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Assessing Economic Internal Rate of Return of Education

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Abstract

This paper tackles to estimate the economic internal rate of return on education in Armenia, using the 2018 Labor Force Survey data. The extended earning function regression showed that an extra level of education brings about 7% return. In line with global literature, women have a higher return on an additional level of education than men. In contrast to many findings in the literature, returns to education of employees in the public sector are higher than in the private sector. Not surprisingly, individuals with professional occupations see higher returns to their education than the ones with elementary and less professional occupations. The developed model has been used for generating wage profiles depending on education level and gender. When taking into account the costs of education and predicted earnings, the full discounting analysis showed that vocational education has the highest internal rate of return. The return to university education seems to increase gradually with each degree acquired. Because of the existing gender pay gap, investment in men's education yields higher returns using the investment approach.

Keywords: Return to Education, IRR, Earnings Function

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Introduction

The existence of a qualified human capital is an essential factor for the development of a particular economy. According to human capital theory, education is one type of investment, and acquired knowledge can contribute to the worker's productivity and efficiency (Becker 1964; Mincer 1974). To be able to make an informed decision about whether to invest in education or somewhere else, it is useful to measure the rate of return in education.

The rate of return in education has been a subject for consideration for economists since the second half of the previous century (Psacharopoulos and Patrinos, 2002). Since today it is a quite demonstrative and widely used measure for policymakers to understand the profitability of education and the demand for education levels. This rate can be a guideline for making financing decisions and improving the education system. Hence, this is a subject of concern for both individuals and public institutions which invest money in education.

Assessment of the economic internal rate of return of education for Armenia is the main focus of this research paper. In Armenia, public spending on higher education is limited because of the tight government budget; hence higher education institutions are mostly dependent on profits generated from tuition fees. Having this in mind, the research mainly concentrates on estimating the private rate of returns taking into account only individual contributions to education.

The analysis is based on the extended version of the earnings function that was developed by Jacob Mincer (Mincer, 1974). Besides age and education level, other individual characteristics are included in the regression model. The generated wage profiles of individuals with different levels of education and gender have been used as input parameters for calculating the return on investment in education through internal rate of return (IRR) and net present value (NPV) analysis.

The main findings of the research are the following. According to the Mincerian earnings function, an additional level of education increases the mean earnings of an individual by 7%. Women have a higher return to education than men. Workers of the public sector experience higher returns to education than workers of the private sector. People with professional occupations gain more from additional levels of education than people with less professional occupations. The discounting approach showed that vocational education has the highest internal rate of return in Armenia. Also, IRR results indicate that investment in men's education generates a higher return in contrast to regression results. One explanation of this difference is that women's education is a crucial determinant of wage promotion in the labor market. In contrast, the cost-benefit analysis showed that men see higher returns to the initial investment in their education. Both men and women may spend the same amount of money on education, however, the existing gender pay gap provides higher IRR to male education.

This study will push the frontier of the existing knowledge through the following ways. First of all, this paper will enrich existing literature on the topic, particularly for Armenia. In this sense, the research will have a significant contribution to the literature, because of the lack of existing studies on return to education in Armenia. Moreover, the research will provide enough guidance and evidence to personally decide how much money to invest in one's own human capital.

The paper has the following structure. The next section provides a review of the previous studies on the topic. Then the applied methodology and the data are being presented. Discussion of the extended earnings function and the estimation of the return to education by gender, sector, and occupation follow next. Then, the estimates of the discounting approach are presented. The last section concludes the paper.

Literature Review

In the 1960s, economists started to treat the expenditures in education as an investment that builds human capital (Schultz, 1961; Becker, 1964). And since it is considered as an investment, the need raised to measure its profitability. One of the early developed ways of measuring the returns is the earnings function developed by Jacob Mincer (Mincer, 1974). The function is a logarithmic wage equation that controls for work experience and education. Most of the findings and estimates in the literature are based on the Mincerian equation. Heckman, Lochner, and Todd (2003) firmly state that this earnings function is the cornerstone of labor economics, and it greatly influenced the way economists estimate education profitability. Estimations have been conducted in different parts of the world to find out the rate of return to varying levels of schooling (Psacharopoulos 1995).

Psacharopoulos (1995) differentiates two distinct types of return to education. First is the private rate of return, which simply shows the demand for education from the society's point of view and accounts for individual expenditures on education. Second is the social rate of return, which shows the rate of return from the state's point of view, accounting for public spending on education.

Psacharopoulos and Patrinos (2002) estimated the return of 98 countries using the latest available data, and found that during the last 12 years, average returns to education decreased by 0.6 percentage points, while the average schooling levels have increased. Furthermore, women are experiencing higher returns to education than men. Psacharopoulos and Patrinos (2018) have analyzed the latest trends and patterns based on the 1,120 estimates of 139 countries. The study found that the private global average rate of return to one additional year of education is about 9 percent, which is quite constant over the decades. Also, females continue to yield higher returns to

schooling, indicating that girls' education is a priority. Additionally, people who work in the private sector have higher rates of returns than the ones working in the public sector. Both earning function and discounting method are applied, but finally the full discounting approach is recommended because of its relevance over the Mincerian function.

The return to education has been estimated in different spots of the world. Romele (2013) estimated the internal rate of return (IRR) to education in Latvia using OECD methodology, which is based on the investment approach. The author found a relatively high internal rate of return, which is typical for developing countries. Romele (2013) also points out that in countries like Denmark, France, Germany, Italy, Netherland, Norway, Sweden, and United Kingdom private rate of return is below 10%, which is not an indicator of investment inefficiency, but rather related to the wage structure and the higher education system, which is almost free of charge.

Wahrenburg and Weldi (2007) conducted a similar study for Germany. The authors calculated the return to education for different subjects, degrees, and gender. The applied regression analysis showed that the return to education varies from subject to subject. Medicine, Law, Economics, and Social Sciences provide the highest private return to education. In contrast, subjects like Art, Agriculture, Language, and Culture studies seem to be less profitable. Similar pattern exists in other developed countries too, according to an international study by Gunderson and Oreopolous (2020). When it comes to gender, the subject choice of two genders is segregated, which means that each gender chooses a particular field, where he/she has a competitive advantage, which helps to achieve a relative return advantage in that field. Wahrenburg and Weldi (2007) used the expanded version of the Mincerian equation to find the earnings profiles of the respondents, using these findings in the IRR calculation.

Uusitalo (1999) estimated the rate of return of education for Finland using ability test scores and family background. The study found that the omission of ability scores from the estimates leads to an upward bias in the estimated returns. It also provided evidence that the ability to test scores and family background has a significant impact on the choice and length of education and subsequent earnings. Gunderson and Oreopolous (2020) highlight that many empirical studies showed that the bias caused by the omission of innate ability and/or family education is trivial. Card (1999) provides a comprehensive review of the literature on the causal relationship between education and earnings. The author concludes that a person's ability makes simple OLS estimates a bit upward biased based on previous studies of identical twins. Card (1999) also highlights that the return to education varies with the quality of acquired education and parental education.

