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Observing the Unobservable: Education and Signaling in Middle-Income Countries

bachelor thesis

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I hereby declare on my honor that I wrote this bachelor's thesis independently, and I used no other sources and aids than those indicated.

Daniil Kashkarov
Prague, 15.05.2017

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BACHELOR THESIS TOPIC

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General content:

1. There is an active discussion about the features of modern educational system and its influence on labor market interactions. Several economic theories of education stand opposed to each other. One of them, the signaling theory, suggests that schooling diplomas are used by employer to deal with the problem of asymmetric information and signal the level of applicants' natural ability. It is generally very difficult to empirically derive the impact of signaling on wages. Meanwhile, the extent of this impact can significantly affect the approach towards education all around the world.
2. The aim of the thesis is to analyze the possibly existing signaling practices in lower-middle-income countries. The basic hypothesis of the paper will be that a signaling component of education should significantly affect wages and hiring decisions in this group of states. Possible explanation could be that the mechanisms for distribution of information across labor markets are underdeveloped in lower-middle-income countries (Strobl, 2003). Information gathering is more costly for employers and they are more likely to rely on such signaling devices as schooling diploma.
3. Theoretical part of the thesis will use the foundation of signaling theory created by Michael Spence (1973). According to this scholar, it is not as costly for more able people to get education, as it is to less able ones. Thus, education credentials deliver information about natural ability of employee and employers use these credentials to estimate the level of workers' natural aptitude. The experience of more recent researches will be included as well. Strobl (2003) was trying to check for the existence of signaling on Ghana labor markets and created a useful framework for the analysis of education signaling in low- and lower-middle-income countries. Fields (2010) will be used to get overall image about the features of labor markets in developing states. Hussey's (2012) paper will provide with

useful and recent insight about relative importance of human capital and education signaling. Arteaga (2016) will illustrate how actual institutional reforms, in favor of signaling theory, may affect earnings of graduates.

4. Empirical part will use data from STEP Skills Measurement Household Survey realized in 2012-2014 (The World Bank, 2016). Individual cross-sectional data for four lower-middle-income countries (Bolivia, Armenia, Ghana, Vietnam) will be used in regression analysis to test the effect of education signaling. This will be realized partially in line with methodology developed Altonji and Pierret (2001). The natural logarithms of wages will be regressed on work experience and schooling years, ability (father's education) and also on two interaction terms: years of schooling - years of experience, natural ability - years of experience. Allowing for correlation between natural ability and schooling, those interaction terms will allow to check the existence of signaling practices. If signaling is present and employers learn about the ability of workers over time, coefficient for the first interaction term will be negative and for the second one - positive. As employee gets more experience, natural abilities are revealed and signaling role of education decreases. In the absence of signaling, coefficients for interaction terms won't be statistically different from zero.

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Abstract

The thesis examines the role of education signaling in dealing with information asymmetry on labor markets of lower-middle-income countries. The original hypothesis states that signaling component of education has significant effect on hiring decisions and wages in this group of states. To test the hypothesis, the model of employer learning is launched on individual cross-section data for four lower-middle-income countries: Armenia, Bolivia, Ghana and Vietnam. The natural logarithms of hourly wages are regressed on years of education, experience, measures of employees' aptitude, education-experience and aptitude-experience interaction terms. Maximum of parents' education, self-reported cognitive skills score and job-related skills score are used as proxies for workers' ability. No reliable evidence of education signaling being applied on labor markets of the studied countries was found, although information asymmetry is present.

Keywords: education signaling, human capital, labor markets, employer learning, information asymmetry.

JEL classification: J24, D82, I26

Abstrakt

Práce zkoumá úlohu signalizační funkce vzdělání při řešení informační asymetrie na trzích práce v zemích s nižším středním příjmem. Výchozí hypotéza práce je, že signalizační složka vzdělání má v této skupině států významný vliv na rozhodnutí o přijetí do zaměstnání a na mzdy. Pro testování hypotézy je použit model učení zaměstnavatele na průřezových datech pro čtyři země s nižším středním příjmem: Arménii, Bolívii, Ghanu a Vietnam. Regresní model využívá přirozené logaritmy hodinových mezd vysvětlované délkou vzdělání, zkušeností, měřítky zaměstnaneckých dispozic (*aptitude*) a interakčními termíny zkušenost-vzdělání a zkušenost-dispozice. Jako proxy pro měření schopností zaměstnanců jsou využity proměnné nejvyšší dosažené vzdělání rodičů, skóre autoreportovaných kognitivních schopností a skóre hodnocení pracovních dovedností. Přestože informační asymetrie je na trzích práce ve studovaných zemích přítomná, žádná spolehlivá evidence o využívání signalizační funkce vzdělání nebyla nalezena.

Klíčová slova: signalizační funkce vzdělání, lidský kapitál, trhy práce, učení zaměstnavatele, informační asymetrie.

JEL klasifikace: J24, D82, I26

Contents

Introduction

A design and actual purpose of education system, as well as its effects on processes taking place on labor markets, were actively discussed for many decades. It is well-known that the level of education is positively correlated with earnings. There are two prevailing theories which strive to explain this relationship. *Human capital theory* says that education increases the productivity of workers and this higher productivity results in increasing wages. *Signaling theory* offers another explanation for the observed education-earnings relationship. It suggests that education represents a way of dealing with information asymmetry on labor markets. Information asymmetry is related to the fact that employer cannot precisely determine productivity of a prospective employee. At the same time, the employee has better knowledge about his or her own productivity and tries to signal it by acquiring appropriate amount of education. In this theoretical framework, the cost of getting certain level of schooling is assumed to be negatively correlated with natural aptitude of an employee.

Majority of studies on education signaling are conducted in either upper-middle- or high-income economies. There is only a handful of papers in this field which scrutinize informative function of schooling in less developed states. This is mainly related to the insufficient data on earnings, education and experience of individuals in this group of countries. Moreover, tests for education signaling require the use of proxies of innate ability, such as IQ. Even surveys carried out in developed societies rarely include such measures, let alone small-scaled and often underfunded surveys in low- and lower-middle-income states. Meanwhile, features of labor markets in such countries suggest that signaling component of education may have a substantial effect on employer-employee interactions.

This thesis represents an attempt to test the existence and practical role of education signaling on labor markets of the countries from the lower-middle-income group. The text is conventionally divided into two parts. The first part capitalizes on the stock of knowledge accumulated in the field since early 1970's till nowadays. Review of the literature summarizes the research both confirming and rejecting the signaling function of education. It also confronts signaling theory with human capital view, where it is relevant, and analyses possible implications for labor markets of developing countries. The second part applies the model of employer learning to empirically test the applicability of a signaling hypothesis in the context of lower-middle-income economies. The work uses data gathered in the framework of the STEP Skills Measurement Household Survey, conducted by the World Bank in 2012-2014. The results obtained during the process of the research suggest that, although there a certain amount of information asymmetry on labor markets of studied countries, education signaling is not used as

a tool for dealing with it. Concluding parts of the thesis provide with possible explanations for an observed outcome and lay a ground for a further research in the field.

1. Theoretical Background

1.1. Human Capital Theory

While the thesis is mainly focused on the signaling in the context of low-middle-income countries' labor markets, it appears useful to make a brief overview of another direction in economic thought - human capital theory. This classical approach to the role of education in productivity and earnings variations is widely accepted nowadays and can be used as a benchmark for studying more "exotic" theories, such as the theory of signals.

