ECONOMIC THEMES (2017) 55(3): 377-397

http://www.economic-themes.com/

INVESTMENT IN EDUCATION AS A WAY OF OVERCOMING THE PROBLEM OF INFORMATION ASYMMETRY IN THE LABOR MARKET

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UDC 364.2:37]:330
Review paper

Abstract: The need for classifying workers in the labour market exists in the case of information asymmetry between workers and employers. It is expected that certain mechanisms will be developed in order to overcome this information asymmetry. One of those mechanisms is signalling, whose basic idea is that highly productive workers take certain actions in order to separate themselves from the low productive workers. This paper reviews an economic role of education as a signal in the labour market. The goal of the paper is to show theoretically how education can play the role of signal in order to solve the problems caused by the asymmetric information. The importance of such analysis is reflected in the fact that the recommendations for educational policy makers in terms of investment in education are different depending on whether education serves as a mechanism for improving productivity or as a mechanism for signalling different productive capacity. It is shown that these differences arise from distinct ways of measuring social rates of return on investment in education.

Received: 09.05.2017.
Accepted: 20.08.2017.

Keywords: information asymmetry, labour market, signalling, economic role of education.

JEL classification: D82, I21, J01

1. Introductory considerations

The economic role of education in the labour market is one of the topics in economics of education, as well as is the explanation of the existence of a positive relationship between educational levels and future earnings of an individual. A significant number of papers (eg. Psacharopoulos, 1994, Bezil, 2007, Chen, 2008)

reveal that education of an individual is the dominant determinant of his/her earnings and that a big part of the differences in earnings among individuals can be explained by differences in educational attainment. It was found that a higher level of education results in higher earnings, at which point one additional year of education leads to earnings increase by approximately 8-13% (Chevalier et al., 2004). In the literature several theoretical models has been developed in order to explain the existence of a positive relationship between the level of education of an individual and his/her earnings in the future.

The starting point in the analysis of the economic role of education in the labour market represents a theory of human capital, founded on the papers of Schultz (1961), Mincer (1974) and Becker (1975). From the aspect of the theory of human capital, education contributes to increasing the productivity of an individual, and consequently higher income of an individual in the future is the result of higher productivity. The human capital theory assumes there is no information asymmetry between employee and employers, and that individuals rationally choose to invest in education so the potential benefits of education are equal to the expected costs during education. Thus, education is seen as an investment activity which contributes to increasing the productivity of an individual. By investing in education, individuals can improve their quality of their labour services in such a way as to raise their future market value. In this regard, human capital is akin to physical capital, whose acquisition requires current costs, however, secures a benefit in the form of profits. According to this theory, education can be seen as an investment good and should be acquired until the point at which the marginal productivity gain equals the marginal opportunity cost (Brown and Session, 2004).

However, the theory of human capital cannot explain certain phenomena in the labour market such as unemployment or educational disparity. Apropos, according to the theory of human capital such occurrences should be short-term. The long-term presence of such phenomena has contributed to myriad critiques of the theory of human capital and has encouraged the development of alternative theories that differently perceive the economic role of education in the labour market (Blaug, 1993). One of the alternative explanations of investment in education by individuals and the existence of a positive relationship between education level and future earnings of individuals is signalling theory. Spence (1973), Arrow (1973) and Stiglitz (1975), in particular, contributed to the development of the theory of signalling. The basic idea of the theory of signalling is that education does not have to contribute to increasing productivity, but that education acts as a signal of productivity or as a signal of some other characteristics, such as ability, talent or reliability which employers value and which are not easily discernible. Spence (1973), who introduced the theory of signalling, considers that employment of an individual is an activity which is identical to purchasing a lottery. Spence (1973) assumes that the employer pays a certain monetary equivalent of a lottery to a

worker in the form of profits. In other words, employment is investing in conditions of uncertainty, since it takes place in conditions of information asymmetry among workers and employers. The employer does not hold information on the capabilities of the workers at the time of his/her employment, nor such information is necessarily available right after employment, as it assumes the theory of human capital. In this regard, the higher level of education is positively correlated with future earnings, not because it raises productivity, but because it certifies that employment of such worker is a good bet (Brown and Sessions, 2004).

Education can play a signal role if potential employers find it difficult to perceive the ability of workers or other characteristics of workers that are important to them. This can be illustrated by the following example. Assume that there are two types of workers in the labour market, high ability, and low ability workers. Further assume that the fraction of low ability workers in the total population is represented by q, and high ability workers by $1-q$, where the current value of productivity for low ability workers is p_1, and high ability workers is p_2; so that is true $p_2 > p_1$. It is assumed that differences in workers' productivity are innate and are not correlated with education level. If the employer would be able to choose a worker according to their productivity without difficulties, then, the low ability workers would receive the current value of earnings I_1, and high ability workers I_2, where is true $I_2 = 2 \cdot I_1$. However, even if a certain worker knows to which group of productivity type he/she belongs, the employer may take up to several years in order to detect whether the worker is a low productive or highly productive. This fact is a consequence of the existence of information asymmetry in the labour market, where one party in the transaction is better informed than the other. When an employer should ask a potential worker if his productivity is low or high, the worker in order to earn more money would certainly respond that he/she is highly productive regardless of his actual productivity. Therefore, low productive workers have incentives to pretend to be highly productive, and employers due to the information asymmetry cannot determine if the workers are sincere in the terms of productivity, then both types of workers will be treated identically. In this regard, employers will offer all employees the average present value of earnings which represents a weighted average of the present value of the earnings of both types of workers, where the weights are the fractions of these types of workers in the total population. Most likely, these offered earnings will attract low productive workers, and drag highly productive workers. As a consequence, there will be a certain mismatch between workers and jobs, which will reduce the efficiency of a firm. Since grouping of employees is not in the interest, either of employers or highly productive workers, these sides will strive for finding ways to overcome these problems related to the information asymmetry in the labour market. High productive workers have to provide incentives and firms have an incentive to account credible information that can be used for allocation of workers in the

