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EFFECTIVENESS OF HIGHER EDUCATION TO LABOR PRODUCTIVITY

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Abstract

The purpose of this study is to empirically examine the contribution of higher education to labor productivity at the national level, using company-based panel data. The panel data from 1990 to 2007 was used, which was from the national panel institution Korea Information Service - Financial Accounting System (KIS- FAS). The analysis result reveals a highly positive relationship from 1990 to 2007 between the change of the rate of people with higher education among the economically active population and sales per person. The analysis of panel data also shows that the increase of the economically active population with higher education has a positive influence on labor productivity (sales per person). These results are significant in that they are the basic information to activate the human resource development at the level of a nation or a company.

Keywords

Human Capital, Endogenous Growth Theory, Economics of Education, Panel Analysis, Higher Education

1. Introduction

Globalization and knowledge-based economy are rapidly spreading with the recent advent of post-information and ubiquitous computing in recent society. At this time of moment with intense international competition, to secure national competitiveness is emerging as a vital task. Many researchers are suggesting that creative and high-quality knowledge and technologies are the source of national competitiveness (Choi, 2002; Choi, 2008). In other words, high-quality knowledge should increase strengthen the competitiveness of companies and nations.

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To examine the relationship between education and economic development, Harbison & Myers (1964) looked at the relationship between human resource development through education and economic development, considering a variety of factors contributing to economic development. They found that the human resource ofa country is the core factor for the economic development of the country. This result is used as an essential standard to measure the economic growth and modernization of countries.

Harbison & Myers empirically analyzed the correlation among selected indices for educational development and economic development of 75 countries in order to study the relationship between education and economic growth of each country. They suggested that educational development brings economic development by showing a meaningfully high correlation between composite index [1] which signifies educational development, and Gross National Product (GNP) per capita which signifies economic development. At the level of a company, a number of studies researched the relationship between the change of the rate of people with higher education among economically active population and productivity. (Applebaum et al., 2000; Bartel, 2000;, Black & Lynch, 2001; Barrett & O'Connell, 2001; Fey et al., 2001; Hatch & Dyer, 2004; Zwick et al., 2005; Wright et al., 2005; Conti, 2005; Dearden et al., 2006). These studies empirically examine the relationships between the change of the rate of people with higher education among economically active population and productivity and the effect of them using short-term panel data of only two to three years. They can also provide implications for the importance of higher education, but that is not enough to evaluate the significance of human capital at the national level.

Moreover, these studies failed to provide common conclusions about the importance of higher education, which might have resulted from analysis data[2], estimation methods, and research model. [3] In order to investigate how much influence the improvement in the quality of quantitative human capital has on labor productivity at the national level, the relationship between education and labor productivity needs to be studied,taking into account factors of labor productivity mentioned in the previous research by Harbison & Myers.

This study tries to overcome the limitation in Harbison & Myers's examination of the relationship between education and economic growth and the effect of them namely that they only used cross-section data collected

[1] Composite index is one of the nine indexes for educational development by Harbison and Myers. It was calculated after multiplying the percentageof college enrollment by five and adding the percentage of elementary school enrollment and secondary school enrollment.

[2] Considering the characteristics of human capital, the use of relatively short-term panel data of two to three years cannot solve the problem of
simultaneous bias, which means that company productivity can have an effect on the investment to higher education as well as the investment tohigher education has an effect on company productivity (Hirsch, 2004).

[3] These studies failed to solve the problem of parametric bias caused by omitted variables or unobserved variables such as the capacity of a company,which are regarded as influential factors for labor productivity (Bartel, 2000).

from late 1950s to early 1960s and correlation coefficient. The panel data[4] at the level of a company was used to research the relationship between education and labor productivity and the effect of them over time.[5]

The purpose of this study is to empirically analyze the effect of the change in the rate of people with long-

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term higher education among economically active population on labor productivity. To achieve this purpose, this study includes control variables in regression formulation, which explains labor productivity, and compares and contrasts various regression models from the perspective of the contribution of higher education to labor productivity. The estimated result of cross-section data and panel data in the level of a company were compared, and the difference in the contribution of higher education to labor productivity according to the degree of control for unobservable individual effect was analyzed in this study.