An exclusive importance of education for various spheres of people's lives is emphasized by many outstanding scientists. No later than in the 18th century scholars started to point out that education has its own important place in economic theory and practice. Adam Smith in his book *An Inquiry into the Nature and Causes of the Wealth of Nations* (Smith 1977 [1776]) considered "useful abilities of inhabitants" as one of the four basic types of fixed capital, especially mentioning that education of workers is of equal importance with technical equipment and means of trade. Together with other types of fixed capital, education incurs real expenses and, at the same time, brings real profits. In 1890 Alfred Marshall published *Principles of Economics*. In this fundamental work the author explicitly says that education of human beings is extremely important for the functioning of economy (Marshall 2009 [1890]).

With the tertiary sector absorbing more and more available workforce over time, a theory of human capital started to develop more actively and comprehensively. The tertiary sector requires more skills, knowledge and talent. From this perspective, labor force stopped to be uniform in its mass. Employees differed from each other in their abilities and skills, and firms could be successful or not depending on their employees' stock of knowledge and experience. The foundations for human capital theory were laid by prominent scholars such as Theodore Schultz, Jacob Mincer and Gary Becker. In the context of their research, education, as well as knowledge, skills and talent development, are treated as integral parts of human capital. Obtained in the process of schooling, skills and knowledge contribute to personal productivity. High level of education in technically developed states can be seen as a source of economic advantage (Schultz 1972). Time, effort and money spent on education, in fact, represent investments in human capital and form the stock of human skills. The stock of education accumulated through the lifetime has influence on earnings, labor force participation and time spent on work (Mincer 1975). According to Gary Becker, education is one of the three key components of human capital (the other two are health and training). Higher education has significant positive influence on earnings in a wide range of societies with different cultural and economic backgrounds. This positive income effect considerably exceeds all expenses incurred during the process of

schooling. Introduction of new technologies and complex processes in industry requires more knowledge and makes education more valuable (Becker 1983 [1975]).[1]

While the basic framework of human capital theory was set in the second half of the 20th century, this field continues to be extended and developed by the modern scholars. Huggett, et al. (2006) use the human capital model to explain variations in income distribution in the United States. The research shows lower levels of earnings for agents with above-average abilities at early stages of life, as compared to those with lower abilities. Around the age of 24 the situation changes and now it is high ability individuals who earn more. These alterations are explained by the fact that in the beginning of lifecycle capable people invest more time into accumulation of human capital (by means of education) and consequently don't earn too much. As the time passes, the stock of human capital allows them to overtake another cohort. Rubinstein and Weiss (2006), in their miscellaneous analysis of reasons for the wages' growth, apply the Mincer's earnings function and show that human capital is one of two determinative factors which shapes the profile of experience and earnings. Another "Mincer-style" model was launched on the representative sample of Danish workers with different amounts of education (Bagger et al. 2014). Such study provides with evidence that human capital is responsible for roughly a half of growth in earnings in the group of highly educated employee. Educational attainment and the stock of human capital not only affect the respective person, but also influence the income of his descendants. The intergenerational study of Swedish families (Lindahl et al. 2015) shows that life-time earnings of individuals are to a large extent determined by the human capital possessed by at least three generations of their ancestors.

1.2. The Theory of Signals: Foundation

Unlike the theory of human capital, the signaling theory (also known as screening or sorting) sees education as a channel through which employee can communicate the level of his natural abilities. From the perspective of this theory, the contribution of schooling to the productivity and earnings of workers is negligible.

The foundation for the theory of signals was laid by Michael Spence (1973). In the framework of his studies, the decision of employer regarding the acceptance of potential employee for some position is considered to be the case of investment under uncertainty. It is an investment because the hiring of the worker pays off only after the certain amount of time and often requires expenditures on the job-specific training right after the person was accepted. At the same time, uncertainty is related to the fact that abilities of employee are unknown at the moment of application for a vacancy. In case the employer is risk-neutral, he should set the wage equal to

[1] Two previous paragraphs are the part of my publication "Education and Economic Dominance" (Kashkarov 2016).

the marginal productivity of his worker. At this stage the problem arises: how to reveal the productivity of the person who never worked for the hiring organization? The only option for the employer is to try to estimate this productivity based on the list of observable characteristics possessed by newly hired person. Spence differentiates between two types of observable features. The first type, called indices, includes characteristics usually unalterable with time. This includes gender, sex and race. Another type, called signals, is for attributes which can be relatively easily changed over the lifetime of a person. Obviously, education falls within the latter category. Employer, having certain hiring experience on the given labor market, can approximate the productivity of applicant, conditional on observed indices and signals. In his turn, potential employee has to make decision regarding the amount of education acquired before entering labor market. This is where the signaling function of education originates. An important assumption here is that there is negative correlation between costs of signaling and productivity level. Applicants with lower natural ability, or productivity, must incur greater costs to get the same amount of education, and consequently the same strength of signal, as those with higher innate productivity levels. Besides purely monetary expenditures, these costs may also include time, effort and emotional pressure. Individual agents choose the level of education so, that to maximize the difference between future wages and costs of signal acquisition.

This principle mentioned above is illustrated on Figure 1. Group 1 consists of workers with lower ability, while Group 2 includes highly able individuals. Level of education is denoted by "y" and measured on the horizontal axis. Discontinuous function of earnings is denoted by W(y) and depends on level of education. A leap in earnings appears at level of education (y*) which, according to beliefs of employers, allows to divide workers into high and low productivity groups. The education cost function for Group 1 (C_I) is steeper than for Group 2 (C_{II}), since studies are more expensive in case of Group 1. If an individual faces C_I and wants to maximize his lifetime payoff, he chooses y=0, because all other education decisions would lead to decrease in difference between future wage and costs of signal. On the other hand, y=y* is maximizing payoff for members of Group 2. Further investments into education will not be accompanied by growth in wage and vertical distance between points on C_{II} and W(y) will only decrease. If employers' beliefs regarding y* are confirmed from one period to another, the situation depicted below represents a signaling equilibrium.

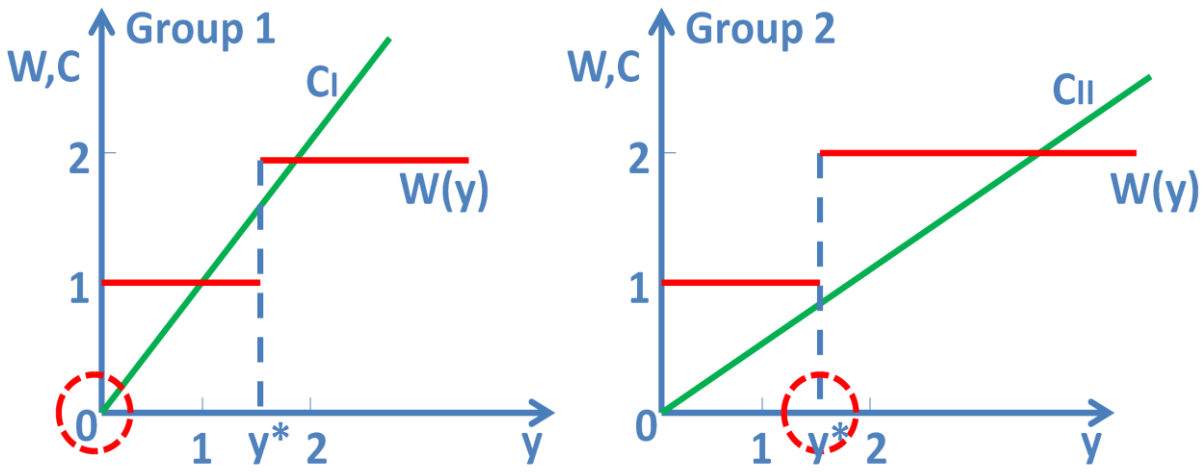

Figure 1. Optimal choice of education signal for groups with different ability. Source: Spence 1973.