Trostel (2005) calculated the marginal rates of return to schooling in 12 countries. The study found an economically and statistically significant nonlinearity in return to education. The author found that the marginal rate of return to schooling is increasing at the low levels of education, and then starts to decrease at higher levels of education. Gunderson and Oreopolous (2020) provide an interesting review of the rate of return to education for developed countries, where they also highlight some drawbacks of the commonly used Mincerian equation. Among these drawbacks are measurement error or misreporting of education in surveys, omitted variables such as innate ability, motivation, time management, and other essential skills that can impact earnings but are not usually controlled in the literature. Furthermore, the study underlines the importance of skills obtained from schooling on earnings. Literature provides evidence of such signaling or sheepskin effects, indicating that the rate of return to additional degree completion is higher than that of an additional year of education without degree attainments (Ferrer and Riddell, 2002).

Harmon, Oosterbeek, and Walker (2003) use different country datasets and provide evidence that education has a clear positive impact on earnings. Moreover, the size of the return to schooling is even higher than the return from other investments with a similar degree of risk. Sianesi and Van Reenen (2002) emphasize the indirect benefits and externalities of education that stimulate economic growth. According to the study, investment in education leads to better public health, environment, higher life expectancy, lower infant mortality, and lower population growth. Other indirect economic benefits are the increase in productivity due to the use of new technology and more active political and community involvement by the population (Sianesi and Van Reenen, 2002).

When it comes to the neighboring Caucasian countries, several studies should be highlighted here. Botchorishvili (2007) and Khitarishvili (2010) estimated the return to education in Georgia. Both studies calculated the return to education using the OLS method on the extended Mincerian earnings model, and the Heckman selection model. Botchorishvili (2007) points out the data intensity of the NPV method, which does not apply to the Georgian Household Survey data. Besides the OLS and Sample Selection Model, Khitarishvili (2010) also uses the Instrumental Variables (IV) approach. Using the basic OLS method Botchorishvili (2007) found that in 2006 the return to an additional year of education was 6.9%. Applying a similar methodology, Khitarishvili (2010) found a rate of 2.8% for the year of 2004.

Tansel & Bodur (2012) estimated the return to education in Turkey for 1994 and 2002. They did OLS regressions using the Mincerian wage equation and quantile regression techniques paying particular attention to the connection between education and wage inequality. The OLS results show that the return to an additional year of education in 1994 is 7.7%, and in 2002 it is 7.6%. They conducted the same estimation with the education categories and found out that university

education provides the highest return - around 11%. Oksuzler (2008) provides a study for Turkey again using the Mincerian wage function but for an ordered logit model, which helps determine the probability of gaining higher income depending on the education level. The empirical results showed the probability of gaining higher income increases as the education level rises. Patrinos, Psacharopoulos, & Tansel (2019) used both the earnings function and the discounting methods to estimate the return to education in Turkey using 2017 household survey data. The OLS estimates showed that an extra year of education results in 8.8% return. The discounting method suggested the lowest returns to secondary education, while higher education provided the highest yield; 15.8% private and 10.4% social rate. Moreno & Patrinos (2020) conducted a study for Azerbaijan. They applied the widely used Mincerian earnings function and the discounting method. The estimates showed that return to schooling in Azerbaijan is 6%, while the discounting approach provided a private internal rate of return of 9% and a social return of 8% to tertiary education.

When it comes to Armenia, there is inferior literature on rates of return to education, despite the only paper available. Hakobyan and Joulfaian (2016) estimated the return to education in Armenia by investigating how earnings change with educational attainment. The findings show an increase in wages along with additional education, which is highly gender specific. Only the Mincerian method has been applied while conducting the estimates. The results show that the overall average rate of return to an additional year of schooling is 3.24%. The rate is higher for females (3.5%) and slightly lower for males (2.95%). However, Hakobyan and Joulfaian (2016) employed a 2003 year wave of the Armenian Household Integrated Living Conditions Survey, which was only available for the analysis at that time.

Methodology

Earnings function and the Discounting Approach

As mentioned, there are two conventional approaches for estimating the rate of return in education. First is the Mincerian earnings function, which determines the earnings as a semi-logarithmic function of education and experience (Mincer, 1974). For the purpose of this research and upon the data availability, the Mincerian wage function will be like this:

$$\ln wage = \beta_0 + \beta_1 edulevel + \beta_2 age + \beta_3 age^2 + \beta_4 X + u$$

where, *lnwage* is the dependent variable that is the natural logarithm of an individual's monthly earnings, and *edulevel* is the highest level of education acquired. Assuming that an individual's age has almost the same effect on earnings as experience, *age* has been selected as a substitute variable for the experience because of the data unavailability of the latter. As in the original Mincerian equation, here also we are adding a quadratic term of *age* because of the expected diminishing returns. In this model β_1 approximates the rate of return to an additional level of education acquired. *X* stands for the other control variables, which are gender, marital status, sector, and etc. The estimates resulting from this model would probably be biased, because of the omission of unobserved factors like ability and motivation which might affect wages. The available dataset does not allow to control those factors, hence the estimates might be biased.

After fitting the expanded Mincerian equation, the earning profiles of all the education level graduates should be estimated. Those estimations would be used as input parameters for the IRR analysis. The IRR is the rate of discount (*r*), which equalizes the stream of discounted benefits to the costs. The costs of education are considered the forgone earnings and the other expenses that the

student incurs during his/her study (e.g., tuition fees, books, and study material costs). After calculating the IRR for different education degree holders we will be able to compare the rate and see how much more benefits the individual with higher education gets, compared to the one who has a lower level of education. To conduct the IRR estimation the following discounting cash-flow formula will be applied:

$$\sum_{t=1}^{10} \frac{W_t}{(1+r)^t} = \sum_{t=1}^4 \frac{(W_f + C_u)_t}{(1+r)^t}$$

where W_t is the earnings of an individual, which will be estimated for people from all the levels of education separately. C_u represents the direct costs of university or college education (tuition and fees, books, etc.), and W_f denotes the student's foregone earnings or, in other words, the opportunity cost of getting an education. 10 years of working life of an individual is considered for the computation of the internal rate of return. Three years of vocational education and 4, 6, and 9 years of Bachelor's, Master's, and Ph.D. studies are assumed for the duration of investment in education.

Data

As a source of data, the dataset of the Armenia Labour Force Survey 2018 will be applied, which is the latest one available in the Statistical Committee of the Republic of Armenia. This is an anonymized micro database that suits best for the research purpose. However, the available variables are limited compared to similar household surveys of other countries. All in all, the sample size is 16,383 observations; however, after dropping the ones under age 15 and keeping only the ones who mentioned their wage, the sample size decreased to 2,542 observations. The rest of the control variables are also available for these respondents. Table 1 shows that 36% of the

respondents have completed secondary education, which includes the respondents whose highest achieved education is primary, basic or high education. Nearly 30% have a vocational or secondary-specialized education as a part of vocational education. As for the higher education graduates, 15% have a Bachelor's degree. 19% of the sample possesses a Master's degree or is a Certified specialist, which requires at least five years of schooling and is equivalent to a Master's degree per the 2004 year's law of the Republic of Armenia on higher and postgraduate professional education. Only a small portion of the respondents acquired postgraduate qualification - nearly 0.7%.

