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Effect of Demand for Labor On Investment in Education

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노동에 대한 수요가 교육에 대한 투자에 미치는 영향

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Abstract The purpose of this paper is to examine how demand for labor affects the job seeker's decision on the level of investment in education. In the current paradigm of economic growth in which innovations and technological developments generally weaken the strength demand for labor and increases the uncertainty related to employment, this paper provides a theoretical framework that can be used as a basic framework in understanding the decision of investment in education in varying conditions of demand for labor. The following are the findings of this paper. First, the level of investment in education can generally be regarded to be higher as the demand for labor exacerbates but for the job seekers with a certain characteristic. Second, the Arrow-Pratt absolute risk-aversion measure is the characteristic of the job seeker that determines in what direction the job seeker changes in the level of investment in education, For an arbitrary level of demand for labor there exists a certain threshold which determines the minimum degree of risk-aversion required for the job seeker's Arrow-Pratt should go over to increase the level of education as demand for labor weakens. Third, the job seekers lower the level of education even though the demand condition in labor markets weakens if the compensation function does not depend on the level of education. This is surprising because it turns out that one of the reasons why job seekers invest in education is that they want to be recognized in their compensation for their level of education even when more education still raises the probability of employment.

Key Words : Demand for Labor, Investment in Education, Risk-Aversion, Asset Specificity, Human Capital Specificity

요 약 본 연구의 목적은 노동에 대한 수요가 구직자의 교육에 대한 결정에 어떤 영향을 미치는가를 분석함에 있다. 혁신과 기술진보가 노동에 대한 수요를 줄이고 노동시장의 불확실성을 증대시키는 상황에서 본 연구는 노동자의 교육에 대한 투자가 노동에 대한 수요에 어떻게 의존하는가를 판단하는데 도움이 되는 이론적 구조를 제공하고자 한다. 본 연구의 결과는 다음과 같다. 첫째, 노동에 대한 수요가 감소할수록 교육에 대한 수요는 일반적으로 증가한다. 하지만 이런 결과는 반드시 성립하는 것은 아니다. 둘째, 감소하는 노동에 대한 수요에 대하여 노동자가 교육에 대한 수요를 증가시키는 것은 노동자의 (애로우-프랏 절대위험기피계수로 측정한) 위험기피도가 어떤 수준을 상회하는 경우에만 성립한다. 셋째, 노동에 대한 수요가 감소하더라도 노동자에 대한 보수가 그의 교육에 대한 투자를 반영하지 않는 경우, 노동자는 오히려 교육에 대한 투자를 줄인다.

키워드 : 노동에 대한 수요, 교육에 대한 투자, 위험기피도, 자산특정성, 인적자본 특정성

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1. Introduction

Labor has always been the most important production factor in all kinds of economy in history. It is widely and very well recognized that education is the most useful way of increasing labor productivity. Undoubtedly, there are a plethora of academic research, theoretical and empirical, which examine if and how firms use labor force efficiently. This implies that more education can be understood as a desirable for firms, and accordingly, society as well. However, the level of education not exogenous to the system, and is an important choice made by tob seekers. This aspect gains more significance as society changes more deeply and rapidly.

This study attempts to come up with a simple theory to show how the condition of labor markets affect the investment in education chosen by job seekers. Much to every researcher's surprise, it is almost impossible to find a theoretical model that links the investment in education to the condition of labor markets. Certainly, there is an unmet need for a theoretical framework that help us understand how job seekers respond to the environment of labor markets. This is the point that differentiates this paper from previous research in this area.

As is known too well and pointedly discussed, the findings of a host of research on the relationship of level of education to the condition of labor markets run a whole gamut of diverse results. This diversity is understandable in that the demand and supply conditions of labor are greatly different in many aspects depending on job descriptions. For instance, studies for less skilled workers and high school education can produce markedly different results from those for professional workers and education at the level of graduate education. It is quite surprising, nevertheless, it is hard to find a theoretical model that can provide the logical perspective which helps predicts how the condition in labor markets affect the choice of education. For this reason, this paper intends to present a simple theoretic model that can provides insight on how the conditions of labor markets can affect the choice of job seekers on the level of education.

As economic growth depends more and more on the depth and speed of technology progress and innovation, job seekers have harder time finding a job for themselves. First, technological innovation replaces human labor forces. Second, race among innovative firms increases the magnitude of uncertainty in labor markets. Expertise that were useful some years ago could become obsolescent by the ground-breaking innovation. This means that demand for labor is declining in macroeconomic viewpoint, and changes a lot even in the fields that require expertise.

In the recent market conditions that are generally adverse to job seekers, this study is to examine how demand for labor affects the job seeker's investment in education. It is assumed in this that both the probability of employment and the compensation when employed are higher for those who invest more investment in education. Both the probability of employment and the compensation increase in the level of education only at a decreasing rate. In addition, the demand condition in labor market affects the level of compensation. The compensation falls as the situation in labor markets grows direr.