2. Theoretical Background

This study examines the relationship between the change of the rate of people with long-term higher education among economically active population and labor productivity on the basis of human capital theory[6] and endogenous growth theory.[7] Harbison & Myers (1964) took a macro look at the relationship between regular education and economic growth in the level of a nation. They estimated the level of contribution of the educational development to economic growth by analyzing the correlation between composite index and GNP per capita.

Many researches looking at the relationship between regular education and economic growth took a relatively simple statistical approach to compare and provide indices for educational development and other socioeconomic indices (Harbison & Myers, 1964; Johns et al., 1983). This is to estimate the degree of contribution of educational development to economic growth by analyzing correlations between the number of students per class, which reveals the educational development, educational cost per a person, which is an index to show the level of investment in education, and GNP per capita, which shows the economic growth. They suggested that there are considerably positive correlations between the level of education and economic growth, and thus education is significantly related to economic growth.

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[4] Panel data is very effective for designing research models because it has as much observed value as nT by collecting population number n of year t (Dougherty, 2006).

[5] The use of panel data can solve the problem of parametric bias caused by the typical effect of individual companies. In other words, the net effect
of the quantitative level of human capital on labor productivity as time passes can be exactly estimated by fixing the constant characteristics ofindividual companies and controlling the population effect.

[6] Human capital theory attempts to explain the relations between education and income with the concept of human capital (Il Woo Paik, 2007).

[7] Endogenous growth theory can provide explanation about long-term growth by immaterial endogenous elements such as improvement oftechnology and accumulation of human capital.

The statistical report by The United Nations Educational, Scientific, and Cultural Organization (1980) selected 100 countries, comparing and analyzing the correlations between indices for educational development and indices for economic growth from 1960 to 1976. This report revealed high correlations between the rate of public education cost, an index showing educational support from government, and GNP per capita as an index showing economic development, concluding that educational development contributes to the economic growth. In addition to the research by Harbison & Myers and the report by UNESCO, there are other researches comparing and analyzing the correlations between indices for educational development and indices for economic development, as shown in Table 1.

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Table 1: *Various Researches on Educational Development and Economic Development*

Researcher	Analysis Year	Target and Number	Analysis Index for Educational Development	Index for Economic Development	Analysis Method
Harbison	75		-Percentage of enrollments in schools	-GNP per	Estimation of cross-

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	1959 & Myers		countries	- Percentage of public education fee	sectional capita correlation coefficient
	1955-Bannett	1956	69 countries	- Percentage of academic education in secondary school - Percentage of vocational education in secondary school	of cross-sectional - GNP per capita correlation coefficient	Estimation
Curle		1958	57 countries	- Percentage of enrollment in secondary school - Percentage of investment in education - GNP per capita	- Rate of savings of cross-sectional correlation coefficient - Rate of economic growth	Estimation
Bowman		1950-1955	83 countries	- Percentage of enrollment in elementary school - Percentage of literacy	- Infant mortality rate - GNP per capita	Estimation of cross-sectional correlation coefficient

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The research mentioned above suggests that educational development brings economic growth by analyzing the correlation between indices for educational development and GNP per capita using cross-section data. However, the coefficient from the cross-section data could not explore a clear cause and effect ifeducational development causes economic growth or vice versa. That is to say, whether economically developed countries invested more in education or they could develop because they invested more in education cannot be proved with clearly.

However, the implications of those researches are drawn by looking at the relationship between long-term regular school education and economic growth considering the features of human capital, from a macro-point of view at a national level. This way, they suggested the significance of the investment in human capital.Additionally, they provided directions to many researchers in various fields looking at the effect of education from a macro-point of view.

