

## Social return and quality of HEI: wage effect on small firms

### Methodology

The estimates analyzed state differences in HEI quality, considering the QS university ranking and the Government Quality and Business Productivity surveys. The percentage of workers with higher education and salaries were used to calculate the social return.

### Objective

Measure the social return of higher education, estimating the effect on the salaries of management and operational personnel, associated with the work of university students hired in small and medium-sized companies.

### Introduction

The social return of higher education is a benefit that non-college graduates gain from interacting with college graduates; the interaction of workers with different skills creates learning opportunities and increases productivity.

### Result and conclusion 1

Small and medium-sized companies with universities in the top 150 of the QS

are taking benefit from higher salaries for their operational staff.

### Result and conclusion 2

It was estimated that a worker would earn a higher salary between 11 % and 19 %, in states with universities in the top 150 of the QS ranking, and there would also be an increasing salary as the percentage of university students increases.

### Result and conclusion 3

A positive social return was observed when increasing the percentage of university students in the companies. When considering the quality of the HEIs, the social return is higher in the institutions where their public universities are placed in better positions within the ranking.



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## Social return and quality of HEI: wage effect on small firms

### *Retorno social y calidad de las IES: el efecto salarial en pequeñas empresas*

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**Abstract:** providing an education with the highest quality possible, making efficient use of resources, is a permanent demand for publicly funded universities. It is known that university graduates receive a private benefit (wage), although estimates of the social benefit of higher education are still lacking, i.e., the positive effects that university students create in other workers. In this regard, the aim of this paper is to measure the social return of higher education, estimating the effect on the wage of managers and workers, associated with the job of university graduates hired in small and medium-sized companies. The analysis was carried out with data from Mexico, combining official figures from the Government Quality Survey, which reports satisfaction with university education, and the Productivity Survey, which describes wages and schooling, among others. The sample was formed with small and medium enterprises. The abundant information available allowed us to use instrumental variables and a two-stage regression. It was confirmed that tertiary education has a positive social effect and that this effect is greater in regions with higher quality HEIs. By broadening the perspective towards the quality of HEIs and social return, universities can demonstrate that their impact exceeds their graduates, reaching workers without university studies through a positive salary effect.

**Keywords:** wage, universities, managers, QS, SME, 2SLS, INEGI, Mexico.

**Resumen:** brindar una educación de la mayor calidad posible, haciendo un uso eficiente de los recursos, es una exigencia permanente para las universidades con financiamiento público. Aunque es conocido que los egresados con estudios universitarios reciben un beneficio privado (salarial), todavía faltan estimaciones del beneficio social de la educación superior, es decir, de los efectos positivos que los universitarios crean en otros trabajadores. En este contexto, el objetivo de este artículo es medir el retorno social de la educación superior, estimando el efecto sobre el salario del personal directivo y operativo, asociado al trabajo de universitarios contratados en pequeñas y medianas empresas. El análisis se realizó con datos de México, se combinaron cifras oficiales de la Encuesta de Calidad de Gobierno, que reporta la satisfacción de la educación universitaria, y la Encuesta de Productividad, que describe salarios y escolaridad, entre otros. La muestra se enfocó en pequeñas y medianas empresas. La abundante información disponible permitió utilizar variables instrumentales y una regresión en dos etapas. Se corroboró que la educación universitaria tiene un efecto social positivo y que este efecto es mayor en las regiones con las Instituciones de Educación Superior (IES) de mayor calidad. Al ampliar la perspectiva hacia la calidad de las IES y el retorno social, las universidades pueden demostrar que su impacto sobrepasa al conjunto de egresados y provoca un efecto salarial positivo en trabajadores sin estudios universitarios.

**Palabras clave:** salario, universidades, gerentes, QS, PYME, MC2E, INEGI, México.

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## Introduction

Higher education has made significant progress in all countries, especially in developing economies. Two cases with great expansion are Spain and South Korea, where in 2020 the percentage of young people (24-34 years old) with university education is 50 % and 70 %, respectively, very high rates compared to previous generations, for example, in the 55-64 age group (30 % and 26 %, respectively). In Latin America, there were low rates of people with university education, with an average rate of 16 % in the 55-64 age group. As time passed by, schooling increased and, currently, around 30 % of young people in countries such as Chile, Colombia and Mexico have completed higher education. In Brazil, the percentage is close to 24 %, and in Argentina 13 % (OECD, 2022). In 15 Latin American countries, ECLAC has documented that the vast majority of university graduates are employed in sectors with medium or high productivity (2021, pp. 92-94). It is known that university workers earn higher incomes. Analytically, this private return to education has been studied using the well-known Mincer equation (Urzúa, 2017; López-Acevedo, 2004).

Literature is new about the performance of universities. It was in the 1980s when university rankings and intra and inter-country comparisons began, partly led by private universities (Balán, 2012). In the 2010s, surveys that measure the quality of governments started which, among other aspects, includes the evaluation of public education, both at its basic and higher levels (Charron *et al.*, 2019). In Mexico, the government quality survey (ENCIG) is biannual and has been conducted six times (2011-2021). In this article, the quality of public higher education will be studied and the information from the ENCIG will be complemented with one of the most well-known university rankings (QS, 2020). In Latin America, a common goal is to expand the coverage of higher education and achieve international standards in teaching, research and outreach. As long as there is a low percentage of university students, especially in the most precarious regions, it is difficult to socialize the benefits of higher education (Corak, 2013) and the potential decreases due to the lack

of sufficient people and technological capabilities to move towards a knowledge-based economy.