Kenneth Arrow (1973) doubted human capital doctrine as well. In his opinion, education improves neither economic performance nor cognitive capacity, and rather functions as a device for screening on labor markets. Colleges and other higher educational institutions *de facto* represent two level filters. At the first level, they admit the best available secondary school graduates to studies and then, at the second level, certain students don't manage to pass some of the courses and are winnowed. Arrow calls his theoretical set-up a filter model. In this model colleges attempt to maximize the number of potential graduates based on available information about matriculates' pre-college records. If positive correlations between productivity and probability of being admitted or between productivity and the probability of graduation take place, college degree, as well as its absence, conveys information regarding the performance ability of an individual. Joseph Stiglitz (1975) suggests that education provides both skills and information and shows that in this case private returns differ from social ones. Screening contributes to efficiency as well as to inequality levels. The greater are the expenditures on higher education, the greater is inequality.

Kenneth Wolpin (1975) also tried to explore the screening component of education and made one of early attempts to empirically test the robustness of screening hypothesis. He was able to show that the demand for labor is associated not only with the average skill level in certain schooling group, but also with variance-mean skill ratio typical for this group. Hence, schooling has to have informational component in it. However, comparing schooling decisions and life-time earnings of private employees and self-employed individuals, Wolpin failed to demonstrate that screening function of education plays substantial role in labor market interactions. Another technique was applied by John Riley (1979). His assumption was that there are two samples with similar characteristics. The first sample consists of employees not subjected to screening, while the second one includes individuals who choose occupations where screening is usual. The prediction read that the function of life-time earnings for the first group lies above the same

function for the members of the second group. Riley estimated life-time earnings functions for different professions based on Mincer's earnings function with cross-section data from the Current Population Survey. Then the data was separated into four subsets according to occupational intercept and mean education. Presumably screened subsample (low occupational intercept and high mean education) had a better fit in Mincerian function, as compared to potentially unscreened group (high occupational intercept and low mean education). Negative correlations between earnings intercepts and levels of education, increase in variance of earnings after several years of experience and higher earnings of self-employed were also found by the author. All these facts were interpreted as confirming the existence of screening in certain professions. The signaling component of education and particularly the influence of acquired credentials on earnings, also known as sheepskin effect, was empirically confirmed by Hungerford and Solon (1987). Their specification of the model controlled for discontinuity in returns to education with different years. The relationship between wage and years of education was expressed in the form of discontinuous spline function with discontinuities at 8, 12 and 16 years of schooling. This set-up allowed to see whether the presence of officially recognized credential (high school or college diploma) significantly affects the earnings of their owner, i.e. credential do really serves as a signaling device. Launching the model on 1978 Current Population Survey has shown that indeed returns to education change discontinuously and there are sudden jumps in estimated effects of schooling in indicated diploma years. Moreover, regressing log of hourly wage on experience, experience squared and separate dummy for each year of education, Hungerford and Solon were able to confirm Arrow's proposition of college admission serving for the purposes of screening. A large leap in education years' effect appeared in the first year of college.

1.3. The Theory of Signals: Current Research

In the 21st century, signaling theory does not lose its topicality. A number of papers discussing the informative function of education were published in the recent decade. It was suggested that educational achievements are used to signal the level of motivation and effort, rather than some kind of innate ability or intelligence (Kjelland 2008). To check this hypothesis, Kjelland regressed wages on the loci of external and internal individual control, together with intelligence measure and dummies for level of education reached. While the positive relationship between level of intelligence and earnings was statistically significant, the relationship between motivation and earnings was not. However, the author does not see this as a proof of motivational component's insignificance and relates his failure to unreliable measure of motivation and multicollinearity among certain explanatory variables. Kübler, et al. (2008)

extended Spence's education game by increasing the number of participating employers to three. They have also compared the outcomes for signaling and screening set-ups. It was confirmed again that the highly efficient workers tend to invest into their education more than those with lower efficiency. Differences in productivity result in wage spread between groups which invest into education and which do not. At the same time, the results of an experiment show that it is impossible to perfectly discriminate between efficiency groups based on the signal and the spread mentioned above is actually smaller than predicted by theoretical constructs. With enough competition, signaling and screening approaches lead to practically the same outcomes in terms of wages paid and investments to education made.

The educational investment decisions may be affected not only by the natural ability of the worker, but also by the opportunity to match with the firms (Hopkins 2012). Potential employees send their signals to firms of different quality. Then, individuals delivering the signal of the highest quality are matched with the best firms, while those with lower intensity of signal are absorbed by less successful and respected entities. According to Hopkins, this leads to inefficient labor market equilibrium when low-ability workers underinvest in education, which otherwise could help them to develop certain useful skills. In contrast, high-ability workers tend to invest more than necessary with respect to their social optimum. Waldman (2016) combined education and promotion signaling models and studied the ways of their interaction. The analysis in the framework of such composite model allowed to isolate three returns to education. The first, classical one, stated that higher ability, signaled by education, is transferred into higher wages at early stages of person's career. Another type of return was related to asymmetric learning after labor market entry, which implied that non-promoted workers experienced growth in wages associated with education signal even after spending a substantial amount of time in their occupations. The third return to educational signal is a higher probability of being promoted in the future, which in turn leads to higher wage. Mause (2009) suggested that it is not only employees who use education signals, but also educational institutions which use market signaling in order to attract the best students. Expenditures on advertisement, tuition discounts and hiring of well-known lecturers may result in allocative inefficiency. Competition between universities can be seen as positional arms races. The opportunity cost of a good signal acquisition can be an extension of research and teaching activities, which is more beneficial for the society as a whole.

Arcidiacono, et al. (2010) explored the difference between informational function of college and high school education. They found out that college degree reveals the ability of employee almost perfectly, returns to the aptitude (measured by the Armed Force Qualification Test) are large right after entering the labor market and stay virtually the same with growth in experience.

On the other hand, high school alumni do not have significant returns to ability in the very beginning of their careers. However, these returns start to increase rapidly when high school graduates become more experienced. So, there is a difference in how education of different levels manages to deliver precise signal about employees' productivity. The signaling value of high school diploma was estimated by Clark and Martorell (2014). The authors argue that diploma, as a piece of paper, does not have a causal effect on productivity of graduates and therefore can serve as an ideal device in tests for signaling. Wage increases associated with diploma are by default attributed to the informative function of education. The abovementioned proposition was empirically tested on the sample of students from Texas. The results suggested that a signaling value of high school diploma converges to zero. However, the authors mention the possibility that these results are not general and hold only for a given sample. At college level, theories of education signaling and human capital were confronted by Carolina Arteaga (2016). An educational reform in Columbian University of les Andes have created favorable conditions for natural experiment. Curriculum for certain study programs was substantially shortened, which decreased the amount of human capital acquired in the process of education. At the same time, the value of education signal remained the same. The wages for post-reform graduates decreased by 16 and 10 per cent for economics and business programs respectively. This results suggest that college education does not have a purely signaling function and also affects earnings through the channel of human capital.

