elderly population over 65 years old to total population
Source: Statistics Korea

Table 4: Proportion of the aged[1)] in some advanced countries and BRICs (%, ratio)

	Korea	US	France	German	Japan	Brazil	Russia	India	China
1990	5.1	12.5	14.1	15	11.9	4.5	10.2	3.9	5.8
2000	7.2	12.4	16	16.3	17.2	5.5	12.4	4.4	6.9
2010(A)	11	13.1	16.8	20.8	23	6.9	13.1	5.1	8.4
2020	15.7	16.6	20.3	23.1	28.6	9.5	14.8	6.3	11.7
2030	24.3	20.1	23.2	28.2	30.7	13.6	18.1	8.2	16.2
2040(B)	32.3	21.2	25.4	31.8	34.5	17.6	18.3	10.2	22.1
B/A	2.9	1.6	1.5	1.5	1.5	2.6	1.4	2	2.6

Note: 1) percentage of elderly population over 65 years old to total population
Sources: UN (2012), World Population Prospects: The 2012 Revision

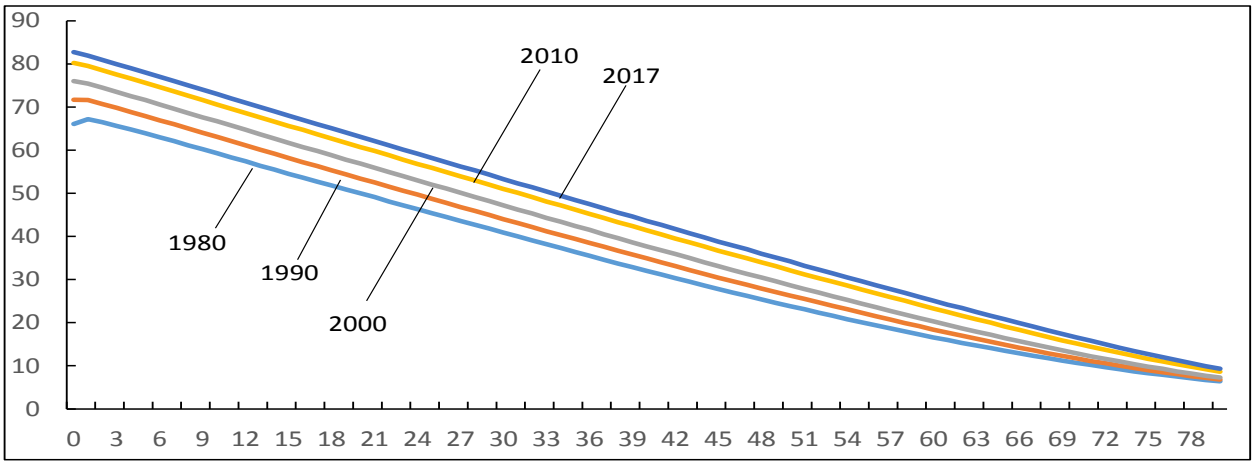
The life expectancy of people in Korea was 71.3 years in 1990. In other words, the average survival years expected of those born in 1990 were 71.3 years. Then, it increased to 76.2 years in 2000, and increased to 82.7 years in 2017. So the years increased by more than 10 years during 1990-2017.

The increase in the life expectancy affects household labor market and consumption

decisions. That is, the increase in the life expectancy affects the retirement and consumption decisions of the household in the direction of maintaining the future consumption over the longer period after retirement by decreasing the current consumption and delaying retirement. Of course, as shown in Figure 6, the lifetime increase is not a phenomenon occurring only in a specific age group, but is evenly distributed over all ages. However, the response of households to this may vary by their age. This is because it is difficult to generate income in the labor market due to the low labor productivity during the extended life span. For example, a 40 years old worker was expected in 2000 to live for 37.8 years more and die at 77.8 years old. Thus, in 2000, the employee planned to retire from the labor market at age 65 and save enough money for the consumption over the period of 12.8 years without labor income.