Table 1. Education levels

Level of education	Freq.	Percent	Cum.
Secondary	925	36.39	36.39
Vocational/Secondary	751	29.54	65.93
Bachelor's degree	371	14.59	80.53
Master's degree	478	18.8	99.33
Ph.D.	17	0.67	100
Total	2,542	100	

Most of the respondents mentioned their monthly earnings; however, for those mentioning periodic wages, the data was normalized to monthly full-time equivalent payments. Also, respondents from the Agriculture, Forestry, and Fishing sector are dropped from the sample, as the mentioned earnings are not wages but rather income from farming that are mostly periodic, and generating monthly earnings from the data will lead to inaccurate results. There is a portion in the sample (12%) that works part-time. An apt transformation has been made to balance part-time

workers' wages as if they worked 40 hours per week. After doing these transformations, we discover that the average monthly salary of the ones who do not possess higher education is 99,400 AMD, whereas that of higher education graduates is 119,420 AMD per month. On the other hand, the monthly mean earnings of men are 125,075 AMD, while for women, it is 85,565 AMD, as we can see from Table 2.

Table 2. Descriptive statistics

	All		Male		Female	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Monthly wage in AMD	106,222	94,123	125,075	103,176	85,565	78,054
Not higher education	0.66	0.47	0.70	0.46	0.61	0.49
Higher/university education	0.34	0.47	0.30	0.46	0.39	0.49
Age	42.72	13.38	41.15	13.58	44.45	12.95
Female	0.48	0.50	-	-	-	-
Married	0.71	0.45	0.77	0.42	0.65	0.48
Marzes	0.89	0.32	0.91	0.29	0.86	0.35
Yerevan	0.11	0.32	0.09	0.29	0.14	0.35
Rural	0.36	0.48	0.41	0.49	0.31	0.46
Urban	0.64	0.48	0.59	0.49	0.69	0.46
Professionals (occupation)	0.43	0.50	0.29	0.46	0.58	0.49
Non-professionals	0.57	0.50	0.71	0.46	0.42	0.49
Industry	0.25	0.43	0.35	0.48	0.14	0.35
Trade and Transportation	0.20	0.40	0.21	0.41	0.18	0.38
Finance	0.01	0.10	0.01	0.11	0.01	0.10
Professional	0.04	0.19	0.04	0.19	0.04	0.20
Public and Social	0.44	0.50	0.33	0.47	0.57	0.50
Other Services	0.06	0.24	0.06	0.23	0.07	0.25
Private	0.54	0.50	0.63	0.48	0.43	0.50
Public	0.46	0.50	0.37	0.48	0.57	0.50
Fulltime	0.88	0.32	0.95	0.21	0.80	0.40
Observations	2,542		1,329		1,213	

Table 2 provides some descriptive statistics about the sample. It shows that the mean age in the sample is around 43 years. Out of the sample, 48% are female, and the rest are male. 71% of the respondents are married; the rest are either single, widowed, or divorced. About 89% of the respondents are from the ten marzes of Armenia, only 11% is from the capital city Yerevan. Furthermore, 36% of them are located in rural areas, and 64% live in urban neighborhoods.

Based on the primary duties/occupation, two groups have been created for workers: professionals (43%) who are legislators, senior officials, managers, professionals, technicians professionals, and clerks; and non-professionals (57%) who are service & sales workers, skilled agricultural workers, craftworkers, operators & assemblers and the ones with elementary occupations.

Similar grouping is made for the remaining 20 sectors of the economy. 25% of the respondents work in Industry, which consists of the following sectors: "Mining and Quarrying," "Manufacturing," "Electricity, Gas, Steam and Air Conditioning," "Water Supply, Sewerage, Waste Management, and Remediation Activities" and "Construction." 20% work in Trade and Transportation activities, which are mostly "Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles", "Accommodation and Food Service Activities," and "Transportation and Storage" sectors. A tiny part - 1% works in Finance, which are "Financial and Insurance Activities" and "Real Estate Activities."

A group called Professional consists of "Information and Communication," "Professional, Scientific, and Technical Activities," and "Administrative and Support Service Activities," which are 4% of the sample. Public and Social workers (44% of the sample) are from "Public Administration and Defence; Compulsory Social Security," "Education," and "Human Health and

Social Work Activities." The rest are grouped in Other services - 6% of the sample and they work in the following sectors: "Arts, Entertainment and Recreation," "Other Service Activities," "Activities of Households as Employers; Undifferentiated Goods- and Services- Producing Activities of Households for Own Use" and "Activities of Extraterritorial Organisations and Bodies."

Additionally, 54% of the respondents work for private enterprises or employers, and 46% work in the public sector.

Discussion of Estimations

Extended earnings function results

Table 3 is the short version of Table A-1 in appendix. It shows the OLS regression results of the extended earnings function, which takes into account the level of education, the age (as a substitute for experience) of the individual and all the other factors that might affect earnings. Consequently, several worthy points should be mentioned. First of all, in the basic model the education level is an ordinal variable that shows the effect of an additional level of education on wages. By that means, for all the respondents of the sample, one additional level of education brings, on average, 7% more return on monthly wage, holding the other factors fixed. This estimation makes sense because education increases productivity and hence leads to higher earnings. This rate is a bit low from the world average private rate of return to one extra year of schooling, which is about 9% (Psacharopoulos and Patrinos, 2018). Nonetheless, it is not right to compare the effect of extra years of schooling with extra levels of education, since the latter would

have a bigger effect on earnings. Hence, the return to the extra year of education in Armenia would be even lower than 7%.

An alternative specification has been used to enrich our understanding of the return that separate education levels provide. Model 2 in Table 3 provides such results, where the levels of education are dummy variables with five categories, and the secondary education is the reference group. The OLS shows that vocational education and Ph.D. are statistically insignificant, and F-test showed that they are jointly also insignificant. The number of observations of Ph.D. holders is small, and this could be the reason for the insignificant variable. However, the estimate of the returns to completed Bachelor's degree is 16.4%, and that of Master's degree is 19.7%, which indicates that the marginal benefit of acquiring a Master's degree relative to Bachelor's is 3.3%. The estimates also demonstrate that higher education is bringing significantly higher benefits than secondary education. Khitarishvili (2010) used a similar method and found that the return to completed tertiary education in Georgia in 2004 was 27.5%. Moreno & Patrinos (2020) found that return to tertiary education in Azerbaijan is 38% using 2015 data. Tansel and Bodur (2012) found a rate of 13% for higher education in Turkey using 2002 data. Karatas (2018) estimated a return of 16% to higher education in Turkey for the 2009-2014 period. Newell & Reilly (1999) provide comparative cross-country estimates of returns to education for countries in transitional economies of Central and Eastern Europe, Russia, and the Former Soviet Union countries of Central Asia. Although the results are old, when compared to our findings, Armenia has comparatively higher returns to a university education than those countries.

The variables *age* and *age2* are separately statistically insignificant; however, the *F*-test showed that they are jointly significant at 1%, 5%, and 10% significance levels. Age has a positive effect on wages up to a turning point, which, according to the basic model, is about 27 years. Each

additional year of experience increases the salary by less than the previous year—reflecting a diminishing marginal return to experience. At 27 years, an extra year would actually lower earnings. This is not very realistic, but it is one of the consequences of using a quadratic function to capture a diminishing marginal effect. At some point, the function must reach a maximum and curve downward. The variable will have a more realistic result when calculated for different genders in the next section. Not surprisingly, the variable *male* has a positive sign and a very high value. That shows the huge gender pay gap that exists in the labor market of Armenia. Men, on average, earn 40% more monthly income than women, *ceteris paribus*.

