

## ASSESSING THE ECONOMIC INTERNAL RATE OF RETURN OF EDUCATION\*

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**Abstract** – This paper estimates the internal rate of return on education in Armenia using the 2018 Labor Force Survey data. The extended earning function regression shows that an extra level of education brings about a seven percent return. In line with the literature, women have a higher return on an additional education level 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 those with elementary and less professional careers. The developed model is used to generate wage profiles reflecting on education level and gender. When considering the cost of education and predicted earnings, the full discounting analysis shows 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.  
**JEL Classification:** G12, E43, E44, E58

### 1. INTRODUCTION

The presence of qualified human capital is an essential factor for the development of a particular economy. According to the human capital theory, education is one type of investment, and acquired knowledge can contribute to workers' productivity and efficiency (Becker 1964; Mincer 1974). Measuring the rate of return in education helps decide whether to invest in education or elsewhere.

The rate of return on education has been a subject for consideration for economists since the second half of the previous century (Psacharopoulos and Patrinos, 2002). It is a widely used measure for policymakers to gauge education's profitability 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.

The assessment of the economic internal rate of return of education for Armenia is the primary focus of this paper. In Armenia, public spending on higher education is limited because of the tight government budget; higher education institutions primarily depend on tuition fees for support. With this in mind, I concentrate on estimating the private rate of return taking into account only individual contributions to education.

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The analysis employs the extended version of the earnings function developed by Jacob Mincer (Mincer, 1974). In addition to age and education level, other individual characteristics are also accounted for in the regression model. The generated wage profiles of individuals with different levels of education and gender are then 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 education level increases the mean earnings by 7 percent. We find women have a higher return to education than men. Similarly, public sector workers experience higher returns to education than workers in the private sector. And those in professional occupations gain more from additional levels of education than those in less professional careers. 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 than 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 significantly contribute 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 decide how much money to invest in one's 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.

## 2. LITERATURE REVIEW

In the 1960s, economists began to view education expenditures as investments that build human capital (Schultz, 1961; Becker, 1964). And since it is considered as an investment, this raised the need to measure its profitability. One of the early developed ways of measuring 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 determine the rate of return to varying levels of schooling (Psacharopoulos 1995).

Psacharopoulos (1995) differentiates two distinct types of return to education. The first is the private rate of return, which shows the demand for education from the society's point of view and accounts for individual expenditures on education. The 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. They 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 relatively constant over the decades. 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 those working in the public sector. Both the earning function and discounting method are applied, but finally, the complete discounting approach is recommended because of its relevance over the Mincerian function.

The return to education has been estimated in different parts of the world. Romele (2013) estimated the internal rate of return (IRR) to education in Latvia using the OECD methodology 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, Netherlands, Norway, Sweden, and United Kingdom, the private rate of return is below 10 percent. The latter is not an indicator of investment inefficiency but somewhat 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 by specialty. Medicine, Law, Economics, and Social Sciences provide the highest private return to education. In contrast, fields like Art, Agriculture, Language, and Culture studies seem to be less profitable. A similar pattern also exists in other developed countries according to Gunderson and Oreopolous (2020). When it comes to gender, the subject choice of two genders is segregated. 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 respondents' earnings profiles, using these findings in the IRR calculation.

For Finland, Uusitalo (1999) estimated the rate of return of education 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 test scores and family background significantly impact 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 or/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 identical twins' studies. 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 education increases at low education levels and decreases at higher education levels. 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 for 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).

Using data for different countries, Harmon, Oosterbeek, and Walker (2003) provide evidence that education has a clear positive impact on earnings. Moreover, the return to schooling is 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 new technology and more active political and community involvement by the population (Sianesi and Van Reenen, 2002).

I next highlight several studies that focus on neighboring Caucasian countries. Botchorishvili (2007) and Khitarishvili (2010) estimated the return to education in Georgia. Both studies calculated the return to education using OLS estimates of 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. In addition to the OLS and Sample Selection Model, Khitarishvili (2010) also uses the Instrumental Variables (IV) approach. Using OLS, Botchorishvili (2007) found that in 2006 the return to an additional year of education was 6.9 percent. But applying a similar methodology, Khitarishvili (2010) found a rate of 2.8 percent for 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 percent, and in 2002 it is 7.6 percent. They conducted the same estimation with the education categories and found out that university education provides the highest return - around 11 percent. 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 Turkey's return to education using 2017 household survey data. The OLS estimates showed that an extra year of education results in an 8.8 percent return. The discounting method suggested the lowest returns to secondary education, while higher education provided the highest yield; 15.8 percent private and 10.4 percent 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 the return to schooling in Azerbaijan is 6 percent. In comparison, the discounting approach provided a private internal rate of return of 9 percent and a social return of 8 percent to tertiary education.