There are several findings of this paper. First, the level of investment in education can generally be higher as the demand condition for labor exacerbates but for all kinds of job seekers. This result appears to be intuitively appealing because job seekers attempts to raise the probability of employment and also getting a higher compensation when employed. But this

does not happen to all job seekers, which leads to the second finding of this study. Second, the investment in education is greater as demand for labor weakens only for those job seekers whose Arrow-Pratt absolute risk-aversion coefficient is larger than a certain threshold level. To be specific, for an arbitrary level of demand for labor (which will be captured by σ), there exist a certain threshold which determines the minimum degree of risk-aversion that the job seeker's Arrow-Pratt should go over for her to increase the level of education as demand for labor weakens. A relevant argument can be as follow. If the job seeker is entirely insensitive to the risk of being unemployed, she may well not care to invest more in education even when the demand conditions in labor markets worsen. Rigorously speaking, this does not exactly mean that the more risk-averse the job seeker is, the higher her investment in education is. Nonetheless, it appear to suggest that a more risk-averse job seeker will invest more in education. In this rather broad interpretation, the following argument is plausible. if the job seeker is more risk-averse, then she will likely be more concerned about the event of being unemployed. All in all, it is entirely understandable that the job seeker with a high degree of risk-aversion will likely choose a greater level of education. Third, job seeks lower the level of education even if the demand condition in labor markets weakens if the compensation function does not depend on the level of education. This is surprising because this finding tends to suggest that investing in education would not be made if the level of education is not recognized in their compensation although it still raise the probability of employment.

This study also lends itself to addressing issues in labor markets associated with obsolescence of expertise. As of late, the speed of technological innovation is getting faster. This means that a specialized expertise now may become outdated in some years. If the labor forces with this expertise that have replaced by some other new methods may have difficulty in finding a job. That is, a extremely fast changing economy makes the outdated expertise somewhat "obsolescent". If the concept of asset specificity. Tirole(1988) has a very good exposition on the concept of asset specificity[1]. is applied to labor markets, those labor forces suffering from "human capital specificity". The labor forces can be "locked in" the good old days when their expertise is in high demand. Those days are gone. This study lends itself to understanding the present condition of labor markets in a world that is experiencing changes at the unprecedented speed and scope.

The paper consists of the following sections. Theoretical background of this study is presented in Section 2. Section 3 presents the model and analysis of this study. In Section 4, the theoretical findings of this paper are presented and some discussion is provided in view of real-world observations. Section 5 concludes this paper.

2. Theoretical Background

For an economy to sustain a meaningful growth, it is indispensable that labor has be enhanced to be a factor with a higher productivity. This means that firms, who are the leading engine of economic growth, enjoy a profit margin with it, which in turn implies a higher economic growth in soceity as a whole. This belief is best represented by human capital theory.

This leads to more practical investigations on the means that enhances the productivity of labor forces. A flood of innovative education methods are applied in various fields of education. Jang(2021) and Yoon & Jang(2020)

show that scientifically designed education methods that are developed as the results of interdisciplinary research are actually effective to elementary and secondary school students[2,3]. Jun(2020) and Suh, Kim & Suh(2021) suggest the ways to promote the education performance with the proper use of education devices[4,5]. In Yeon(2020), the micro management of education with the concept of customization can be adopted as a way of improving the effect of education to a certain group of students[6]. From the standpoint of human capital theory, all these detailed development in education should be understood as practices and efforts enhance the productivity of human capital. In a nutshell, the most prevalent way of putting the idea of human capital theory to work in reality is education. Education, in school, in workplace, or any parts of society, is the most widely accepted way of increasing the efficiency of markets by enhancing the capability of human capital.

Although human capital theory takes the center stage of labor economics and human resources management, in the area of information economics, the role of education is shown to play the role of information asymmetry, and accordingly, mitigate the inefficiency in labor markets. The point is that the choice of investment in education can be used as a signaling or screening device that credibly differentiates the labor force with high ability from those of low ability. Spence(1973), Spence(1974) and Stiglitz(975) are the pioneering work in this research line[7-9]. The basic feature that make it possible for labor market participants to discern the labor force of good type from those of bad rest on the difference of education for each type. That is, the good type bears a lower cost of education than the bad type. Taking advantage of this aspect, the good type choose the investment ins education at the level more than that cannot be mimicked by the bad type even though it exceeds the level of optimal investment in education in the absence of private information. It should be noted that this line of research under adverse selection does not deny the role of education in enhancing the productivity of human capital. It just emphasizes that the choice of investment in education can alleviate the inefficiency in labor markets even if there were no role of education in increasing productivity of human resources. If the basic proposition of human capital theory is added to the information economics, the positive role of education in labor markets is only reinforced.