appropriate group according to the type of productivity. Such credible information we call signal. It turns out that education can perform the role of the signal in the labour market, and that the education level of an individual can be used, under certain conditions, as a product for overcoming the mismatch between workers and jobs which in the case of the information asymmetry may appear (Borjas, 2015).Thereby, this paper reviews an economic role of education as a signal in overcoming information asymmetry between workers and employers. The goal of this paper is to show theoretically how education can play the role of signal in the labour market in order to solve the problems caused by the asymmetric information.

The structure of the paper consists of six parts. After introductory considerations, in the second part a theoretical problem of information asymmetry between workers and employers is examined, as well as the consequences in the labour market caused by this problem. The third part describes the mechanism of signalling, as well as the conditions that must be met in order to allow the signal. The fourth part presents the role of education as the signal and the establishment of separating equilibrium in the labour market. The fifth part is devoted to the analysis of the differences between private and social rates of return on the investment of education that exists when the signal applies. The last part of the paper is the conclusion.

2. Asymmetric information in labour markets: theoretical background

The need for classifying workers in the labour market exists in the case of the information asymmetry between workers and employers. Since an employer is unable to directly recognise actual productivity of a potential worker, the employer cannot rely on a statement of an employee on his/her own characteristics which are relevant to the employer because all potential workers have incentives to claim to belong to the type of highly productive workers. Moreover, generally speaking, the same problem appears in any sale situation where the products differ in terms of quality, but a buyer and a seller do not have the same information about these products. Without proper classifying of low-quality and high-quality products, the problems that origin from there can be significant (Brown and Sessions, 2004).

If it is not possible to discern the quality of a given product at the time of a purchase, and if the sellers receive information about the quality of the product that is the subject of the sale after a certain time, the product will be sold in the market at a price which reflects its average quality. Moreover, the price of that product will adjust until the buyer acknowledges the average quality of the product subsequently. These markets, as a consequence of these facts, have two undesirable characteristics: (1) sellers will strive to lower the costs by reducing the quality of

the product, and (2) if buyers are not able to influence the quality of the product, then the sellers of high-quality products, with high costs, would want to leave such market. The average quality of the product can fall below the level and that is characteristic of a market where there is no information asymmetry between buyers and sellers. This problem has been pointed by Akerlof (1970), in one of his/her papers where he developed an appropriate theoretical model that is considered to be a pioneer in the field of information asymmetry. According to this model, the previously described process will take place as long as the products of the lowest quality are not traded in the market. Akerlof (1970) illustrated the example of used cars and thereby focused on the key information asymmetry: the seller of a used car is better informed about its quality than a potential buyer.[1] For a seller, the value of low-quality cars is θ_1, while the value of high-quality cars is θ_2, where $\theta_2 > \theta_1$. Buyers, who are neutral towards risk, know that the fraction of low-quality cars in this market is π. If buyers are not able to recognise the quality of a particular used car, then the high-quality and low-quality used cars will be sold at a price which reflects the average quality of used cars in the market, defined as $\bar{\theta} = \pi \cdot \theta_1 + (1 - \pi) \cdot \theta_1$.The more low-quality cars are used, the more average quality of these cars becomes lower and the price is lower for all used cars in that market. Faced with this situation, according to Akerlof (1970), owners of high-quality used cars will not be encouraged to sell their cars and probably would leave such market. Assuming that there is a uniform distribution of quality of used cars, Akerlof (1970) shows that sellers of used cars of the highest quality are first to leave the market, then sellers of used cars of slightly lower quality, until sellers of used cars of the lowest quality are the only one to stay in the market. With the assumption of a uniform distribution of quality of used cars no car will be sold.[2] This kind of inefficiency in the market, due to the problem which is related to information asymmetry, is known as a adverse selection. In the presented case, the market of used cars, the problem of adverse selection is reflected in the fact that the owners of used cars and lower quality cars are the only ones willing to sell these cars.

Mas-Colell, Whinston, and Green (1995) presented a theoretical model that describes the problem of information asymmetry in the labour market, and that is an adaptation of Akerlof's theoretical model (1970). The assumption in this model is based on the fact that there are many identical firms that may employ workers. Furthermore, each firm produces an identical product using identical technology which is characterised by constant economies of scale, where labour is the only factor of production. It is assumed that firms are neutral towards risk and aim

[1]Akerlof, in the paper for low-quality used cars, uses the term *lemons*, and for high-quality used cars term *peaches*, therefore, the described market in the literature is known as *the market of lemons*.