As to Armenia, the literature on rates of return to education is scant. 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 is employed in their estimates. The results show that the overall average rate of return to an additional year of schooling is 3.24 percent. The rate is higher for females (3.5 percent) and slightly lower for males (2.95 percent). 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.

## 3. METHODOLOGY

**3.1. 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). Reflecting on data availability, the following Mincerian wage function is estimated:

$$(1) \quad \ln wage = \beta_0 + \beta_1 edulevel + \beta_2 age + \beta_3 age^2 + \beta_4 X + u$$

where,  $\ln wage$  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 latter's data unavailability. As in the original Mincerian equation, we also adding a quadratic term of age because of the expected diminishing returns. In this model,  $\beta_1$  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, etc. The estimates resulting from this model would probably be biased because of the omission of unobserved factors like ability and motivation, which may affect wages. The available dataset does not allow to control of those factors; hence the estimates might be biased.

After fitting the expanded Mincerian equation, the earning profiles are estimated for all education levels. These estimates are used as input parameters for the IRR analysis. The IRR is the discount rate ( $r$ ), which equalizes the stream of discounted benefits to the costs. The costs of education include the foregone 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 compare the rates and see how benefits vary with education levels. The following discounting cash-flow formula is employed for the IRR estimation:

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

where,  $W_t$  is the earnings of an individual, which will be estimated for all education levels 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. Ten 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.

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	

3.2. **Data.** I employ the 2018 Armenia Labour Force Survey which is the latest available from the Statistical Committee of Armenia. This survey is an anonymized micro database that is well suited for this research. 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 those who reported wages, the sample size decreased to 2,542 observations. Table 1 shows that 36 percent of the respondents have completed secondary education. Nearly 30 percent have a vocational or secondary-specialized education as a part of vocational education. As for the higher education graduates, 15 percent have a Bachelor's degree. Nineteen percent 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 tiny portion of the respondents acquired postgraduate qualification - nearly 0.7 percent.

Most of the respondents reported their monthly earnings; however, the data were normalized to monthly full-time equivalent payments for those reporting periodic wages. Also, respondents from the Agriculture, Forestry, and Fishing sector are dropped from the sample. The reported 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 percent) 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 these transformations, we discover that the average monthly salary of those 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 provides some descriptive statistics about the sample. It shows that the mean age in the sample is around 43 years, with 48 percent female. Seventy-one percent of the respondents are married; the rest are either single, widowed, or divorced. About 89 percent of the respondents are from the ten marzes of Armenia, with only 11 percent from Yerevan, the capital city.

TABLE 2. Descriptive statistics

VARIABLES	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	

Furthermore, 36 percent are from rural areas and 64 percent urban. Based on the primary duties/occupation, two groups are created for workers: professionals (43 percent) who are legislators, senior officials, managers, professionals, technicians professionals, and clerks; and non-professionals (57 percent) who are service & sales workers, skilled agricultural workers, craft workers, operators & assemblers and the ones with elementary occupations.

A similar grouping is made for the remaining 20 sectors of the economy. Twenty-five percent 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." Twenty percent 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 percent works in Finance, which includes "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 percent of the sample. Public and Social workers (44 percent of the sample) are from "Public Administration and Defense; Compulsory Social Security," "Education," and "Human Health and Social Work Activities." The rest are

grouped in the "Other Services" category and represent about six percent of the sample. This group includes the "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 percent of the respondents work for private enterprises or employers, and 46 percent work in the public sector.

#### 4. DISCUSSION OF ESTIMATIONS

**4.1. Extended earnings function results.** Table 3 is the short version of Table A-1 in the appendix. It shows the OLS regression results of the extended earnings function, which considers 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. One additional level of education brings, on average, a 7 percent increase in monthly wages, 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 of 9 percent for one extra year of schooling (Psacharopoulos and Patrinos, 2018). Nonetheless, it is not proper to compare the effect of extra years of education with extra levels of education since the latter would have a bigger impact on earnings. Hence, the return to the extra year of education in Armenia would be lower than 7 percent.

An alternative specification has been used to enrich our understanding of the return that different 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 the F-test showed that they are jointly also insignificant. The number of observations of Ph.D. holders is small, which could be the reason for the insignificant estimate. However, the estimate of the returns to completed Bachelor's degree is 16.4 percent, while that of Master's degree is 19.7 percent. These indicate that the marginal benefit of acquiring a Master's degree relative to a Bachelor's is 3.3 percent. 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 percent. Moreno & Patrinos (2020) found that return to tertiary education in Azerbaijan is 38 percent using 2015 data. Tansel and Bodur (2012) found a rate of 13 percent for higher education in Turkey using 2002 data. Karatas (2018) estimated a return of 16 percent 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 percent, 5 percent, and 10 percent 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 lower earnings. But this is not very realistic and is a consequence 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 large gender pay gap that exists in the labor market of Armenia. Men, on average, earn 40 percent more monthly income than women, *ceteris paribus*.