However, when the worker becomes 57 years old in 2017, he finds that his life expectancy becomes 26.4 years and he will live up to 83.4 years. In other words, life is extended by 5.6 years. But during the extended period, he cannot earn labor income, so the resources to be consumed during that period will be in urgent need to be saved before retirement. As a result, the worker has to reduce current consumption and increases labor market activity to secure the resources that can be consumed during the extended life span. On the other hand, 20-year-old workers who are younger in 2000 do not have to cut their current consumption and delay retirement significantly. This is because the period in the labor market is long enough to secure the resources that can be consumed over an extended period of time, even if the life expectancy is unexpectedly extended. Therefore, employees' responses to the increase in the life expectancy are different for each age group. In other words, for the exogenous shock of the increase in the life expectancy, households are responding in a way that the older people are reducing the current consumption and increasing labor market activity even more.

Figure 8: Life expectancy[1)] by age group (year)



Note: 1) The average survival years at which a survivor of a certain age x is expected to survive
Source: Statistics Korea

2.2 **Baby Boom Generation**

Baby boom generation in Korea refers to those born from 1955 to 1963 during the period of high birth rates after the end of the Korean War. The existence of an age cohort of baby boom generation within an economy implies a demographic impact. The baby boomers have already begun retirement in the form of early retirement since 2011. And baby boomers' retirement is expected to continue until 2023, in that the statutory retirement age in Korea is 60 years old.

The biggest economic difficulty facing the baby boomers is the time gap between 'wish retirement age' and 'actual retirement age'. According to the Statistics Korea, the wish retirement age is 65.5 years on average, but the actual retirement age at main job is only 54 years old. Amid of the decrease of interest income due to falling deposit interest rates, baby boomers want to delay the exit of the labor market as much as possible due to an increase in the burden of education expenses for their children and a lack of benefit from public pensions. The increase in youth unemployment also contributes to the delay of the retirement of the baby boomers. This is

because the father's economic burden increases as the child's employment delays. In addition, baby boomers who are relatively more educated than previous generations have a high level of accumulation of human capital, which can be a factor in inducing the generation remain at the labor market.

However, in the Korean labor market, there is no developed "bridging job[1]" market linking the retirement age from his main job and the wish retirement age. Therefore, even if a highly educated full-time baby boomer is retired from his main job, it is difficult to find a job that matches his experience and aptitude, and thus he have no choice but to enter into small self-employment business sector. Not only the retired baby boomers but also the wage earners who have lost their jobs due to corporate restructuring flow in the self-employment business sector. As lots of baby boomers are coming into low-profit small self-employment business sector, employment is increasing despite of the stagnant economic growth.

IV. Data

To analyze the characteristics of the Korean labor market, this paper attempts to use the Economically Active Population Survey, which is conducted by Korean Government monthly in order to provide basic data required for analyzing macro-economy and setting up policies to nurture human resources by researching the characteristics of economic activities, such as employment, unemployment, labor force, etc. The Economically Active Population Survey is very similar to the Current Population Survey conducted by The U.S. Census Bureau in that these data set provide a comprehensive set of data on the employment, hours of work, persons not in the labor force, type of occupation, earnings, age, education level, and other demographic

[1] In the case of Japan, SMEs are well developed, so there are plenty of opportunities for workers who retire from a large company to work at SMEs utilizing their expertise and experience until the complete retirement from the labor market.

characteristics. The unit of The Economically Active Population Survey is not an individual but a household, and target population size is approximately 35,000 households. This survey is conducted on one week of every month, which includes the 15th of the month.

The trends in the unemployment rate and the number of employed persons by age since 1990 are as follows. First the unemployment rate, on average, is about 3.5% since 1990. The unemployment rate remained around 2% in the 1990s and rose to 7.4% during the financial crisis in 1998. However, the unemployment rate has gradually declined to 6.7% in 1999, 4.4% in 2000, and 4.0% in 2001, and has remained stable at around 3% since then. By age, the unemployment rate in the 20s is the highest at 7.8%. The unemployment rate in the 30s is on average 3.0%, 40s, 2.3%, 50s, 2.2% and over 60 years old is 1.6%. The age groups that show the biggest difference from other age groups are those in their 20s and 60s. First, the unemployment rate in the 20s rose to about 13% in 1998, and then decreased gradually.