Further stages of education were studied as well. According to Hussey (2012), returns to MBA have predominately signaling or screening origins, while accumulated human capital does not contribute as much to the consequent earnings. The survey used in the paper, apart from other variables, provided with data on pre-education experience of MBA graduates. It allowed to test and empirically confirm one of the screening model's predictions stating that the more experience individual has before entering education, the less are returns to this education afterwards. However, the author mentions, as limiting factor for the realized research, an opportunity to observe wages only in the first several years of post-MBA job experience. It may happen that the screening component of master's degree in business administration determines wages only in the very beginning of graduates' careers. The possibility exists that some time has to pass until acquired human capital will reveal itself and will start to exhibit higher returns.

The model of educational signaling and sorting was also applied in order to explain why black population tends to get more education than white, given the same levels of cognitive ability (Lang and Manove 2011). It turns out that the difference in school quality between blacks and whites is not as important in explaining interracial wage differentials as it was thought before. Differences in education may predominantly have labor market origins, where employers still

often discriminate based on the race of applicants. To overcome this discrimination and get the same salary as whites, blacks have to invest more into educational signal, which compensates for the disadvantageous racial sorting.

Zheng (2013) has integrated education signaling into dynamic production model in order to explain the parallel growth in wages and supply of skilled labor force, which took place in the USA since the 1980th. The studied period in USA was characterized by increasing availability of college education. In such circumstances high school diploma should have become a clearer signal of lower ability. It was less likely that a person with only high school education is actually talented, but unable to get college degree due to unfavorable financial circumstances. The author managed to demonstrate that, during the period of 24 years, around 15 per cent in growth of college wage premium was related to signaling mechanism.

1.4. Developing Countries: Human Capital or Education Signaling?

Many of the recent studies and extensions of basic theories are taking closer look at the role of human capital, particularly education, on economic growth and welfare of developing nations. Analysis of modern schooling in different countries has shown that the availability of education is necessary, but not a sufficient factor for economic development of society and increase in earnings. For human capital being effectively accumulated, quantitative growth in school and university attendance should be combined with qualitative changes in educational institutions. Educational systems in developing countries should focus not only on the maximization of enrollment and attainment, but also on the development of cognitive skills among population. There is a strong relationship between cognitive skills development and variables such as distribution of income, earnings and economic growth (Hanushek and Woessmann 2008; Hanushek 2013). Cognitive abilities and education are more substantial for GDP growth than the level of economic freedom. Intelligence of people contributes significantly to the welfare of nations (Rindermann 2008). Higher educational institutions are not only producing human capital, but also creating a demand for it. Universities' research and development activities often result in spillovers to various spheres of economy. Sectors which absorb these spillovers require more employees with rich stock of human capital and offer higher salaries (Abel and Deitz 2012).[2]

As compared to the theory of human capital, the signaling theory of education was rarely tested in developing countries. The most probable reason for this is the lack of reliable and comprehensive data. Empirical analysis of education's informative function requires the availability of variables which are not usually included into basic censuses. As mentioned in the

[2] This paragraph is also the part of my publication "Education and Economic Dominance" (Kashkarov 2016).

previous part, even statistics gathered for the population of developed countries often fails to provide researchers with all data they would like to have. No need to say that this situation is much worse in case of developing societies. There was an early attempt to theoretically analyze the role of education and its signaling component in dual labor markets of such states (Kim and Mohtadi 1992). Using the model where younger population decides about educational investments and older one is absorbed either by primary or secondary sectors, the authors were able to show that education functions as a screening device for workers to be chosen into primary sector. However, they also take into account the fact that education directly contributes to productivity. Strobl (2003) had an access to Regional Programme for Enterprise Development data for Ghana, which allowed him to launch the tests of employer learning and empirically investigate the role of signaling in this African country. There was neither IQ nor some other ability test measures at the author's disposal. Father's years of schooling were used as a proxy for natural aptitude unobserved by employers. Strobl uses various set-ups controlling for different types of hiring channels (direct vs. non-direct contacts) and availability of on-the-job-training. The results stated that when employers hire workers whom they know personally or who were recommended by other employees, i.e. in the case of direct contacts, signaling is not playing important role. At the same time, in the case of more formal employment practices, for occupations which do not imply on-the-job-training, the presence of signaling was proven to be statistically significant.

Despite limited amount of data for signaling hypothesis verification, labor markets in developing countries possess certain features which theoretically should increase the importance of informative function of schooling. According to Fields (2011), in developing countries wage employment is considered to be better than self-employment. While there is logically not so much space for signaling in self-employment, wage employment potentially implies the use of screening and sorting techniques. To get this better wage job, employees may invest into education in order to acquire appropriate level of signal. Moreover, there is a significant imbalance between the supply and demand for wage jobs (Cho et al. 2012). Facing a great amount of applicants for limited number of positions, employers are likely to sort pretenders based on their level of education. Another argument for the existence of signaling practices is underdeveloped mechanisms for transition of information on labor markets of developing countries (Strobl 2003). With significant lack of vacancy advertisement and employment exchange offices, the cost of getting deliberate information on each potential employee may be higher, and hirers try to overcome the uncertainty relying on informational function of education.

1.5. Summary of the Primary Discussion

The stock of knowledge accumulated in the field shows that education signaling model represents an interesting alternative and addition for more traditional theory of human capital. There are substantial challenges related to both theoretical and empirical framework of this model, although contemporary labor market economists continue to improve, extend and modify it. The problem of theoretical part is the isolation of signaling component from other features of education affecting wages. Difficulties with precise and unambiguous determination of informative returns to education frequently affect empirical researches in this field. Tests for signaling often require the availability of natural aptitude measures, which are unobservable for employers. Datasets including such measures (e.g. IQ, Armed Forces Qualification Test or parent's education) are not always available and, if available, rarely contain large number of observations. Moreover, it may happen that these measures are not good proxies of ability to perform certain jobs.

While the researchers who study signaling theory on labor markets of developed countries encounter problems of insufficient data, studies of developing countries are virtually unrealizable because of the same reason. However, according to the literature analyzing developing societies' labor markets, there is a possibility that sorting is widely applied by employers there and informative function of schooling is significant. With high-quality data available for at least some of these countries, it will be possible to find out the true role of signaling and draw some conclusions regarding the policies applied in developing countries' education and labor markets.

2. Empirical Analysis

2.1. Hypothesis and Methodology

The following proposition serves as the original hypothesis for this paper: signaling component of education significantly affects wages and hiring decisions in lower-middle-income economies. As of 2017, lower-middle-income economy is defined as a country with GNI per capita in the range from $1,026 to $4,035 (The World Bank 2017). According to the United Nation's classification (2012), such states either belong to developing nations or undergo transition from centrally planned to market based economy. The features of developing countries' labor markets described in the theoretical part suggest that signaling may play important role in dealing with information asymmetry and uncertainty in the case of lower-middle-income economies.