There have been a number of literature that examine how the level of education is related to demand condition for labor. Mincer(1991) shows that a more investment in education may lead job seekers to a greater risk of unemployment[10]. This runs counter to the conventional wisdom in education. That is, it is normally believed that more education will reduce the probability of being unemployed. There are two forces at work for this observation. First, Job seekers with highly intense and specialized education tend to expect generous compensation for his investment in education (and also for his expertise). expectation of compensation to job seekers who have higher education. Second, job seekers with high quality expertise may suffer from a lock-in effect, which makes it hard for them to find a job outside the fields in which their expertise can be properly recognized. In other words, there exists an asset specificity in labor markets for highly specialized fields. This is easy to understand by the observations that many Ph.D.'s have difficulty finding a proper and decent job for them.

Black et al(2005) presents an interesting finding on the how an increase in earnings can affect high-school education[11]. In their empirical study using the US data during 1970s and 1980s for workers in coal industry, they show that 10% increase in low-skilled workers decrease about 5-7% of high-school enrollment. According to Black et al(2005), the level of education falls as the demand condition for labor improves[11]. Although their research is confined to low-skilled workers, the result sheds an interesting light on how individual hoice of education is related to the condition of labor markets. It is worth noting that Blinder et al(2019) offers an empirical finding contrary to Black et al(2005)'s result[12]. Blinder et al(2019) shows that less educated US males reduce their investment in education as the prospects for labor markets grows darker[12].

The most highlighted issue in contemporary labor markets is mismatch between demand and supply. Lauder et al(2020) and Ortiz et al(2020) pay attention to mismatch in labor market and attempt to suggest ways to reduce the social costs arising from the matching problems in labor markets[13,14]. Jensen(2010) conducts a convincing investigation as to why education and job placement do not go together smoothly[15]. His evidence is from the Dominican Republic high school students. His research rests on the belief that the level of education depends on the perceived (not the actually realized) returns to education. His study shows that the perceived returns are very inaccurate, and do not significantly depend on schooling. This implies that it is hard to find a significant relationship between the level of education and the formation of perceived returns from labor markets.

As can be easily known, there are too many a great study to mention here. However, it is surprising to find that there are no theoretical paper that addresses the subject of the effect of demand for labor on a job seeker's choice of education level. This study attempts at this point. The following Section 3 describes the model of this study and proceeds with theoretical analysis.

3. Model and Analysis

The level of education increases the probability of employment. Under the risk described above, the job seeker decides on the level of education. Throughout the paper, this study takes a representative agent model, who can be either those aiming on labor markets that do not require special expertise (such as college students) or those seeking professional career (such as Ph.D. students).

The job seeker chooses the level of education for the purpose of employment after finishing her education in labor markets with human capital specificity. The following Assumptions describe the design of this study. The level of education is represented by e.

3.1 Demand for Labor

In this study, demand for labor is represented by the coefficient $\sigma \in (0,1)$. A greater σ represents a weaker demand for labor.

There are many factors that affect the strength of demand for labor. The most general factor will be the macroeconomic condition of economy. If an economy grows at a fast rate, then there will be quite a strong demand for labor. However, the strength of demand for a particular type of human resources may also depend on how broadly this type can effectively function in various jobs. In this regard, the concept of asset specificity can be applied to labor forces. If the job seeker's expertise is useful only for a very narrow range of jobs,

demand for the job seekers of this particular expertise will likely have difficulty finding a job. This "asset specificity" in labor forces can be more serious in contemporary society in which changes are tremendously fast. For instance, an expertise in a specialized field can before long be obsolescent with the advent of new innovation that replaces the previous technology. This means that the size of σ is also affected by the flexibility of labor forces. A job seeker who is locked in expertise of old days may be represented by a high σ. Accordingly, it is perfectly right to understand σ as the coefficient reflecting the weak demand for labor. It can also capture the extent to which a certain group of labor forces has a limited mobility or is outdated. Nevertheless, a greater σ implies the degree of toughness that a job seeker faces in labor markets, and can be accepted as a "weak" demand for labor.

3.2 Compensation for the worker

Compensation for the worker depends on σ and e. If the degree of human capital specificity is higher, then the compensation becomes lower. If the level education is higher, then the compensation is higher. The compensation for the worker (that is, the job seeker who successfully finds a job) is denoted by $\theta(\sigma, e)$ with

$$\text{(a) } \theta_\sigma(\sigma,e) \equiv \frac{\partial\theta}{\partial\sigma} < 0 \text{ and } \theta_{\sigma\sigma}(\sigma,e) \equiv \frac{\partial^2\theta}{\partial\sigma^2} > 0; \quad (1)$$

$$\text{(b) } \theta_e(\sigma,e) \equiv \frac{\partial\theta}{\partial e} > 0 \text{ and } \theta_{ee}(\sigma,e) \equiv \frac{\partial^2\theta}{\partial e^2} < 0 \quad (2)$$

where θ_i is the first-order partial derivative, and θ_{ii} is the second-order partial derivative for $i = \sigma, e$.