[2] For more details see: Akerlof, G. (1970). The Market for 'Lemons': Quality Uncertainity and the Market Mechanism. *The Quarterly Journal of Economics*, 84(3), 488-500.

towards profit maximisation. For simplicity, it is assumed that the price of firm's products is equal to 1. Workers vary in the number of units of output they produce if they are employed by the firm, so the expected level of worker's productivity is marked by θ. Let $\left[\underline{\theta},\ \overline{\theta}\right] \subset R$ denote the set of possible worker productivity levels, where $0 \leq \underline{\theta} < \overline{\theta} < \infty$. The total number of worker is N. The fraction of workers with a productivity level that is equal to or less than θ is described by distribution function $F(\theta)$ which is assumed to be continuous, so there are at least two types of workers. The assumption is that the workers aim to maximise the amount of money they can earn from their work. The workers may choose either to work in the firm or to work at home so that a worker with a level of productivity θ can earn $r(\theta)$ if he/she decides to work from home. Therefore, $r(\theta)$ represents the opportunity cost of workers with the level of productivity θ that is accepting employment within the firm. In this connection, the worker of this type will accept to work in the firm if and only if he/she receives a wage ω which amount is not less than $r(\theta)$. For comparison purpose, we have considered the equilibrium in the model in which the levels of workers' productivity are recognised and equilibrium in the model in which these levels are not recognised by the firm.

Assuming that the firm can without difficulties detect the level of productivity of workers, and there is no information asymmetry, keeping in mind the competition and continuous economy of scale, in the balance, it is needed to have $\omega^*(\theta) = \theta$ for each θ, because the price of products is equal to 1, so that the set of workers which accept employment in the firm is represented by $\{\theta: r(\theta) \leq \omega(\theta) = \theta\}$. By introducing a binary variable, $I(\theta)$, which is equal to 1 if the type of workers θ is employed in the firm, otherwise it is 0, a total surplus in the labour market would be equal to:

$$\int_{\underline{\theta}}^{\overline{\theta}} N\left[I(\theta)\cdot\theta + \left(1 - I(\theta)\right)\cdot r(\theta)\right]dF(\theta) \qquad (2.1).$$

The previous equation represents nothing more than the total income generated on the basis of labour as a factor of production. Therefore, the total surplus is maximised so that: $I(\theta) = 1$ for the type of workers θ where $r(\theta) \leq \theta$ and $I(\theta) = 0$ for the type of workers θ in another case. The balance set like this will be optimal (Mas-Colell, Whinston, and Green, 1995).

However, if the firm cannot easily recognise the level of productivity of workers, then we talk about the case of achieving a balance in terms of information asymmetry. Then it has to be valid that the wage of workers ω is independent of the type of workers, and will consequently be unique for all workers. In this respect, labour offers will function of wages ω. A worker of the type θ will accept the employment if and only if it is true: $r(\theta) \leq \omega$. A set of workers who accept the job by the wage ω will consequently be $\Theta^*(\omega) = \{\theta: r(\theta) \leq \omega\}$. Additionally, a

demand for labour will be a function of wages ω. If firms believe that the average productivity of workers who accept employment is μ, a demand for work will be presented in the form of:

$$z(\omega) = \begin{cases} 0, for \mu < \omega \\ [0, \infty], for \mu = \omega \\ \infty, for \mu > \omega. \end{cases} \quad (2.2)$$

If it's true that worker types in set $\Theta^*(\omega)$ are accepting employment offers and if it's true that the firms' beliefs about the productivity of potential workers correctly reflect the actual average productivity of the workers employed in the firm, than in the equilibrium we must have $\mu = E[\theta|\theta \in \Theta^*(\omega)]$. Thus, the demand for labour will be equal to the labour offers at a positive level of employment of workers if and only if $\omega^* = E[\theta|\theta \in \Theta^*]$, and $\Theta^* = \{\theta: r(\theta) \leq \omega^*\}$.

However, the equilibrium described in this way by these terms will not be optimal, meaning that the total surplus will not be maximised. Specifically, it is assumed that is true $r(\theta) = r$ for each θ and it's true $F(r) \in (0,1)$,so that for some worker $\theta > r$, and for the other workers is $\theta < r$. The set of workers who accept employment by the given wage ω, $\theta(\omega)$, will be $[\underline{\theta}, \overline{\theta}]$for $\omega \geq r$ or $\emptyset$ for $\omega < r$. Therefore, we have $E[\theta|\theta \epsilon \Theta(\omega)] = E[\theta]$ for each ω, and in the equilibrium it must be $\omega^* = E[\theta]$. If $E[\theta] < r$ none of the workers will accept employment, and if $E[\theta] \geq r$ all the workers will accept employment. Which type of the balance will be achieved, if there is information asymmetry, depends on the fraction of low and high productive workers. If for example, a fraction of low productive workers is high, then the firms due to inability to separate the low productive from highly productive workers, will be reluctant to hire workers at a wage rate that is sufficient for them to accept employment, respectively the wage rate which will be r at least. If a proportion of highly productive workers is high, then the average productivity of all workers will be higher than r, and the firm would be willing to hire workers at a wage rate that is appropriate from their standpoint. In one case, the employment would be little, and in the second case there would be too many workers, so the balance in both cases would not be optimal (Mas-Colell, Whinston, and Green, 1995). The consequence of the existence of information asymmetry in the labour market is as follows: If the firm cannot recognise the type of productivity between workers, then the labour market cannot allocate workers according to appropriate jobs in these firms.[3]

[3] For more details see: Mas-Colell, A., Whinston, M. and Green, J. (1995). *Microeconomic Theory*. Oxford University Press.

Having in mind previous problems that may occur in the labour market in the case of information asymmetry, it is expected that certain mechanisms will be developed in order to overcome the information asymmetry between workers and firms. This is expected because the firm and highly productive workers have incentives to develop such mechanism that would allow differentiation of workers by the type of productivity, and therefore the resolution of the mismatch problems in the terms of workers qualifications and jobs that require specific qualifications. One of those mechanisms is signalling, whose basic idea is that highly productive workers take certain actions in order to separate themselves from the low productive workers.