In order to test the existence of job signaling practices in lower-middle-income countries a model of employer learning and wages, developed by Altonji and Pierret (2001), is applied. Logarithms of hourly wages of employees are used as explained variable and are allowed to vary with changes in years of education, experience and natural ability across workers. Interactions of experience with natural ability and years of education are used to control for the fact that the influences of schooling and aptitude are not fixed and change with years spent in current occupation. In case of information asymmetry present and education signaling used, coefficients for two abovementioned interactions should be statistically significant. Ability-experience term should have positive sign, while coefficient for education-experience term is expected to be negative. Employers do not posses much information about the ability, and hence productivity, of new employees. At the same time, they have certain image about the correlation between amount of schooling obtained and worker's natural ability. Hence, years of education, confirmed by corresponding diploma, to higher extent determine the level of earnings in the very first years of job experience. As time spent in the position passes, more of natural ability is being revealed and education loses its signaling value. A theoretical relationship is expressed by equation 1.

$$lnW_i = \beta_0 + \beta_1 T_i + \beta_2 T_i^2 + \beta_3 S_i + \beta_4 (S_i * T_i) + \beta_5 Z_i + \beta_6 (Z_i * T_i) + \varepsilon_i. \quad (1)$$

Here lnW is a natural logarithm of individual's hourly wage in USD, T_i and T_i^2 are the first and the second order terms for experience in current occupation, S_i is a number of education years, Z_i is a measure of employee's natural ability (not directly observable by employer), products $(S_i * T_i)\ and\ (Z_i * T_i)$ are education-experience and ability-experience interaction terms respectively. In line with the theory described above, coefficients β_4 and β_6 should be both statistically significant. Coefficient for interaction between schooling years and experience

should be negative, while the one relating natural ability and experience should have a positive sign. Otherwise, if there is no signaling and employer possesses perfect information regarding workers' productivity, both coefficients should be insignificant on any conventional level of confidence.

The most challenging part of such approach is to find an appropriate proxy for natural ability of an employee. For the sake of experiment's clarity, aptitude should be approximated by a variable which is mostly unobservable by employer and is easily observed by researcher. The best option would be to have results of IQ tests or some of its analogues. However, these variables are rarely included into datasets. Besides the Armed Forces Qualification Test of cognitive capacity, Altonji and Pierret (2001) also use father's education as *Z* variable. Other similar papers (Bauer and Haisken-DeNew 2001; Strobl 2003; Cheung 2010) use education of both parents for these purposes. The positive effect of parents' education on school performance, cognitive ability and earnings was theoretically and empirically validated by several researchers (Li 1986; Card 1999; Dubow et al. 2009; Anger and Heineck 2010). So, the basic set-up of signaling model in this paper uses maximum of mother's and father's education years as an ability controlling variable. Moreover, the data used in the research (see section 2.2) allows to calculate composite scores for cognitive and job-related skills possessed and applied by the workers from the sample. These scores are utilized as alternative measures of *Z* and make the test of signaling hypothesis more comprehensive.

A classical Mincer earnings function (1974) is used as a benchmark and allows to confront signaling set-up with pure human capital view. Empirical analysis in the framework of Mincer's model involves regressing natural logarithms of hourly wages on schooling years and on the first and second order terms of experience. Equation 2 illustrates a theoretical set-up of Mincer's model.

$$lnW_i = \beta_0 + \beta_1 T_i + \beta_2 T_i^2 + \beta_3 S_i + \varepsilon_i. \quad (2)$$

For each set-up, models are first launched on the full array of available data. Then restrictions related to age, years of schooling and employment status are imposed on dataset. Such restricted dataset is further divided into two groups, representing positions with and without the option of on-the-job-training. The logic behind this differentiation is that, in case of the on-the-job-training available, significant part of job-related skills is acquired in the process of apprenticeship. Formal education (i.e. colleges, universities, etc.), supposedly, should have only minor direct influence on productivity and is more likely to be used as a signal of natural aptitude of employee. The level of innate ability determines effectiveness of the on-the-job training and a subsequent productivity of a trainee.

2.2. Data and Restrictions

Data for analysis is taken from the World Bank's STEP Skills Measurement Program realized in 2012-2014 (The World Bank 2015). This Program conducts household-oriented and employer-oriented surveys in several low- and middle-income countries across the globe. Datasets include observations of population aged from 15 to 64 and living inside urban areas. STEP is unique in the sense that, besides very basic individual variables, it attempts to measure skills of workers in this group of states. It allows to assess the structure of labor force, its abilities and social background. The current research uses individual cross-sectional data from household level survey in four lower-middle-income countries. These four countries are: Armenia, Bolivia, Ghana and Vietnam. The choice of these states is related to the fact that they are situated in different parts of the world, which makes possible conclusions potentially more spacious and applicable to wider range of societies. Preliminary statistical analysis shows the positive relation between years of education and hourly wages in these countries (Figure 2). However, it is unclear whether this relationship is determined by signaling or by accumulation of human capital throughout the years of studies. To clarify the causal connections, model of employer learning is launched on the STEP data for four countries.

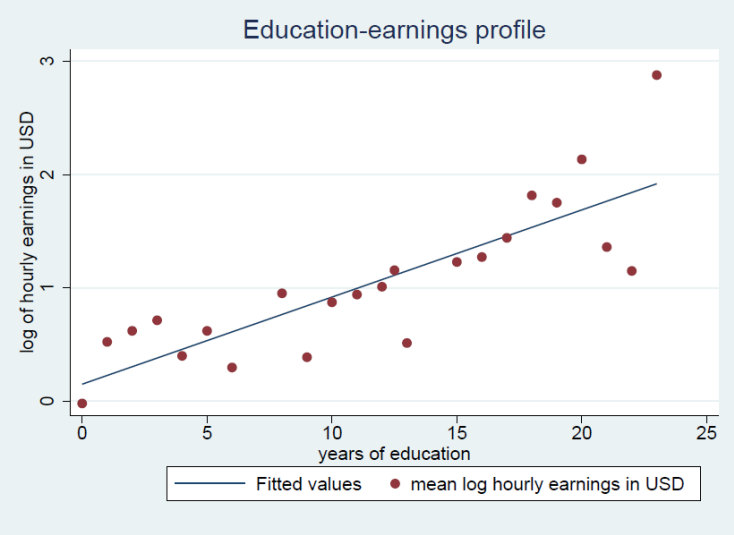

Figure 2. Pooled education-earnings profile for the population of four studied countries. Source: The World Bank 2015.

Observations in the STEP Household Survey include information on such variables as hourly wages in USD and their natural logarithms, tenure and years of schooling, i.e. all variables necessary for equation 2. Wages are denominated in USD to allow for international compatibility of data on earnings. Tenure is measured as the number of months spent in current occupation. The observations of this variable are divided by 12 in order to get a respective number of years. Education years are defined as the number of years corresponding to the highest level of schooling achieved. Such measure can be better than the actual number of years spent on studies,

since in this case the number of years is by default confirmed by congruent diploma with potential signaling value.

Father's and mother's education is available as well, although it is presented in the form of categories (e.g. primary, secondary, etc.). To transform it into numerical variable, schooling of employees expressed in categories is confronted with schooling of employees expressed in years. This comparison allows to find year equivalents for the categories of parents' education. So, the first proxy of *Z* is adapted for use in the model of employer learning.

As it was mentioned in 2.1., the model is also tested on alternative *Z* proxies. One of them is an aggregate score for self-reported cognitive skills. In the framework of the STEP Household Survey, individuals are asked about complexity and frequency of reading, writing and mathematical tasks which they have to perform at work. Reported levels of frequency and complexity are then used for the assessment of respective cognitive characteristics. Individual scores for writing, reading and mathematics are combined into one overall self-reported cognitive skills score. In line with aggregation methodology suggested by manual for the STEP (Pierre et al. 2014), self-reported cognitive skill score is calculated as a simple average across these three component sub-domains. The same principle is used for the construction of job-relevant skills aggregate. Simple average is calculated across scores for intensity of computer use, autonomy and repetitiveness, solving and learning required by the position. Aggregates are measured on the scale from 0 to 3, where 0 means no use of skills included into a composite score and 3 stands for high intensity of skills' application. In case of at least one of individual variables missing, the whole aggregate score was coded as a missing value. Summary statistics for all variables used in the models, including alternative measures of *Z*, are shown in Table 1.

