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RETURNS TO UNIVERSITY HIGHER EDUCATION IN PERU
The Effect of Graduation

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ABSTRACT

This study measures the importance of finalizing university higher education in the income of Peruvian workers. Thus, information from the National Household Survey of Peru is analyzed, estimating three regression models based on who finished university studies and who did not. Our results show that completing university presents higher private returns than not doing it, and that the gap in returns by sex is shortened in those who finish their studies. In addition, there are higher returns in urban areas, capital cities, quality universities, and in those who do not study an education career.

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1. Introduction

The returns related to education investment have been an issue widely discussed by different researches in recent years. The current existent evidence allows us to know the clear association between education and economic development of countries.

In Latin America, and specifically in Peru, have appeared series of different policies with access to high education, in response to market demand for more technical requirements, where research and obtention of academic degrees gained greater strength within a knowledge-based economy (Araneda-Guirriman & Pedraja-Rejas, 2017). The massification of the access to universities in the Latin American region, even when differences regarding United States and Europe persist (López Segrera, 2016), has been a first step towards development. Nevertheless, there are relevant variables that have to consider the educational policies, as the quality and completion, because they are related to the success of their implementation. Regarding quality, in Peru efforts have been made in order to institutionalize it, through a series of measures aimed at standardizing the educational offer, especially in universities, starting at the mandatory compliance of a series of basic quality conditions. However, even if significant steps, although initial, have been taken at the level of quality policies, it is also necessary to attend the aspects related to completion, as it will guarantee the provision of professionals with greater skills. It has been previously seen that completion rates in Latin American countries, such as Chile, Costa Rica, Colombia (23% in each of the three cases) or Argentina (21%), are distant from the average of OECD countries (37%) (OCDE, 2019). In the case of Peru, rates from the ESCALE Portal (Educational Quality Statistics) of the Ministry of Education, of 2018, showed that the completion rate in the 25–34-year-old cohort is approximately 23%. In this scenario, and considering the rentability of education, it has been seen that the completion of university studies presents higher returns that the rest of educational levels, including unfinished university level (Bermúdez Zapata & Bedoya Riveros, 2018; Parodi et al., 2017; Sanchez et al., 2016; Adrogué, 2006). In this sense, it is important and relevant for development policies based on the generation of human capital, to know the returns generated for finishing university studies according to the reality of each country. Thus, strategies can be designed and implemented, aimed at strengthening the available resources each State has to achieve and maintain their development.

2. Literature review

For more than 50 years, lot of educational researchers have been interested in quantifying the future profitability that could be derived from schooling, showing that is higher than that of physical capital and is a very important element in productivity and economic growth (Schultz, 1961; Becker, 1962); also, said profitability occurs at all educational levels, that is, the higher the educational level, the greater the profitability of education (Paz, 2009; Yamada & Castro, 2010; Vargas Urrutia, 2013; Tarupi Montenegro, 2015; Villarreal Peralta, 2018; Gil León et al, 2020).

In this way, schooling has been seen as an investment with medium and long-term profitability. Mincer (1974) set up an earnings equation and estimated the impact of an additional year of schooling on wages using the Ordinary Least Squares regression (OLS) (Freire Seoane & Teijeiro Álvarez, 2010; Yamada & Castro 2010). It is important to specify that, according to Chiswick's work (1997), the coefficient associated with the years of education that are part of Mincer's earnings equation is considered as the return to education.

The results of the application of the methodologies implemented to measure the profitability of education on the salary tend to be different by educational level, with higher returns as it progresses, so there is a general consensus that the relationship between schooling and salary is convex (Torres Carrasco, 2021; Reyes Sánchez, 2020; Ramírez Mordán & Rodríguez Núñez, 2019; Villareal Peralta, 2018; Tarupi Montenegro, 2015; Morales Ramos, 2011). Thus, there is broad evidence that investing in education, specifically in high level, is profitable (Yamada, 2007; Ordaz Díaz, 2008; Yamada & Castro, 2010; Daviña García & Ramil Días, 2014; Fuentes Pincheira & Herrera Cofré, 2015; Murillo & Raymond, 2017; Yamada et al., 2016; Parodi et al., 2017; Gacel Ávila, 2018; Freire Seoane et al., 2018; Villarreal Peralta, 2018; García Bermeo, 2019). Additionally, it is important to point out that the returns are notoriously higher in those who have completed higher education, especially university, as

it has been seen in various studies (Adrogué, 2006; Parodi et al., 2017). It has even been observed that the salary of those who completed the university can be 122% higher than those who do not complete it (Sánchez, Munari et al., 2016), which shows the importance not only of the investment in higher education as a generator of economic development but also that, specifically, the completion of such studies must be registered within the components on which the success of public policies in higher education is measured.