## The social return of higher education

This article estimates the social return of higher education, which consists of the benefit of people without university studies when interacting with university graduates, for example, when working in the same company. According to Moretti (2004a, p.179; 2004b, p. 660), this human capital externality hypothesis has been around since the time of classical economists, which enables that the interaction of workers with different skills creates learning opportunities and higher productivity. There would be other explanations as to why productivity increases when workers with university education increase, in one case -external pressure- states that as there are more university students, the pressure on less qualified workers to achieve higher productivity increases and, in another -complementary skills- both types of workers (with high and low schooling) complement each other and build better work routines.

If there is evidence of social return, this would reduce questions that public investment to universities is fiscally regressive, because those benefits are captured by the upper strata, those enrolled in universities (Carnoy, 2020; CONEVAL, 2018, pp. 82-84; Keller, 2010). The case study is Mexico, a country where about five million people pursue higher education studies in some public institution annually (ENCIG, 2013-2019). The educational offer is made up of public and private institutions of varying sizes. Of this group, 20 public universities are ranked among the 200 most important universities in Latin America (QS, 2020). This territorial dispersion, as well as membership in the QS ranking, was used in the analysis to estimate the effect of higher education on wages.

The evidence confirms that higher wages are paid in companies in a higher percentage of workers with higher education. In particular, it was estimated that an increase of 10 percentage points (p.p.) in the percentage of university graduates increases the salaries of operational workers by 9.4 % and the salaries of management

personnel by 11.9 %. It was also confirmed that in the regions with universities in the top 150, companies pay higher salaries between 10 % and 20 % compared to the rest of the country. These findings are important because they show that the benefits of public investment in HEIs do not only occur in their own community. Through the companies, these benefits are distributed beyond the university students, and should be part of the calculation of the various positive effects with which universities contribute socially.

Several authors have studied the economic effects of higher education in Latin America. Manacorda *et al.* (2010) report the percentage wage return in five countries, for those with tertiary education and their share in total employment. The effect of university education has also been studied (Brambilla *et al.*, 2012) more broadly, assuming that there is a reward for acquired skills (skill premium). Other analyses (Aboal and Veneri, 2016; García, 2020) show that graduates of higher education -university and technological institutions- are more likely to become entrepreneurs, whether part-time or full-time.

### Governance and the third mission of HEIs

Higher Education Institutions (HEIs) are required, especially those that receive public funding, to provide quality education for their students, but also to give back to their communities with specialized knowledge and services (Ireland, 2015). In that sense, universities are demanded to be spaces of interaction with other members of their region. In this regard, this third mission is an increasingly visible aspect with the cooperation flows between HEIs and companies.

Universities expanded significantly during the 20th century, after World War II, due to the belief that higher education institutions were essential for economic and social progress because (Summers, 2011; Holmes and Mayhew, 2016): they provide qualified personnel, who are providers of innovation, and contribute to shaping democratic institutions and values. Valero and Van Reenen (2019) conclude that a 10 % increase in the number of universities in a region is

associated with 0.4 % more GDP per capita and detect that capital cities have a higher per capita growth compared to the rest of the regions. They also found that the effect of universities is heterogeneous in time and space. For example, they identified that there is a catch-up effect when new universities are installed in the lagging regions of a country. In the United States, France, Germany and the United Kingdom, universities have had a positive economic impact for decades. In other countries, such as those in Asia, this positive experience began belatedly after 1990 (Valero and Van Reenen, 2019).

For universities to enhance their positive outcomes, governance that includes accountability but also autonomy is required (Bruckman and Carvalho, 2014; Pandey, 2004). Universities became key players because the advent of a knowledge-based economy coincided with a social demand for greater transparency. In this context, the concept of the third mission of universities gained popularity, links with companies and non-academic institutions intensified (Abreu *et al.*, 2016; Peña-Vinces and Urbano, 2014); these links served to share knowledge, to carry out technology transfer, to create leadership in entrepreneurial and creative thinking, all favoring innovation and economic development.

It is important to differentiate the features of universities, which, in their simplest version, are divided into two groups: teaching-based HEIs and research-based HEIs. Both types of universities contribute to business development and increase regional productivity (Abreu *et al.*, 2016). First, teaching-focused HEIs focus on facilitating an entrepreneurial context, generating productive leadership, capacity building and networking. Second, research-focused HEIs specialize in innovative knowledge exchange. A common approach is to state that teaching-based HEIs had a stronger link at the local and regional level, while research-focused HEIs played a more active role at the national and international level, but this distinction has been changing.

It is important to highlight the benefits of education-based HEIs, since these institutions are more business-oriented and some are anchors of technological clusters, and in addition to tra-

ining specialized personnel, they also promote entrepreneurial culture and practices. This would explain why it has been found that companies that are closer to universities have better management practices (Valero and Van Reenen, 2019).

## Institutions and local development

Local economic development is related to government performance and the quality of institutions. Therefore, to explain the differences in the economic trajectories of regions, it is possible to find part of the answer in their institutions (Rodríguez-Pose and Di Cataldo, 2015). The quality of institutions provides the type of incentives and constraints that affect the decisions of economic actors. To the extent that incentives and long-term strategies are in place, government effectiveness facilitates the transmission of knowledge, promotes investments in desired areas, and allows regional actors to maximize their technological capacity (Kahn and MacGarvie, 2016).

In turn, institutions define the way in which collective decisions are made, and they also support the formation of mutual trust and the control of corruption, affecting the degree of uncertainty faced by society. Specifically, Rodríguez-Pose and Di Cataldo (2015) identify that government effectiveness is related with principles of social equity and quality public services, such as education and health. Using regions in Europe, Rodríguez-Pose and Di Cataldo (2015) compared central and peripheral regions, where the former had higher government quality indexes and the latter showed governments with lower quality and also a relatively higher social lag. The authors found that a small improvement in government effectiveness and control of corruption has substantial benefits in peripheral regions in both innovation and knowledge generation.