The use of two aggregate scores can, in principle, more effectively estimate the natural ability of labor market participants. All variables used in the aggregates are assessed in relation to their applicability at work and therefore should approximate aptitude better than some general cognitive ability tests. Productivity is determined by relevant practical skills, rather than by ability to solve abstract problems, unrelated directly to specific fields of occupation.

Variable	Obs.	Mean	Std. Dev.	Min	Max
lnW(log of hourly earnings)	6,710	0.827	1.123	-7.708	7.344
T (tenure in years)	7,400	8.044	8.752	0	70
S(years of education)	11,773	10.891	4.535	0	23
Z_1(max of parents' education)	8,377	8.561	5.991	0	23
Z_2(cognitive skills)	7,909	1.044	0.711	0	3
Z_3(job-related skills)	7,832	1.101	0.676	0	3

Table 1. Summary statistics for the dataset

As can be seen from Figure 3, the relationship between age and hourly earnings is non-linear and can be approximated by concave quadratic function. After age of forty the rate of growth in

wages is substantially smaller than at earlier stages of life. Quadratic relationship between earnings and age estimated for the given sample is illustrated by equation 3.

$$lnW = -0.2074 + 0.0530age - 0.0006age^2. \quad (3)$$

First derivative of this function equated to 0 gives a value of age after which earnings start to decrease year by year. This happens around the age of 44. So, after launching models on the unrestricted dataset, all further set-ups are limited to those individuals who are less than 44 years old. Otherwise, decrease in wages in the second half of life can bias coefficients for interaction terms, which include experience correlated with age. Another restriction imposed is related to the years of education. The model is launched on the sample of those individuals who possess more than 9 years of education. All restricted specifications also include only employees, hired by private or public entities. Self-employed workers are excluded since they do not have an employer to whom they should signal their ability. Hence, the model of employer learning is inapplicable to them.

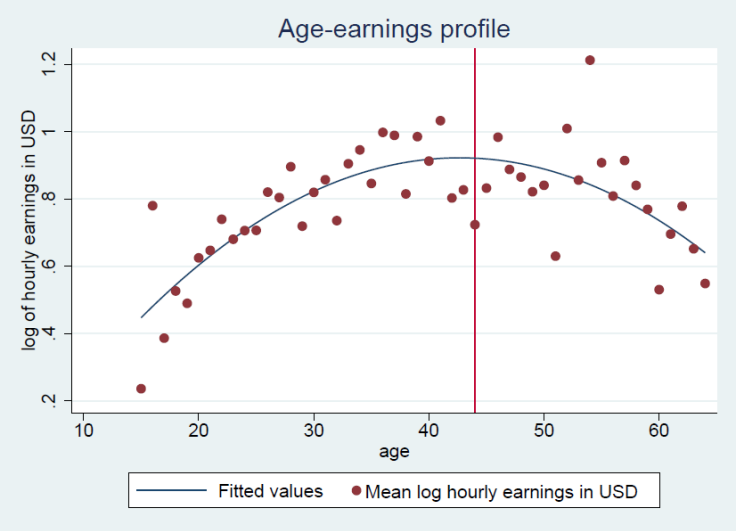

Figure 3. Pooled age-earnings profile for the population of four studied countries
Source: The World Bank 2015.

2.3. Overall Regressions

Running the models on unrestricted STEP survey dataset returns the results summarized in Table 2. As shown in the column 1, the variations in wages of workers in four examined countries can be partially described by classical Mincer earnings function. Estimated coefficients for tenure, tenure squared and years of education are all individually significant on 99 per cent confidence level. *I.e.*, the null hypothesis that the effects of mentioned variables on logarithms of hourly wages are not statistically different from 0 can be rejected on significance level equal to 0.01. Each additional year of education and tenure is associated with 8 and 2 per cent increase in hourly earnings respectively, holding all other variables constant. At the same time, significantly

negative coefficient for the second order term of tenure shows that relationship between wage and experience is non-linear. When certain critical amount of tenure is accumulated, each additional year starts to negatively affect the individual's earnings. The coefficient of determination for Mincer earnings function is approximately 0.128, meaning that around 13 per cent of variations in dependent variable are explained by three independent variables included into the model.

VARIABLES	(1) Mincer Earnings Function	(2) Max of Parents' Education as Z	(3) Cognitive Skills as Z	(4) Job-Related Skills as Z
Tenure (T)	0.0194***	0.0215***	0.0189***	0.0188***
	(0.00398)	(0.00604)	(0.00497)	(0.00503)
Tenure^2 (T^2)	-0.000365***	-0.000406***	-0.000342***	-0.000304**
	(0.000124)	(0.000148)	(0.000125)	(0.000123)
Education Years (S)	0.0796***	0.0866***	0.0602***	0.0510***
	(0.00259)	(0.00520)	(0.00439)	(0.00414)
Education Years*Tenure (S*T)		6.79e-05	-0.000103	0.000592*
		(0.000404)	(0.000367)	(0.000324)
Max Parents' Education (Z_1)		0.00254		
		(0.00424)		
Max Parents' Education*Tenure (Z_1*T)		-0.000229		
		(0.000337)		
Cognitive Skills Score (Z_2)			0.238***	
			(0.0301)	
Cognitive Skills Score *Tenure (Z_2*T)			-0.000135	
			(0.00254)	
Job-Related Skills Score (Z_3)				0.396***
				(0.0296)
Job-Related Skills Score*Tenure (Z_3*T)				-0.00754***
				(0.00254)
Constant	-0.144***	-0.273***	-0.176***	-0.262***
	(0.0354)	(0.0565)	(0.0441)	(0.0450)
Observations	6,696	4,298	6,647	6,594
R-squared	0.128	0.152	0.142	0.159
Adjusted R-squared	0.127	0.151	0.141	0.159

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Regressions without restrictions on the dataset

The column 2 in Table 2 shows the results for employer learning model with maximum of father's and mother's education used as a proxy of natural ability. Traditional variables (tenure, tenure squared and years of education) remain individually significant on 99 per cent confidence level and their effects on endogenous variable even increase slightly, as compared to the first set-

up. Coefficients for years of parents' education (Z_1) and interaction terms ($S*T$ and Z_1*T) are not statistically different from zero. In the sample of 4,298 observations the model explains 15.2 per cent of variations in hourly earnings of workers. F-test for joint significance of coefficients for the three added variables fails to reject the null hypothesis at 95 per cent confidence level. This means that restricted model (without parents' education and interaction terms; n=4,298) fits the data in the same way as unrestricted model (Table 2, Column 2).

When self-reported cognitive skills score is used instead of parents' education (Table 2, Column 3), ability variable (Z_2) demonstrates significance on 99 per cent confidence level. One unit increase in this score is associated with 24 per cent growth in hourly wage, other things equal. First and second order terms of tenure, as well as years education, are also highly significant. Despite statistically confirmed positive relationship between cognitive skills and earnings, the effect of interaction terms controlling for the presence of employer learning converges to zero. With the sample size very close to the one used in classical Mincer function, cognitive skills set-up is able to explain more variations - 12.7 per cent in the first set-up against 14.1 per cent in the third (according to adjusted R-squared).