Regarding the studies of the income determinants, it has been seen, for example for the Chilean case (Fuentes Picheira & Herrera Cofré, 2015), under an analysis that considered the Mincer equation extended with variables of gender, age, years of schooling, among others, that the main determinant of incomes wasthe amount of schooling years. Thus, for each year of education the individual perceives an increase of 11,3% in the income. On the other hand, for each additional year of work experience, the salary increases by 2,8%. It is remarkable that, given the individual's work cycle, for each year of work experience the salary increases, but each time in a smaller proportion (0,05% less for each year in this case), reflected in the negative coefficient that accompanies this variable. Furthermore, a negative coefficient was observed in the gender variable, that resulted in the fact that if the person is a woman, their future income would decrease by 46,9%. It was also noticed that the increase of one year of age of the person raises their income by 0,9% and that an additional year of education of both the mother and the father increases the income of the children by approximately 2%. Following the same tendency of a convex relationship between schooling and salary, in Ecuador it has been reported, in terms of higher education, returns of 11,6% (Tarupi Montenegro, 2015). However, when controlling variables such as parental education, it was observed that the average return to higher education dropped to 10,6%.

Besides, in Colombia (Tarazona Quintero & Remolina Amórtegui, 2017) was observed a rate of return of education on wages of 9,1%; also, that for one more year of experience, the salary would increase by 2,2%. Moreover, differences were found in income by city of residence, a variable that explained up to 30% of incomes. When analyzing by gender, it was noticed that men received 23,8% more salary than women. Nevertheless, authors point out that the causes of such behavior would also be a matter of sociological or anthropological analysis. Also in Colombia, completing higher education increased the salary by 116%, compared to a person who did not complete any education level. Although, in the case of population in rural areas, there is a much smaller difference, since higher education increased wages by 42%, compared to a person who has not completed any level of education. Furthermore, there were higher educational returns in those who being born in rural spaces, then worked in the city, compared to those who stayed to work in rural areas, which would reinforce the notion of migration to the city for economic reasons, given that those who complete higher education "will be more encouraged to migrate, since the country-city differentials in the highest educational levels are even greater" (Vargas Urrutia, 2013). In Mexico, a person with university studies earns 143% higher incomes than a person without studies, a much higher percentage than other educational levels compared to a person without studies (Villarreal Peralta, 2018). Following the Mexican case, it has been considered that the decision to join the labor market was mediated by sex, household number of residents, years of schooling and work experience, and it has been observed, when comparing the profitability of university higher education (period 1994-2005), that in 2005 the profitability in rural areas was 14,9%, while in urban areas was 9,9% and that in 2004 were 16,3% and 11,3% respectively, also in favor of the rural area, a situation that is related to the growth of agricultural Gross Domestic Product (GDP), according to Ordaz Díaz (2008).

In Panama, considering the period 2001-2009 (Freire Seoane et al., 2018), it has been found that, although education is the safest way to improve someone's income, in that period there is a reduction in the Panamanian case. This would be due to a greater supply of people who have achieved education achievements in that time, reflected in the fact that workers with primary level decreased by more than 6%, while those who had reached primary or higher education increased by 2,6% and 4,1%, respectively. Regarding gender, it was observed that the average returns to education were much higher for women (16,5%) compared to men (9,6%). In the case of the Dominican Republic, considering the period 2000-2015, it has been found that the relationship between education and returns remained convex, even though the return rate for all levels decreased in that period; also observing that for the university level, it went from 20,8% to 18,6%. However, an additional year of

university education represents a rate of return four times higher than in secondary education (Parodi et al., 2017).

In the case of Spain (Daviña García & Ramil Díaz, 2014), the education level and age have been considered as important variables in the explanation of salaries, although, even if the incomes increase until reaching a maximum around 53-56 years, after this age they tend to decrease. Regarding profitability by education level, it was observed for example, that the income of a 30-year-old person without studies was 736 euros, and, if that same person had secondary education, the salary would be approximately 1065 euros; if they had higher education, they would earn 1521 euros; with respect to gender, it was founded that women earned approximately 25% less salary on average than men, and that being a foreigner earned, on average, less than a person of Spanish nationality. Following the Spanish case, specifically in Galicia (Freire Seoane & Teijeiro Álvarez, 2010), it was observed, under a methodology based on the Mincerian model and also using the instrumental variables technique, —considering the logarithm of wages as the dependent variable and those related to the level of education, sex, age, experience, among others, as independent variables—, that the education years have a positive impact on the perceived salary, estimating a profitability of 5,36% with the Mincer model, and reaching 7,49%, considering instrumental variables. In addition, in the extended model, the squared experience is not significant, finding this way a possible explanation in the characteristics of the sample, specifically in the age variable, since when considering the 16 to 34-year-old cohort in the analysis, it is expected that a significant part of the participants will not show heterogeneity in the amount of experience. Finally, it has been observed that being a man had a significant and positive effect on wages, compared to a woman.