However the unemployment rate in the 20s has been rising since 2010. Looking at the correlation between the unemployment rate by age, the correlation of unemployment rate in the twenties with other age unemployment rates is relative low. For example, the correlation of unemployment rate in the twenties is 0.91 with the 30s, 0.84 with the 40s, and 0.88 with the 50s. The unemployment rate of people aged 60 and over is also different from other unemployment rates. Unemployment rate over 60 is at the lowest level compared with unemployment rates of other age groups, but have been on a steady rise since 2013. In addition to that unemployment rate over 60 years old is showing a very low correlation with the overall unemployment rate. The correlation is only 0.58.

Figure 9: Unemployment Rate by age group

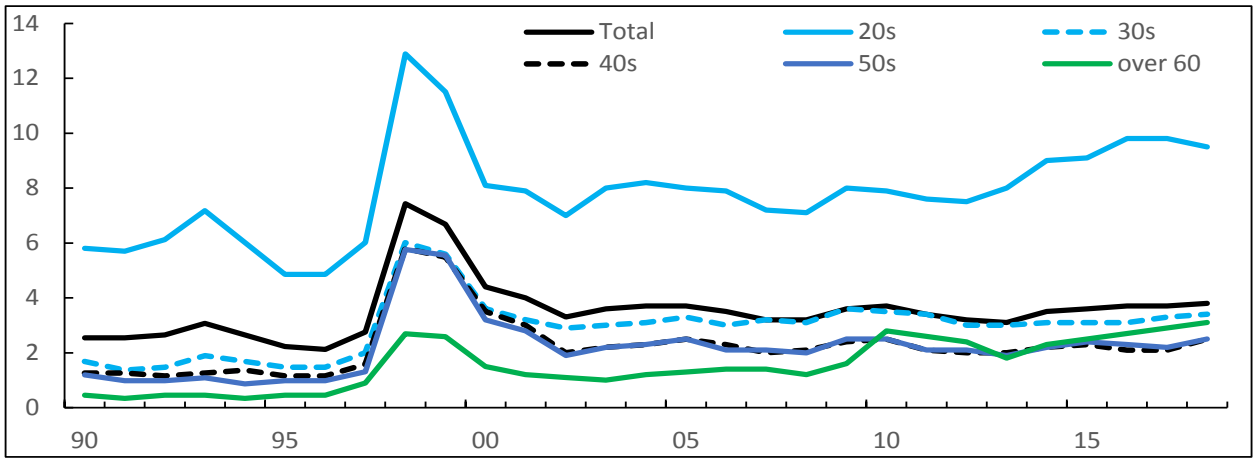


Table 5: Correlation of Unemployment Rate between age groups

	Total	20s	30s	40s	50s	over 60
Total	1					
20s	0.90	1				
30s	0.94	0.91	1			
40s	0.98	0.84	0.94	1		
50s	0.98	0.88	0.97	0.99	1	
over 60	0.58	0.79	0.73	0.56	0.63	1

The increase in the number of employed workers by age is more volatile than the unemployment rate. However, in general, the increase in the number of employed workers has been decreasing since 2005. In particular, the increase in the number of workers in their 20s and 30s has been declining. The number of employees in the 50s showed a high increase in the 2000s, but the growth rate has been decreasing since 2010. The number of people aged 60 or older has been growing considerably since 2011. As a result, it can be seen that the magnitude of the correlation coefficient of the number of employed persons between different age groups is significantly lower than that of the unemployment rate. In some cases, the correlation coefficient of the number of employed persons by age group is negative.