3.3 Probability of Employment

The probability of employment depends on the level of education, which is denoted by $p(e)$. With consideration of the demand for labor, the ``virtual" probability of employment with the investment in education e is $(1-\sigma)p(e)$, and that of being unemployed is $1-(1-\sigma)p(e)$. $p(e)$ is assumed to have the following property:

$$p_e \equiv p'(e) > 0; \text{ and } p_{ee} \equiv p''(e) < 0. \quad (3)$$

When a student is employed in the field of her expertise, the compensation to her is $\theta(\sigma, e)$, and zero when she is not employed in her field.

3.4 Utility Function of the Employe

The utility function of a representative job seeker is denoted by an increasing concave function $U[\theta(\sigma, e)]$ with

$$U_\theta \equiv U'[\theta(\sigma,e)] > 0 \quad ; \quad \text{and} \quad U_{\theta\theta} \equiv U''[\theta(\sigma,e)] < 0 \quad (4)$$

3.5 Cost of Education

The cost of education is a convex function given by

$$C(e) = \frac{1}{2}e^2 \quad (5)$$

The job seeker maximizes the following problem with the choice of e.

$$W(e) \equiv (1-\sigma)p(e)U[\theta(\sigma,e)] + [1-(1-\sigma)p(e)]U_r - \frac{e^2}{2} \quad (6)$$

where $W(e)$ is the "net benefit" function of the job seeker. U_r is the job seeker's utility when $e=0$. Without loss of generality, it is assumed that $U_r=0$. Then, the objective function is reduced to

$$W(e) \equiv (1-\sigma)\, p(e)\, U[\theta(\sigma, e)] - \frac{e^2}{2}. \qquad (7)$$

Let $e(\sigma)$ represent the optimal level of education. In this paper, for simplicity, e^* is used as the shorthand notation for $e(\sigma)$. That is, $e(\sigma) \equiv e^*$. In what follows, all the terms with superscript * represent the value of the terms evaluated at $e = e^*$. Accordingly, for the analysis of this study, the following shorthand notations will be used.

$$e^* \equiv e(\sigma);\, p^* \equiv p(e^*);;\, p_e^* \equiv p'(e^*);\, p_{ee}^* \equiv p''(e^*)$$
$$U^* \equiv U[\sigma, e^*];\, U_\theta^* \equiv U_\theta[\sigma, e^*];\; U_{\theta\theta}^* \equiv U_{\theta\theta}[\sigma, e^*];$$
$$\theta_e^* \equiv \theta_e(\sigma, e^*);\; \theta_{ee}^* \equiv \theta_{ee}(\sigma, e^*);\; \theta_\sigma^* \equiv \theta_\sigma(\sigma, e^*). \qquad (8)$$

With the model specification given above, the rest of this section is devoted to analyzing the model and produces the theoretical results.

By differentiating the job seeker's expected utility function with respect to e, the optimal level of education is obtained as in Theorem 1.

Theorem 1. The job seeker's choice of education level is determined by

$$e(\sigma) \equiv e^* = (1-\sigma)\left[p_e^*\, U^* + p^*\, U_\theta^*\, \theta_e^*\right] \qquad (9)$$

Proof of Theorem: refer to Appendix.

Let the indirect "net benefit" function of the job seeker be denoted by $V(\sigma)$. Then, it is defined by the following condition.

$$V(\sigma) \equiv W[e(\sigma)]$$
$$= (1-\sigma)\, p[e(\sigma)\, U[\theta(\sigma, e(\sigma)] - \frac{e(\sigma)^2}{2} \qquad (10)$$

Examine how the job seeker's choice of education changes as the degree of coefficient σ, which captures how tough the labor market is for the job seeker. To this end, $\frac{de(\sigma)}{d\sigma} \equiv \frac{de^*}{d\sigma}$ should be obtained. This derivative can be accomplished by differentiating $V(\sigma)$ defined above. Then, Lemma 1 follows.

Lemma 1. $$\frac{de^*}{d\sigma} = \frac{\Gamma(\sigma)}{1-\Delta(\sigma)} \qquad (11)$$

where

$$\Delta(\sigma) \equiv (1-\sigma)\left\{p_{ee}^*\, U^* + p^*\, U_{\theta\theta}^*\, (\theta_e^*)^2 + (1+\theta_e^*)\, p_e^*\, U_\theta^*\right\}; \qquad (12)$$

$$\Gamma(\sigma) \equiv -\left\{p_e^*\, U^* + p^*\, U_\theta^*\, \theta_e^*\right\} + (1-\sigma)\, \theta_\sigma^* \left\{p_e^*\, U_\theta^* + p^*\, U_{\theta\theta}^*\, \theta_e^*\right\}. \qquad (13)$$

Proof: Refer to Appendix.