Reported wages have been adjusted to reflect full-time work schedule, assuming part-time workers contribute 40 hours 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 percent less than part-time workers if they worked on a full-time basis. From this, 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 percent less monthly earnings than people from Yerevan. This finding is also reasonably expected, as Yerevan is more advanced in 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 marital status has zero effect on wages. An important 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 are defined for each group. Not married, includes single, widowed, or divorced/separated. In Model 3 of Table 3, as a base group, an unmarried male has been selected. The 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 other factors fixed. The difference is even higher with married females; thus, they make about 39 percent less than unmarried males. Unfortunately, the dummy variable *married male* is statistically insignificant.

TABLE 3. Ordinary Least Squares Results (short)

	(1)	(2)	(3)	(4)
VARIABLES	Basic	Alternative (level dummies)	With interaction terms	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*** (0.0381)	0.0440 (0.0268)
unmarriedmale				0.388*** (0.0392)
Constant	11.16*** (0.116)	11.21*** (0.116)	11.57*** (0.112)	11.18*** (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				

We can also estimate the proportionate difference between unmarried and married women, which is  $-0.344 - (-0.388) = 0.044$ . This suggests that unmarried women earn 4.4 percent more than married women. Model 4 of Table 3 shows the regression estimates where the base level is a married female, and the coefficient of unmarried women is 0.044, which is precisely 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 percent more than unmarried men. One explanation could be that married men experience more living and family costs. Hence they are driven to earn more. All in all, there is distinct gender discrimination against women when it comes to earnings in Armenia.

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							

Workers in private enterprises earn more than in public ownership, and the difference is about 7.2 percent. In the world, the variations between public and private sector wages vary from country to country (Christofides and Michael, 2013). The variable Professionals estimates that people who possess professional occupations are naturally earning more than those with non-professional and somewhat elementary occupations. As for employment in various sectors of the economy, the estimates show that except for industrial sector workers, the rest of the workers, including trade and transportation, finance, professional and other 'services' workers, earn less than the public and social employees. However, the purpose of this study is to find the return on education, and we would instead estimate that for workers depending on the sector, occupation, and other factors, then simply calculate the wage difference. Further discussion follows below.

**4.2. Return to Education by Gender, Sector and Occupation.** Additional OLS regressions are estimated using the developed basic model to better understand the economic return on education. Table 4 provides a nice summary of the returns to an extra level of education in different scenarios.

**4.2.1. Gender.** The same model is estimated for different genders. 'Females' education tends to generate more returns on one additional level of education, about 11.6 percent. Whereas males only see 3.08 percent of return on education. The returns to female education are higher, with around eight percentage points. Hakobyan and Joulfaian (2016) report a similar pattern, which is the only study available for Armenia. Globally, the average return on education for women is also higher than for men. Considering that women's mean monthly earnings is 85,565 AMD, and that of men is 125,075 AMD, the higher return to female education does not imply higher earnings. One conjecture to this finding could be that men are earning more with less education. Higher education is not a determinant for higher wages for them, which minimizes the return on additional male education levels. As a result, the estimated returns to schooling are higher for females than for men. A similar explanation for the return to education for women and men can be found in Schultz (1995). Also, Dougherty (2005) claims 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, education reduces the gap in male and female earnings, resulting from discrimination, tastes, and circumstances.

**4.2.2. Private/Public sector.** Returns to education differ depending on the sector of employment - public and private. In contrast to Psacharopoulos (1995) and Psacharopoulos and Patrinos (2018), the returns for