Figure 10: Employment by age group

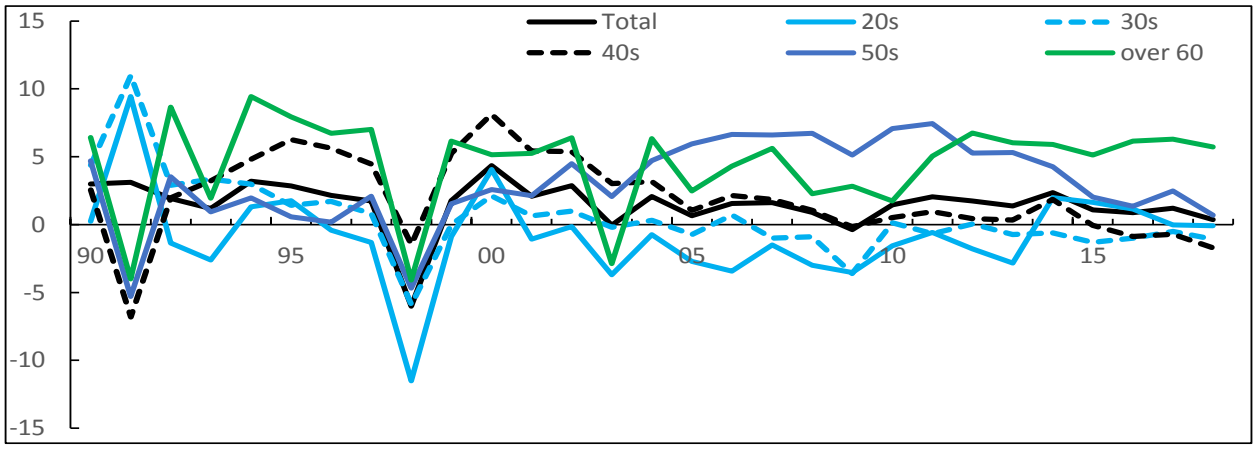


Table 6: Correlation of Employment between age groups

	Total	20s	30s	40s	50s	over 60
Total	1					
20s	0.80	1				
30s	0.67	0.74	1			
40s	0.41	-0.04	-0.03	1		
50s	0.28	-0.17	-0.28	0.21	1	
over 60	0.56	0.23	0.00	0.51	0.39	1

V. Estimation

There is a close relationship between unemployment and economic activity. This is because the slowdown in growth directly reduces the number of employed and raises the unemployment rate through various indirect channels. Okun (1962) first started the study to estimate the magnitude of unemployment due to economic growth or the loss of production due to unemployment. Okun assumes that the proxy variable of all idle resources is unemployment rate, and showed empirical relationship between US unemployment rate and economic growth rate as follows.

$$\frac{y - y_n}{y_n} = -\beta(u - u_n) \qquad (1)$$

In equation (1), y and y_n denote real GDP and potential GDP respectively, and u and u_n, unemployment rate and natural unemployment rate respectively. According to the above equation, if the cyclical unemployment rate ($u - u_n$) increases by 1 percentage point, the actual GDP growth rate against potential GDP decreases by β%. Here β is called Okun's coefficient.

According to Okun, the increase in economic growth required to lower the unemployment rate by 1 percentage point in the United States was estimated at 3.3 percent. Since then, various estimates of potential GDP and natural unemployment rate are being used, and analysis results are different depending on the methodology. Recently, various analytical methods have been applied to the law of Okun as the analytical technique of time series data has been developed. Knotek (2007) outlines a number of statistical approaches used to estimate Okun's coefficients.

This paper follows the econometric model of Ball et al. (2017) since the paper studies coefficients in the relationship–the effect of a one-percent change in output on the unemployment rate – for the United States since 1948 and for twenty advanced countries since 1980. According to their estimate, the coefficient is –0.15 in Japan, –0.45 in the United States, and –0.85 in Spain. In their paper, they estimated the seemingly unrelated regressions (SUR) model comprising following three equations shown in equation (2).

$$\begin{aligned} E_t - E_t^* &= \gamma(Y_t - Y_t^*) + \mu_t, \ \ \gamma > 0 \\ U_t - U_t^* &= \delta(E_t - E_t^*) + \varepsilon_t, \ \ \delta > 0 \qquad (2) \\ U_t - U_t^* &= \alpha(Y_t - Y_t^*) + \omega_t, \ \ \alpha > 0 \end{aligned}$$

The first equation represents Okun's Law for Employment, the second equation represents Unemployment-Employment Relation, and the third equation represents Okun's Law for Unemployment. In estimating Okun's Law we need to measure the natural unemployment rate U_t^*, the long-run level of employment E_t^*, and potential output Y_t^*. In this case we applied the Hodrick Prescott (HP) filter with λ=100 to smooth the output, employment and unemployment series. This implies that unemployment, employment and output equal their long run levels on average.