Table 3. Ordinary Least Squares Results (short)

Source Table A-1 in Appendix A

Dependent variable - natural logarithm of monthly wage in AMD

VARIABLES	(1) Basic	(2) Alternative (level dummies)	(3) With interaction terms	(4) With interaction terms
education level	0.0700*** (0.0103)		0.0691*** (0.0104)	0.0691*** (0.0104)
vocational		-0.00349 (0.0260)		
bachelor's		0.164*** (0.0343)		
master's		0.197*** (0.0330)		
phd		0.118 (0.0927)		
age	0.00469 (0.00512)	0.00640 (0.00512)	0.00346 (0.00517)	0.00346 (0.00517)
age2	-8.63e-05 (5.69e-05)	-9.98e-05* (5.68e-05)	-7.65e-05 (5.73e-05)	-7.65e-05 (5.73e-05)
male	0.414*** (0.0208)	0.410*** (0.0209)		
married	-0.00322 (0.0227)	-0.00378 (0.0227)		
marriedmale			0.0532 (0.0357)	0.441*** (0.0233)

marriedfemale			-0.388***	
			(0.0392)	
unmarriedfemale			-0.344***	0.0440
			(0.0381)	(0.0268)
unmarriedmale				0.388***
				(0.0392)
Constant	11.16***	11.21***	11.57***	11.18***
	(0.116)	(0.116)	(0.112)	(0.125)
Observations	2,542	2,542	2,542	2,542
R-squared	0.217	0.223	0.219	0.219

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All the sample's wage records have been balanced for a full time working schedule, assuming part-time workers provide 40 hours contribution per week. The dummy variable *fulltime* shows the wage difference of having a full-time agreement and considering part-time workers as they work full-time. The estimate shows that full-time workers earn 7.4% less from part-time workers if they worked on a full-time basis. Given that, we can infer that the remuneration of full-time workers is underestimated. People would instead choose part-time engagement and gain from spending fewer hours in the workplace. People from the marzes experience, on average, about 13% less monthly earnings than people from Yerevan. This finding is also quite expected, as Yerevan is more advanced in terms of economic development and work opportunities than the rest of the country (Hergnyan, 2016).

The variable *married* in Model 1 Table 3 is statistically insignificant, which means that the marital status has zero effect on wages. An essential limitation of this model is that the effect of being married on wages is assumed to be the same for men and women. So, instead of dropping the insignificant variable, an interaction term has been created that controls for wage differences among four groups: married men, married women, not married men, and not married women. Dummy variables have been defined for each group. By saying not married, we mean single, widowed, or divorced/separated. In Model 3 of Table 3 as a base group, an unmarried male has been selected,

and coefficients of the other dummy variables show the proportionate difference in wage relative to unmarried males.

For example, both married and unmarried females are estimated to earn less than unmarried men, holding the other factors fixed. The difference is even higher with married females; thus, they are earning about 39% less than unmarried males. Unfortunately, the dummy variable married male is statistically insignificant, and it could not be compared to the reference group. We can also estimate the proportionate difference between unmarried and married women, which is $-0.344 - (-0.388) = 0.044$. This means that unmarried women are earning 4.4% more than married women. Model 4 of Table 3 shows the regression output where the base level is a married female, and the coefficient of unmarried women is 0.044, which is exactly what we have calculated above. Also, we see that the rest of the groups are estimated to earn more than a married female. Here we can calculate the wage difference between males, which is about 0.053, suggesting that married men make about 5.3% more than unmarried men. One explanation could be that married men experience more living and family costs which need to be met, hence they are tackling to earn more. All in all, there is a distinct gender discrimination against women when it comes to earnings in Armenia.

Workers in *private* enterprises are earning more than in public ownership, and the difference is about 7.2%. In the world, the variations between public and private sector wages vary from country to country (Christofides, & Michael, 2013). The variable *professionals* estimates that people who possess professional occupations naturally are earning more than the ones with non-professional and somewhat elementary occupations. As for the sectors of the economy, as a reference category, the *public and social sector* has been taken, which makes up 44% of the sample. The estimates show that except for industrial sector workers, the rest of the workers, including trend

and transportation, finance, professional and other services’ workers are earning less than the public and social employees. However, the purpose of this study is to find the return on education, and we would rather estimate that for workers depending on the sector, occupation, and other factors, than simply estimate the wage difference. Further discussion will follow on this.

Return to Education by Gender, Sector and Occupation

To better understand the economic return on education, additional OLS regressions have been run using the developed basic model. Table 4 provides a nice summary of the returns to an extra level of education in different scenarios.

Table 4. Returns to an additional level of education by gender, sector and occupation (percent)

	All	Male	Female	Private	Public	Professional	Non-professional
Education level	7.0	3.08	11.6	5.84	8.97	10.2	3.2

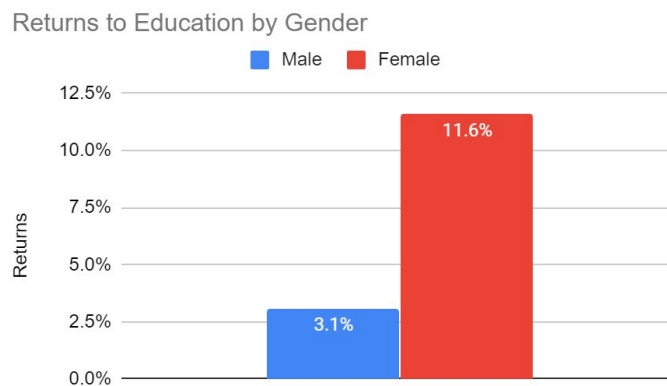
Source: see Appendix A, Table A-2

Gender

The same model has been estimated for different genders. Females’ education tends to generate more returns on one additional level of education, about 11.6%. Whereas, males only see 3.08% of return on education. The returns to female education are higher, with around eight percentage points. A similar pattern has been discovered by Hakobyan and Joulfaian (2016), which

was the only study available for Armenia. Globally, the average return on education for women is also higher than for men. Taking into account that the mean monthly earnings of women are 85,565 AMD and that of men is 125,075 AMD, the higher return to female education does not imply higher earnings for them. One conjecture to this finding could be that men are earning more with less education, and higher education is not a determinant for higher wages for them, which minimizes the return on additional levels of male education. As a result, the estimated returns to schooling are higher for females than for men. Similar explanations on the return to education for women and men can be found in Schultz (1995). In addition, Dougherty (2005) claims that there is a link between higher returns of females and the gap between male and female log wages, and the deficiency is negatively associated with schooling. Due to this, schooling reduces the gap in male and female earnings, which are the result of factors such as discrimination, tastes, and circumstances.