3. Signalling in the labour market

One of the first papers where the role of information is examined is the paper of Stigler (1962). In this paper, the decision-making processes about the workers' employment by the employer are analysed in details, with the presence of information asymmetry of the parties in the process. The idea which is presented in Stigler's paper, as well as many after, were used for the definition and introduction of the concept of signalling in the labour market by Spence (1973), who focused on the labour market and the role of signalling as activities of the informed party which has as the goal to reveal information about its characteristics to uninformed party. The basic idea from which Spence (1973) starts is as follows. In the labur market, there are two types of workers that the firm needs to recruit: (1) *good*, a highly productive worker and (2) *bad*, a low productive worker. The firm is not able to recognise the productive capacity of workers at the time of employment, which can consequently be seen as an investment in the conditions of uncertainty. In fact, we have a situation of investment, because it takes the time for the firm to start making profits from hiring workers, which is determined by the ability of the workers, and uncertainty because these skills are not known in advance. However, even though the employer cannot recognise the productivity of the workers, he/she can recognise the myriad of other relevant information about the employee in the form of characteristics that may be of importance for employment. These characteristics of workers, which are recognisable by the employer and are in the control of workers, are signals. After some time, the employer shall obtain information on whether the worker is *good* or *bad*, and based on previous experience in the market he will be able to evaluate the conditional probabilities of productive capabilities of workers in the terms of the numerous combinations of the signals. At any point, when considering potential workers with certain characteristics, employment as an investment decision will be defined by these conditional probabilities. Since it is assumed that the firm is neutral to the risk, the firm will be able to determine the marginal productivity of a potential worker with

an appropriate combination of signals, and the marginal productivity will be reflected later in the form of offered wage (Brown and Session, 2004).

The theoretical model presented by Spence (1973) is based on the fact that the party which is superior in terms of information takes certain activities in order to indicate to inferior side about the quality of a product that is being offered, thus the signal is provided. In order to be successful, the signal cannot be free of charge. If the signal is free everyone would use it, and would not transfer the useful information. Also, it must be true that the signal is less expensive for an individual who has a better quality product. Otherwise, if it is not true, then everyone would have incentives to use the signal, and therefore nothing about the quality of the signal would have been revealed (Mankiw and Taylor, 2011). If we go back to the example of the market of used cars, the seller of high-quality cars will offer a guarantee to a buyer, which not only provides compensation to the customer in case of failure of the car but also serves as a signal of a car's quality. Specifically, most likely such guarantee will not be offered to the seller of low-quality cars because the costs of compensation in the case of a failure of a car are high.

One of the worker's characteristics which can reflect in a credible way of his/her ability, and therefore serve as a signal to the labour market, is the educational level of the worker. According to the theory of signalling, employers based on the level of achieved education distinguish workers with high and low skills. Workers can predict how the recruitment is done and they can consider being a useful investment in various levels of education because it will signal their skills to potential employers. In this regard, employers use educational attainment, for instance, a possession of a university degree, as an instrument for selecting individuals for whom it is most likely to be highly capable. When, for example, an individual acquires a university degree he/she does not have to become more productive, but this way he/she signals its high ability to prospective employers. Since individuals who are highly capable are easier to gain a university degree than individuals who are less capable, there are more of those with high skills who possess a university degree. Consequently, for employers is understandable that a university degree is treated as a signal of the high ability of an individual who possesses that degree (Arcidiacono, Bayer and Hizm, 2010). As already pointed out, the individual's ability is negatively correlated with the costs of education that individual bears, i.e. the costs of schooling are higher for those individuals who are less capable. The benefit of an additional year of schooling is the same for workers with high and low skills, but the costs of an additional year of schooling are higher for workers with low skills. This assumption forms the basis of the theory of signalling, because in the event that the costs of education are the same for both groups of workers, employers would be unable to choose, because the workers with low skills would send a signal identical to the one that would send workers with high skills (Riley, 2001).

4. Education as a signal: separating equilibrium

Spence's theoretical model (1973) of the economic role of education as a signal in the labour market can be formally presented in the following way. It is assumed that there are two different groups of workers in the total population, which differ according to the level of productivity. Workers in the first group have a level of productivity which is equal to 1, and the workers belonging to the second group have a level of productivity which is equal to 2. In the total population, fraction for workers with lower productivity is q and for the workers with higher productivity is $1-q$. Further, workers can take specific action to provide an employer with the signal for a belonging to a certain group. Such activity, in Spence's theoretical model (1973), refers to the educational level y, meaning the number of years for workers' education. It is true that reaching the educational level y requires certain costs $c_i, i = 1,2,$ which can be can be monetary and non-monetary. For educational level to serve as a signal, the costs associated with it must be non-zero and different for workers with different productivity levels. Moreover, these costs have to be higher for low-productivity workers, so that the cost for achieving the educational level y for workers with lower level of productivity $c_1 = y$ and for the worker with higher level of productivity is $c_2 = {}^{y}/_{2}$. Is true that education is a pure signal, meaning it does not affect the productivity of workers. This assumption has been introduced for simplification, and not to suggest that education does not contribute to improving the productive capacities of workers.[4]