FIGURE 1. Returns to an additional level of education by Gender

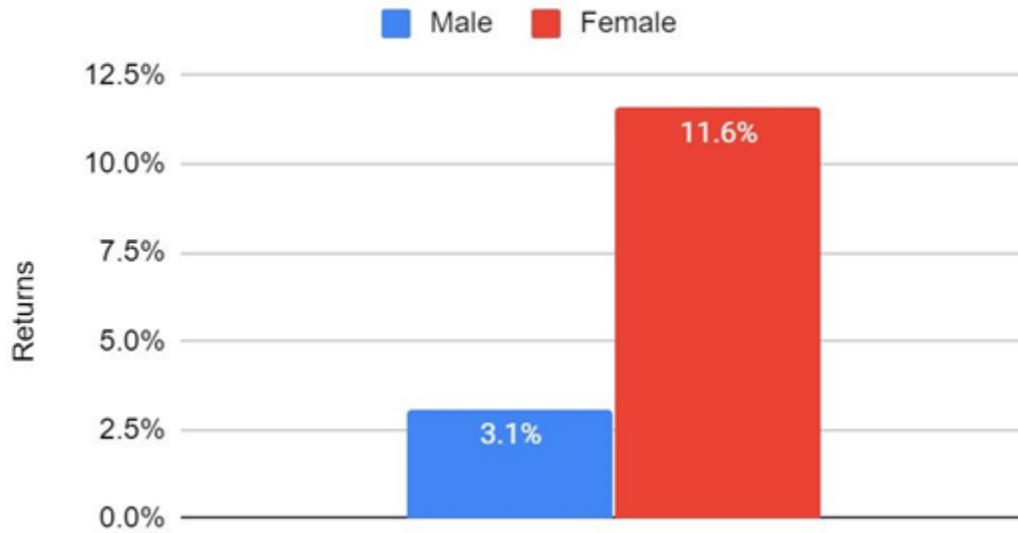
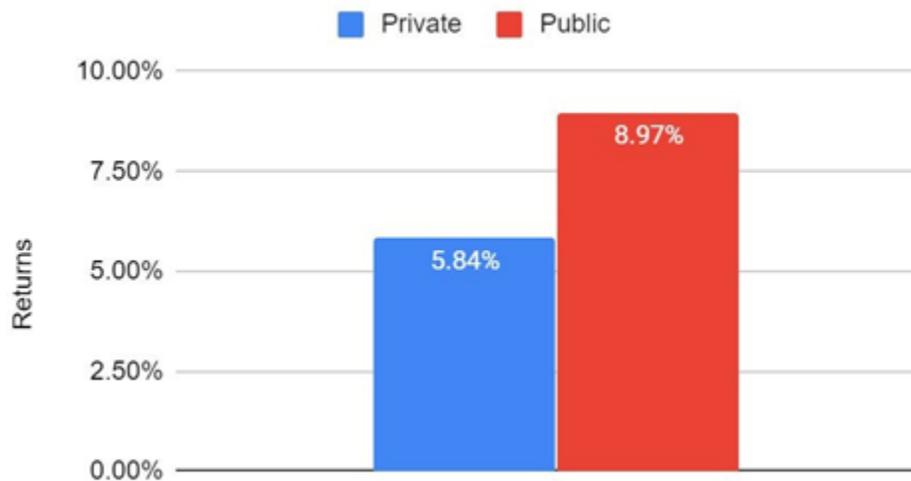
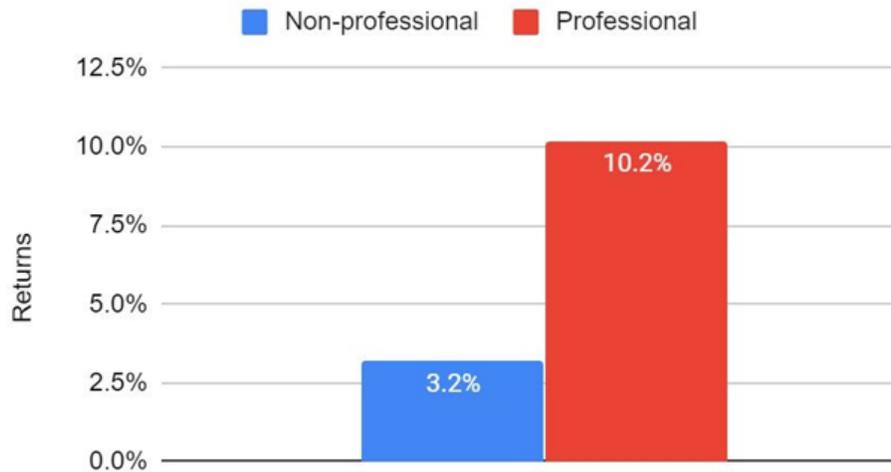


FIGURE 2. Returns to an additional level of education by Sector



those employed in the public sector are higher than those 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 those of the private sector, the return to education is considered 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 education level would have a higher yield if one works in a public enterprise.

FIGURE 3. Returns to an additional level of education by Occupation



4.2.3. *Occupation.* Another estimate from the summary of Table 4 is the difference in returns depending on the occupation. Recall professionals are defined to include legislators, senior officials, managers, professionals, technicians, and clerks, and that non-professionals include service & sales workers, skilled agricultural workers, craft workers, operators and assemblers, and those with elementary occupations. Not surprisingly, the return for professional roles is greater than those in elementary or non-professional occupations. In this case, professional workers benefit more from their education than non-professionals, and maybe this is the reason for such difference in returns.

4.3. **Discounting approach results.** Based on the predictions of the basic Mincerian earnings function model discussed above, a complete discounting method has been employed in estimating the internal rate of return (IRR) of individuals who acquired higher education. For doing this, ten conditional scenarios are 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.

It is worth mentioning that the forecasts for those with secondary education have been estimated for ages 18-28, assuming entering the job market immediately after leaving school. For those with vocational education, the age group is defined as 19-29, and for higher education graduates, 21-31.