This evidence shows that the central regions, unlike the peripheral ones, have benefited the quality of their institutions and have built learning and knowledge spaces in an environment of regional innovation systems. Conceptually, a similar discussion has been raised for the United

States by Brint and Clotfelter (2016) and for Europe by Holmes and Mayhew (2016). Based on those findings, this article studies the Mexican case focusing on regional differences in the quality of public higher education. It was chosen to observe the wage effect on small and medium-sized enterprises. The mechanism analyzed was the social return of higher education and smaller firms were chosen, since their hired personnel come mostly from the same region. In this way, it is partially controlled that the wage effect measured corresponds to the educational institution of the region itself.

## Materials and methods

The purpose of the article is to estimate the positive effect of public higher education on wages. The estimation strategy consisted of analyzing state differences in the quality of higher education institutions (HEIs).

### Quality of public higher education

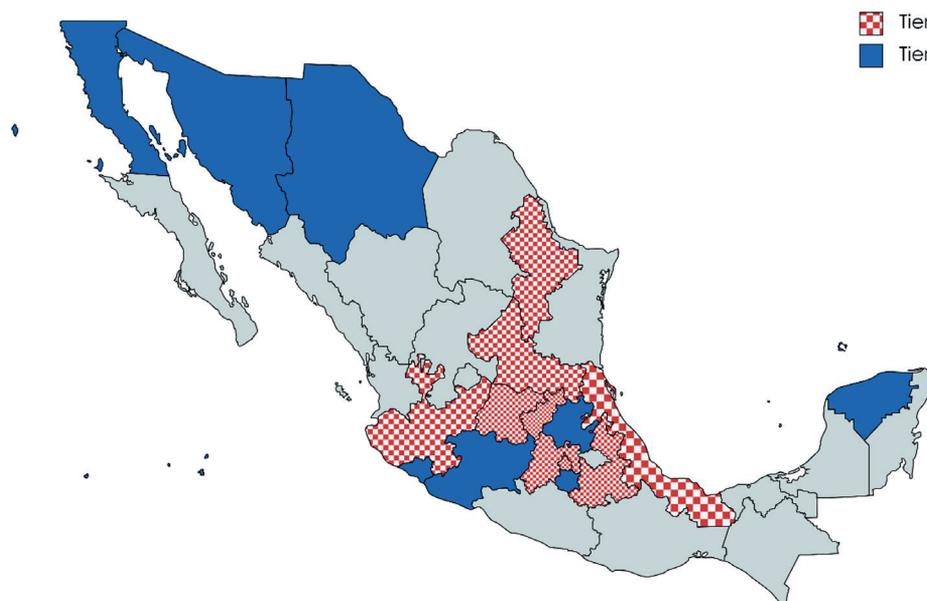
Two sources of information were combined to measure the quality of HEIs: i) the QS ranking of universities, prepared by Quacquarelli Symonds, a company specialized in higher education, and ii) the governmental quality and impact survey (ENCIG-INEGI), which evaluates the satisfaction of higher education users, among other services (Monsiváis, 2019). A more detailed assessment of the quality of higher education was applied by Bernate *et al.* (2020). Map 1 shows the nine states with the best evaluated universities (tier-1) in the top 100 in Latin America, except for the states of Veracruz and Querétaro that rank near 140<sup>th</sup> place. In another block (tier-2), eight states with the next best evaluated universities were assigned in the range of 150-200 positions in Latin America. In a preliminary version, a third tier included seven states with universities that rank near the 250<sup>th</sup> position. However, statistical tests showed no differences between these tier-3 states and the other states. For this reason, the analysis was limited to three comparison groups: tier-1, tier-2 and without-tier, the third group includes states without universities rank by QS or ranked

outside the top 200. To validate the consistency between the QS ranking and the response of users of public university education, the percentage of

overall satisfaction of the government quality survey (ENCIG, 2013-2021) and by each characteristic of higher education was compared.

### Map 1

Mexico. Territorial distribution of tier-1 and tier-2 universities



*Note.* The map shows that Tier-1 universities are located in the central part of the territory, Tier-2 universities are dispersed in three regions: the northern border with the United States, the central region, next to the Tier-1s, and in the southeast. Own elaboration with data from QS Universities Rankings, 2019 and 2020.

Consistency was found in the broadest item -satisfaction with higher education- and positive evidence in the analysis by characteristic. Figure 1 shows a 4 p.p. advantage of higher satisfaction in tier-1 states over non-tier states. Although there is also greater tier-2 satisfaction (vs. no-tier), that small advantage is insufficient to detect statistically. The specific aspects that produce greater satisfaction in the tier-1 states consist of three characteristics: having adequate facilities and furniture in good condition, and users report satisfaction with both the syllabus and the days of classes scheduled in the calendar. It is strange that the users of the tier-1 universities do not report high satisfaction where it would have been expected: the capacity of the professors and the quality of education. Despite this difference, it is confirmed that the states previously classified