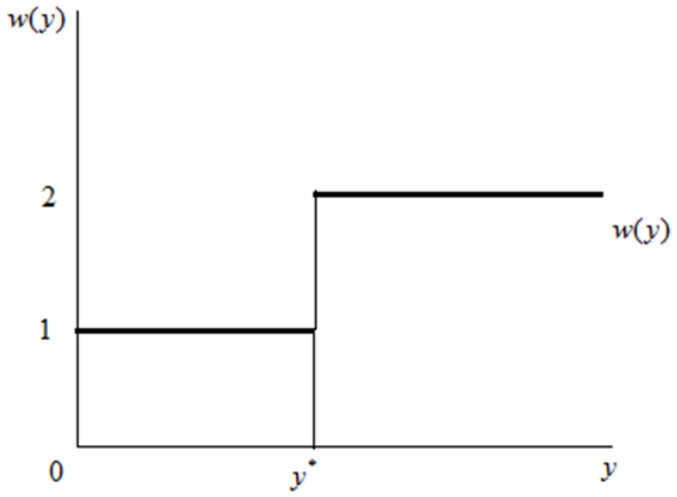
It is assumed that the employer applies some kind of a thumb rule to allocate workers to the appropriate groups according to the level of productivity. This rule can be amended as follows: If a worker has at least y^* years of schooling, then that worker is highly productive and will be assigned to a job that requires a high level of skills in a wage rate ω_2 that is equal to 2, and if the worker has less than y^* years of schooling, then that worker is low productive and will be assigned to a job that requires a low level of skills in a wage rate ω_1 is equal to the 1. We can say that y^* is a critical level of education. So beliefs of the employer on the type of workers can be represented as:

$$\omega_i(y) = \begin{cases} 1, & if y < y^*, than\ MP_L = 1\ with\ probability\ 1 \\ 2, & if y \geq y^*, than\ MP_L = 2\ with\ probability\ 1. \end{cases} \quad (4.1)$$

[4] Relaxing assumptions about the role of education as a pure signal, so that education in addition to overcoming the problem of information asymmetry in the labour market contributes to improving the productivity of workers, it does not change the basic results of Spence's theoretical model. Moreover, in certain papers (e.g. Weiss, 1995) we start from the fact that the theory of human capital and signalling theory are not mutually exclusive so that it applies this relaxed assumption.

Certain conditional probabilities determined this way will create the scheme of wages the employer will provide the worker with, and this can be represented graphically.

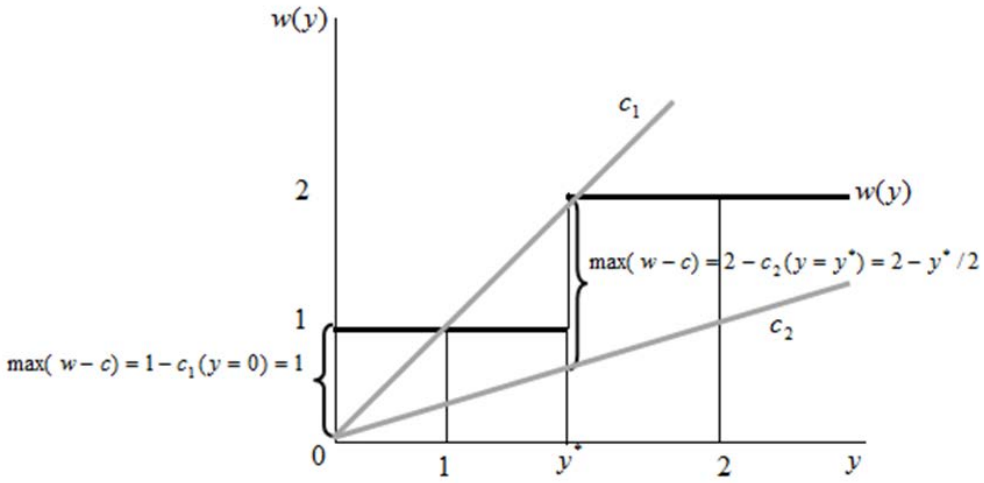
Figure 4.1. Offered wage by the employer as a function of the educational level of worker



Source: Spence, M. (1973). Job Market Signaling. The Quarterly Journal of Economics, 87(3), 362

According to this offered scheme of wages by the employer, all workers will choose the optimal level of education taking into consideration their abilities. Workers tend to maximise the difference between the offered wage corresponding to the selected educational level and the costs of reaching that level of education. A low productive worker, with the level of productivity 1, will probably select$y = 0$. Specifically, as the costs of education for that worker are relatively high and according to the scheme of wages by the employer, that worker will not benefit from additional years of schooling until he reaches y^*, he/she will only have the costs, for him/her is not profitable to invest into education level $y > 0$.Similarly, highly productive worker, with the level of productivity 2, will probably select$y = y^*$. The costs for the education of that worker are relatively low, but according to the scheme of wages offered by the employer each additional year of schooling which exceeds y^* only requires costs but not the benefits, it is not rational to invest in the education level $y \geq y^*$. Thus, low productive worker will choose $y = 0$, while the highly productive workers will chose $y = y^*$. This kind of a separating equilibrium is shown in the following figure.