Jeong (1988) specifically divided the degree of contribution to economic growth per school and analyzed it.He clarified the influence that the gradual quantitative growth of Korean education from 1955 to 1985 had on the total amount scale of economic growth and economic growth per industry. Furthermore, he mentioned that the increase in the rate of enrollment in elementary school had a positive effect on total economic calculation, specifically in manufacturing industry or mining industry. Meanwhile, the increase in the rate of enrollment in middle school education did not have a meaningful influence on whereas it had a positive influence on agriculture and fishing industry and negative influence on manufacturing industry or service industry. The increase of the rate of enrollment for high school education had an effect on the total economic productivity.

However, the coefficient from the cross-section data could not clearly settle the exact cause and effect of whether educational development causes economic growth or vice versa, and many of the researches use GNP per capita as an index for economic development. Although researches need to be conducted to study the importance of human capital investment using various indices for economic growth, they use only GNP per capita as a proxy variable of economic growth. Moreover, middle school education in Korea is mandatory. The rate of enrollment for middle school since 1990 is over 87% (Korean Education Statistics Yearbook, 2009), but there are little relevant researches since 1990s.

This study assesses the degree of contribution of higher education to labor productivity establishing long-term company-based panel data in order to overcome the limitations of research data and research method in precedent researches. In other words, this study fixes the constantly occurring features of individual companies and controls the unobservable entity effect to grasp the features of individual companies over time. Then, this study analyzes the relationship between the change of the rate of people with higher education among economically active population and labor productivity per person in order to assess the degree of contribution of higher education to labor productivity.

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3. Research Methods

3.1 Analysis Data

This study used the data from Korea Information Service-Financial Accounting Systems (KIS-FAS), a representative panel data managed by the government. KIS-FAS possesses financial information of companies from 1990 to 2009 listed on Korea Stock Exchange.[8] Using this information, research on the effect of the change of the rate of people with higher education among economically active population, accumulated human capital in other words, on the labor productivity can be conducted for an extended period of time.

That is to say, the influence that the long-term change of the rate of people with higher education among economically active population has on labor productivity of companies, considering the features of human capital, can be observed. The information for the change of higher education is statistical information from National Statistical Office on the percentage of people with higher education out of the economically active population.[9]

3.2 Organization of Research Variables and Technology Statistics

1. Reference Variables

[8] Companies that have tradeable items(types) in stock markets (Korea Exchange, 2009).

[9] The reason why this study examined the rate of people with higher education out of economically active population is that middle school education in Korea is mandatory. The rate of enrollment for middle school since 1990 in Korea is exceeding 87% (Korean Education Statistics Yearbook, 2009). For this reason, only the rate of people with higher education out of economically active population was considered to see how labor productivity changes as the rate of people with higher education among workforce increases.

Table 2 shows the names of research variables and how to apply them. Table 3 shows the average and standard deviation of natural logarithm[10] of 216 companies for the period of 18 years, which is a dependent variable in this study. The sales per person of sample companies for this study is distributed from 90 million won in 1990 to 520 million won in 2007. A dependent variable takes natural logarithm on the sales per firm.The static unequal distribution, which reflects the geometrical growth of the sales, was transformed to natural logarithm normal distribution by taking natural logarithm on the sales per firm. As a result, the linear regressionanalysis using dependent variables normally distributed with natural logarithm makes the statistics verification of regression coefficient easier because the error term of a regression model is normally distributed.