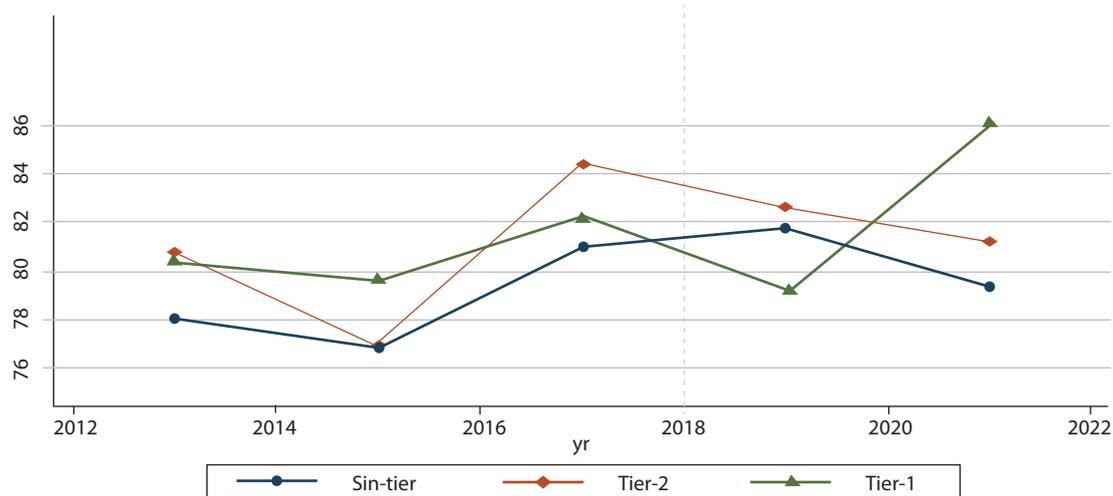
as tier-1 have supremacy in the national higher education system.

The second group of interest are the states with tier-2 universities; in the ranking this group is somewhat distant from the leaders, although within the top 200 universities in Latin America. Users in these states report high satisfaction with the capacity of the professors, even higher than in tier-1, and also report satisfaction with the fulfillment of the syllabus. The high performance in only two of the eight characteristics was insufficient to be able to statistically affirm that in tier-2 states there is greater overall satisfaction compared to non-tier states. Finally, other characteristics appear to be common or shared across regions and universities, namely: cleanliness of facilities, faculty profile, and number of students per class.

These findings provide the necessary evidence to validate that differences in the quality of public higher education can be captured through the

groupings of states into three clusters. In the next section, we describe the wage data with which the effect of higher education will be analyzed.

**Figure 1**  
Mexico. Percentage of satisfaction with public university education



*Note.* The following analysis is restricted to 2015-2017, a vertical line was added in 2018 to narrow that period. Own elaboration with data from ENCIG-INEGI and QS World Universities Rankings.

## Wages and social return

Wages were chosen to study the social effect of higher education. The estimation strategy used is mainly based on Moretti (2004a). Like Moretti, the percentage of workers with higher education (hereafter, percentage of university students) was used as a key variable, although it was additionally proposed that the effect of university students on wages intensifies as the quality of university education increases. The hypothesis of education quality as an interaction is supported by the European experience (Rodríguez-Pose and Di Cataldo, 2015). In particular, the governance of public higher education institutions can be conceptualized as part of the performance of existing institutions in a region. Although university education contributes to raising wages in all states of a country, this effect should be greater in those states where the quality of their

institutions, particularly public higher education institutions, is higher.

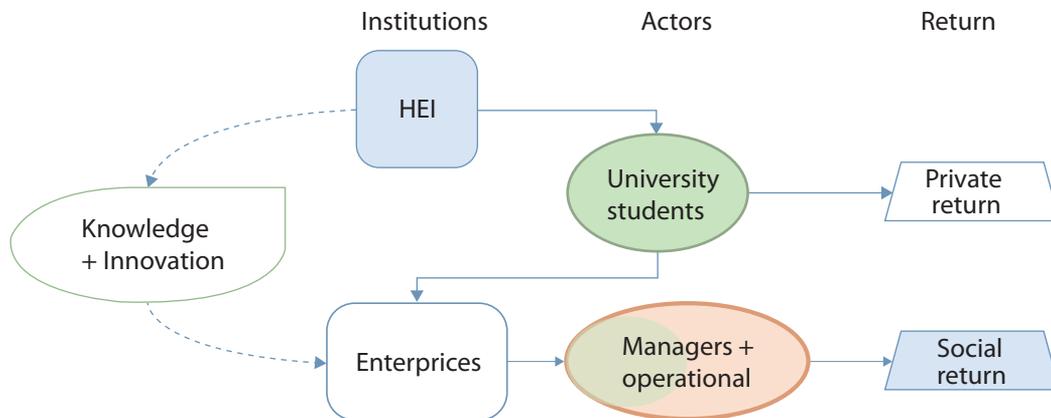
The objective is to measure the social return of higher education, unlike most research that focuses on the private return. To illustrate the difference, Figure 2 was prepared. The private return to higher education consists of quantifying the level of income that university graduates achieve for themselves. In this case, the social return was estimated, i.e., the benefit for different types of workers when interacting in companies, for which the salary effect achieved by operating personnel (mostly non-university graduates) and managers or supervisors (mostly university graduates) was estimated. Figure 2 also shows, on the left side, the potential effect of HEIs in companies, called the third mission (Abreu *et al.*, 2016; Zamora-Sánchez *et al.*, 2022). Thus, the estimation seeks to measure the social return and, additionally, to test whether the quality of HEIs has an impact on the rate of return.

The variables used will be described in the following paragraphs and then the characteristics of the estimation will be detailed. The two explanatory variables used are the quality of public higher education and the percentage of university students. The quality variable is described in the previous section and was implemented through a dichotomous variable to show three groups of states, those with tier-1, tier-2 and no-tier institutions. The quality of HEIs should have a positive impact on firms, which would be observed

through higher social return and higher wages in tier-1 and tier-2 states. The other explanatory variable is the percentage of university graduates (undergraduate, engineering, specialty and graduate), which was obtained by dividing the number of workers with higher education by the total number of workers ( $\times 100$ ). An increase in the percentage of college graduates is expected to induce a higher overall wage, because of greater labor interaction.