Figure 4.2. Establishing a separating equilibrium in the labour market



Source: Adapted according to Spence, M. (1973). Job Market Signaling. The Quarterly Journal of Economics, 87(3), 363

To realise the above-described equilibrium in the labour market, following requirements must be met:

$$1 > 2 - y^*, \tag{4.2}$$

$$1 < 2 - \frac{y^*}{2}. \tag{4.3}$$

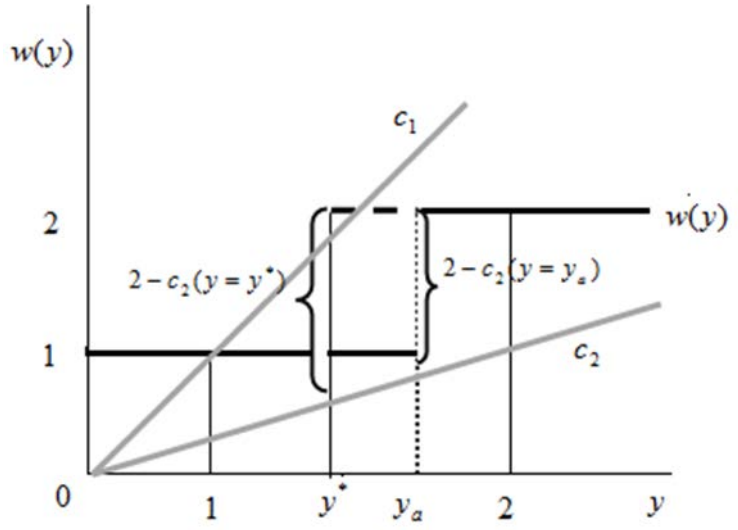
The left side of these expressions is the difference between benefits and costs, respectively, workers with low and workers with high productivity of chosen education level of $y = 0$, while the right side of these expressions shows the difference between benefits and costs of these two types of workers in the choice of educational level $y = y^*$. Respectively, in order to establish a separating equilibrium must be true that in the case of low productive workers, the difference between benefits and costs of chosen education level $y = 0$ is greater than these differences in the choice of the level education $y = y^*$, while in the case of highly productive workers opposite must be true. Combining these two conditions we come to:

$$1 < y^* < 2. \tag{4.4}$$

If y^* would be less than 1, then all workers would choose the same education level, and if y^* would be greater than 2, then there would be no workers investing in education. According to this, we can come to separating equilibrium only when y^* is between 1 and 2. We can see that in that case there are unlimited many situations in the labour market which can represent possible equilibrium, meaning that the separating equilibrium is not unique. We should also have in mind that all

possible equilibriums are not identical in terms of the welfare of members of both groups of workers. For example, increasing the value of y^*, ie. increasing the number of years of education on the basis where the employer makes a distinction between workers, that is a negative impact on the welfare of the members belonging to the group of highly productive, while it is not affecting the welfare of members who are in the low productive group. If the new critical level of education would be y_a instead of y^*, where $y^* < y_a < 2$, thanthe difference between the wage of highly productive worker that corresponds to education level y_a and the costs for achieving that level for these workers would be less because $c_2(y^*) < c_2(y_a)$. By choosing such critical educational level the welfare of workers with high productivity would be less, while for the workers with low productivity would the unchanged, comparing to the welfare achieved in the first critical educational level. This is graphically shown below.

Figure 4.3. Welfare of highly productive workers in a variety of critical levels of education



Source: Adapted according to Spence, M. (1973). Job Market Signaling. The Quarterly Journal of Economics, 87(3), 366

However, if there would be some competitive pressure, resulting from tendering firms for workers, then the survival of the infinite number of situations in the labour market that would represent possible equilibrium would be impossible. For example, assume that a firm determined the critical level of education y_1, where $1 < y_1 < y^*$, and that another firm determined the critical level of education y_2, where $y^* < y_2 < 2$. Then all highly productive workers would prefer the first

firm with determined lower level of critical education because if is true that both firms pay identical wages ω_2 in the amount of 2, that those workers would not benefit from the additional education that another firm requires, but would have only the costs. After that, the second firm can determine new critical level of education y_3, where $1 < y_3 < y_1$. Than all highly productive workers would prefer the second firm from the reasons stated previously. The process of firm adaptation described this way would be taking place until competitive pressure would reduce the level of critical education on:

$$y^* = 1 + \delta, \tag{4.5}$$

whereδ is infinitesimal value. In separating equilibrium, where the critical level of education is set this way, the valid would be:

$$nb_1 = 1, \tag{4.6}$$

$$nb_2 = 2 - \frac{1+\delta}{2} = 1.5 - \frac{\delta}{2}. \tag{4.7}$$

where nb_i, $i = 1, 2$, is the difference between benefits and costs of low and highly productive workers, respectively, from the selection of the appropriate level of education, ie. net benefit.

One cannot, however, ignore the fact that the welfare of the members of the low-productivity group is worse than it was without signalling. In the absence of signalling, the employer would offer the average wage in a given group equilibrium to the low-productivity workers, based on the expected marginal productivity of workers, which would be higher than the wages specified in separating equilibrium:

$$\overline{\omega} = q \cdot 1 + (1 - q) \cdot 2 = 2 - q > 1, \tag{4.8}$$

because of $q < 1$. But, the welfare of highly productive group of workers doesn't have to be better than it would without signalling. Moreover, the welfare of the member of this group can be worse with signalling if we have:

$$2 - \frac{y^*}{2} < 2 - q, ie.\ y^* > 2 \cdot q. \tag{4.9}$$

So, if the average wage in the group equilibrium based on the expected marginal productivity of workers is higher than the wage in separating equilibrium, then the welfare of the members belonging to the group of highly productive with signalling will be less than in the case where the signalling doesn't exist. This will happen even when $q \leq 0.5$, ie. if the total population is consisted of higher productive workers. In this case, the separating equilibrium will certainly be inefficient compared to the group equilibrium. It can be noted that the final judgment about what are the effects in terms of the welfare of members of both groups of workers with and without signalling depends on the critical level of