In the Peruvian case (Yamada & Castro, 2010), considering a traditional Mincerian specification estimated by OLS, it was noticed a return of 15,2% for public university education, 17,9% for private university higher education, and, at career levels, that Medicine and Engineering careers presented the highest returns (17,7% and 16,4%, respectively), while Pedagogy and Social Sciences had the lowest (11,2% and 12,3% return per year studied). On the other side, there are some evidences that indicate that when estimating using OLS, the return to university higher education is 2,7% times the return to complete secondary education, while, when correcting for selection bias, it is extended to 5 times. Furthermore, the TIR for those who studied at public universities represented 21,6%, while for private universities it was 18,4% (Yamada, 2007). In this context, some conclusions have been drawn: graduating from university increases the probability of having a formal job by more than 40%, compared to not having university education; if you have graduated from a university with high or medium scientific production, the probability of unemployment decreases in 8.8%; and, in addition, the income of university graduates has increased substantially in recent years, being much higher than those who have technical education or do not have higher education (SUNEDU, 2020).

Also in the Peruvian case, it has been seen that attending a quality institution had a positive effect of more than 17% on the salary, which would represent 40% of the existing gap between the salaries perceived by a person who attended a high quality university compared to another that attended a lower quality university, with the remaining 60% explained by variables prior to access, such as socioeconomic status, educational level of the parents or sex, among others (Yamada et al., 2016). Despite the important challenge entailed by the quality of the educational offer after a first approach to higher education policies focused on access, there is little evidence on the differences between students, according to the quality of the institutions they attend. This situation is more worrying as it has been found that those who come from richer homes are more likely to study at the university, as well as to study a career with higher returns (Sánchez, Favara et al., 2021). Also it has been observed, in different contexts, that the differences by socioeconomic status are reflected both in the permanence and in the completion of higher education (García De Fanelli & Adrogué, 2021), all of which would reflect the circle of poverty that higher education policies must address.

The evidence described above shows the clear positive relationship between education and returns, also resulting in higher education and its culmination, as the educational achievement that generates the highest returns, which has special importance in the Latin American context. Moreover, even if at the beginning the policies were focused on access to higher education, the greatest challenge currently involves the finalization of studies as engine of change and economic development of the country. In that sense, this present study aims to measure in the Peruvian case how in recent years finishing or not university higher education affects the salary of Peruvian workers, also considering variables of

sex, residence area, economic activity in which they work, career, type of management of the university of origin, and quality of the educational institution of origin, among others.

3. Method

To estimate the returns to university higher education in Peru, between those who completed higher education and those who did not, the database of the National House Survey (ENAHO) was used as a source of information, in its Employment and Income, Education, Social Programs and Summary modules for the period 2014-2018. The ENAHO is constituted as the official source of statistical information in Peru and is used for the determination of poverty and other economic and social investigations. The data collection is carried out in the Peruvian national scope, with a 95% confidence level on the sample results. In the present work, the sample size was 35,501 observations, made up of 21,908 observations for the cases of people who completed university higher education, and 13,593 observations for the cases of people who did not complete it.

In this study, the estimation of returns is based on the work carried out by Mincer (1974), through the following equation:

$$ln [Y(s,x)] = \pi + \rho s + \beta 0\, x + \beta 1\, x2 + \varepsilon \quad (1)$$

ln [Y(s,x)] is the logarithm of the earnings of workers, whose main explanatory variables are years of education (s) and work experience (x); ρ is the return to education; β_0 is the return for years of experience; β_1 is the coefficient related to years of experience squared. It is assumed that there is a lower contribution to income as experience increases (concavity of the income function).

The main problem with estimation of a model in (1) is the sample reflected in the dependent variable (income), that is, only the income of those who are willing to work is observed, but not the income of the entire economically active population (EAP); there is no information on the reserve salary and opportunity cost that an individual is willing to assume to participate in the labor market. In this sense, since there are unobservable variables that influence the decision to work or not, the model proposed in (1) would be affected by biased and inconsistent estimates. To correct the previously mentioned, Heckman (1979) states the income equation (I), where W is income and X would be the observable characteristics that determine the income of an individual, also considering that W is only observable for those individuals who work and receive their income:

$$Wi = \beta Xi + \varepsilon i \ (I)$$

The self-selection refers to the fact that only the income of those people who are part of the labor force will be observable; therefore, the second equation to consider is:

$$ei^* = zi\gamma + ui \ (ii)$$

E* is the difference between the salary and the reserve salary, Ei* = Wi – Ei'; in case the wage is lower than the reserve one, the individual will decide not to work; then the employment indicator will be E=1 in case the reserve wage is greater than 0, Ei*>0 and Ei=0 in any another case. To identify the selection problem, Heckman (1979) takes the expected value of equation (II):

$$E\ (Wi \mid Ei=1, Xi) = E\ (Wi \mid Xi\ Zi\ ui)$$

Then, from the equation (I) you can arrive at equality:

$$E\ (Wi \mid E=1, Xi) = E\ (Wi \mid Xi\ Zi\ ui) = \beta Xi + E\ (\varepsilon i \mid Xi\ Zi\ ui) \ (III)$$