**Figure 2**

*Social return estimation strategy*



*Note.* R. is the abbreviation for return. Own elaboration based on Moretti (2004a) and Abreu *et al.* (2016). This figure shows that Higher Education Institutions (HEIs) interact with firms through two channels: a) university graduates who will work as managers or operational personnel; the green subset - ellipse below - represents the low percentage of university graduates, and b) the transfer of knowledge or innovations is a second channel of interaction.

The Productivity Survey of Micro, Small and Medium Enterprises (ENAPROCE) published by the National Institute of Statistics of Mexico was used as a source of information, which collects information at the firm level. This feature is relevant, since it directly provides both the salary and the percentage of university students, as well as the industry, company size, etc. Usually, in order to know the number of people with higher education, administrative records or household surveys are used and, based on these data, the percentage of university students is imputed with great inaccuracy to business statistics. The need to impute the number of workers with higher education is eliminated by using ENAPROCE.

Combining the two editions of ENAPROCE 2015 and 2018, data were obtained for 2015, 2016 and 2017, as the second edition published data for two years. With this, a panel was prepared with peer observations by sector and state. The survey is conducted by design only in strategic sectors and its breakdown by state is limited to small and medium-sized enterprises (SMEs). On average, a state has seven strategic sectors ( $\approx 615$ ); therefore, the constructed data panel has a total of 635 observations ( $= 3 \text{ years} \times 32 \text{ states} \times 615 \text{ sectors}$ ).

The criterion used in the survey to define a SME was to have a minimum of 11 employees in any sector and a maximum of 100 employees

in commerce or services and 250 employees in manufacturing. In addition, INEGI used sales volume as an additional criterion to stratify company size (INEGI, 2019). In the sample, 26 % of the workers have university studies and in some sectors that percentage reaches 46 %, for example, in Business Support Services, Pharmaceutical Products or Research and Technological Development Services. A challenge of the research is to test whether the quality of the HEI has a positive impact on the effect of university graduates on wages. Since only the percentage of university graduates is known, with no information on the HEI in which they studied, then it must be assumed that most workers graduated from a university in the same state in which they work. This assumption is restrictive, but realistic since, compared to large companies, SMEs have a lower percentage of immigrant workers.

The social return will be measured with the salary of two types of workers. The salary was obtained by dividing the annual salary by the employed personnel. The two types of workers are: a) Managerial and supervisory (university education), and b) Operational and support (mostly non-university) (INEGI, 2019, p. 74), the former perform executive, planning and inspection work performed by operational staff, and the latter perform production, sales and service work. This excludes personnel who worked only for fees or commissions without receiving a base salary. By having two types of workers, it is possible to compare whether there are different effects associated with the percentage of university students.

It is complicated to measure analytically the effect of university students on wages, since both variables are intermingled. Consequently, the estimation strategy consists of using instrumental variables that allow us to obtain information related to the percentage of university students, uncorrelated with wages. In Moretti (2004a), the proportion of young people in total employment is proposed as an instrument; the rationale of this instrument is that each generation increases the percentage of people with university studies. In this sense, there would be a positive relationship

between a higher proportion of young workers (under 29 years of age) and a higher percentage of university graduates in employment.

Control variables and fixed effects were also included in the estimation, and all the information came from the ENAPROCE. The fixed and time effects were included as dichotomous variables for each industry and year. In the control variables were used: (1) firm size (employees per firm), since wages are higher in larger scale firms, (2) working hours (hours per week), since a higher number of working hours is usually related to a higher wage, (3) female managers (percentage of women in managerial positions), to take into account the wage disparity between men and women, especially in managerial positions, and (4) span of control (operating personnel among managers) shows the number of operating personnel under the responsibility of each manager or supervisor; this variable would provide additional information on the characteristics of the industries and their effect on wages.

## The model

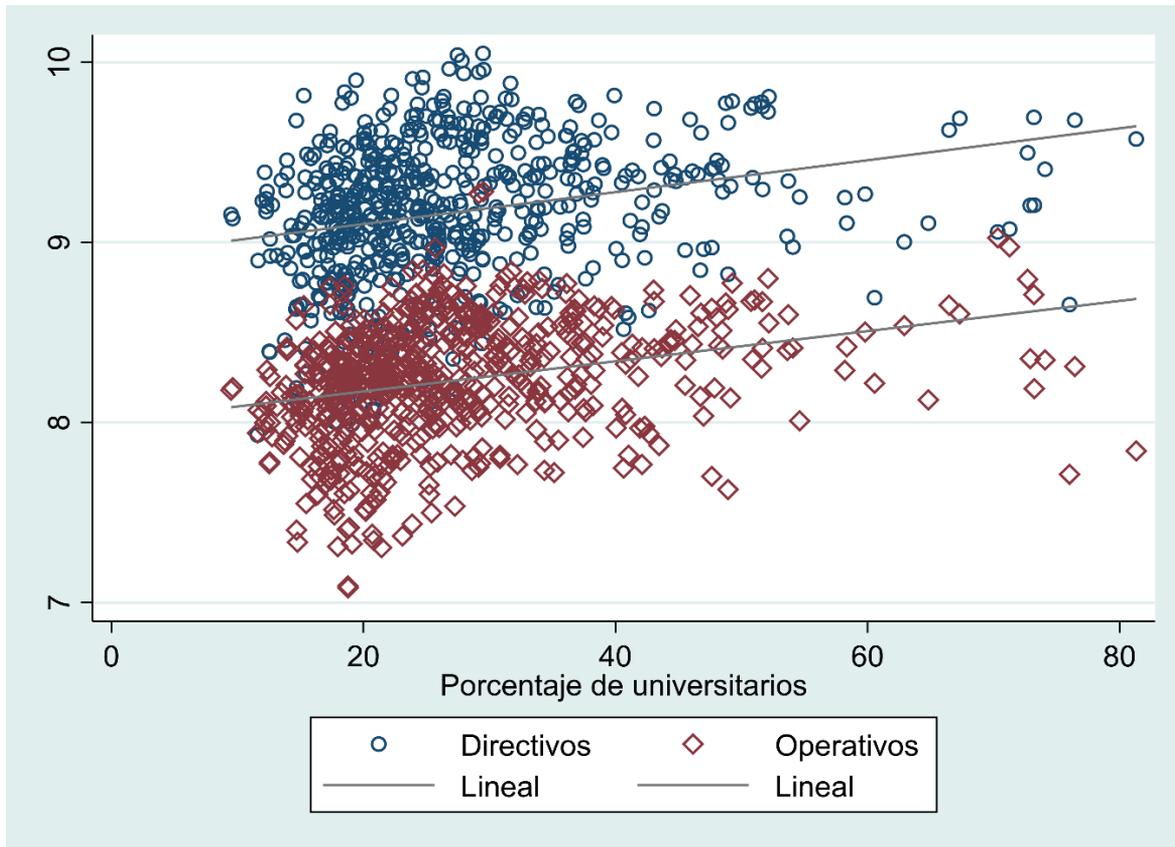
The variables described in the previous section allow to study how a higher rate of university graduates differentially affects the wages of two different groups of workers (Managerial and Operational), the former with university education and the latter with people without university education. The following equation predicts the (logarithm) wage of a group of workers  $i$  in a state-industry pair  $s$  in a year  $t$