It has been known that the HP filter suffers from an end-point problem. To solve this problem, extending the series with ARIMA forecasts is generally used, so that the point of interest is no longer at the end of the time series. However the problem with this method the quality of the forecast. So Ball et al. (2017) used estimates of the natural rate and potential output from the Congressional Budget Office. It is true that it is one of widely-used method, but as they said in their paper, it has some limitation in that the CBO estimates the natural rate and potential output with a macro model that includes a version of Okun's Law as one assumption. However in our paper, the last point of the series is not the one which is particularly interesting. So we do not try to forecast the series, but apply the HP filter simply.

First, we examine the estimation results for the whole period from 1990 to 2018. The coefficient of Okun's law related to unemployment was estimated to be -0.361. Compared with the results of Ball et al. (2017) estimated in a similar way, the coefficient of Okun's law in the United States was reported to be -0.405 in their paper. This shows that Korea has a weaker relationship between unemployment and growth than the United States.

However, when compared with the coefficient values of other countries estimated by Ball et al. (2017), it can be seen that Korea is generally at the average level. The average value of

countries reported in by Ball et al. (2017) is -0.405, but if Spain is excluded, the average value drops to -0.371, which is not much different from that of Okun's law in Korea. However, when we estimate Okun's law for the period 1990-2010 only, the value of the coefficient is estimated to be -0.404, which is larger than that for the whole period This demonstrates the weakness of Okun's law since 2010, raising the possibility that there has been some structural change in the labor market since 2010. When we estimate the model for the period of 1990-2010, estimated coefficient of Okun's law increased somewhat, higher than Germany and France, but still lower than the US.

For the Okun's Law for Employment, the coefficient of employment change for growth change is estimated to be 0.667 for the whole period. On the other hand, the coefficient was estimated to be 0.721 when estimated for 1990-2010 only. This shows that the employment effect of growth is reduced after 2010. In fact, if we look at the input-output table, Korea's Employment coefficients and Total labor coefficients are falling sharply. In Korea, labor-intensive production is relatively high, so Korea's coefficient is higher than the US coefficient of 0.543. However, it should be noted that this employment inducement effect is decreasing in Korea.

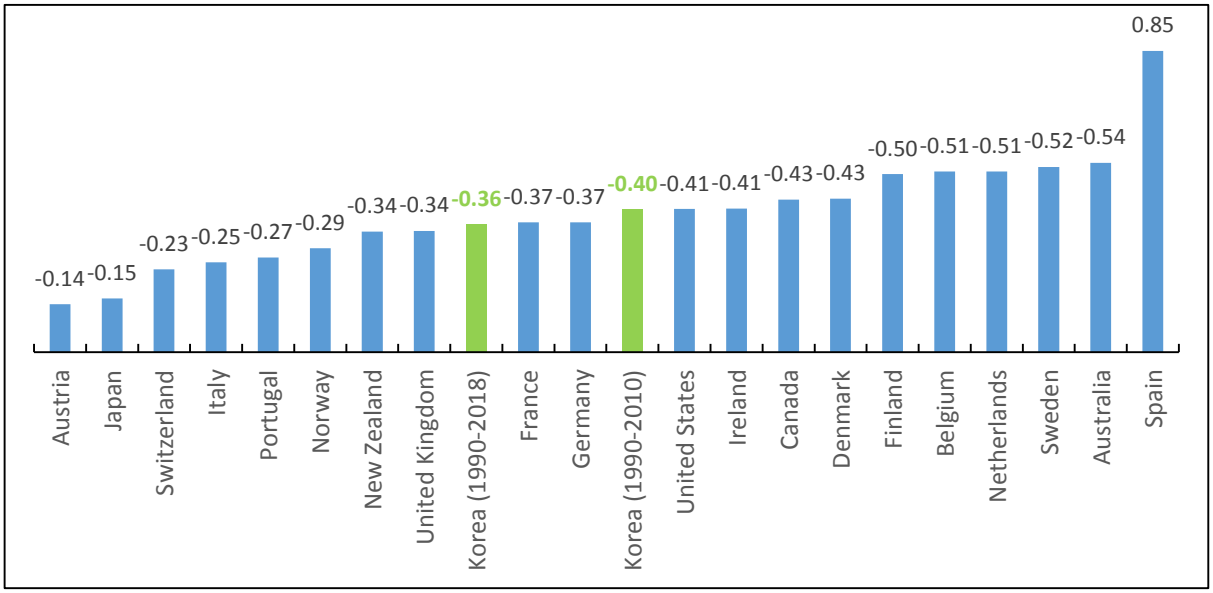
When we look at the relationship between employment and unemployment, Korea's estimates are lower than US estimates. Korea was estimated at -0.537, while the US was estimated at -0.728. Korea's estimates are lower than those of the United States because of structural differences in the labor market such as unemployment insurance. In economies where employment insurance is well-established, if unemployed, the unemployed will remain unemployed for the period covered by unemployment insurance. In Korea, however, employment insurance coverage is so small that the unemployed tend to be incorporated quickly