Figure 1. Returns by Gender

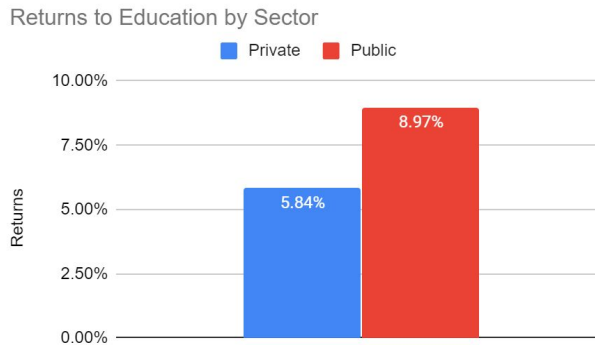


Private/Public sector

Returns to education differ depending on the sector of employment - public and private. In contrast to findings of Psacharopoulos (1995) and Psacharopoulos and Patrinos (2018), in Armenia, the returns for those working in the public sector are higher than for those who work in the private

sector. There is a noticeable three percent difference in the returns (see Figure 2). Even though the mean wages in the public sector are lower than that of the private sector, the return to education is considered to be a competitive advantage for people employed in the public sector. In other words, for getting a job in the public sector, one must have specific skills and qualifications which are not a burden for working in the private sector. Hence, an additional level of education would have a higher yield if one works in a public enterprise.

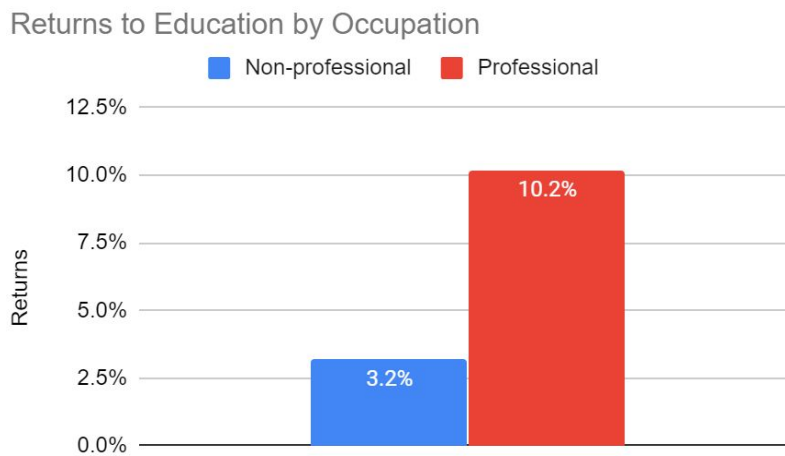
Figure 2. Returns by Sector



Occupation

Another estimate from the summary of Table 4 is the difference in returns depending on the occupation. To recall professionals were defined to be legislators, senior officials, managers, professionals, technicians, and clerks; and non-professionals were service & sales workers, skilled agricultural workers, craft workers, operators & assemblers, and the ones with elementary occupations. Not surprisingly, the ones with professional roles yield more on education than the ones with elementary or non-professional occupations. In this case, professional workers are benefiting more from their education than non-professionals, and maybe this is the reason for such difference in returns.

Figure 3. Returns by Occupation

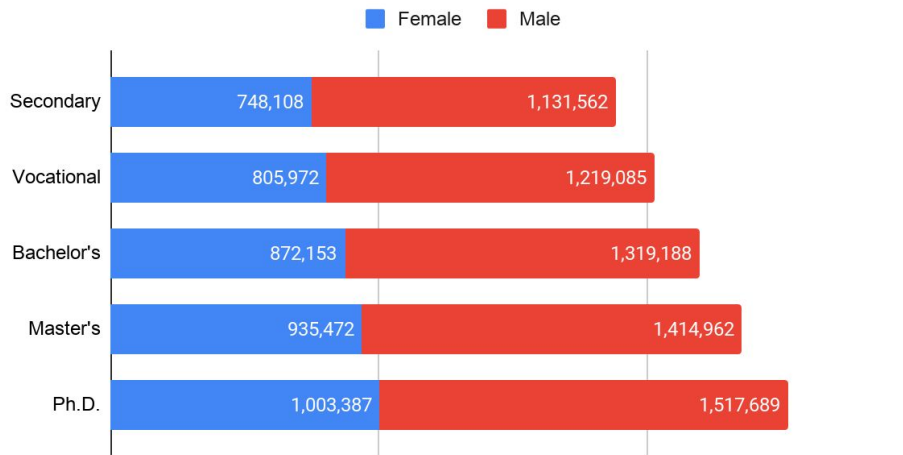


Discounting approach results

Based on the predictions of the basic Mincerian earnings function model discussed above, a full discounting method has been applied for estimating the internal rate of return (IRR) of individuals who acquired higher education. For doing this, ten conditional scenarios have been considered. Gender and the five levels of education are the main distinguishing factors while conducting predictions. Figure 4 gives the predicted average earnings for ten years, depending on the education level and gender.

Figure 4. Predicted Earnings for 10 years

Predicted Mean Earnings for 10 years in AMD



It is worth mentioning that the forecasts for the ones with secondary education have been estimated for ages 18-28 because of entering a job market immediately after leaving school. Whereas for those with vocational education, the age conditions are defined as 19-29, and for higher education graduates 21-31.

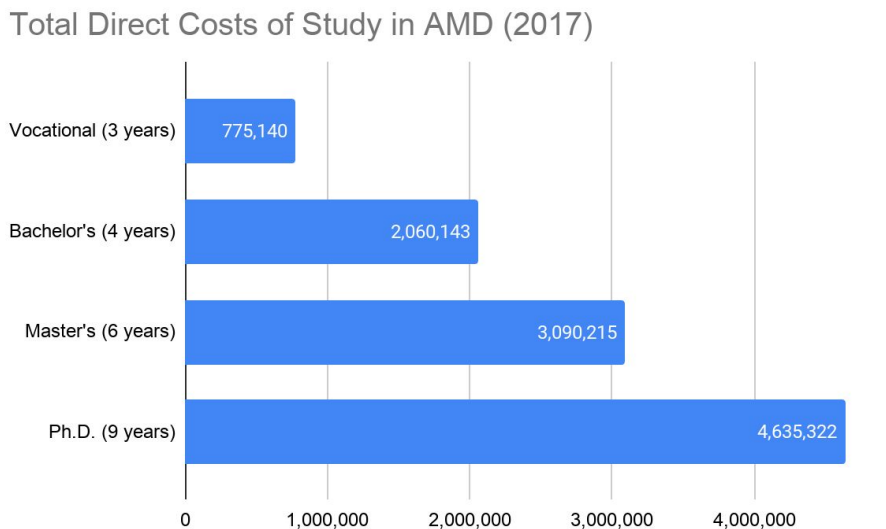
Regarding the costs of acquiring vocational and higher education, the annual average tuition costs have been calculated using the data provided by the Statistical Committee of Armenia¹². Based on the calculations, on average, a single student in Armenia is annually spending about 430,000 AMD on higher education and 185,000 AMD on vocational education. As for the other expenses, due to a lack of available figures, 20% of tuition fee has been assumed for higher education and 40% for vocational education. Summing up, we are getting 515,000 AMD and 258,000 AMD direct costs of higher education and vocational education. This is about 2,060,143