Equation (III) can be simplified, noting that self-selection in employment (E=1) depends only on Zi and ui, not on Xi:

$$E(Wi \mid Ei=1, Xi) = \beta Xi + E(\varepsilon i \mid Ei=1) = \beta Xi + E(\varepsilon i \mid ui > -Zi\gamma) \ (IV)$$

If equation (IV) is estimated using OLS, as already mentioned, the estimated parameters will not reflect the population parameters. Those who are employed would tend to have higher earnings than

those who are unemployed, reason why they are not in the employed labor force. Heckman's solution (1979) revolved around correcting the omission of the variable (εi| ui > -Ziγ); then, for its specification, equation (V) is proposed:

$$E\,[(\varepsilon i|\ ui > -Zi\gamma)] = \rho\varepsilon u\sigma\varepsilon\ \lambda i(-Zi\gamma) = \beta\lambda\ \lambda i(-Zi\gamma)\ (V)$$

λi(-Ziγ) is the inverse of the Mills ratio evaluated at the indicated value βλ for an unknown parameter (=ρεuσε); this variable is obtained from the estimation of the probability of participation in the labor market. By using this parameter, the income equation was estimated through two stages.
To estimate the probability of participation, a logit model was used in equation 2, since there was a dichotomous limited dependent variable—the decision to participate in the labor market or not of an urban informal worker—, for which the individual characteristics of the workers were considered within the explanatory variables.

$$\text{Prob [Participaci]}=\beta0+ \beta1(\text{educa lev}) + \beta2(\text{age}) + \beta3(\text{age2}) + \beta4(\text{sex})+ \beta5(\text{urban}) + \beta6(\text{married}) + \beta7(\text{head\_house}) + \beta8(\text{department}) + \beta9(\text{year}) + \mu$$

Level_educa represents the education level of an individual according to the reported years of study, age, age squared, sex —with men as basis—;that is, the parameter was estimated taking as a reference the income of women in relation to men's; urban, dichotomous variable that takes a value of 1 if it comes from an urban area; married, dichotomous variable that takes the value of 1 when the individual reports being married; head of household if the individual is the one who answers the survey questions or who has the most knowledge about the household (it takes a value of 1 when the individual is categorized as head of household); dummy variables associated with the 24 departments (used to control the regressions); and dummy variables for the study period, 2014-2018. After estimating the equation, predicted values of the estimate were obtained, through which the inverse of the Mills ratio was constructed. This variable is represented by *λ*, which was included in all the models to correct the sample self-selection bias.

In this sense, using the ENAHO database, for the period 2014-2018, the estimation of the income model (original Mincer plus control variables and Heckman correction) was made with the addition of other explanatory variables related to the determination of income such as: sex, geographical area (urban-rural), origin (Metropolitan Lima and rest of the country), career, work activity (dependent/independent), category or economic activity in what you work, quality of the Educational Institution (if it is in the ranking of the 10 best educational institutions, according to SCIMAGO), type of university (public or private).

In this model, estimations were made for both the entire period of analysis and per year, only for the return to education, segmenting the sample into (a) Total University Higher Education (TUHE), (b) Complete University Higher Education (CUHE) and (c) Incomplete University Higher Education (IUHE). The following equation was estimated through OLS:

$$\text{log\_salin\_real} = \alpha+ \beta_1*(\text{a\_edu}) + \beta_2*(\text{experience}) + \beta_3*(\text{experience\_2}) + \beta_4*(\text{log\_H1}) + \beta_5*(\text{women}) + \beta_6*(\text{LM}) + \beta_7*(\text{ECO}) + \beta_8*(\text{urban}) + \beta_9*(\text{anio}) + \beta_{10}*(\text{ocupation}) + \beta_{11}*(\text{career}) + \beta_{12}*(\text{private}) + \beta_{13}*(\text{log\_imr1}) + \beta_{14}*(\text{cal\_scimago}) + \mu$$

log_salin_real: monthly income deflated by Consumer Price Index.
a_edu: years of education.
experience: work experience.
experience_2: work experience squared.
log_H1: logarithm of hours worked.
women: 1=women, 0=men.
LM: 1= Metropolitan Lima, 0=rest of the country.
EAC: economic activities classified into 9 categories (agriculture, mining, manufacturing, construction, commerce, transportation and communications, hotels and restaurants, government and other services)
urban: 1=urban, 0=rural.
anio: year of analysis (2014, 2015, 2016, 2017,2018).

type_occupation: categories of occupations such as productive unit (business or company owner); self-employed (own business or pursues career or trade without paid workers) and dependent (employees and workers).
Career: groups of professional careers according to the standardized INEI nomenclature, that includes education, humanities and arts, social sciences, business and law, natural sciences, exact and from computer studies, engineering, industry and construction; agriculture and livestock and veterinary science, health sciences and others.
private: 1=private university, 0=public university.
log_imr1: logarithm of the inverse of the Mills ratio.
cal_scimago: ranking of universities according to SCIMAGO rating for Perú (10 best universities in 2018).
α: constant.
βi: regression coefficients.
μ: random disturbance, with constant mean and variance -> N(μ,σ2).