into economically inactive population rather than remaining unemployed. Also, in Korea, it is often the case that the overall employment situation is not good so that the unemployed tend to give up active job search activities. Thus, in Korea, it is assumed that the relationship between the employed and the unemployed is very low, since when a worker loses his job in Korea, he directly becomes economically inactive without going through the unemployed status.

.Table 7: Estimates of Okun's Law and Unemployment-Employment Relation

	Korea (1990~2010)	Korea (1990~2018)	U.S. (1948~2011)
Okun's Law for Employment			
γ	0.721***	0.667***	0.543***
	(0.076)	(0.072)	(0.040)
Unemployment-Employment Relation			
δ	-0.541***	-0.537***	-0.728***
	(0.031)	(0.022)	(0.027)
Okun's Law for Unemployment			
α	-0.404***	-0.361***	-0.405***
	(0.043)	(0.037)	(0.024)

Figure 11: Estimates of Okun's Law By countries



Note : Ball et al. (2017) estimated natural rates based on Hodrick-Prescott filter with λ = 100.
Source: Ball et al. (2017) Table 5.20

To see which age groups have caused structural changes between growth and employment since 2010, we have estimated the seemingly unrelated regressions (SUR) model by age. Age group was divided into 20s, 30s, 40s, 50s, and 60s and over. The estimation periods are 1990-2010 and 1990-2018. First, Okun's Law for Unemployment estimates are statistically significant at all age groups. In the case of estimating the 1990-2018, the 20s and 30s showed -0.42 and -0.47, respectively, while those in their 40s and 50s and 60s and older were about -0.33 which is somewhat lower than 20s and 30s.

Compared with estimates for 1990-2010, the estimates of Okun's Law for Unemployment declined for all ages. However, the biggest drop among these is in their 20s and over 60s. They fell by -0.063 and -0.057 respectively. In the 30s and 40s, however, the decline was relatively small. These results suggest that there has been a structural change in the relationship between growth and the labor market since 2010, especially in the 20s and 60s.

Next, let's look at the estimates of Okun's Law for Employment. We can see a pattern similar to Okun's Law for Unemployment. This also shows that there has been a structural change in the relationship between growth and employment since 2010. However, there is a difference in the decline by age group. The biggest decline in the age group is over 60 years old, down by about 0.224, and in the 20s by about 0.218. On the other hand, the decline in 30s and 40s was not large. The biggest difference from Okun's Law for Employment is that there is no statistically significant relationship in the 50s. There was no correlation between growth and employment in the 50s, whether estimation period is 1990-2010 or 1990-2018.

Lastly, Unemployment-Employment Relation shows that 20s and 30s have a relatively high correlation before 2010 and 40s, 50s, and 60s and over had a very low correlation. However, since 2010, it is estimated that the correlation of 20s has decreased significantly. This weakening

of unemployment-employment relation in 20s indicates that workers in their 20s enter into the state of noneconomic activity immediately after unemployment rather than stay in the unemployment status. On the other hand, the 30s are still highly correlated after 2010, and the correlation has risen since 2010. This shows that in their 30s, active job search continues even after unemployment.