As to the cost of acquiring vocational and higher education, the annual average tuition costs have been calculated using the data provided by the Statistical Committee of Armenia.<sup>1</sup> On average, a single student in Armenia annually spends 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 percent of tuition fee has been

<sup>1</sup>[HTTP://www.armstat.am/file/article/soc\\_vich\\_2017\\_6.pdf](http://www.armstat.am/file/article/soc_vich_2017_6.pdf) and [HTTP://armstat.am/file/article/soc\\_vich\\_2018\\_5.pdf](http://armstat.am/file/article/soc_vich_2018_5.pdf)

FIGURE 4. Predicted mean earnings for 10 years in AMD



assumed for higher education and 40 percent for vocational education. Summing up, we have 515,000 AMD and 258,000 AMD direct costs of higher education and vocational education. This is about 2,060,143 AMD for the full four-year university cycle and 775,000 AMD for three years of vocational education. Four years of higher education is for attaining a Bachelor's degree, whereas the Master's and Ph.D. holders are assumed to spend 6 and 9 cumulative years on their studies. Hence the higher education costs are much higher for those people (see Figure 5 above). Three years of foregone earnings is 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 NPV estimate results 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 percent in 2017. 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.

The rate of return on higher education is much higher than the rates generated via the Mincerian equation as Figure 7 shows. 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 study's short length. For females, the IRR of Bachelor's and Master's degrees is the same - 17 percent. This suggests that an additional qualification does not increase the profitability of women's education. However, the IRR of Ph.D. holders is slightly greater at 18 percent. Men proved to gain more from investment in their education. The difference between the IRR of the Ph.D. qualification of the two genders is 7 percent.

FIGURE 5. Direct Costs of Studying in AMD, 2017

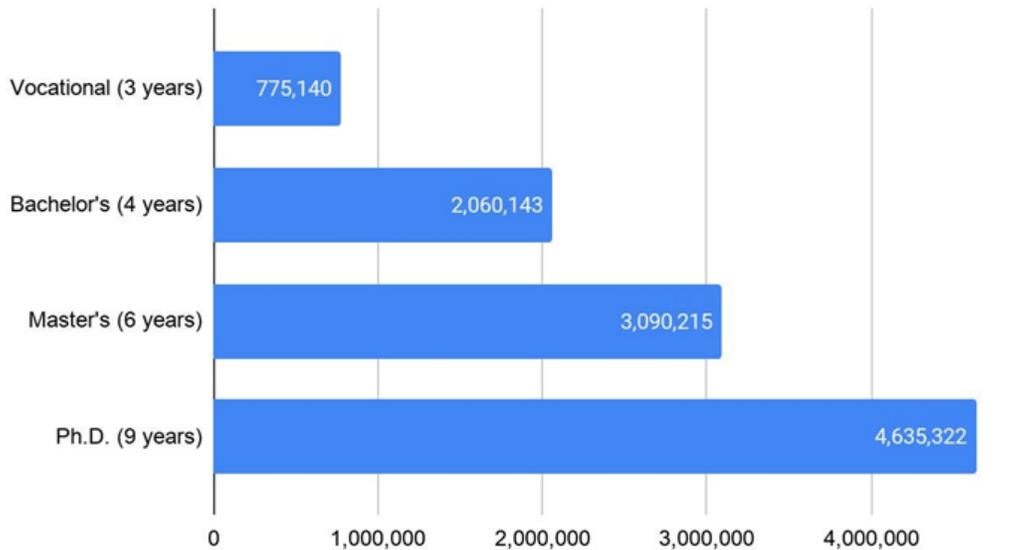
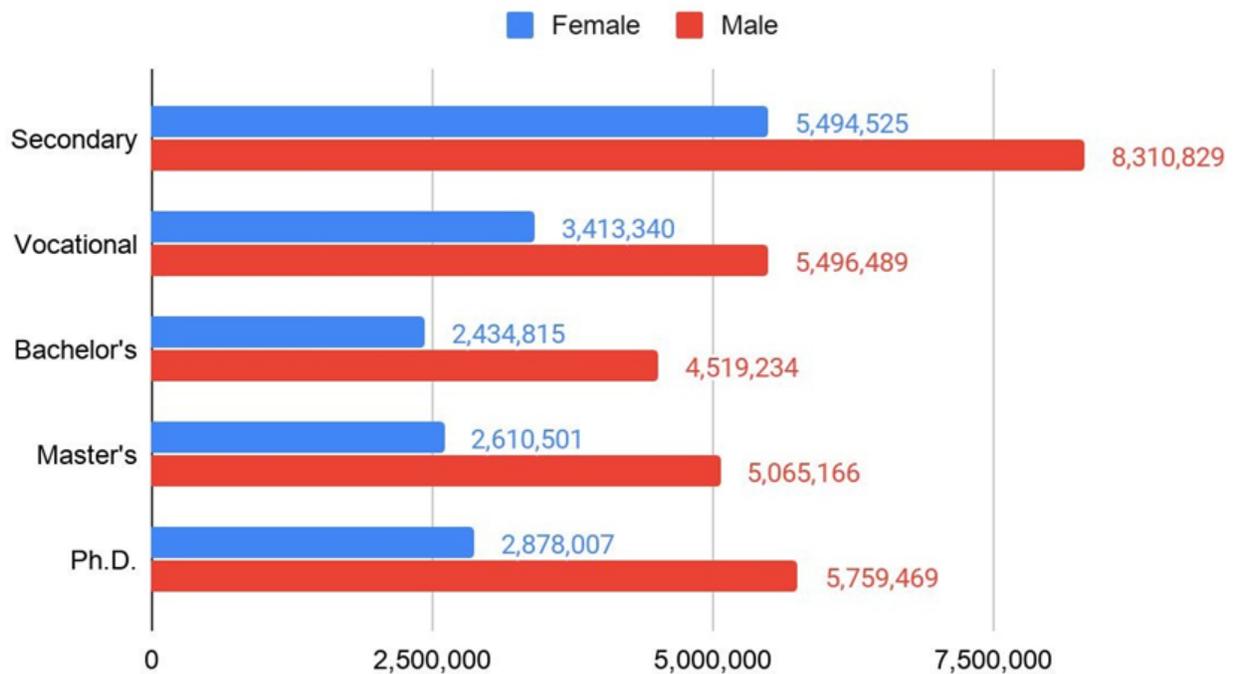