Models to estimate the returns to education in those who completed the university career and among those who did not, present statistically significant regression coefficients at 99% (p-value <0.01), with the exception of the category "others" in professional career groups. In order to complement the estimation of the econometric models, tests of multicollinearity, heteroscedasticity, and normality of the errors were carried out. In that regard, the models presented VIF (Variance Inflation Vector) test values of less than 10%. Likewise, the Breusch-Pagan test was performed to detect heteroskedasticity resulting in no statistical significance (Prob>Chi-square was less than a 0.05). For this reason, robust standard error correction was used (Imbens & Kolesar, 2012). Finally, these models incorporate the correction of the sample self-selection bias developed by Heckman (1979), through the lambda of the inverse of the Mills ratio.

The residuals did not present normality. However, applying the Central Limit Theorem (Canal Díaz, 2006), due to the number of observations in the ENAHO database from 2014 to 2018 for this group (more than 35 thousand observations), it is assumed that the information comes from a normal population. In addition, it should be noted that the ENAHO presents a random, stratified, and multi-staged sampling design that allows it to guarantee representativeness when expanding the sample at the population level.

4. Results

In the period 2014-2018, the returns to university education increased in those who completed their university studies, from 15,4% to 16,4%; while in those who did not complete their studies, the increase was from 2.3% to 5,1% (Table 1).

Table 1. Returns to university higher education 2014-2018 by year

Año	*TOTAL*			*UPPER COMPLET*			*UPPER INCOMPLET*		
	Coef (%)	*St. error*	*p-value*	*Coef (%)*	*St. error*	*p-value*	*Coef (%)*	*St. error*	*p-value*
2014	*11.59*	*0.005*	*0.000*	*15.39*	*0.022*	*0.000*	*2.34*	*0.010*	*0.022*
2015	*11.82*	*0.004*	*0.000*	*15.52*	*0.016*	*0.000*	*3.29*	*0.007*	*0.000*
2016	*12.06*	*0.003*	*0.000*	*15.87*	*0.012*	*0.000*	*3.77*	*0.006*	*0.000*
2017	*12.43*	*0.004*	*0.000*	*16.22*	*0.014*	*0.000*	*4.66*	*0.007*	*0.000*
2018	*12.54*	*0.005*	*0.000*	*16.42*	*0.019*	*0.000*	*5.07*	*0.010*	*0.000*

Source: ENAHO. Own elaboration.

On the other hand, the results of the 2014-2018 data pull show that, ceteris paribus, the rate of return to university education is 12,1%, that is, an additional year of education represents an increase

of 12,1% in the monthly income of people with this level of education. Meanwhile, among those who completed university higher education, an additional year of education represents an increase of 15,9% in their monthly income, and among those who did not complete, an additional year of education represents only a 3,9% increase.

Table 2. Returns to University Higher Education in Peru 2014-2018

Variables	**Model 1. ESUT**	**Model 2. ESUC**	**Model 3. ESUI**
Years of education	0.121*** (0.00306)	0.159*** (0.0121)	0.0385*** (0.00583)
Experience	0.0334*** (0.00155)	0.0316*** (0.00174)	0.0348*** (0.00314)
Experience (squared)	-0.000825*** (5.00e-05)	-0.000752*** (5.52e-05)	-0.000862*** (0.00010)
Worked hours (logarithm)	0.578*** (0.00954)	0.481*** (0.0148)	0.619*** (0.0126)
Sex (women)	-0.0450*** (0.0101)	-0.0441*** (0.0125)	-0.120*** (0.0167)
Place of residence (lima metro)	0.273*** (0.0102)	0.268*** (0.0124)	0.273*** (0.0174)
Economic activity			
Mining	1.032*** (0.0448)	1.076*** (0.0604)	0.956*** (0.0697)
Manufacture	0.474*** (0.0389)	0.545*** (0.0555)	0.392*** (0.0545)
Construction	0.678*** (0.0389)	0.801*** (0.0555)	0.543*** (0.0549)
Comercio	0.399*** (0.0372)	0.433*** (0.0545)	0.385*** (0.0510)
Transports and communications	0.583*** (0.0377)	0.617*** (0.0548)	0.526*** (0.0520)
Hotels and Restaurants	0.249*** (0.0407)	0.314*** (0.0654)	0.233*** (0.0536)
State	0.787*** (0.0358)	0.833*** (0.0514)	0.726*** (0.0502)
Other services	0.680*** (0.0359)	0.766*** (0.0519)	0.555*** (0.0498)
Urban	0.167*** (0.0220)	0.133*** (0.0309)	0.194*** (0.0305)
Years of analysis (CONTROL)	0.0428*** (0.00276)	0.0424*** (0.00331)	0.0411*** (0.00467)
Type of occupation			
Variables	**Model 1. ESUT**	**Model 2. ESUC**	**Model 3. ESUI**
Independents	-0.889*** (0.0262)	-0.921*** (0.0332)	-0.888*** (0.0419)
Dependents	-0.327*** (0.0233)	-0.257*** (0.0288)	-0.448*** (0.0390)
Career			
Humanities and arts	0.109*** (0.0327)	0.102*** (0.0405)	0.166*** (0.0548)
Social sciences, business and law	0.236*** (0.0124)	0.282*** (0.0143)	0.220*** (0.0271)
Natural, exact sciences and	0.204*** (0.0245)	0.289*** (0.0304)	0.132*** (0.0440)