The second-order condition of the job seeker's optimization problem is shown in the following Lemma 2.

Proof: Refer to Appendix.

Lemma 2. The following condition should hold as the second-order condition at $e = e^*$.

$$\left\{p_{ee}^*\, U^* + p_e^*\, U_{\theta\theta}^*\, \theta_e^* + p_e^* + U_\theta^*\, \theta_e^* + p^*\, U_{\theta\theta}^*\, (\theta_e^*)^2 + p^*\, U_\theta^*\, \theta_{ee}^*\right\} < \frac{1}{1-\sigma} \qquad (14)$$

Proof: Refer to Appendix.

With the help of the second-order condition presented in Lemma 1, the signs of $\Gamma(\sigma)$ and $1-\Delta(\sigma)$ can be determined as in Lemma 3.

Lemma 3. $1-\Delta(\sigma) > 0$. That is,

$$1-\Delta(\sigma) = \left\{1+(1-\sigma)p_e^* U_{\theta *}\right\} - (1-\sigma)\left\{p_e^* U_{\theta\theta}^* \theta_e^* + p_e^*) U_\theta^* \theta_{ee}^*\right\} > 0 \quad (15)$$

Proof: Refer to Appendix.

As it is shown that $1-\Delta(\sigma) > 0$, the sign of $\frac{de^*}{d\sigma}$ depends on the sign of $\Gamma(\sigma)$. It is easily seen that

$$\Gamma(\sigma) \geqq 0 \quad \text{if and only if} \quad A^*(\sigma) \geqq \Psi(\sigma) \quad (16)$$

where

$$A^*(\sigma) \equiv -\left\{\frac{U''[\theta(\sigma, e^*)]}{U'[\theta(\sigma, e^*)]}\right\}; \quad (17)$$

$$\Psi(\sigma) \equiv -\frac{1}{\theta_\sigma^*} + \frac{p_e^*}{p^* \theta_e^*}\left\{1-\frac{p_e^* U^*}{p^* U_\theta^* \theta_e^* \theta_\sigma^*}\right\}. \quad (18)$$

Note that is $A^*(\sigma)$ the coefficient of Arrow-Pratt absolute risk-aversion evaluated at $e = e^*$ for an arbitrary σ. Now it is possible to present the following Theorem 2.

Theorem 2. Suppose that compensation depends on both the difficulty of finding a job (captured by σ) and the level of education (represented by e). Then the optimal level of education responds to a change in the coefficient σ as follows.

$$\frac{de^*}{d\sigma} \geqq 0 \quad \text{if and only if} \quad A^*(\sigma) \geqq \Psi(\sigma) \quad (19)$$

where

$$A^*(\sigma) \equiv -\left\{\frac{U''[\theta(\sigma, e^*)]}{U'[\theta(\sigma, e^*)]}\right\}; \text{ and}$$

$$\Psi(\sigma) \equiv -\frac{1}{\theta_\sigma^*} + \frac{p_e^*}{p^* \theta_e^*}\left\{1-\frac{p_e^* U^*}{p^* U_\theta^* \theta_e^* \theta_\sigma^*}\right\}.$$

Proof: Refer to Appendix.

Theorem 2 is not difficult to understand. If the job seeker's concern for being unemployment will be greater if her risk-aversion is greater than some level. Hence, it is rational for her to increase the level of education. This motivation can be reinforced because a higher level of education provides her with a higher compensation when she is employed. It should be noted, however, that Theorem 2 does not directly prove that a more-risk averse job seeker will increase in her choice of education level as demand for labor weaken. Rather, it states that for the job seeker to increase her level of education as it gets harder for her to find a job, her risk-aversion should be adequately high. This point will be discussed in greater detail in section 4.

It is interesting to see that Theorem 2 offers an indirect perspective that can be used in understanding why the job seekers aiming on a job in upcoming and trendy fields with high pay and great potential. The investment in education is growing greater in Korean society every year at an unstoppable pace. This tendency is even greater in the fields of great future value. In fact, Korea is not alone in the phenomenon of excessive investment in education. In almost all

Asian countries run into many social and financial problems arising from excessive investment in education.

A special case that draws attention is the one in which compensation does not depend on education. The following Theorem 3 presents a finding in this case.

Theorem 3. Suppose that compensation depends only on the difficulty of finding a job (captured by σ) and not on the level of education (represented by e). Then, an increase in he difficulty of finding a job (captured by σ) invariably decreases in the level of education. That is,

$$\frac{de^*}{d\sigma} < 0 \tag{20}$$

Proof: Refer to Appendix.