education and average wages specified in the group equilibrium. What are critical educational level y^* and average wage higher, it is likely that the separating equilibrium would be inferior compared to the group equilibrium. That is, there will be a certain critical level of fraction of low productive worker q where the effects in terms of welfare for both groups of workers in the case with and without signalling would be identical. It can be shown that it is true that the fraction of critical level is determined by the cost of education workers with lower and workers with higher productivity, ie. it is true $\hat{q} = \frac{c_2}{c_1}$. Therefore, somewhat surprisingly, will the separating equilibrium be superior to group equilibrium depends exclusively on the relative costs of achieving a certain educational level of low and highly productive workers, and it is not influenced by the relative level of productivity of these two types of workers (Gravelle and Rees, 2004). One of the ways to improve the efficiency of the labour market in the case of separating equilibrium is taxation of education by the state, under the assumption that something like this does not require the costs in respect of appliance and administration of taxes. Taxation of education will make the acquisition of certain educational levels more expensive for members of other groups, for highly productive workers, by reducing the critical level of education without losing the informational importance of the signal. Also, it is necessary that the revenue generated by in this way introduced tax would be equally distributed to all members of both groups regardless of education level they choose. If the t is a tax rate on investment in education and if k is amount of the generated revenue for the tax which is distributed to the members of both groups, then the members who belong to the group of the low productive workers will choose education level $y = 0$ if:

$$2 - y^* - t \cdot y^* + k = 2 - (1 + t) \cdot y^* + k < 1 + k, \tag{4.10}$$

while the member of the highly productive group will choose the educational level of $y = y^*$ under condition:

$$2 - \frac{y^*}{2} - t \cdot y^* + k = 2 - (0.5 + t) \cdot y^* + k > 1 + k. \tag{4.11}$$

In these terms, the left side indicates the difference between the benefits and costs of workers with low and workers with high productivity, respectively, from the choice of the educational level $y = y^*$ taxed according to the tax rate t. While the right side of these expressions represents the benefits and costs of these two types of workers from the choice of education level $y = 0$ taxed at the identical tax rate. Where these differences, increased by the amount of the tax revenue generated and distributed by the state k, are higher for the low productive workers, as well as for the highly productive for workers. Combining these two conditions we reach the critical level of education in which it will be realized separating equilibrium in the labour market, for which is achieved:

$$\frac{1}{1+t} < y^* < \frac{1}{(0.5+t)}. \tag{4.12}$$

If we consider the process of adjustment due to the existence of competitive pressure of the firm, then, in this case, the critical level of education will be:

$$y^* = \frac{(1+\delta)}{(1+t)}. \tag{4.13}$$

The difference between benefits and costs of low-productivity and high-productivity workers from choosing the right educational level, respectively, is:

$$nb_1 = 1 + k, \tag{4.14}$$

$$nb_2 = 2 - \frac{\frac{(1+\delta)}{(1+t)}}{2} + t \cdot \frac{(1+\delta)}{(1+t)} + k = 2 - \frac{(0.5+t)\cdot(1+\delta)}{(1+t)} + k, \tag{4.15}$$

where it is true $k = \frac{t\cdot(1+\delta)\cdot(1-q)}{(1+t)}$. It can be shown that in this way determined net benefit for both groups of workers tends to $(2-q)$, because when value of δdecreases and value of t increases then k tends to $(1-q)$. So the taxation of education in terms of efficiency brings closer separating equilibrium to group equilibrium and therefore eliminates the possible inefficiencies while keeping the importance of information signals (Spence, 2002).

5. Private and social rate of return on investment in education in the case of signalling

Previously described Spence's theoretical model (1973) suggests that education can play the role of signals in the labour market and that it may signal some of the characteristics that employers value and which are not easily recognisable. However, the real challenge is to empirically determine whether education improves the productivity of an individual or it is a feature that signals its productive capabilities. In fact, no matter which of these two economic roles play education, it can be seen that in the labour market individuals with higher education levels gain higher earnings than those with lower levels of education, with other identical characteristics. As the theory of human capital and the signalling theory predict that more education leads to higher earnings, positive correlation between educational levels and future earnings of an individual as such does not provide a precisely determined mechanism which stands behind this positive relationship. As a result, there is no widely accepted empirical test[5] of

[5] One of the most common way for empirical verification of the signalling theory is to assess degree effects. The operational definition of the degree effects used in empirical studies (e.g. Layard and

decomposition of differences in earnings between highly and lower educated individuals with the component of productivity and signal component of this productivity. Decomposition of the differences in earnings is important because the theory of human capital and signalling theory have different implications for many issues related to education policy. The theory of human capital, for example, suggests that investment in education by increasing the human capital of an individual is a way to reduce inequality and poverty. In this regard, the state programmes oriented to subsidise the education of certain individuals allow these individuals to move along the social ladder since education improves their level of productivity and improves their status in the labour market. Signalling theory argues that education does not contribute to, or does not have to contribute to the maximisation of human capital of an individual, but that this value is innate, and that it does not change by investing in education. Therefore, a state programme of subsidising education represents a waste of resources, because low productive individuals remain low productive regardless of how much money is spent on their education, and their position in the labour market cannot be improved (Borjas, 2015).[6]

The various recommendations regarding education policy by advocates of the one or the other theory rests on whether and to what extent the private rate of return on investment in education measures, when measured as an increase in pay of individuals from additional years of schooling is different from the social rate of return on investment in education which is measured by increasing the national income with the same additional year of schooling. In this regard, if the signalling theory is true, from the standpoint of the individual, a rate of return on investment in education would be positive, while from the standpoint of society, this rate would be zero. However, both terms ignored the fact that education in the role of signals can have a very important social role for classifying workers to appropriate jobs. In this connection, advocates of the signalling theory criticise advocates of the theory of human capital for measuring the wrong things, because the social rate of return on investment in education is actually rate of return on a particular mechanism of selecting jobs, and not a reclaim of resources that are invested in the improvement of human capital of an individual (Blaug, 2017).The employer uses

Psacharopoulos, 1974; Groot and Oostrebeek, 1994; Jeager and Page, 1996; Belman and Heywood, 1997; Crespo and Cortez, 2005; Meer, 2011; Mora and Muro, 2014) depends on the methodology which was used and the data which were available to the researchers. According to Belman and Heywood (1997), degree effects are related to the differences in earnings between the individual who possesses a diploma and the individual who does not hold a diploma, conditioned by the number of years of education. In other words, degree effects represent an increase in earnings that are associated with the possession of a diploma. These effects are also known in the literature as sheepskin effects.