$$(1) \log(w_{ist}) = \alpha_0 + \alpha_1 H_{st} + \delta Z_{st} + t + u_{ist}$$

where  $i=1$  Managerial, 2 Operational,  $s$  corresponds to the various combinations of the 32 states  $\times$  17 industries,  $t=2015, 2016, 2017$ ,  $H$  is the percentage of university workers,  $Z$  is a vector of industry characteristics, and  $u$  is the residual of the equation capturing unobserved components of workers and sectors across states; these residuals are assumed to be identically and independently distributed.

Figure 3

Mexico: Salaries in SMEs



Note. Salary in logarithmic scale. SMEs: Small and Medium-Sized Enterprises. An increase in the percentage of workers with higher education is associated with higher managerial and operational wages. Each observation represents a state-industry pair, 2015-2017. Both linear trends have  $R^2$  of 0.74. ENAPROCE-INEGI.

The coefficient of interest is  $\alpha_1$  which estimates the percentage effect of university students on wages,  $\alpha_1$  is expected to be positive. The observations in the model are grouped by state and the control variables seek to isolate the percentage effect of university students in order to correctly estimate its effect on wages. Alternatively, two terms were included to the equation to contrast the effect of the quality of higher education on social return

$$(2) \log(w_{ist}) = \beta_0 + \beta_1 H_{st} + \beta_2 Q_{st} + \beta_3 (H_{st} \times Q_{st}) + \gamma Z_{st} + t + \epsilon_{ist}$$

where  $Q_{st}$  is a dichotomous variable indicating the perceived quality of higher education and has

associated parameters  $\beta_2$  and  $\beta_3$ . The first term,  $\beta_2$  is expected to be positive, since it is an effect of the quality of institutions on salary. The second term,  $\beta_3$  measures a joint effect, as a result of the interaction between educational quality and the percentage of university students.

Figure 3 shows the dispersion of salaries for the two groups of workers with different percentages of university students. Management salaries are distributed in the upper part of the graph, although there is a small area of overlap with the salary of operatives that could be due to regional and sectoral salary differences. A regression line is also shown for each group of workers. In general, it is observed that wages are increa-

sing with a higher increase in the percentage of university students. A slight difference can be seen in the slopes, with the slope being slightly higher for managers, i.e., managers would have a greater wage increase when the percentage of university graduates in their company increases. The following section presents the results of the estimations proposed in equations 1 and 2 that evaluate the social return of public higher education and the effect of the quality of public institutions.

## Results

The findings enable to affirm that the average salary in small and medium-sized companies is related both to the percentage of workers with university studies and to the quality of the public higher education institution (HEI) in the region. Therefore, the higher the percentage of university graduates in the companies, the higher the salary and, at the same time, the higher the salaries of managers and operatives in states with universities classified in the QS ranking (tier-1 or tier-2), compared to salaries in states without public universities in the QS Latin American ranking.

Using ordinary least squares (OLS), with no interactions or control variables, salaries are approximately 20 % higher in states with tier-2 universities and between 20 % and 30 % higher in states with tier-1 universities compared to states with universities outside the QS ranking. It was also found that a 10 percentage point (p.p.)

increase in the percentage of undergraduates would increase salaries by 9.5 % for management staff and 9.7% for operational staff.<sup>1</sup>

When including the four control variables (section 2.2), a significant reduction was observed in the percentage effect on salary of university students, from 9.5 % to 6.5 % and 8.3 % respectively for operational and managerial personnel, for every 10 p.p. increase in the number of university students. Likewise, there was a decrease in the effect of the quality of public higher education institutions on salaries. Nevertheless, these estimated coefficients continue to indicate that an increase in the percentage of university graduates in the companies would be related with a higher salary, and a worker could obtain an additional salary increase of between 10 % and 20 % depending on the quality or ranking of the state university.