¹ https://www.armstat.am/file/article/soc_vich_2017_6.pdf

² https://armstat.am/file/article/soc_vich_2018_5.pdf

AMD for the full four-year university cycle, and 775, 000AMD for three years of vocational education. Four years of higher education is for the attainment of Bachelor’s degree, whereas the Master’s and Ph.D. holders are

Figure 5. Direct Costs of Studying



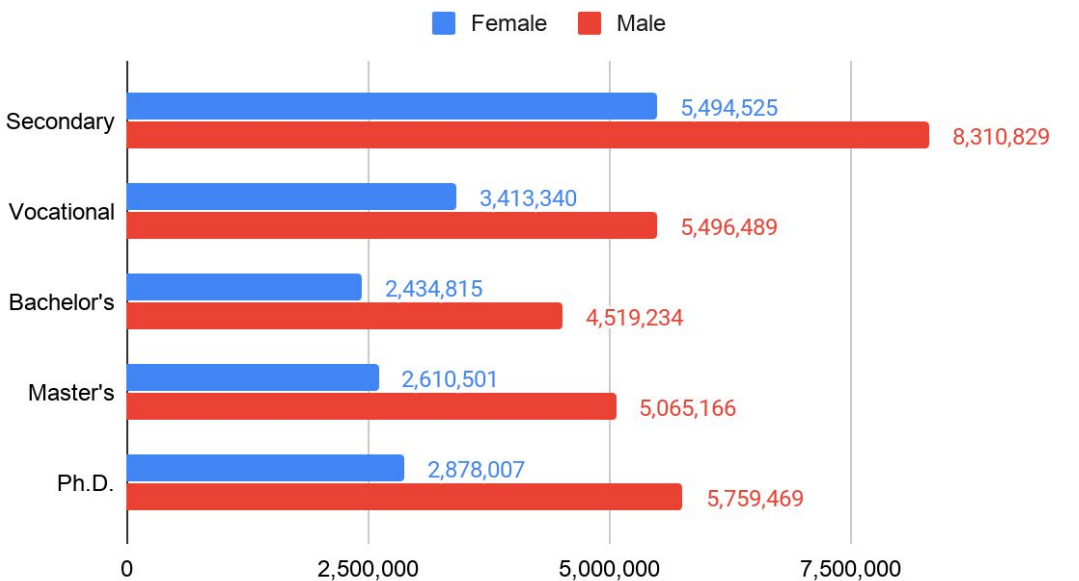
assumed to spend 6 and 9 cumulative years on their studies, correspondingly. Hence the higher education costs are much higher for those people (see Figure 5 above). Three years of foregone earnings have been assumed for vocational education and four years for all higher education levels. Students usually start working while acquiring Master’s and Ph.D. studies; that is why foregone earnings for these levels is also assumed to be four years - the foregone earnings during Bachelor studies.

Figure 6 shows the results of the NPV estimates for each scenario, and all have a positive net present value. As a discount rate, the refinancing rate defined by CBA has been taken, which was 6% in 2017. Obviously, people with non-higher education have higher NPV because of the

absence of initial investment costs. Vocational education also has comparatively higher NPV because of the lower tuition fees of the institutions. When it comes to higher education, the NPV seems to increase with an extra qualification earned.

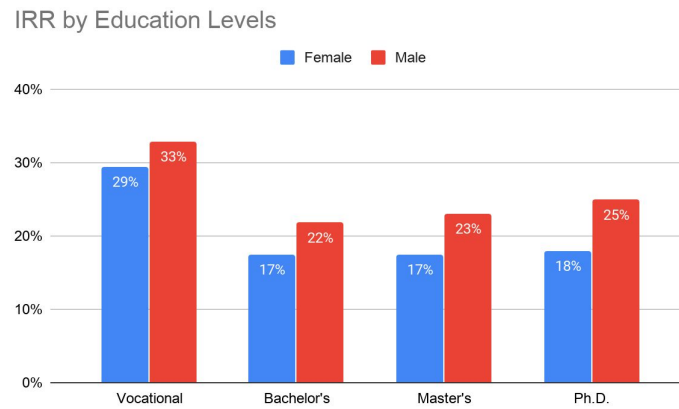
Figure 6. Net Present Value with Scenarios

NPV by the Level of Education (in AMD)



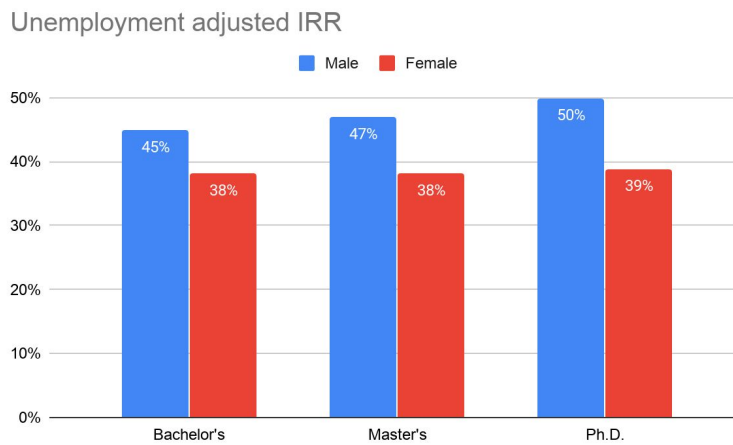
As Figure 7 shows, the rate of return on higher education is much higher than the rates generated via the Mincerian equation. Furthermore, men experience higher IRR than women. Vocational education has the highest internal rate of return, which is again because of the smaller investment costs and the short length of the study. For females, the IRR of Bachelor's and Master's degrees is the same - 17%. This indicates that an additional qualification does not increase the profitability of women's education. However, the IRR of Ph.D. holders is greater - 18%. Men proved to gain more from investment in their education. The difference between the IRR of the Ph.D. qualification of both genders is 7%.

Figure 7. Internal rate of return of each education level



It is important to note that people with higher education have a higher probability of being employed. Many studies in the literature also consider the unemployment effect on earnings while conducting NPV/IRR analysis (Fuente & Jimeno, 2005). This being said, an additional calculation has been undertaken to capture the unemployment effect and to adjust the estimated returns of the

Figure 8. Unemployment adjusted IRR



ones with higher education. As of the year 2018, the unemployment rate in Armenia was 17.5% that has been used for adjusting the earnings of higher education graduates (1 minus unemployment rate). The adjusted internal rate of return is significantly higher than the unadjusted return (see Figure 8).

Conclusion

The paper was aimed to measure the economic internal rate of return of education, using 2018 household survey data. The OLS estimates of earnings function showed that an acquired extra level of education increases an individual's earnings by 7%. In addition, women experience higher returns to their education, which is in line with what has been found in global literature. This could imply that for women education plays a key role in the wage increase, while men may earn more with less education. Education yields higher returns in the public sector than in the private sector - there is an obvious 3% difference. The finding might indicate the competitive advantage of more educated people in the public sector. Professional roles yield more on education than the elementary or non-professional occupations. In this case, professional workers are benefiting more from their education than non-professionals. Those estimates do not consider the costs of studying and are the result of the earnings function regression.