Table 8: Estimates of Okun's Law and Unemployment-Employment Relation(1990-2010)

	20s	30s	40s	50s	over 60
Okun's Law for Employment					
γ	0.767***	0.710***	0.571**	0.011	0.511***
	(0.204)	(0.059)	(0.242)	(0.028)	(0.078)
Unemployment-Employment Relation					
δ	-0.690***	-0.662***	-0.690*	-0.350*	-0.321***
	(0.052)	(0.028)	(0.034)	(0.133)	(0.112)
Okun's Law for Unemployment					
α	-0.483***	-0.464***	-0.334***	-0.386***	-0.383***
	(0.062)	(0.037)	(0.031)	(0.074)	(0.116)

Table 9: Estimates of Okun's Law and Unemployment-Employment Relation(1990-2018)

	20s	30s	40s	50s	over 60
Okun's Law for Employment					
γ	0.548***	0.624***	0.454***	-0.018	0.288***
	(0.185)	(0.064)	(0.072)	(0.256)	(0.027)
Unemployment-Employment Relation					
δ	-0.371***	-0.775***	-0.730*	-0.221*	-0.057
	(0.017)	(0.032)	(0.016)	(0.197)	(0.168)
Okun's Law for Unemployment					
α	-0.420***	-0.465***	-0.313***	-0.359***	-0.325***
	(0.047)	(0.116)	(0.025)	(0.110)	(0.060)