[6] Whereby it should be noted that this view stems from the premise that education does not affect the productive capabilities of workers, and does not stand if the opposite is true.

education as a signal for allocating highly productive workers to jobs that require a high level of skill and low productive workers to jobs requiring low levels of skill. In other words, the signal prevents or at least significantly reduces a mismatch between workers and jobs which in the conditions of information asymmetry becomes certain. Society is characterized by specific information problems and with it are associated problems of allocating the right people to the right jobs. Education in the role of the signal makes possible solution of these problems, and therefore statements about the zero social rate of return on investment in education, in this case, are not valid. So education can have a positive value not only for the individual but also for a society without contributing to the maximisation of the human capital of the individual because it reduces the costs in the cases of incorrect allocation of workers to jobs (Spence, 1973). It is extremely difficult to determine the value of these costs, therefore, it is problematic to determine a value of the mechanism for job selection in the case where signalling theory exists. Thereby, none of the advocates of signalling theory has been able to quantify the social rate of return on investment in education, which is understood in this way (Blaug, 2017).

6. Conclusion

There is a need for a signalling mechanism in the labour market due to information asymmetry between workers and employers. Without the ability to distinguish workers in terms of their level of productivity, the problems in the case of information asymmetry can be significant. Namely, if the firm cannot recognise workers' type of productivity without difficulties, then the labour market cannot allocate workers to appropriate jobs in these firms. As a result, there will be a certain mismatch between workers and jobs, which will reduce the efficiency of the firms.

Basically, signalling theory presented by Spence (1973) is the idea that highly productive workers take certain actions in order to separate the low productive workers. That being said, highly productive workers have incentives to provide and firms have the incentive to account the credible information that can be used for allocation of workers in the appropriate group according to the type of productivity. Such credible information is called signal, which in order to be successful cannot be free and must be less expensive for the workers who is highly productive. It turns out that education can perform the role of signals in the labour market, and that the education level of an individual may serve as a product for overcoming the mismatch between workers and jobs which in the case of information asymmetry may appear. Under certain conditions, separating equilibrium will be established in the labour market according to which each worker depending on the selected educational level will be assigned to a job that is in accordance with its productive capabilities, at a wage rate that matches that level

of productivity. Separating equilibrium determined in this way will have two characteristics: (1) will not be uniform, and (2) will be less effective comparing to the group equilibrium of well-being. However, the existence of competitive pressure by adjusting the critical level of education can lead to the establishment of unique separating equilibrium, while by taxing the education efficiency can be improved so that the welfare of the members of both groups in separating equilibrium brings closer to that which would be achieved in the group equilibrium.

Even though, there is a little more than four decades since the time when Spence presented signalling theory, a lot of it remains unknown, especially empirically, in terms of the relative importance of the economic role of education as a mechanism for improving productivity or as a mechanism for signalling different productive capacities. These uncertainties should be investigated because the recommendations regarding education policy are different depending on which of these two mechanisms prevails, where these differences stem from different ways of measuring social rates of return on investment in education. In this regard, having in mind the importance of determining the economic role of education for education policy creators, it could be concluded that the signal has practical implications besides the theoretical ones. Therefore, the growing number of empirical studies in the field of economics of education which aim to identify the role that the educational level of an individual has in the labour market is not surprising.

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ULAGANJE U OBRAZOVANJE KAO NAČIN PREVAZILAŽENJA PROBLEMA ASIMETRIČNIH INFORMACIJA NA TRŽIŠTU RADA

Apstrakt: Potreba za sortiranjem radnika na tržištu rada postoji u slučaju asimetrične informisanosti radnika i preduzeća. Očekivano je da će se određeni mehanizam razviti u cilju prevazilaženja ove informacione asimetrije. Jedan od takvih mehanizama jeste signaliziranje, čija je osnovna ideja da visokoproduktivni radnici preduzimaju određene akcije kako bi se izdvojili od niskoproduktivnih radnika. S tim u vezi, predmet ovog rada jeste teorijska analiza ekonomske uloge obrazovanja u prevazilaženju informacione asimetrije između radnika i preduzeća. Cilj rada jeste da prikaže način na koji obrazovanje može igrati ulogu signala na tržištu rada kako bi problemi nastali usled asimetričnih informacija bili otklonjeni. Značaj ovakve analize se ogleda u tome što su preporuke kreatorima obrazovnih politika u pogledu investiranja u obrazovanje različite u zavisnosti od toga da li obrazovanje služi kao mehanizam unapređenja produktivnost ili kao mehanizam signaliziranja različitih produktivnih sposobnosti. U radu je pokazano da ove razlike proističu

iz drugačijeg načina merenja društvene stope povraćaja na ulaganje u obrazovanje.

Ključne reči: informaciona asimetrija, tržište rada, signaliziranje, ekonomska uloga obrazovanja.

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