FIGURE 6. Net Present Value of education in AMD



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). Accordingly, and to capture the unemployment effect, the returns are adjusted for those with higher education. In 2018, Armenia's unemployment rate was 17.5 percent, and this

FIGURE 7. Internal rate of return of each education level

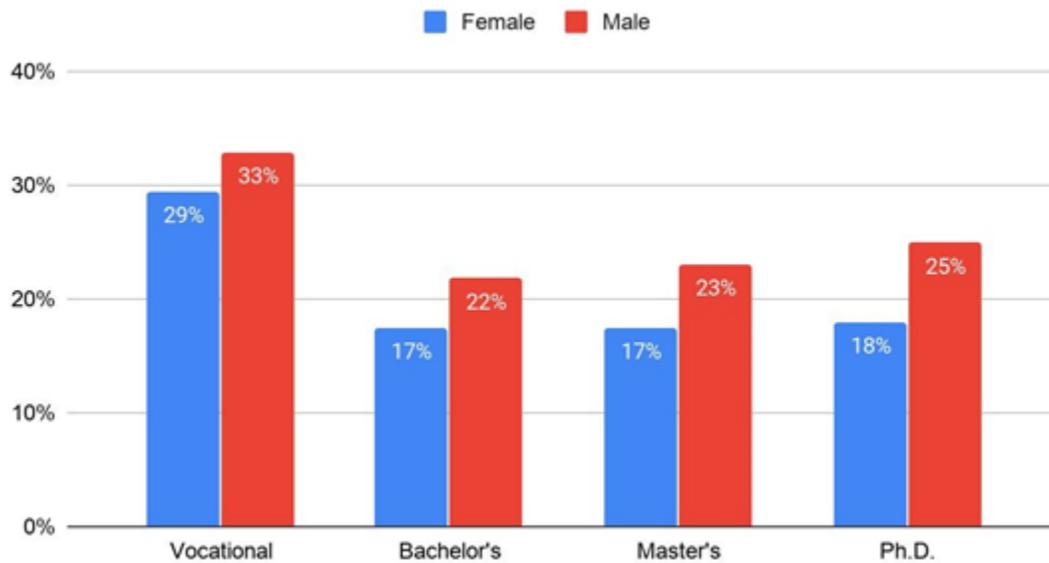


FIGURE 8. Unemployment adjusted internal rate of return

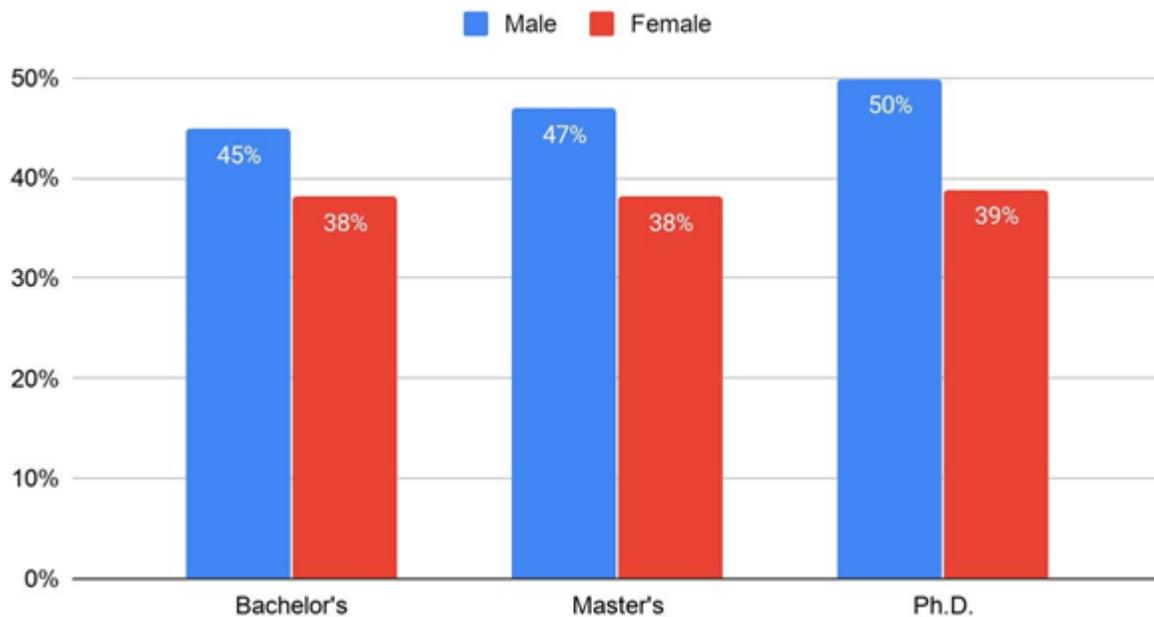


figure is used to adjust earnings (1 minus unemployment rate). The adjusted internal rate of return is now significantly higher than the unadjusted return (see Figure 8).

## 5. CONCLUSION

The paper presented estimates of the economic internal rate of return of education in Armenia using the 2018 Labor Force Survey. The estimates show that an extra level of education increases an individual's

earnings by seven percent. In addition, women experience higher returns to their education, which is in line with what has been found in studies for other countries. This could imply that education plays a crucial role in attaining higher wages for women, while men may earn more with less education. Education yields higher returns in the public sector than in the private sector, with a noticeable 3 percent difference. The finding might indicate the competitive advantage of more educated people in the public sector. The return is greater for those in professional roles than those in 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 considering the costs of study and applying the full discount approach, we found that returns are the highest at the vocational level. The costs of vocational education are comparably lower than that of university education. Even though university graduates' earnings are higher than vocational education graduates', vocational education's cost advantage makes it more profitable. There are 96 middle vocational educational and 47 preliminary vocational institutions in Armenia. And there was a total of 10,884 entrants in vocational institutions in 2019. But in the last five years, there was a slight decrease in the number of applicants to vocational institutions.

Considering that many unobserved factors are related to educational attainment and earnings, the paper's estimates might be subject to potential bias. Future research may control for omitted factors such as individual cognitive ability, motivation, and family background, which are not available in the 2018 Labor Force Survey.

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TABLE A.1. OLS Estimates of  $\ln$  monthly wages