Figure 12: Estimates of Okun's Law for Employment

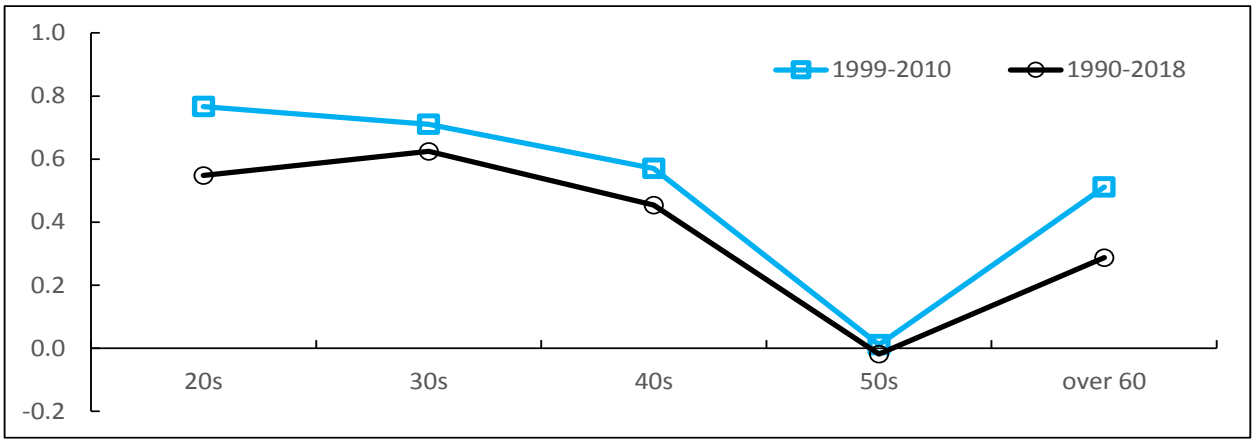


Figure 13: Estimates of Unemployment-Employment Relation

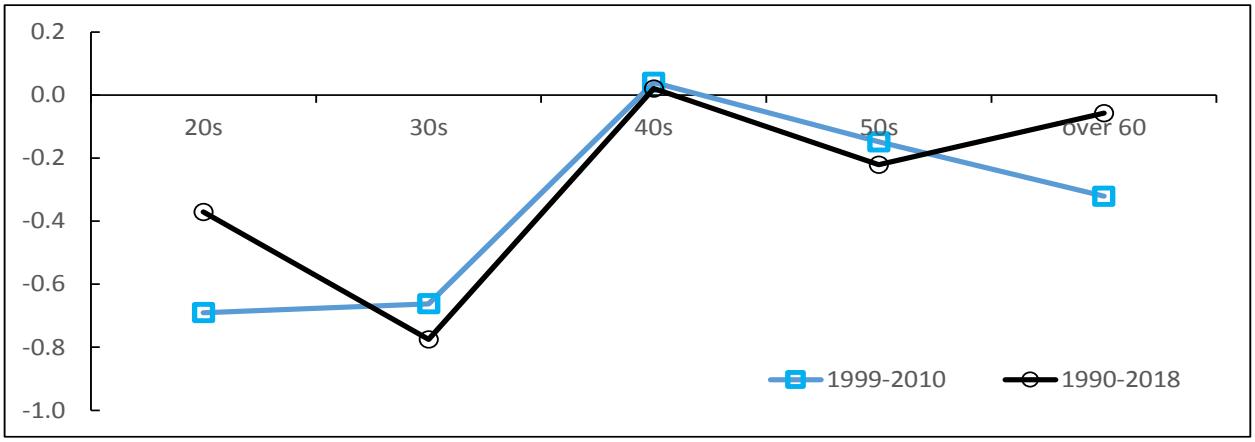
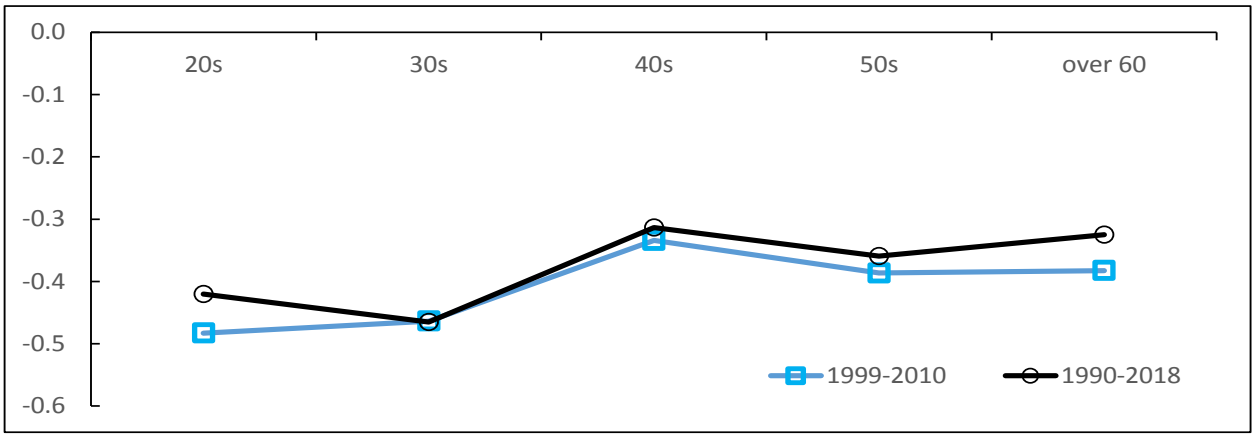


Figure 14: Estimates of Okun's Law for Unemployment



VI. Conclusion

Recently, there appears to be a decoupling phenomenon between economic growth and employment in Korea. It means that although Korea went through a slowdown in economic growth, employment growth remained high. In this paper, we examine whether the unusual phenomenon is caused by labor supply side factors such as population aging and baby boom generation in population structure. In addition to providing stylized facts of demographics of population in Korea, in the spirit of Okun (1962) and Ball et el. (2017), we estimated coefficients with the Economically Active Population Survey data of Korea.

We examine the estimation results for the whole period from 1990 to 2018. The coefficient of Okun's law related to unemployment was estimated to be -0.361. This shows that Korea has a weaker relationship between unemployment and growth than the United States. However, when we estimate Okun's law for the period 1990-2010 only, the value of the coefficient is estimated to be -0.404, which is larger than that for the whole period This demonstrates the weakness of Okun's law since 2010, raising the possibility that there has been some structural change in the labor market since 2010.

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Compared with estimates for 1990-2010, the estimates of Okun's Law for Unemployment declined for all ages. However, the biggest drop among these is in their 20s and over 60s. They fell by -0.063 and -0.057 respectively. In the 30s and 40s, however, the decline was relatively small. These results suggest that there has been a structural change in the relationship between growth and the labor market since 2010, especially in the 20s and 60s.

When we look at the estimates of Okun's Law for Employment, there has been a structural change in the relationship between growth and employment since 2010. However, there is a difference in magnitude of the decline by age group. The biggest decline in the age group is over 60 years old, down by about 0.224, and in the 20s by about 0.218. On the other hand, the decline in 30s and 40s was not large. The biggest difference from Okun's Law for Employment is that there is no statistically significant relationship in the 50s. There was no

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