computing			
Engineering, industry and construction	0.316*** (0.0149)	0.451*** (0.0181)	0.200*** (0.0293)
Agricultural and veterinary	0.258*** (0.0243)	0.348*** (0.0292)	0.195*** (0.0444)
Healthy sciences	0.253*** (0.0157)	0.299*** (0.0171)	0.161*** (0.0353)
Others	0.322*** (0.0591)	0.434*** (0.0609)	0.194 (0.200)
Private (type of gestion)	0.0801*** (0.00843)	0.0406*** (0.0100)	0.177*** (0.0149)
Inverse ratio oof mills	-0.103*** (0.00321)	-0.0802*** (0.00392)	-0.115*** (0.00561)
Ranking scimago	0.118*** (0.0115)	0.126*** (0.0133)	0.0791*** (0.0217)
Constant	-84.17*** (5.557)	-83.62*** (6.682)	-79.78*** (9.419)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: ENAHO. Own elaboration.

An additional year of work experience contributes to a salary return of approximately 3,2% among those who have completed university studies, and 3,5% among those who did not complete it. On the other hand, since, ceteris paribus, the sign of the estimated parameter of β_2 (corresponding to experience) is positive, but that of β_3 (corresponding to the experience^2) is negative, this implies that, as experience increases, income grows, since the estimated value of β_2 is greater than the corresponding to β_3. However, this growth is declining (experience concavity versus revenue).

$$\frac{\partial\, log\_salin\_real}{\partial \text{experience}} = \beta_2 + 2\beta_3\,(\text{experience})$$

Likewise, Table 2 shows that, in terms of elasticities, a percentage increase in worked hours generates a positive variation in earnings, since ceteris paribus, $d(\text{LogY})/d\text{H} = \beta d(\text{LogH})/d\text{H}$ and therefore $\Delta\%Y / \Delta\ \%H = \beta$ (en %). In this sense, the results show that 10% of the additional work hours contributes a 4,8% return in income in the people who completed their university education; meanwhile, in those who did not complete it, it represents a return of 6,2%.

On the other side, it is observed that being a woman reduces income compared to men. Thus, among those who completed their university studies, the retraction is 4,4% and among those who did not complete it, 12,0%. Also, it was found that residing in the capital city generates a remuneration of 26,8% and 27,3% higher in their income (complete and incomplete university education, respectively), in relation to those who reside in the rest of the country. Moreover, it was observed that those who lived in the urban area had returns of 13,3% and 19,4% higher than those who lived in the rural area, in the case of complete and incomplete university studies, respectively.

About the occupation, 3 categories are presented: productive unit (own business), dependent, and independent. In this sense, being dependent or independent generates a fall in the return of income with respect to the employing productive units, both for the complete or incomplete university. This variable is associated with the formality and informality of the activity they carry out, as well as with the discounts linked to tax rates and other contributions. As it can be seen in Table 2, ceteris paribus, the self-employed presents a loss of 92,1% and 88,8% of income (complete and incomplete university, respectively) in relation to people who have their own business. Similarly, dependent workers show a loss of 25,7% and 44,8% in income for complete and incomplete university studies, compared to those who have their own business. In relation to the economic activity, in the case of complete university, mining provides 103,2% more income than agriculture (by transforming economic activities into dummy variables, this category is the basis for comparison with other economic activities, in order to avoid perfect multicollinearity). Likewise, working in state entities, construction, and other services provides 83,8%, 80,1%, and 76,6% more income than agriculture, respectively. Lower impacts are presented by transportation and communications (61,7%), manufacturing (54,5%), commerce

(43,3%), and, finally, hotels and restaurants (31,4%). On the other hand, in terms of incomplete university, mining provides 95,6% more income than agriculture, while working in the state provides 72,6% more income than agriculture. Less impact is presented by other services, construction and transportation and communications (55.5%, 54.3% and 52.6% more income, compared to agriculture). Manufacturing, commerce, and restaurants and hotels provide 39.2%, 38.5%, and 23.3% more income than agriculture.