	(1)	(2)	(3)	(4)
VARIABLES	Basic	Alternative		
(level dummies)	With interaction terms	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*** (0.0480)	-0.133*** (0.0480)	-0.134*** (0.0482)	-0.134*** (0.0482)
professional	-0.0906 (0.0603)	-0.0972 (0.0602)	-0.0921 (0.0604)	-0.0921 (0.0604)
marriedmale			0.0532 (0.0357)	0.441*** (0.0233)
marriedfemale			-0.388*** (0.0392)	
unmarriedfemale			-0.344*** (0.0381)	0.0440 (0.0268)
				0.388*** (0.0392)
Constant	11.16*** (0.116)	11.21*** (0.116)	11.57*** (0.112)	11.18*** (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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
VARIABLES	All	Male	Female	Private	Public	Professional	Non-professional
education level	0.0700*** (0.0103)	0.0308** (0.0145)	0.116*** (0.0149)	0.0584*** (0.0146)	0.0897*** (0.0143)	0.102*** (0.0146)	0.0320** (0.0144)
age	0.00469 (0.00512)	0.0105 (0.00760)	-0.000327 (0.00699)	0.0123* (0.00713)	-0.00458 (0.00732)	-0.00575 (0.00745)	0.0181*** (0.00667)
age2	-8.63e-05 (5.69e-05)	-0.000186** (8.32e-05)	4.36e-06 (7.79e-05)	-0.000170** (8.11e-05)	1.40e-05 (7.96e-05)	6.17e-05 (8.23e-05)	-0.000262*** (7.40e-05)
male	0.414*** (0.0208)			0.374*** (0.0304)	0.409*** (0.0284)	0.401*** (0.0308)	0.389*** (0.0300)
married	-0.00322 (0.0227)	0.0727* (0.0398)	-0.0354 (0.0273)	0.0550 (0.0337)	-0.0485* (0.0289)	-0.0379 (0.0330)	0.0386 (0.0311)
region	-0.132*** (0.0312)	-0.0627 (0.0463)	-0.179*** (0.0405)	-0.122*** (0.0402)	-0.149*** (0.0450)	-0.128*** (0.0431)	-0.0846** (0.0429)
urban	-0.0479** (0.0196)	-0.0443 (0.0276)	-0.0501* (0.0273)	-0.117*** (0.0301)	0.0229 (0.0244)	-0.000955 (0.0292)	-0.0716*** (0.0263)
fulltime	-0.0736** (0.0343)	0.116 (0.0792)	-0.138*** (0.0357)	0.0954 (0.0661)	-0.185*** (0.0348)	-0.199*** (0.0364)	0.138** (0.0668)
private	0.0715** (0.0347)	0.0887* (0.0488)	0.0571 (0.0475)			0.0394 (0.051)	0.0739 (0.0451)