Preliminary estimates are consistent in the presence of time effects, industries, firm size, etc. Even so, there would be unobservable characteristics that could simultaneously affect the wage and the percentage of college students. To prevent possible biases in the estimation, two-stage regression was employed using instrumental variables. This consisted in the first stage, in instrumenting (predicting) the percentage of university students using both the percentage of young people (under 29 years old) with employment (ENOE-INEGI) and using fixed effects by industry and, in the second stage, this instrument is used to explain the wage.

1 Since the model specification is  $\log(w) = \beta_0 + \beta_1 H$ , if increasing  $H$  by one unit the result could be denoted as  $\log(w') = \beta_0 + \beta_1(H + 1)$ . The increment would be  $\log(w') - \log(w) = \beta_1 e^{\beta_1} = w' / w$ . The rate of change  $((w' / w) - 1) \times 100 = (e^{\beta_1} - 1) \times 100$ , is the percentage change in  $w$  associated with a unit increase in  $H$ . For simplicity, the coefficients were reported for a 10 p.p. increase.

**Table 1***Social return: the effect of the percentage of university students on salaries*

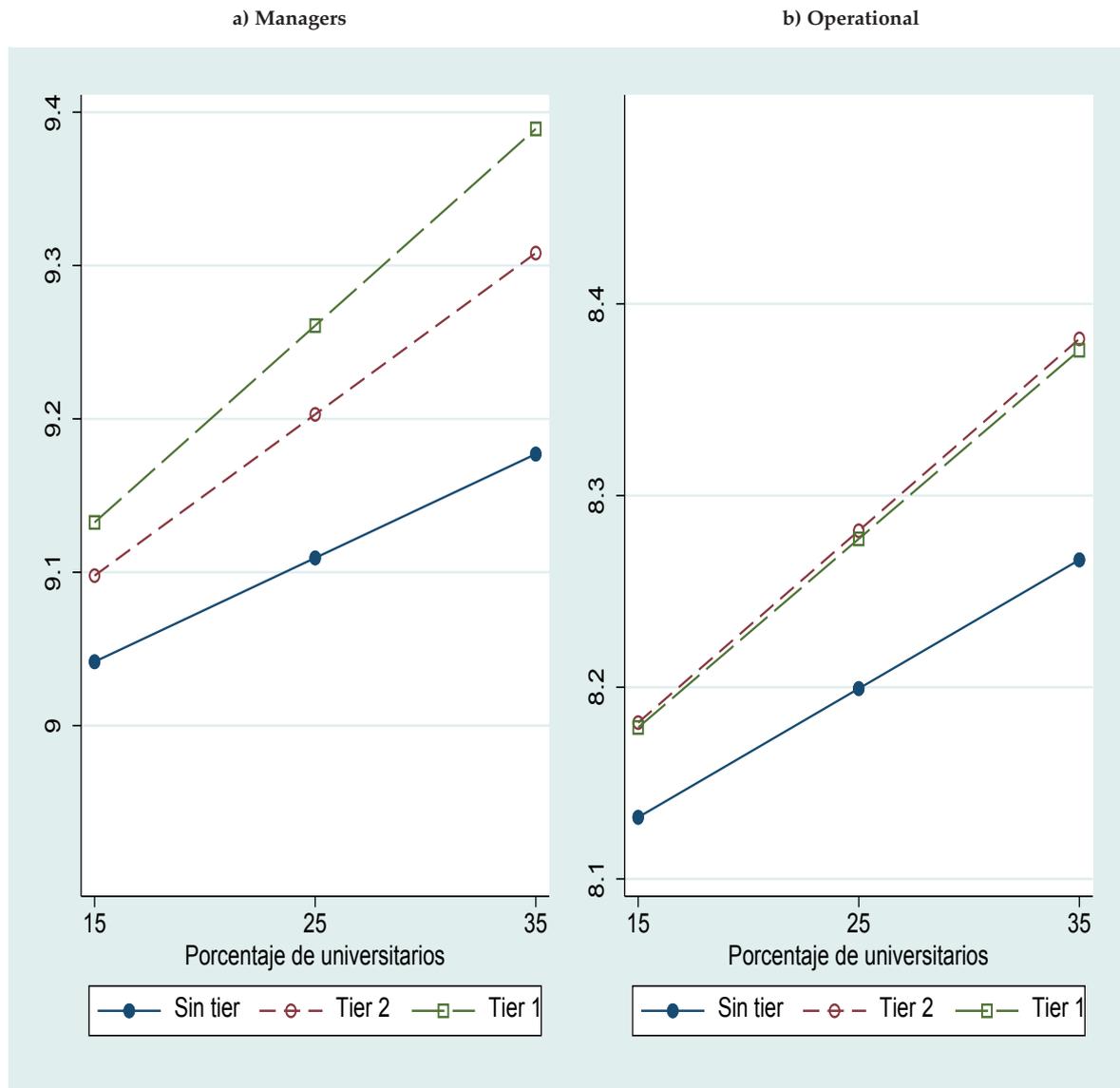
	Least Squares in two stages			
	No interactions		With interactions	
	[1] Operational	[2] Managers	[3] Operational	[4] Managers
Percentage of university students	.0094*** (4.5e-04)	.0119*** (4.4e-04)	.0067*** (.0013)	.0068*** (.0012)
Tier-1	.113*** (.023)	.187*** (.0266)	--	--
Tier-2	.124*** (.0416)	.131*** (.036)	--	--
Tier-1 X Porc university students	--	--	.0031*** (.001)	.0061*** (.0012)
Tier-2 X Porc university students	--	--	.0033* (.002)	.0037* (.0017)
Constant	8.64*** (.0763)	9.09*** (.0885)	8.72*** (.0686)	9.24*** (.0776)
Control variables	Sí	Sí	Sí	Sí
Temporary effects	Sí	Sí	Sí	Sí
Statistics F	1400.94	1516.42	1371.77	1435.98
R <sup>2</sup> -adjust (centered)	0.693	0.645	0.694	0.644
ECM Root	0.170	0.218	0.170	0.218
Under-identification (p value)	29.45 (0.031)	29.45 (0.031)	27.70 (0.049)	27.70 (0.049)
Overidentification (p value)	24.02 (0.089)	21.33 (0.167)	24.61 (0.077)	20.67 (0.192)
*** p<.01, ** p<.05, * p<.1				

*Note.* Standard errors in parentheses. MSE is Mean Square Error. Each regression had 635 observations (state-industry pairs).