The effect of job-related skills on wages is positive and highly significant (Table 2, Column 4). A unit increase in this variable corresponds to almost 40 per cent increase in hourly earnings, holding tenure at the level of 0 and all other variables constant. Unlike in two previous employer learning set-ups, coefficients for interaction terms $S*T$ and Z_3*T are significant on 90 and 99 per cent confidence levels respectively. However, the effects of this interaction terms have opposite direction to those predicted by the theory. It appears that each additional year of experience decreases the effect of ability on earnings and, simultaneously, increases the importance of education - a result polar to what was described by Altonji and Pierret (2001). Such outcome may suggest that, although there is a certain amount of information asymmetry on the labor markets of studied countries, education signaling is not used for dealing with it.

2.4. Regressions with Restrictions on the Dataset

As mentioned in 2.2., certain conditions have to be applied on the data from the STEP survey, in order to isolate the groups of workers in which signaling practices are more likely to take place. First, data constraints are applied on the model with maximum of mother's and father's education as Z variable (Table 3). It turns out that the years of parents' education start to be significant for the group of employees with more than 9 classes of education and no older than 44. Moreover, Z_1*T interaction term becomes significant on 90 per cent confidence level, although it has a negative sign. Next, the sample of 1,336 workers meeting abovementioned criteria is divided into two subsamples: employees with and without the on-the-job-training

(OJT). Coefficient for the interaction term between parents' education and tenure demonstrates some significance for the cohort without the OJT. In this case the null hypothesis of the coefficient for Z_1*T being statistically equal to zero can be rejected on 10 per cent significance level. Negative sign of this interaction term seems odd from the perspective of employer learning theory. No other interactions between explanatory variables show significance on any conventional confidence level (See Columns 1-3 in Table 3). It worth noting that coefficients for the second order term of tenure become insignificant for the first and the second set-ups of the model with maximum of father's and mother's education (the same can be observed for the models with other measures of Z). This loss of significance is related to the age constraint imposed on the dataset. For individuals younger than 44, the relationship between age and earnings, and consequently tenure and earnings can be expressed in linear form. However, for the subsample of individuals without the OJT, tenure squared becomes significantly negative again. Probably, age-earnings function for this particular group of workers reaches its maximum earlier and hourly earnings start to decrease even before the age of 44.

VARIABLES	(1) ≥9 education; ≤44 age; employees	(2) With On-The-Job-Training	(3) Without On-The-Job-Training
Tenure (T)	0.0549***	0.0651*	0.0825***
	(0.0193)	(0.0334)	(0.0262)
Tenure^2 (T^2)	-4.39e-05	0.000311	-0.00177***
	(0.000224)	(0.000360)	(0.000549)
Education Years (S)	0.141***	0.175***	0.134***
	(0.0113)	(0.0243)	(0.0132)
Education Years*Tenure (S*T)	-0.00157	-0.00331	-0.00102
	(0.00144)	(0.00291)	(0.00174)
Max Parents' Education (Z_1)	0.0114*	-0.00133	0.0170**
	(0.00600)	(0.0126)	(0.00680)
Max Parents' Education*Tenure (Z_1*T)	-0.00130*	-0.00108	-0.00156*
	(0.000743)	(0.00167)	(0.000829)
Constant	-1.211***	-1.398***	-1.266***
	(0.149)	(0.287)	(0.182)
Observations	1,336	303	1,033
R-squared	0.224	0.248	0.221
Adjusted R-squared	0.220	0.233	0.216

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Maximum of Parent's education as Z with restrictions on the dataset

When employer learning model with cognitive skills score as Z is launched on the sample fulfilling previously described conditions (Table 4), Z_2 is positive and significant. Coefficients for both interaction terms are significantly different from 0 on 99 per cent confidence level for

the group of workers undergoing apprenticeship. Education years-tenure interaction term has a negative sign, while cognitive skills-tenure has positive effect on hourly earnings. This result is in line with theoretical framework. It suggests that each additional year of experience weakens the effect of education on hourly earnings by 0.7 per cent and increases the effect of ability (approximated by cognitive score) by 3 per cent. Interactions have no effect in the subsample of workers without the OJT, although the aggregate score Z_2 is significant for them.

VARIABLES	(1) ≥9 education; ≤44 age; employees	(2) With On-The-Job-Training	(3) Without On-The-Job-Training
Tenure (T)	0.0519***	0.0804***	0.0690***
	(0.0155)	(0.0274)	(0.0206)
Tenure^2 (T^2)	-0.000302	-0.000259	-0.00161***
	(0.000204)	(0.000271)	(0.000456)
Education Years (S)	0.114***	0.133***	0.110***
	(0.00935)	(0.0190)	(0.0110)
Education Years*Tenure (S*T)	-0.00231*	-0.00714***	-0.000946
	(0.00128)	(0.00268)	(0.00152)
Cognitive Skills Score (Z_2)	0.142***	0.0365	0.183***
	(0.0361)	(0.0685)	(0.0425)
Cognitive Skills Score*Tenure (Z_2*T)	0.00395	0.0301***	-0.00579
	(0.00491)	(0.00992)	(0.00570)
Constant	-0.907***	-0.967***	-0.974***
	(0.110)	(0.204)	(0.135)
Observations	2,338	569	1,769
R-squared	0.212	0.231	0.212
Adjusted R-squared	0.210	0.223	0.209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.Cognitive Skills Score as Z with restrictions on the dataset

Another proxy of Z, job-related skills score, also has significant impact on wages for workers up to 44 years old and with 9 plus years of schooling (Table 5, Column 1). It remains significant for groups with and without the OJT. Terms controlling for the possibility of employer learning are insignificant almost everywhere. Exception is an interaction between job-related skill score and tenure in the group of workers without the on-the-job-training. Here, the coefficient for Z_3*T is negative and statistically different from 0 on 1 per cent significance level.

VARIABLES	(1) ≥9 education; ≤44 age; employees	(2) With On-The-Job-Training	(3) Without On-The-Job-Training
Tenure (T)	0.0454***	0.0625**	0.0606***
	(0.0155)	(0.0276)	(0.0204)
Tenure^2 (T^2)	-0.000201	-0.000124	-0.00154***
	(0.000198)	(0.000274)	(0.000448)
Education Years (S)	0.0930***	0.120***	0.0851***
	(0.00925)	(0.0189)	(0.0109)
Education Years*Tenure (S*T)	-0.000965	-0.00422	0.000526
	(0.00132)	(0.00280)	(0.00156)
Job-Related Skills Score (Z_3)	0.301***	0.123*	0.371***
	(0.0363)	(0.0721)	(0.0421)
Job-Related Skills Score*Tenure (Z_3*T)	-0.00642	0.0146	-0.0161***
	(0.00516)	(0.0121)	(0.00582)
Constant	-0.828***	-0.898***	-0.877***
	(0.109)	(0.204)	(0.132)
Observations	2,341	568	1,773
R-squared	0.233	0.223	0.242
Adjusted R-squared	0.231	0.215	0.239

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Job-Related Skills Score as Z with restrictions on the dataset

2.5. Discussion of the Results

It was mentioned several times that, in order to confirm the existence of education signaling on labor markets, coefficients for education - tenure and ability - tenure interaction terms have to be statistically different from 0 and exhibit negative and positive signs respectively. With model of employer learning launched on the data from the STEP Household Survey, the only case this condition holds true is when cognitive skills score is used as a measure of Z and sample is limited to the employees who are less than 44 years old, have more than 9 classes of education and who received the on-the-job-training (see Table 3, Column 2). Such set-up of the model has 569 observations at its disposal, which is a relatively big sample. Nonetheless, for the existence of signaling to be credibly proven, this result must be confirmed by the results from set-ups with alternative correlates of ability. However, in all other cases, with different proxies of Z and restrictions on the dataset, coefficients for interaction terms are either insignificant or have different signs from what is expected. So, in relation with the original hypothesis of the paper, it is possible to conclude that there is no reliable evidence of education signaling being applied by hiring organizations in lower-middle-income countries.