Theorem 3 makes an important point in applying the finding of Theorem 2 in reality. Theorem 2 establishes that the job seeker, when they are sufficiently risk-averse, responds to a stronger human capital specificity with more education. Normally, as is the case with many Asian countries, the level of education is one of the key elements in job markets. Obviously, job seekers with better education backgrounds have a higher probability of employment with a more generous compensation. Theorem 2 shows that if the generosity of compensation does not depend on the level of education while the probability of employment still does, the job seeker responds to a rise in human capital specificity with less education regardless of their degree of risk-aversion. This appear to present a very convincing argument for why job seekers in Korea have the almost unfaltering belief in education.

4. Results And Discussion

There are three major findings of this paper. First, the level of investment in education can generally be higher as the demand condition for labor exacerbates but for all kinds of job seekers. This result appears to be intuitively appealing because job seekers attempts to raise the probability of employment and also getting a higher compensation when employed. But this does not happen to all job seekers, which leads to the second finding of this study. Second, the investment in education is greater as demand for labor weakens only for those job seekers whose Arrow-Pratt absolute risk-aversion coefficient is larger than a certain thresholde level. To be specific, for an arbitrary level of demand for labor (which will be captured by σ), there exist a certain threshold which determines the minimum degree of risk-aversion that the job seeker's Arrow-Pratt should go over for her to increase the level of education as demand for labor weakens. A relevant argument can be as follow. If the job seeker is entirely insensitive to the risk of being unemployed, she may well not care to invest more in education even when the demand conditions in labor markets worsen. .Rigorously speaking, this does not exactly mean that the more risk-averse the job seeker is, the higher her investment in education is. Nonetheless, it appear to suggest that a more risk-averse job seeker will invest more in education. In this rather broad interpretation, the following argument is plausible. if the job seeker is more risk-averse, then she will likely be more concerned about the event of being unemployed. All in all, it is entirely understandable that the job seeker with a high

degree of risk-aversion will likely choose a greater level of education. Third, job seeks lower the level of education even if the demand condition in labor markets weakens if the compensation function does not depend on the level of education. This is surprising because this finding tends to suggest that investing in education would not be made if the level of education is not recognized in their compensation although it still raise the probability of employment.

One of the findings of this study is that the level of education increases as the demand condition for labor weakens only when the job seeker's risk-aversion is greater than a certain threshold level. This result is presented in Theorem 2. Rigorously speaking, this finding does not state that the level of education becomes greater when the job seeker is more risk averse. However, it tends to show that there is a certain relationship with the change in the level of education chosen by the job seeker as the demand for labor lessens.

In this regard, Theorem 2 appears to suggest a way to explain the excessive education in couple with the characteristic of labor markets. If the proposition that states that a more risk-averse job seeker will increase her choice of education level can be established, then the observation on the excess education in many Asian countries can be explained as follows. The investment in education is growing greater in Korean society every year at an unstoppable pace. As such, Theorem 2 could provide one perspective to understand how this can be a rational choice from the Korea job seeker's point of view. Over the past couple of decades, Korea has been trying really hard to be a part of major countries with economic strength. Korea has already passed the phase that can sustain economic growth in manufacturing industries that mainly produces hardware products and equipment. To enhance the value-added from economic activity, Korea has been persistently attempting to transform its economic core competencies from hard and tangible manufacturing intensively using physical resources to soft and intangible services and capabilities that call for intellectual and innovative human resources. This trend in Korea brings about a great investment in high-tech industries with cutting-edge innovation, which accordingly, the labor markets in Korea are in need of high quality human resources who can undertake this task. This is good news and also the news as well for those who are seeking a job in the fields. If a job seeker get a job in one of these areas, she will be amply compensated. However, if she cannot, then she have trouble find a job in other job markets because she will not likely have a proper compensation and her expertise may not be so useful as it would when she were hired in the right fields. Therefore, this characteristic of job markets in the trendy, promising and upcoming fields can be interpreted as the job seeker becoming more risk-averse. That is, the disparity in welfare is so huge. She will be very happy when employed but it will be disaster if she fails to find a job in the right fields for her expertise. According to Theorem 2, the job seeker aiming at job of this characteristic will choose to increase the level of education to stay from disaster. Stated differently, the wider the welfare difference between when employed and when unemployed is, the greater the level of education the job seeker chooses. In the perspective, a seemingly excessive investment in education by Korean job seekers can be understood as the rational choice.