Table 2: *Research Variables and How to Input themItem Variables Details of*

	Variables	
DependentVariables	The sales perperson (lnSPP)	(lnFCP)
ExplanatoryVariables	Quality ofhuman capital (LnEDU)	
	Capital intensity perperson	

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the value after taking a natural logarithm to (the total	s a l e s / t h e	number of employees) (1 million won)
		the value after taking a natural logarithm to population with college degree available for economic activities (1 thousand people)
		the value after taking a natural logarithm to {(intangible fixed asset-construction temporary account/the number of employees)} (1 million won)
Training costper person (lnEEP)		the value after taking a natural logarithm to (the total cost for training/the number of employees)(1 thousand won)

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the value after taking a natural logarithm to thenumber of employees (people)

[10] A dependent variable takes natural logarithm on the sales per a firm. The static unequal distribution, which reflects the geometrical growth of the

sales, was transformed to natural logarithm normal distribution by taking natural logarithm on the sales per a firm. As a result, the linear regression analysis using dependent variables normally distributed with natural logarithm makes the statistics verification of regression coefficient easier because the error term of a regression model is normally distributed.

Proportion of incentives(INC)

Proportion of the incentives per quarter (%)

Table 3: *The average of the sales per person and standard distribution (N=216)*

Year	Average	Standard Deviation	Minimum	Maximum
1990	4.496	0.674	2.706	7.719
1991	4.634	0.704	2.710	7.886
1992	4.750	0.701	2.831	8.057
1993	4.849	0.706	2.592	8.084
1994	5.010	0.679	2.975	8.352
1995	5.146	0.688	3.138	8.619
1996	5.278	0.691	3.406	8.972
1997	5.437	0.714	3.508	9.523
1998	5.578	0.773	3.494	9.794
1999	5.690	0.746	3.666	9.747
2000	5.776	0.743	3.891	8.827
2001	5.833	0.733	4.038	8.872
2002	5.930	0.760	4.163	8.765
2003	5.957	0.744	4.199	8.587
2004	6.068	0.761	4.401	8.809
2005	6.121	0.752	4.394	8.784
2006	6.189	0.778	4.416	8.732

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2007	6.254	0.778	4.166	8.761

1) Explanatory Variables

2)

Table 4 shows the descriptive statistics of independent variables.

Table 4: *Explanatory Variables Technology StatisticsAverage (Standard Deviation)*

Variables	1990	1991	1992	1993	1994	1995	1996	1997	1998
Ln ED	8.074	8.183	8.310	8.408	8.456	8.522	8.584	8.616	8.763
Ln UEEP	3.787 (1.357)	4.024 (1.376)	4.135 (1.401)	4.1770 (1.564)	4.374 (1.524)	4.584 (1.476)	4.677 (1.427)	4.626 (1.396)	3.900 (1.736)
Ln FCP	11.510 (0.754)	11.694 (0.753)	11.830 (0.740)	11.939 (0.755)	12.095 (0.708)	12.232 (0.698)	12.373 (0.710)	12.588 (0.735)	12.809 (0.772)
Ln NOE	6.866 (1.156)	6.877 (1.145)	6.852 (1.144)	6.827 (1.150)	6.806 (1.145)	6.820 (1.152)	6.811 (1.158)	6.759 (1.156)	6.595 (1.188)
INC	9.383 (4.664)	8.560 (4.812)	7.602 (4.976)	7.218 (5.228)	7.780 (5.557)	7.903 (5.848)	7.664 (5.991)	5.652 (6.922)	
N	216	216	216	216	216	216	216	216	

Variables	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ln EDU	8.806	8.858	8.913	8.969	9.096	9.145	9.195	9.243	9.293
Ln EEP	4.092 (1.575)	4.357 (1.537)	4.367 (1.760)	4.692 (1.504)	4.724 (1.638)	4.880 (1.449)	5.018 (1.483)	(1.513)	(1.542)
Ln FCP	12.902 (0.758)	12.908 (0.760)	12.929 (0.732)	12.958 (0.750)	12.999 (0.742)	13.066 (0.746)	13.145 (0.712)	13.230 (0.744)	13.310 (0.741)
Ln NOE	6.564 (1.185)	6.578 (1.193)	6.551 (1.175)	6.505 (1.154)	6.477 (1.160)	6.450 (1.187)	6.421 (1.217)	6.396 (1.231)	6.378 (1.258)