After taking into account the costs of study and applying the full discount approach, we found that returns are the highest at the vocational level. Costs of vocational education are comparably lower than that of university education. Even though the earning benefits of university graduates are higher than vocational education graduates, the cost advantage of vocational education makes it more profitable from investment and financial point of view. As of year 2019, there are 96 middle vocational educational and 47 preliminary vocational institutions in Armenia. In 2019 there have been in total 10,884 entrants in vocational institutions. The statistics show that in the last five years there was a slight decrease in the number of applicants in vocational institutions. There is still a need to improve the quality of vocational education and raise the

attractiveness of vocational schooling among students. It would be even better to increase the allocated seats of the state order training entrants of the occupations that are demanded mostly in the labor market.

Taking into account that many unobserved factors are related to educational attainment and earnings, the OLS estimates might be subject to potential bias, which is one challenge and limitation of this analysis. As a further prospect of research, it is recommended to control factors, such as individual cognitive ability, motivation, and family background, that could be endogenously related to education.

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Appendix A

Table A-1. Ordinary Least Squares Results

Dependent variable - natural logarithm of monthly wage in AMD

VARIABLES	(1) Basic	(2) Alternative (level dummies)	(3) With interaction terms	(4) With interaction terms
education level	0.0700*** (0.0103)		0.0691*** (0.0104)	0.0691*** (0.0104)
vocational		-0.00349 (0.0260)		
bachelor		0.164*** (0.0343)		
masters		0.197*** (0.0330)		
phd		0.118 (0.0927)		
age	0.00469 (0.00512)	0.00640 (0.00512)	0.00346 (0.00517)	0.00346 (0.00517)
age2	-8.63e-05 (5.69e-05)	-9.98e-05* (5.68e-05)	-7.65e-05 (5.73e-05)	-7.65e-05 (5.73e-05)
male	0.414*** (0.0208)	0.410*** (0.0209)		
married	-0.00322 (0.0227)	-0.00378 (0.0227)		
region	-0.132*** (0.0312)	-0.129*** (0.0313)	-0.132*** (0.0312)	-0.132*** (0.0312)
urban	-0.0479** (0.0196)	-0.0431** (0.0197)	-0.0488** (0.0196)	-0.0488** (0.0196)
fulltime	-0.0736** (0.0343)	-0.0718** (0.0342)	-0.0748** (0.0342)	-0.0748** (0.0342)
private	0.0715** (0.0347)	0.0742** (0.0346)	0.0691** (0.0348)	0.0691** (0.0348)
professionals	0.106*** (0.0241)	0.105*** (0.0249)	0.108*** (0.0242)	0.108*** (0.0242)
industry	0.0718* (0.0392)	0.0667* (0.0392)	0.0718* (0.0392)	0.0718* (0.0392)
trade & transportation	-0.0817** (0.0377)	-0.0865** (0.0376)	-0.0832** (0.0378)	-0.0832** (0.0378)
finance	-0.0222 (0.0739)	-0.0252 (0.0715)	-0.0222 (0.0740)	-0.0222 (0.0740)
other services	-0.130***	-0.133***	-0.134***	-0.134***

	(0.0480)	(0.0480)	(0.0482)	(0.0482)
professional	-0.0906	-0.0972	-0.0921	-0.0921
	(0.0603)	(0.0602)	(0.0604)	(0.0604)
marriedmale			0.0532	0.441***
			(0.0357)	(0.0233)
marriedfemale			-0.388***	
			(0.0392)	
unmarriedfemale			-0.344***	0.0440
			(0.0381)	(0.0268)
unmarriedmale				0.388***
				(0.0392)
Constant	11.16***	11.21***	11.57***	11.18***
	(0.116)	(0.116)	(0.112)	(0.125)
Observations	2,542	2,542	2,542	2,542
R-squared	0.217	0.223	0.219	0.219

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A-2: Return to an Additional Level of Education by Gender, Sector and Occupation

Dependent variable - natural logarithm of monthly wage in AMD

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1 All	Model 2 Male	Model 3 Female	Model 4 Private	Model 5 Public	Model 6 Professional	Model 7 Non-professional
education level	0.0700***	0.0308**	0.116***	0.0584***	0.0897***	0.102***	0.0320**
	(0.0103)	(0.0145)	(0.0149)	(0.0146)	(0.0143)	(0.0146)	(0.0144)
age	0.00469	0.0105	-0.000327	0.0123*	-0.00458	-0.00575	0.0181***
	(0.00512)	(0.00760)	(0.00699)	(0.00713)	(0.00732)	(0.00745)	(0.00667)
age2	-8.63e-05	-0.000186**	4.36e-06	-0.000170**	1.40e-05	6.17e-05	-0.000262***
	(5.69e-05)	(8.32e-05)	(7.79e-05)	(8.11e-05)	(7.96e-05)	(8.23e-05)	(7.40e-05)
male	0.414***			0.374***	0.409***	0.401***	0.389***
	(0.0208)			(0.0304)	(0.0284)	(0.0308)	(0.0300)
married	-0.00322	0.0727*	-0.0354	0.0550	-0.0485*	-0.0379	0.0386
	(0.0227)	(0.0398)	(0.0273)	(0.0337)	(0.0289)	(0.0330)	(0.0311)
region	-0.132***	-0.0627	-0.179***	-0.122***	-0.149***	-0.128***	-0.0846**
	(0.0312)	(0.0463)	(0.0405)	(0.0402)	(0.0450)	(0.0431)	(0.0429)
urban	-0.0479**	-0.0443	-0.0501*	-0.117***	0.0229	-0.000955	-0.0716***
	(0.0196)	(0.0276)	(0.0273)	(0.0301)	(0.0244)	(0.0292)	(0.0263)
fulltime	-0.0736**	0.116	-0.138***	0.0954	-0.185***	-0.199***	0.138**
	(0.0343)	(0.0792)	(0.0357)	(0.0661)	(0.0348)	(0.0364)	(0.0668)

private	0.0715** (0.0347)	0.0887* (0.0488)	0.0571 (0.0475)			0.0394 (0.0510)	0.0739 (0.0451)
professionals	0.106*** (0.0241)	0.185*** (0.0348)	0.0460 (0.0331)	0.196*** (0.0350)	0.0270 (0.0336)		
industry	0.0718* (0.0392)	0.0602 (0.0548)	0.0974* (0.0572)	0.204*** (0.0629)	0.187 (0.119)	0.189*** (0.0603)	0.0337 (0.0503)
trade & transportation	-0.0817** (0.0377)	-0.0768 (0.0548)	-0.0706 (0.0492)	0.0705 (0.0636)	-0.180*** (0.0430)	0.0426 (0.0586)	-0.114** (0.0489)
finance	-0.0222 (0.0739)	-0.136 (0.104)	0.131 (0.102)	0.0840 (0.0949)	-0.104 (0.184)	0.152 (0.0974)	-0.179 (0.110)
other services	-0.130*** (0.0480)	-0.163** (0.0695)	-0.0676 (0.0678)	0.0894 (0.0860)	-0.284*** (0.0450)	-0.202*** (0.0582)	-0.0766 (0.0689)
professional	-0.0906 (0.0603)	-0.176* (0.0936)	0.0248 (0.0728)	0.0730 (0.0939)	-0.190** (0.0743)	-0.000778 (0.0743)	-0.233** (0.101)
Constant	11.16*** (0.116)	11.27*** (0.170)	11.22*** (0.158)	10.81*** (0.171)	11.47*** (0.170)	11.40*** (0.169)	10.78*** (0.156)
Observations	2,542	1,329	1,213	1,366	1,176	1,097	1,445
R-squared	0.217	0.085	0.157	0.218	0.269	0.256	0.231