Risk-averse job seekers are always intrigued by the uncertainty in labor markets. Although

job seekers decide on the level of investment in education based on their expectations, it is not unusual that they find themselves facing the job markets that are not favorable to the outdated expertise or skills they have had education for. This tendency is even stronger than ever in history, as of late, as innovations and technological developments become more important in many parts of society. Job seekers are exposed to risks arising from time difference between education and job search. Out on the job markets after their education is finished, the expertise and special skills obtained from education may not as relevant as they were expected to be. This study makes it possible to view this characteristic of expertise as a kind of asset specificity. Special expertise that students are educated for could not so useful as they expected to be because either innovations make them obsolete and accordingly the jobs that require them are waning. Human capital specificity can be understood as being composed of ``matching specificity" and ``timing specificity". Education can also be treacherous because of the increased instability of macro economy. It is commonly recognized that the many countries and industries are connected so closely that a problem in remotely related or even seemingly unrelated field, industries and economies can have a stronger effect on environments in wider markets. This makes it hard for job seekers to form rational expectations for the future.

Asset specificity is a concept that can be used to address the level of investment in education in this situation. Normally, asset specificity can be easily understood in two-period games of perfect information. The player who moves in the first-period (or, Player 1) does not invest adequately since he knows that Player 2, who moves in the second-period, takes an opportunistic behavior at the time of her move, taking advantage of the fact that Player 1's cost is sunk. This concept attracts attention because it is useful in understanding ex ante optimal contracts may not be subgame perfect or sequentially rational. In sequential move games, where the first-mover makes his choice that incurs sunk cost, some Nash equilibrium cannot give a rational explanation of behavior in reality. This study attempts to introduce this feature in education and employment in a one-period static model. Also, in reality, human capital exhibits specificity due to time difference between education and job search, this paper condense it into the one-period model by making both probability of employment and the size of compensation depend on the strength of human capital specificity and the level of education. The substance of asset specificity rests on uncertainty. It should be noted that the fundamental aspect of asset specificity is that the cost of achieving the asset is sunk and cannot be recovered when it is not used in a specific economic activity. This idea can be applied to education in ths paper. Cost of education is sunk, which means that makes the risk of employment greater. Risk of employment, in reality, comes into existence due to the variability of job market conditions. When job market conditions turn unfavorable to a job seeker and she is not employed, he cannot recoup the cost of education. Although this model does not have firms' decision in the model, and there can be no opportunistic behavior of firms that would affect the job seeker's investment in education, the risk of unemployment plays the role opportunism as the force at work that affects the choice of investment that incurs sunk cost.

A basic proposition on asset specificity is that

investment in socially beneficial assets can be undertaken at a level that is less than socially desired. Job seekers still need to decide on their education based on their expectations of job market situations. Aside from human asset specificity, in the job markets, the risk of unemployment associated with uncertainly affects the students' decisions on the level of education. As of late, as the market environments are changing rapidly and unexpectedly partly because of the increased importance of innovations in economy and a limited and inaccurate expectation of the conditions of future economy, it is getting tougher for students to decide on how much and what type of education they have to receive. Conventional proposition on asset specificity will likely lead to the conjecture that students will reduce their investments in education.

Observation of excessive investment in education in Korea runs counter to the this conventional proposition on asset specificity. Investment in education is Korea is growing larger every year. This study provides a framework that explains the observation in Korea. In the model where the probability of employment and the level of compensation rely on those the level of education and the strength of human capital specificity, it is established that an increase in human capital strength can make job seekers invest more in education only when their risk-aversion is greater than a certain threshold level. In fact, the high risk-aversion of job seekers can be understood if a brief thought is given to past and present of Korea. Korea is well recognized for rapid economic growth over the decades. As the Korean economy transforms into a more intellectual and innovative one, many high-pay jobs that required high level of education have been created. Also, as is normally the case, innovation is accompanied by certainty. Accordingly, the job market situation in Korea is more unpredictable than ever although there are opportunities to be employed in jobs with generous compensation. For instance, research and development for innovative products make firms race against time and subject them to run through uncharted fields. Inevitably, this lowers the expectation probability of what will happen in the future down the road. Additionally, Korea is facing a largest macroeconomic instability for many reasons. Undeniably, all this economic and business environment of Korea adds to human capital specificity in Korean job markets. This job market environment in Korea makes job seekerss crave education more than ever. This paper explains how high risk-aversion can be responsible for this observation.

However, this finding should be treated with proper caution. Another result of this study is that the level of education invariably declines with an increase in the strength of human capital specificity regardless of the degree of risk-aversion if the generosity of compensation does not depend on the level of education. This is a very insightful finding in that Korean students would not increase in their investment in education however risk-averse they are in the environment the level of compensation does not depend on the level of education. Therefore, in the job markets in which the level of education does not affect the size of compensation, students unambiguously reduce their level of education no matter how they are risk-averse.

5. Conclusion

The purpose of this paper is to elucidate how the condition of demand for labor affect the job seeker's investment in education in a theoretical setting. There are many studies that examine how the investment in education is related to

the condition of labor markets. Much to the surprise, it is rarely found a basic paper that shows how the job seeker incorporate the condition of labor markets in her decision on the level of education.