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INC	7.948	8.076	8.135	9.882	10.851	12.124	13.285	12.573	14.2
	(9.202)	(9.23)	(9.197)	(10.500)	(13.464)	(16.765)	(23.274)	(17.189)	(25.122)
216	216	216	216	216	216	216	216	216	216

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3.1 Research Model

1) Basic Statistics Model

When analyzing the effect of higher education on the economic outcome of a company, the period for the accumulated human capital through educational training to have an effect on the economic outcome of a company should be considered enough. For this reason, a long-term development model is necessary to examine the causality between the long-term investment in higher education and the improvement of labor productivity along with its impact.

Cobb-Douglas production function is a representative production function comparable with assuming constant return to scale as long-term functions. The 'long-term' here means a significantly long period, such as 10 years, 20 years, 30years, or more. Cobb-douglas production function can be given enough time to change every input factor as well as to be replicated, so as to be able to accept the primary quantic production function.Thus, this study used endogenous growth theory as a Cobb-douglas production function model, which is a long-term relationship model between the change of the rate of people with higher education among economically active population and labor productivity.

$$\ln\left(\frac{Q}{L}\right)_{it} = b_0 + b_1 \ln EDU_{it} + b_2 \ln\left(\frac{Q}{L}\right)_{it} + \varepsilon_{it} \quad (1)$$

*j = firm, *t = year

*L= the number of labor, *Q=gross sales

*EDU= the level of education

ε_{jt}

$$\varepsilon_{jt} = \eta_j + \mu_{jt}$$

The error term ( ) cannot be observed as in formula (1), but the original capacity of a firm (the level oftechnology, etc.), culture, or tradition that can have a correlation with an explanation variable can be included.

*j = firm, *t = year

If the typical regression analysis is used without considering the effect of a firm ( ), the estimation coefficient for the economic achievement of a firm affected by the change of higher education can be biased. Most of the previous research applied estimated models using panel data to solve the problem of endogeneity (Kim, 2002; Lee, Kim, 2004; No, Jeong, 2006).

2) Research Model

The overall model for this study is shown in Table 5. The subject of inquiry for this study is whether the long-term change in higher education contributes to the improvement of labor productivity from the perspectiveof human capital theory. The first hypothesis is that the change in higher education is randomly determined and brings the improvement of labor productivity. This model is appropriate when the change in higher education israndomly determined and has nothing to do with errors including unobservable variables.

If it is related to errors, that is to say, the variable for higher education (LnEDU) has errors (ε) and

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correlation, a model to solve the problem of endogeneity is necessary because the estimation without considering the fact that unobservable variables of companies have an effect on the change in higher education and production can be biased.

In this model, C_i unchangeable and unobservable features of companies having influence on labor productivity, is included in the errors. If C_i has correlation with other independent variables having an effect on the change in higher education, fixed effects model was used for estimation. If C_i does not have correlation with other independent variables, random effect model was used for estimation.

Table 5: *Research Model*

$\mathrm{Ln}SPP_{it} = \lambda_1 \mathrm{Ln}EDU_{it} + \lambda_2 \mathrm{Ln}FCP_{it} + \lambda_3 \mathrm{Ln}EEP_{it} + Control\ Variables + C_i$
* $\mathrm{Ln}SPP$ = the value after taking a natural logarithm to the sales per person
* $\mathrm{Ln}EDU$ = the value after taking a natural logarithm to the percentage of people who completed middle school and high school out of all the people involved in economical activity
* $\mathrm{Ln}FCP$ = the value after taking a natural logarithm to capital intensity per person
* $\mathrm{Ln}EEP$ = the value after taking a natural logarithm to capital intensity per person

$* C_{:} = (Ability + \varepsilon)$

4. Study Results

4.1 Analysis of correlation between labor productivity and higher education ratio

Table 6 shows the analysis of correlation between the change in economically active population and the sales per person for 18 years. The result reveals that there exists a highly positive correlation for 18 years from 1990 to 2007.