In the review of the salary returns by type of career, it is observed that, in the complete university education, the professional careers that mainly stand out are linked to engineering, industry, and construction (451%), followed by agriculture and veterinary (34.8%), in relation to education careers (in a similar way to the treatment of economic activities when transformed into dummy variables, this career was established as the basis of comparison). To a lesser extent, health sciences appear, followed by natural sciences, exact and computer sciences, and, finally, social sciences, business, and law, with 29.9%, 28.9% and 28.2%, respectively. Regarding incomplete university education, social sciences and business and law (22.2%) stand out, followed by engineering, industry, and construction (20.0%). To a lesser extent, it is observed the agricultural and livestock and veterinary career with 19.5%, humanities and arts with 16.6% and, finally, health sciences with 16.1%.

Having studied at a private university generates positive returns in admission, in relation to those who studied at public universities. In this sense, the results show that, within the group of people who completed university education, the returns for those who studied at private universities are higher by 4,1%, while within the group of people who did not complete their university studies, the returns for those who studied at private universities are higher by 17.7%. To sum up, taking into account the SCIMAGO quality ranking, considering the 10 best universities in Peru in 2018, it was found that those who attended complete and incomplete university higher education in said institutions, presented a return of 12.6% and 7.9% in their income, respectively.

5. Discussion and conclusions

In the present study, the income equation to determine the returns to university higher education in Peru meets the theoretical assumptions associated with the Mincerian equation, incorporating the estimation of the sample self-selection bias correction established by Heckman and extended with other explanatory variables such as the hours worked by individuals, gender, place of residence, geographical area, economic activity, chosen professional career, and a proxy variable of university quality. In the same way, the results support the used methodological criteria, in order to find relevant explanations for long-term investment in higher education, and the direct impact that this generates on the future income of individuals. In addition, these results, are compatible with various studies that were previously carried out in countries of the region.

There have been found notable differences between the returns of those who complete their studies and those who do not, in favor of the first ones, which is consistent with what was observed by authors as Adrogué (2006), who found in Argentina that the returns were higher in those who completed higher education compared to those who did not. Parodi et al. (2017) found in the Dominican Republic that completing a university degree meant an increase in the returns of 29.6%, which for the authors would indicate the existence of a *diploma effect*, in which employers would see university credentials as a reliable signal of activity. In the same way, Sanchez et al., (2016) observed in Colombia that the labor income of those who had completed university studies could be up to 122% higher than those who had not completed it. In Peru, comparing university graduates and those without such studies, SUNEDU (2020) observed a notable increase (more than 40%) in the probability of obtaining a formal job. Also, the scientific production of a university has an impact on the decrease in the probability of unemployment of its graduates; the salaries of university graduates are much higher and have had a greater increase in recent years, compared to those who have technical studies or those who have not studied higher education.

The aforementioned statement reflects the importance of completing university studies for a person that enters the labor market. At the same time, it also displays the need to identify the causes of university dropout and to establish, from the State, educational policies that include economic support programs to reduce desertion due to lack of resources, also rewarding said public investment in social terms with a favorable salary difference.

In contrast, the additional variables used in this study allow us to extend the salary return discussion to other areas of social and/or economic activity. For example, the evidence found regarding the superiority of income in the mining activity results from the super cycle of international prices that lasted until 2018 (UNCTAD stat, 2021), which has made possible to boost wages in this sector and even spread their effects towards construction and engineering professionals. Nonetheless, despite the fact that mining takes place in rural areas, the supply of machines, equipment, and materials for its current operational activity, when they are not imported, they are mainly provided by companies located in urban areas, in such a way that the dynamic effect of mining growth in rural areas is limited (Landa, 2019), something that is also reflected in the urban-rural wage gap shown in the results.

The higher returns observed in private university education compared to public education follow the tendency reported by Yamada & Castro (2010), who found that in general, studying at private universities had higher returns than at public universities (17.9% and 15.2%, respectively). On the other hand, the differences in terms of higher returns for additional work hours of those who did not complete university higher education compared to those who did, could reflect that, for people with incomplete university education, the extra hours work in a similar way of compensation due to salary differences with respect to those who did finish university (159% against 3.9% in terms of returns). Barragán Codina et al. (2017) found, for the Mexican case, that those who completed higher education earn an 86% higher salary per hour than those who did not complete said higher level. Regarding the returns observed per additional year of work experience (3.2% for completed studies and 3.5% for incomplete studies), it is noteworthy that other investigations found slightly lower returns. Thus, Fuentes Pincheira & Herrera Cofre (2015) found in Chile that for each additional year of work experience, the salary increases by 2.8%, while Tarazona Quintero & Remolina Amortegui (2017) found in Colombia an increase of 2.2%.