This paper comes up with a simple theoretical model, which succinctly captures the crucial parts that are considered in the job seeker's decision on the investment in education. That is, the education has two effect. First, a greater education increases the probability of employment. Second, the job seeker with a greater education has a high compensation when employment. There is one more important element in the model. It is none other than the coefficient that reflects how hard it is for job seeker to find a job. It is assumed to be a factor that determines the compensation for the employed job seeker.

With this simple model, the following results are obtained. First, as demand for labor weakens, the job seeker generally increases the investment in education unde some condition. Second, the condition that determines if a weaker demand for labor induces the job seeker to invest more in education is risk-aversion. To be specific, those whose Arrow-Pratt absolute risk-aversion coefficient is greater a certain threshold raise the investment in education as demand for labor exacerbates. Third, most interestingly, the level of education chosen by the job seeker lessens as demand for labor decreases if the investment in education is not a variable that affect the compensation for the job seeker when employed.

The model that this study designs and uses is very limited in many aspects. Paradoxically, however, this is the rationale for this study. So many research in the field of human resources management, labor economics, and industrial-labor relations focus on specific cases, which do not add up to give a general view on how the investment in education is motivated by the condition of labor markets. Even with this simple model, it is possible to make some interesting findings that are worth more investigating.

Undoubtedly, the attempt made in this paper is only the beginning of the theoretical search for the choice of education in relation to the condition of labor markets. There are many aspects to extend the research in this line. First, this paper sidesteps the issue of optimization from firms' viewpoint. Second, in reality, there is information asymmetry between labor market participants, which is worth dealing with in future research. Third, there are a class of labor forces that should be treated differently. That is, there is quality difference in human capital. This also needs to be incorporated in a model to increase the realism of research. All these research topics reamain for future research.

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APPENDIX

Proof of Theorem 1:

It is necessary from $W'[e(\sigma)] \equiv W'(e^*) \equiv 0$ that

$$\frac{de^*}{d\sigma} = -[p_e^* U^* + p^* U_\theta \theta_e^*]$$
$$+ (1-\sigma) U_{\theta\theta}^* U^* \frac{de^*}{d\sigma} + (1-\sigma) p_e^* U_\theta^* \times \left[\theta_\sigma^* + \theta_e^* \frac{de^*}{d\sigma}\right]$$
$$+ (1-\sigma) p_e^* U_\theta^* \frac{de^*}{d\sigma} + (1-\sigma) p_e^* U_\theta^* \frac{de^*}{d\sigma}$$
$$+ (1-\sigma) p^* U_{\theta\theta}^* \frac{de^*}{d\sigma}\left[\theta_\sigma^* + \theta_e^* \frac{de^*}{d\sigma}\right]\theta_e^*$$
$$= 0.$$

Rearranging the above condition completes the proof.

Proof of Lemma 1: The proof is completed by rearranging the expression for $\frac{de^*}{d\sigma}$.

Proof of Lemma 2: The second-order condition for e^* is given by the following.

$$(1-\sigma)\{p_{ee}^* U^* + p_e^* U_{\theta\theta}^* \theta_e^* + p_e^* U_\theta^* \theta_e^* + p^* U_{\theta\theta}^* (\theta_e^*)^2$$
$$+ p^* U_\theta^* \theta_{ee}^*\} - 1 < 0$$

This completes the proof.

Proof of Lemma 3:

$$1-\Delta(\sigma) > \{1+(1-\sigma) p_e^* U_\theta^*\}$$
$$- (1-\sigma)\{p_e^* U_{\theta\theta}^* \theta_e^* + p_e^* U_\theta^* \theta_{ee}^*\} > 0.$$

The proof is completed.

Proof of Theorem 2: By rearranging the definition of $\Gamma(\sigma) \geqq 0$, it is obtained that

$$-\frac{1}{\theta_\sigma^*}\left\{\frac{U^*}{\theta_e^*} + \frac{p^* \theta_e^*}{p_e^*}\right\} + 1 \leqq \left\{\frac{p_e^* \theta_e^*}{p_e^*}\right\} A^*(\sigma).$$

Rearranging the above condition completes the proof.

Proof of Theorem 3: In this case, since the compensation for the worker does not depend on the level of education, it is necessary that $\theta_e(\sigma, e) = \theta_{ee}(\sigma, e) = 0$ for all (σ, e).

From (12) and (13), it must be that in this case,

$$1-\Delta(\sigma) = 1 - p_{ee}^* U^* + (1-\sigma)\{p_e^* U_\theta^* + p_e^* U_\theta^*\} > 0$$
and $\Gamma(\sigma) = -p_e^* U_\theta^* + (1-\sigma) p_e^* U_\theta^* \theta_\sigma^* < 0$

The proof is completed.