4.2 The change of labor productivity to higher education ratio by year

Table 7 shows economically active population with more than college education, the sales per person, and the average sales of companies. In order to examine the change in labor productivity in relation to the rate of people with higher education by year, labor productivity per person (the sales per person) was discounted by present value. Figure 1 and Figure 2 show the change in labor productivity to the rate of people with higher education among economically active population by year. The increase of human capital is influenced by the improvement of overall degree of regular school education (Card & Krueger, 1996). In order to investigate this, another studies how the long-term change of theeconomically active population is related with labor productivity for 18 years by year.

Table 7: *The change of higher education ratio, the sales per person and the average sales of companies byyear*

(unit: EDU=1,000 people, SPP=10,000 won, SPPP=1,000,000 won)

YEAR	**economically active population with more than college education (EDU)**	**the sales per person (SPP)**	**the average sales of companies (SPPP)**
1990	3,211	242,687	484,309
1991	3,583	263,915	531,404
1992	4,068	279,507	559,920
1993	4,487	290,365	586,850
1994	4,704	317,486	644,109

1995	5,025	352,854	736,868
1996	5,350	394,950	815,067
1997	5,520	474,145	880,504
1998	6,399	539,473	821,897
1999	6,679	572,381	909,222
2000	7,031	552,099	1,016,294
2001	7,431	556,407	1,032,935
2002	7,863	606,382	1,075,459
2003	8,927	582,117	1,050,310
2004	9,371	642,522	1,153,542
2005	9,848	657,241	1,178,319
2006	10,337	698,761	1,204,078
2007	10,867	730,776	1,267,300

Figure 1 shows the change in the number of people with higher education among economically active population and the average sales of companies. Both of them are generally increasing. In particular, there was quantitative expansion of higher education in Korea since 1980s, such as quota in college graduates, all-day school week in colleges, the expansion of entrance quota, and the expansion of Korea National Open University(Kang, 1988). The proportion of people with higher education out of economically active population by year and the average sales of companies show similar patterns.

This result has something in common with previous researches on the positive effect of the change of the rate of people with higher education among economically active population on the economic development of Korea (Barro & Lee, 1994; Kim et al., 1997; Jang, 2007). In 1997 and 2003, though, the rate of people with higher education among economically active population generally increased while the average sales of companies decreased. This might have resulted from other factors aside from the degree of being educated in regular schools.

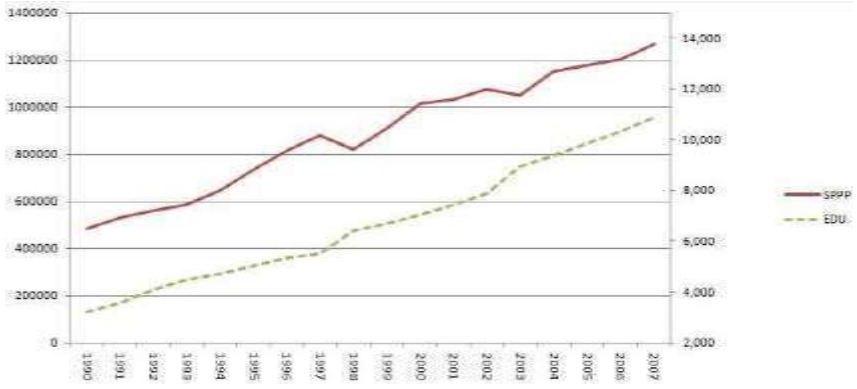

Figure 1: *The change of the rate of people with higher education*

Among economically active population and the average sales of companies by year

* Notes: SPPP= the average sales

EDU= college graduates' rate among economically active population

Figure 2 shows the change in the rate of people with higher education among economically active population and the sales per person by year. The rate of people with higher education among economically active population and the sales per person by year generally increased from 1990 to 2007. However, the sales per person by year shows slight fluctuation. One thing to be noticed is that the average sales of companies in 1997 shows decrease whereas the sales per person shows increase.