It was also observed that there is a gap between the incomes received by men and women, being greater, according to the results obtained, the income of men. However, this difference is much more noticeable in unfinished university studies (12% compared to 4.4% among those who completed their studies). These results coincide with the tendency of higher return for men in comparison to women, reported for the Chilean case by Fuentes Pincheira & Herrera Cofre (2015), who observed that if the person is a woman, their future income would decrease by 46.9%, which for the authors is a longstanding behavior in Chile, including each of its regions. For the Colombian case, Tarazona Quintero & Remolina Amortegui (2017), found a decrease of 23.8% in the salary of women compared to men's, which the authors consider it should be explained in a broad multidisciplinary framework, including sociological aspects, for example. The above results are different from those reported by Parodi et al. (2017) who, in the case of the Dominican Republic, found higher return rates in women.

Another relevant finding is the one referring to returns at the career level, where engineering, industry, and construction careers present the highest rates, as well as mining as an economic activity. For its part, the education careers present markedly lower rates than the rest of the professions and it sets the standard, not only to inquire into the labor market nature in this aspect, but also intp the financing policies at the level of prioritized careers, which includes providing the applicant with information on the returns so that they can make a more informed choice. These results are consistent with what was previously reported by Yamada & Castro (2010), who observed the highest returns were in medicine and engineering (17.7% and 16.4%, respectively), while the lowest returns were found in the careers of Pedagogy and SocialIn addition, it was considered that the high demand the careers with the lowest return have in the Peruvian educational market would be due to variables related to vocation or financial restrictions, information or skills. For his part, Yamada (2007), in terms of average salaries by career, found that those with higher salaries were civil engineering professionals, economists, business administrators, and computing professionals. On the other side, those who received the lowest salaries were primary school teachers.

The results presented show the existence of incentives that feedback the vicious circle that has been a feature of the educational sector: low salaries in the educational activity, low attractiveness to capture the most capable professionals for the sector and low quality in the training of students (Díaz & Ñopo, 2016). Hence the importance of national and international accreditations that serve as a quality hallmark for the institutions that obtain them and that will later be recognized in the labor market through better salaries, as it is also evidenced in the results. In the present study, the quality of

the institutions was measured through a proxy variable determined according to the SCIMAGO quality ranking. The results showed that those who had studied in universities that were located within the first 10 positions in said ranking presented noticeably higher returns than those who had studied at other universities, which is more noticeable in the case of those who completed university (12.6%). This has been previously evidenced by Yamada et al. (2016) who found, measuring the quality of an educational institution in terms of flexibility of access requirements, that attending a quality institution had a positive effect of more than 17% on salary, which would represent 40% of the gap between the salaries received by a person who attended a high-quality university, compared to one who attended a lower-quality university, with the remaining 60% explained by variables prior to access, such as socioeconomic status, educational level parents or sex, among others. Thus, the results indicate the relevance of reinforcing the standardization mechanisms of the quality conditions of the educational offer from the State.

It is important to point out the evidence of higher returns in the Peruvian capital, Lima, compared to those who reside in the rest of the country, as well as the higher returns in those who live in urban areas compared to those who reside in rural areas. In this sense, Parodi et al. (2017) and Vargas Urrutia (2013) coincide with the results of this study by finding higher returns in the urban area (for the Dominican Republic and Colombia, respectively), while Ordaz Díaz (2008) finds, for the Mexican case, that the Education was more profitable in rural areas, which for the author would be associated with changes in agricultural GDP. This aforementioned statement represents a challenge for policies regarding the market's decentralization, as well as for the design of strategies that seek to provide professionals to the regions within the country, in order to address the particular problems of each of these.

In summary, the results of this study allow us to conclude that the completion of university studies has positive wages. Also, that there are instrumental variables, such as residing in the capital, in urban areas, studying careers related to engineering, industry, construction, economic activity related to mining, as well as the quality of the educational offer of the universities; everything is part of the challenges faced by higher education policies to guarantee the conditions conducive to the completion of students, as well as educational training relevant to the need of the country, for which quality and decentralization play a relevant role. It is important to point out that, although the analysis has taken place in a specific context (Peru, period 2014-2018), the results presented here are consistent with a significant amount of evidence from other countries in the region, which would reflect a common reality policies in university higher education must attend. In this sense, it is recommended not only to promote access to higher education, but also that it is necessary to establish mechanisms, from educational institutions and the State, to ensure the completion of studies. In addition, educational quality policies should be taken into account, as well as the relevance of careers and the decentralization of the offer, depending on the needs of each country.

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