Own elaboration with data from ENAPROCE-INEGI.

**Figure 4**

Wages and the estimated effect of educational quality and percentage of university students



The two-stage estimation with instrumental variables is relevant because, unlike schooling, age composition (the percentage of young people) is a more exogenous variable and allows to better predict the real effect on wages. In this sense, age composition is unlikely to affect wages through channels other than worker attributes and, at the same time, most people have practically completed their years of formal schooling before the age of 29. The estimated two-stage coefficients are

shown in Table 1 columns [1] to [4]; the first pair excluding interaction effects and the second pair reporting interactions between the percentage of university students and the quality of public higher education. The conventional case without interactions corresponds to [1] and [2] which is consistent with the results already described, where a worker is expected to obtain a higher wage between 11 % and 19 %, in states with universities within the ranking (tier-1 and tier-2),

and there would also be an increasing wage as the percentage of university students increases.

The preferred result contains interactions between the percentage of university students and educational quality (columns [3] and [4]). Graphically, these results are presented in Figure 4. In the case of managers (Figure 4a), the estimates show that the salary increases with higher educational quality and also with a higher percentage of university students. The vertical shifts indicate that, on average, a manager in a tier-1 or tier-2 state would have a higher salary, 18.7 % and 13.1 %, respectively compared to if it were in a state where no university is in the QS ranking. It should be noted that the difference between 18.7 % and 13.1 % is statistically significant.

Regarding the operational personnel, Figure 4b only reveals two groups of states, those that have a university in some tier (tier-1 or tier-2) and those states with non-tier universities. As with managers, for operational, educational quality translates into higher salaries, but there is a greater 'salary compression' limited to two groups, and not three, as is the case with managers. In addition to the benefit of having a higher salary for residing in a state with a university on the tier, there is the additional benefit of a greater social return on education. Note in Figure 4b that the slope in tier states is higher than in non-tier states, 9.8 % and 6.7 %, respectively as the percentage of university graduates increases. Firms in states with universities in the top 150 manage to benefit from a higher salary for their operating personnel. Quantitatively, when the percentage of university students is 15 % (left side, Figure 4b) the wage gap is 7.7 % between a tier-1 vs. a non-tier state. As the percentage of university students increases to 35 %, the wage gap increases to 13 % (right side, Figure 4b).

## Discussion and conclusions

Using data from small and medium-sized companies in Mexico, there is evidence of a social return from higher education. Specifically, the higher the percentage of university-educated workers and the higher the quality of public HEIs, the higher the salary of management and operational per-

sonnel, where managers are mostly university graduates, although there is also a benefit for operational personnel, mostly non-university graduates. These findings show that HEIs provide a service to the community beyond their facilities and the training they provide to their students. Acemoglu and Angrist (2000) discuss the difference between private and social returns to education. Subsequently, Moretti (2004a) presents estimates of the social return that show that the wages of workers with secondary education and those with higher education increase with more university students in firms,

The analysis also revealed that there is a positive social return, i.e., a generalized increase in salary when the percentage of university students increases. Excluding the quality of education, a similar effect on salary was found for management and operational personnel. On the other hand, when taking into account the quality of the dominant public university in each region, different dynamics were observed with a greater social return found in regions with HEIs ranked in the top 150 Latin American universities. Future research could compare the results of Mexico with the realities of Brazil, Chile or Colombia, countries that have multiple universities outside the national capital in the QS ranking, most of them in the top 150.

The impact of institutions and differentiated benefits across regions has been studied by Rodríguez-Pose and Di Cataldo (2015), who report that central and peripheral regions are defined, to some extent, by the quality of their institutions, including educational ones. The wide coverage of statistics on the quality of local institutions provides a useful input for further research, for example, on citizenship or on business performance.

The private return of education is well known in Latin America; the results extend this knowledge by reporting a social return of higher education. Therefore, contrary to what is usually estimated, a greater efficiency of the public budget for HEIs should be recognized, since in addition to the private return, the social return should be taken into account. A usual criticism of the universities' budget is that it caters to the high-income population (Carnoy, 2020; CONEVAL, 2018)

and that higher salaries for schooling and skills increase the social inequality gap (Brambilla *et al.*, 2012; Keller, 2010). When analyzing the effect of the quality of education and its effect on social return, it was possible to verify that there are potential conditions for social equalization (Corak, 2013; Esquivel, 2011) and that the current inequality that is criticized arises from the centralization of resources in a few cities. Thus, there could be a decrease in income inequality to the extent that educational quality and coverage can grow in more regions of the country.

It was found that the quality of higher education and workers with university studies create a social return, measured by the generalized increase in salaries in companies. These results allow to reevaluate both the role of Higher Education Institutions and the efficiency of the public budget for universities, as well as to justify the budget and review the allocation criteria by region. An instrumental variables method was used to efficiently estimate the effect of university students. In the future, an exhaustive analysis is still needed to verify the causality between HEI activities and social return.

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