The increase of the rate of people with higher education among economically active population, high-quality human capital, might have been the reason. The decrease of the sales per person from 2002 to 2003 might have been caused by the active employment along with the economic boost from hosting Korea-Japan World Cup. However, this flow might have come from the inefficient operation of knowledge and skills in companies acquired by the investment in education.

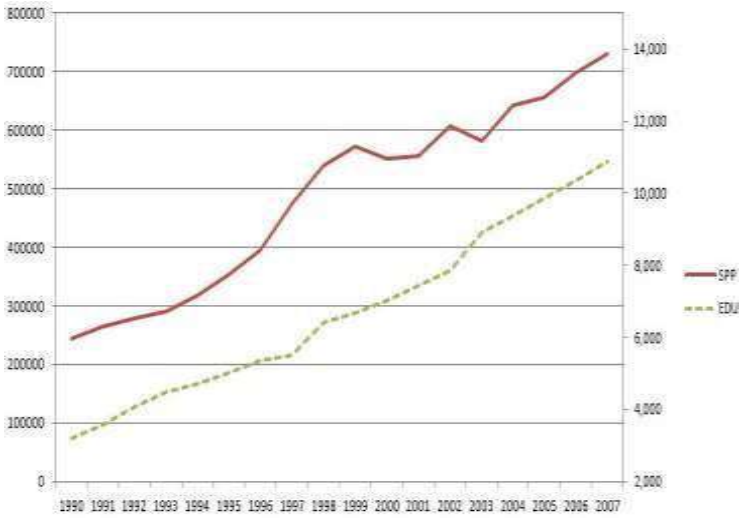

Figure 2: *The change of the rate of people with higher education Among economically active population and the sales per person by year*

* Notes: SPP= the sales per person

EDU= college graduates' rate among economically active population

4.3 Analysis result of the panel data

Table 8 and Table 9 illustrate how the rate of people with higher education has an effect on labor productivity (the sales per person) using panel data. According to the LM (Lang range Multiplier) verification result by Breusch and Pagan (1980), $\chi^2(1)$ =12482.822** rejects the null hypothesis ($H_0: \sigma^2_c = 0$), which reveals the C dispersion, that is, the effect among entities does exist. The verification result by Hausman (1978), too, shows that $\chi^2(5)$ =115.000** rejects the null hypothesis ($Cov(X, C) = 0$), the effect amongentities having something to do with independent variables. Judging from these results, it is desirable to examine the analysis result focusing on the fixed effect.

According to the analysis result of the fixed effect, the increase of the number of economically active population with more than college education has a positive effect on labor productivity (the sales per person). This result is very significant because it came out considering unobservable features of companies like capabilities. However, the resulting value of the fixed effect lost the degree of freedom, so the precision of estimation is low compared to the one of random effect, as long as there is no problem with endogeneity (Greene, 2003). Also, the resulting value of the fixed effect can be biased because it includes the explanationof time-variant variables (Cameron & Trivedi, 2005). Thus, POLS and random effect (RE) are provided together in this study.

The analysis result of the panel data reveals that the increase of economically active population with more than college education has positive influence on labor productivity (the sales per person). In other words, the positive correlation between them was reinforced by solving the problems of short-term data and analysis method mentioned as limitations in previous researches. This result is meaningful in that it solved the problem of parametric bias and proved that long-term investment in human resource development can increase the labor productivity of companies.