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A-3: VIF output

Variable	VIF	1/VIF
age	61.35	0.016299
age2	59.55	0.016792
edulevel	1.73	0.579658
private	3.77	0.265229
gender	1.27	0.789393
married	1.27	0.790335
professionals	2	0.498895
region	1.14	0.874146
urban	1.12	0.896795
industry	3.71	0.269823
tradetrans~n	3.01	0.33274
otherservi~s	1.45	0.690876
professional	1.32	0.75883

finance	1.12	0.890365
fulltime	1.09	0.914625
Mean VIF	9.66	

Table A-4: Correlation matrix

	lnwage	edulevel	age	age2	gender	married	region	urban	fulltime	private	professionals	industry	tradetrans	finance	others	professional
lnwage	1.00															
edulevel	0.15	1.00														
age	-0.12	0.03	1.00													
age2	-0.12	0.03	0.99	1.00												
gender	0.37	-0.16	-0.12	-0.11	1.00											
married	0.04	-0.01	0.27	0.23	0.14	1.00										
region	-0.07	-0.15	-0.04	-0.05	0.07	0.08	1.00									
urban	-0.05	0.11	0.10	0.10	-0.11	-0.02	-0.27	1.00								
fulltime	0.03	-0.11	-0.01	-0.01	0.23	0.03	0.05	-0.01	1.00							
private	0.07	-0.28	-0.05	-0.04	0.20	-0.03	-0.11	0.08	0.12	1.00						
professionals	0.06	0.63	0.02	0.02	-0.29	-0.01	-0.10	0.08	-0.18	-0.39	1.00					
industry	0.15	-0.19	0.04	0.04	0.24	0.08	0.04	-0.02	0.13	0.51	-0.30	1.00				
tradetrans	-0.07	-0.18	-0.03	-0.03	0.05	-0.06	-0.05	0.01	0.08	0.39	-0.22	-0.28	1.00			
finance	0.01	0.05	-0.04	-0.03	0.00	0.02	0.03	0.03	0.03	0.07	0.05	-0.06	-0.05	1.00		
others	-0.07	-0.06	-0.03	-0.02	-0.02	-0.06	-0.06	0.02	-0.07	0.09	-0.05	-0.15	-0.13	-0.03	1.00	
professional	0.01	0.08	-0.01	0.00	0.00	-0.04	-0.12	0.09	0.01	0.08	0.14	-0.12	-0.10	-0.02	-0.05	1.00

Appendix B

Figure B-1: Number of Entrants to Middle Vocational Education

Middle Vocational Education by indicators and years

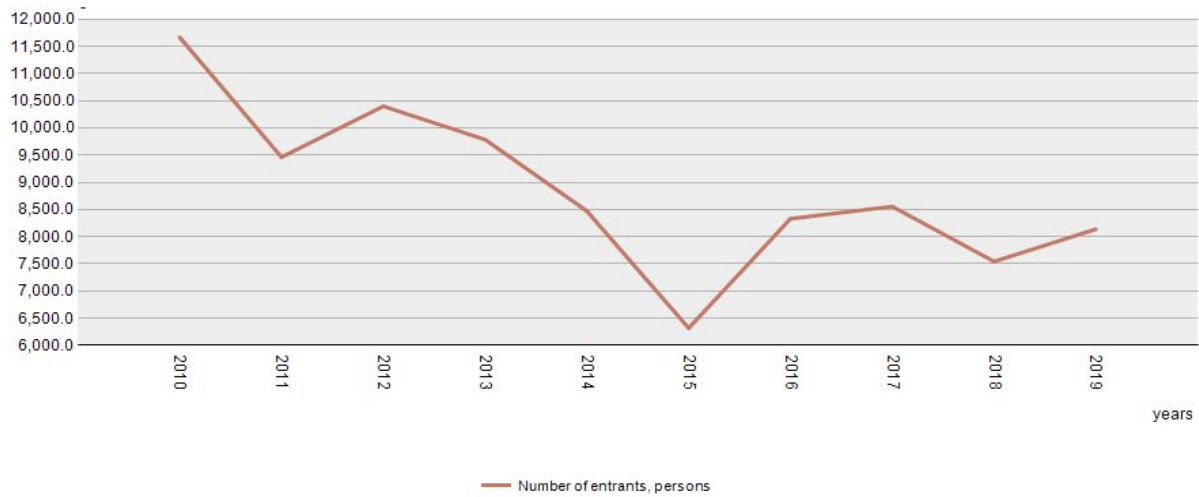
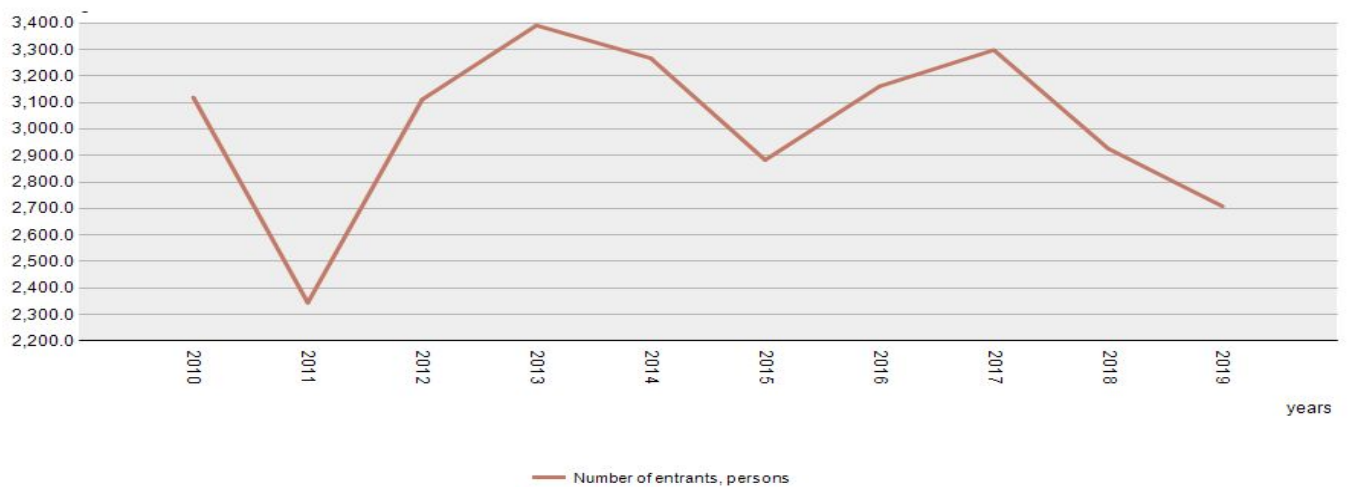


Figure B-2: Number of Entrants to Preliminary Vocational Education

Preliminary Vocational Education by indicators and years



Source: Statistical Committee of the Republic of Armenia