professionals	0.106*** (0.0241)	0.185*** (0.0348)	0.046 (0.0331)	0.196*** (0.035)	0.027 (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*** (0.043)	0.0426 (0.0586)	-0.114** (0.0489)
finance	-0.0222 (0.0739)	-0.136 (0.104)	0.131 (0.102)	0.084 (0.0949)	-0.104 (0.184)	0.152 (0.0974)	-0.179 (0.11)
other services	-0.130*** (0.048)	-0.163** (0.0695)	-0.0676 (0.0678)	0.0894 (0.086)	-0.284*** (0.045)	-0.202*** (0.0582)	-0.0766 (0.0689)
professional	-0.0906 (0.0603)	-0.176* (0.0936)	0.0248 (0.0728)	0.073 (0.0939)	-0.190** (0.0743)	-0.000778 (0.0743)	-0.233** (0.101)
Constant	11.16*** (0.116)	11.27*** (0.17)	11.22*** (0.158)	10.81*** (0.171)	11.47*** (0.17)	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&lt;0.01, \*\* p&lt;0.05, \* p&lt;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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
lnwage	1															
edulevel	0.15	1														
age	-0.12	0.03	1													
age2	-0.12	0.03	0.99	1												
gender	0.37	-0.16	-0.12	-0.11	1											
married	0.04	-0.01	0.27	0.23	0.14	1										
region	-0.07	-0.15	-0.04	-0.05	0.07	0.08	1									
urban	-0.05	0.11	0.1	0.1	-0.11	-0.02	-0.27	1								
fulltime	0.03	-0.11	-0.01	-0.01	0.23	0.03	0.05	-0.01	1							
private	0.07	-0.28	-0.05	-0.04	0.2	-0.03	-0.11	0.08	0.12	1						
professionals	0.06	0.63	0.02	0.02	-0.29	-0.01	-0.1	0.08	-0.18	-0.39	1					
industry	0.15	-0.19	0.04	0.04	0.24	0.08	0.04	-0.02	0.13	0.51	-0.3	1				
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			
finance	0.01	0.05	-0.04	-0.03	0	0.02	0.03	0.03	0.03	0.07	0.05	-0.06	-0.05	1		
otherservi	-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	
professional	0.01	0.08	-0.01	0	0	-0.04	-0.12	0.09	0.01	0.08	0.14	-0.12	-0.1	-0.02	-0.05	1

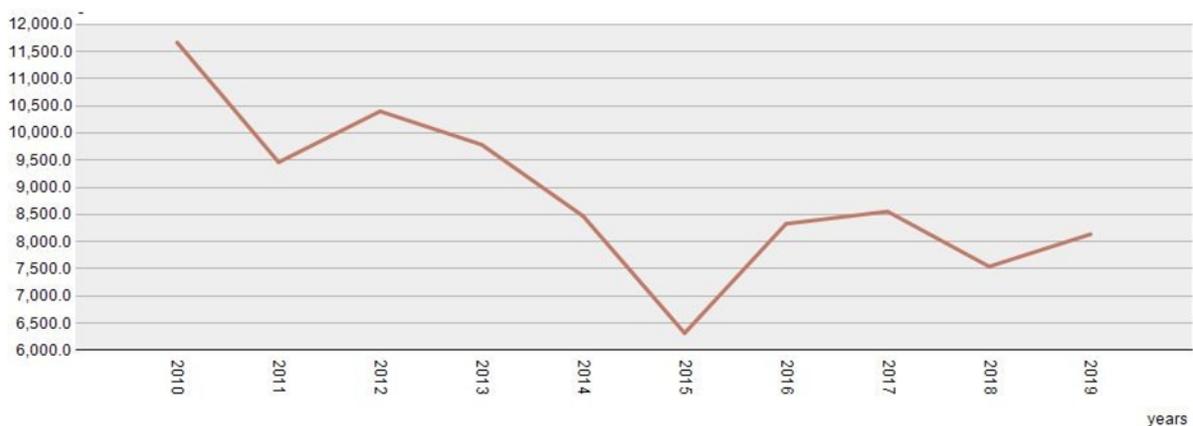
FIGURE B.1. Number of Entrants to Middle Vocational Education  
Middle Vocational Education by indicators and years

FIGURE B.2. Number of Entrants to Preliminary Vocational Education  
Preliminary Vocational Education by indicators and years