Table 8: *Analysis result of panel data*

	FE	POLS	RE
LnEDU	0.710 (33.56) **	0.286 (12.51)**	0.672 (20.86) **
LnEEP	0.051 (11.83) **	0.043 (9.37)**	0.055 (12.44) **
LnFCP	0.486 (36.00) **	0.781 (85.30)**	0.515 (38.79) **

LnNOE	-0.008 (-0.53)	-0.036 (-5.91)	-0.042 (-3.79)**
INC	0.001 (3.90)**	0.002 (5.13)**	0.001 (4.01)**
Adj-R^2	0.756	0.796	0.587
N	3888 (216 companies)	3888	3888 (216 companies)

Notes. 1. * : $p < 0.05$, ** : $p< 0.01$

2. The value in parenthesis is t.

3. variables: LnEDU = the value taken natural logarithm into the number of economically active population with more than collegeeducation, LnEEP = the value taken natural logarithm into the education fee per person, LnFCP = the value taken natural logarithm into capital intensity per person, LnNOE = the value taken natural logarithm into the number of workers, INC = incentive index

Table 9: *Analysis result of panel data per size of companies*

	FE	POLS	RE
LnEDU	0.429 (18.44)**	0.665 (23.93)**	0.440 (19.26)**
LnEEP	0.044 (9.76)**	0.030 (5.08)**	0.043 (9.63)**
LnFCP	0.297 (33.11)**	0.538 (53.88)**	0.309 (34.86)**
INC	0.002 (5.08)**	0.002 (4.10)**	0.002 (5.03)**
SSIZE	-0.433 (-12.40)*	-1.616 (-43.71)**	-0.514 (-14.95)*

	*		*
MSIZE	-0.301 (-11.02)**	-1.166 (-37.85)**	-0.360 (-13.34)**
MLSIZE	-0.184 (-8.79)**	-0.804 (-29.37)**	-0.221 (-10.57)**
Adj-R^2	0.573	0.665	0.586
N	3888 (216 companies)	3888	3888 (216 companies)

Notes. 1. * : p < 0.05, ** : p< 0.01

2. The value in parenthesis is t.

3. variables: LnEDU = the value taken natural logarithm into the number of economically active population with more than collegeeducation, LnEEP = education fee per person, LnFCP = capital intensity per person, INC = incentive index

4. SSIZE= number of workers<350, MSIZE= 350<number of workers<690, MLSIZE= 690<number of workers<1320, LSIZE= number of workers>1320, divided by quartile of the number of workers

5. Conclusions & Suggestions

Based on the results mentioned above, the conclusions are as follow.

First, the increase of the number of people with long-term higher education has a positive effect on labor productivity. According to the sales of companies and the change of the rate of people with higher education among economically active population by KIS-FAS, the correlation shows constant increase. The labor productivity can increase when the government or companies work on human resource development on a long-term basis.

Second, the average sales of companies in 1997 shows decrease whereas the sales per person shows increase. The increase of the rate of people with higher education among economically active population, high-quality human capital in other words, might have been the reason.

Third, the knowledge and skills acquired by investment in education is regarded to have been operated inefficiently in companies from 2002 to 2003, because the active employment caused by hosting Korea-Japan World Cup led to the decrease of the sales per person during this period.

Fourth, the investment in capital by companies increase labor productivity. According to the analysis result of panel data from KIS-FAS considering capacities of companies, which is regarded to play an important role in labor productivity, the capital intensity per person has a positive influence on the increase of labor productivity.

Fifth, the organization of work and the system of personnel affairs have a positive effect on labor productivity, which Zwick. et al. (2005), Wright et al. (2005) and Dearden et al. (2005) pointed out. In particular, among the variables showing the features of the organization of work and the system of personnel affairs, reward has a positive impact on labor productivity. The reason is thought to be that a reward system provides incentives to cultivate human capital or skills.

On the basis of these results, the suggestions for the follow-up research are as follows.

First, more researches on education in Korea since the period when Korea entered the international labor market should be conducted. They will be accumulated to provide more information and suggestions to the government and companies.

Second, the factors affecting labor productivity should be analyzed in the level of not only companies but also individuals.

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