On the other hand, the situation when employers have perfect information about applicants for a vacancy requires all interaction terms to be statistically equal to 0. It would mean that employer has absolute knowledge about employee's productivity at the very beginning of application process So, actual aptitude doesn't have to be revealed over the years of experience. Among various set-ups tested in the current research, there are several cases when interaction terms, although having signs opposite to those predicted by the theory, demonstrate certain level of statistical significance. This may suggest that there is a certain amount of information asymmetry between employees and hirers. Employers in the group of studied countries are not able to precisely determine whether they are facing more or less able individual and, therefore, have to adjust wages after this individual was accepted for some position.

Such ambiguous results lead to the question: why employers and employees in Armenia, Bolivia, Ghana and Vietnam do not use education signaling strategy for dealing with existing information asymmetry? A potential answer can be found in the channels through which employees find their jobs. Table 6 summarizes the answers of employees from the studied sample to the question "How did you find your current job?". Employment service agencies, both public and private, were used by only 7.46 per cent of employee. Other 8 per cent of workers found job through mass media and a little bit less than 4 per cent got the position after undergoing a specific job-related training. Direct contacts between hiring organizations and employees constitute almost 23 per cent of successful job acquisitions. However, the largest share of workers, 48.64 per cent, reported finding the job with help of their relatives or friends. Such channel of job acquisition is considered to be informal.

CHANNEL	Frequency	Percentage
State employment services agency	140	5.77
Private employment services agency	41	1.69
Through university/school career office	57	2.35
Through friends or relatives	1,180	48.64
Through media, including internet	194	8.00
Employer directly contacted employee	199	8.20
Employee directly contacted employer	461	19.00
Job was obtained after training/apprentices	96	3.96
Other	58	2.39
Total	2,426	100.00

Table 6. Job Finding Channels
Source: The World Bank 2015.

A friend or relative, who helps in the process of job finding, plays the role of intermediary between employer and employee. Being related to the both demand and supply sides of labor market, intermediary is trusted by the employer and, at the same time, possesses information

about personal productivity of employee. This allows private information on aptitude and ability, unobservable to employer in other circumstances, to be transferred from hired person to the hirer. Such practice may represent an alternative way of coping with information asymmetry in markets for labor and can potentially be used instead of education signaling.

Although the prevalence of informal channels in the job acquisition process may to a certain extent determine the ways of information transmission on the labor markets of the studied countries, equivocal results gained from the launched models can be also interpreted in the favor of the human capital theory. Since the signaling role of education in Armenia, Bolivia, Ghana and Vietnam cannot be proven with certainty, it seems logical to claim that a positive relationship between earnings and amount of education is determined by the human capital accumulated during the process of schooling in educational institutions of different levels. In this context, information asymmetry may arise since the employer does not know exactly which share of curriculum was successfully absorbed by the applicant for a vacancy. With certain amount of time spent in occupation, the employee is able to fully reveal his or her potential which is defined by skills and knowledge obtained during the process of education.

Conclusion

The review of the literature in the theoretical part of the thesis suggested that labor markets of the lower-middle-income countries are likely to be the place where education signaling is actively applied. Informative function of education can be potentially determined by excess demand for wage jobs and insufficiently developed mechanisms for transition of information on productivity of employees. However, empirical analysis carried out in the thesis did not find any reliable evidence of education signaling being applied on labor markets of lower-middle-income countries. Employer learning model launched on individual-level data from Armenia, Bolivia, Ghana and Vietnam did not yield any results which could be interpreted as a certain proof of signaling practices' existence. Majority of interaction terms, controlling for the use of signaling, were either insignificant or had opposite signs to what is described in the theoretical set-up of the model. At the same time, statistical significance of several interactions in set-ups with different proxies of natural aptitude suggested that employers are not perfectly informed about employees' productivity. So, in the process of the research it has been found that signaling component of education does not seem to significantly affect wages and hiring decisions in lower-middle-income economies, although there is a certain amount of information asymmetry on labor markets of these countries.

Two possible explanations of the absence of signaling were suggested. The first explanation was related to the specifics of job acquisition channels in four studied countries. Informal way, e.g. through relatives and friends, prevails among the methods of vacancy search. Supposedly, such channel allows labor market participants to overcome the problem of personal ability revelation. Friends and relatives may act as mediators between the hirers and the hired, allowing for transfer of private information on productivity between supply and demand sides of labor markets. On the other hand, results of empirical analysis can be seen as confirmation of validity of human capital theory. In this context, positive effect of education on earnings is defined by useful skills and knowledge gained during the process of education.

The research has several features which make it distinct from previous studies. To the best of the author's knowledge, no other study of education signaling in the lower-middle-income countries had such depth and scope of the analysis. Regressions with alternative measures of ability were used in order to supplement and double-check the results obtained from the set-ups with maximum of parents' education - one of commonly used proxies of Z. Aggregate scores for job-related cognitive and practical skills allow to isolate the portion of individual's ability which directly affects productivity and which is more relevant to the tasks performed at work. The data from the STEP Skills Measurement Survey, used in empirical part of the research, simultaneously covers several countries. The results from the models launched on such data are

more general and applicable to wider group of states, as compared to the cases when theoretical set-ups are tested on one particular country. The study contributes to the understanding of signaling and productive functions of education on labor markets of the lower-middle-income states. It suggests that education signaling is not the only way for dealing with employer-employee information asymmetry. Discussion of the results in empirical part can serve as a starting-point for the studies on the role of informal job acquisition channels in processes of information transition on labor markets of developing countries.

The limitations on the analysis carried out in the thesis have to be mentioned as well. The first is related to the measurement of innate ability. Despite the advantages of alternative Z proxies described above, it is possible that all three measures used in the paper are less effective in the estimation of natural aptitude, as compared to more traditional and preferred by researchers IQ and AFQT scores. Datasets for four studied countries did not include results of these conventional tests. Moreover, empirical analysis was mainly focused on employee-side of labor markets while final decisions on salary increase or acceptance of an applicant for a certain position are made by hiring organization. The study of education signaling practices in the lower-middle-income countries would be more comprehensive if supplemented by employer-side analysis. Another limitation is related to the response rates. Elimination of observations with missing values has substantially dwindled the size of the dataset. In case of general specification models were launched on thousands of observations, while the samples with constraints on age, education, employment status and apprenticeship often included only several hundreds of individuals. Sample size still remained relatively large, but additional observations could make the results more precise and reliable.

Suggestions for further studies can be derived from the limitations described above. Availability of IQ or other conventional ability test scores in the individual-level data gathered for lower-middle-income states would allow for precise replication of analysis conducted in more developed regions of the world. It will be possible to fairly compare education signaling practices in more and less economically successful countries. Further research may also be focused on the theoretical development and practical probation of the framework for analysis of education signaling from the employers' perspective. Such approach will provide researchers and policymakers with versatile and, at the same time, deeper understanding of education's informative function in the lower-middle-income states. Finally, all quantitative and qualitative improvements in relevant data available for developing societies will make studies of education signaling more effective and conclusive.

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